swiss physical society

Jahrestagung in Zürich
09. - 13. September 2024

ETH Zürich, Campus Zentrum, Gebäude ETA/ETF/ETZ

Annual Meeting in Zürich
9 - 13 September 2024

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in Zusammenarbeit mit - in collaboration with

Swiss Institute of Particle Physics

Swiss Society for Photon Science

Life Sciences Switzerland

Bulletin SPG / SSP Vol 40, 2024

Danksagungen - Acknowledgements

Wir danken...

- der ETH Zürich als Gastgeberin der Jahrestagung, insbesondere dem Departement Physik und dem lokalen Organisationsteam für die grosszügige Unterstützung..
- der Akademie der Naturwissenschaften Schweiz (SCNAT) für die Unterstützung der Tagungen und anderer Aktivitäten der SPG.
- der Schweizerischen Akademie der Technischen Wissenschaften (SATW) für die Unterstützung diverser Aktivitäten.
- den Stiftern der folgenden Preise:

  ABB Schweiz AG
  (SPG Preis in allgemeiner Physik)

  IBM Research Rüschlikon
  (SPG Preis in Physik der kondensierten Materie)

  Eidgenössisches Institut für Metrologie METAS
  (SPG Preis mit Bezug zur Metrologie)

  COMSOL Multiphysics GmbH
  (SPG Preis in computergestützter Physik)

  Hitachi Energy Switzerland AG
  (SPG Preis mit Bezug zur Energietechnik)

- dem EU Projekt Isabel (*https://emfl.eu/isabel/h2020-project/*) für die Unterstützung der eingeladenen Sitzung "Magnetic fields for materials research".
- den Firmen, die durch Inserate, Beilagen und durch ihre Präsenz an der Ausstellung die Tagung unterstützen (siehe Seite 10).
- der Universität Basel für die durch die SPG genutzte Infrastruktur.

We thank...

- the ETH Zürich as host of the Annual Meeting, especially the Physics Department and the local organizing team for the generous support.
- the Swiss Academy of Sciences (SCNAT) for the support of the conferences and further activites of the SPS.
- the Swiss Academy of Technical Sciences (SATW) for the support of various activities.
- the sponsors of the following awards:

  ABB Schweiz AG
  (SPS Award in General Physics)

  IBM Research Rüschlikon
  (SPS Award in Condensed Matter Physics)

  Federal Institute for Metrology METAS
  (SPS Award with relation to Metrology)

  COMSOL Multiphysics GmbH
  (SPS Award in Computational Physics)

  Hitachi Energy Switzerland AG
  (SPS Award with relation to Enery Technology)

- the EU project Isabel (*https://emfl.eu/isabel/h2020-project/*) for the support of the invited session "Magnetic fields for materials research".
- the companies supporting the conference by advertisements, supplements and their presence at the exhibition (see page 10).
- the University of Basel for the SPS being able to use the infrastructure.

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Navigation
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Letzte Aktualisierung des Programms - Last update of the program
11.09.2024

Tagungsorganisation

SPG: *S. Albietz, L. Gallmann, T Montaruli*, sowie die Leiter der Fachsektionen
CHIPP: *A. Benelli*
SSPh: *L. Gallmann*
LS²: *S. Rahi*
SGN: *R. Sibille, V. Lütz-Bueno*

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Allgemeine Tagungsinformationen - General Information about the Conference

Konferenzwebseite und Anmeldung
www.sps.ch

Tagungsort
ETH Zürich, Gebäude ETA/ETF/ETZ, Gloriastr. 35, 8092 Zürich

Tagungssekretariat
Das Tagungssekretariat befindet sich direkt beim Eingang im Foyer des ETZ Gebäudes im Stockwerk E.
Öffnungszeiten:

Mo 09.09.	10:00 - 17:00
Di 10.09 - Do 12.09.	08:00 - 18:00
Fr 13.09.	08:00 - 12:00

Das Programm am Montag 09. September ist von der Konferenzgebühr ausgenommen. Für die anderen Tage gilt: Alle Tagungsteilnehmer melden sich bitte vor dem Besuch der ersten Veranstaltung beim Sekretariat an, wo sie ein Namensschild und allfällige weitere Unterlagen erhalten sowie die Tagungsgebühr bezahlen.
Wichtig: Ohne Namensschild ist kein Zutritt zu einer Veranstaltung möglich.

Hörsäle
In allen Hörsälen stehen Projektoren zur Verfügung. Sie können direkt Ihre eigenen Mobilrechner anschließen. Die gängigen Adapter (HDMI, VGA, ...) sind vorhanden. Bringen Sie ggf. Adapter und USB Stick mit.

Postersession
Die Postersession findet am Dienstag Abend sowie am Mittwoch während der Mittagspause in der Halle statt. Die Posterwände sind entsprechend diesem Programm numeriert, sodaß jeder Teilnehmer "seine" Wand leicht finden sollte. Alle Poster müssen an allen beiden Tagen ausgestellt bleiben.
Maximale Postergröße: A0 Hochformat.
Die 3 besten Poster werden am Donnerstag um 10:30h in einer kleinen Zeremonie ausgezeichnet.

Zahlung
Wir bitten Sie, die Tagungsgebühren im Voraus zu bezahlen. Sie verkürzen damit die Wartezeiten am Tagungssekretariat, erleichtern uns die Arbeit und sparen darüber hinaus noch Geld !

Conference web site and registration
www.sps.ch

Location
ETH Zürich, Gebäude ETA/ETF/ETZ, Gloriastr. 35, 8092 Zürich

Registration Desk
The registration desk is situated directly at the entrance, level E, in the foyer of the ETZ building.
Opening Hours:

Mon 9.9.	10:00 - 17:00
Tue - Thu 10.9. - 12.9.	08:00 - 18:00
Fri 13.9.	08:00 - 12:00

The program on Monday 9 September is exempt from the conference fees. On all other days: All participants must imperatively report at the registration desk before visiting any session. You will receive your name badge, possible further documents and can pay still due conference fees.
Attention: Without badge, entry to the lecture rooms will be refused.

Lecture Rooms
All rooms are equipped with projectors. You may connect your own laptop. The most common adapters (HDMI, VGA, ...) are available. If need be, bring your own adapter and USB-key.

Postersession
The postersession will take place on Tuesday evening and during lunchbreak on Wednesday in the hall. The poster boards are numbered according to the program, so every participant will find their board easily. All posters are expected to be on display on both days.

Maximum poster size: A0 portrait.
The winners of the best poster prizes will be awarded on Thursday 10:30h in a small ceremony.

Payment
We ask you to pay the conference fees in advance. This way you shorten waiting time at the registration desk, facilitate our work and save even money!

Preise gültig bei Zahlung bis 15. August - Fees valid for payments done before 15 August	
Kategorie - Category	**CHF**
Einzelmitglieder von SPG, SSPh, CHIPP - Individuels members of SPS, SSPh, CHIPP	150.-
Nicht-Mitglieder - Non-members	190.-
Studenten VOR Master/Diplom Abschluß - Students BEFORE master/diploma degree	100.-
Plenarsprecher, Eingeladene Sprecher, Preisträger - Plenary and invited speakers, awardees	0.-
Spezialangebot für "Noch nicht" SPG Mitglieder (s.u.) - Special offer for "not yet" SPS members (see below)	200.-
Konferenz Abendessen - Conference Dinner	90.-
Zuschlag für Zahlungen nach dem 15. August sowie Barzahler an der Tagung - Surcharge for payments made after 15 August as well as for cash payments at the registration desk	**20.-**

Die Angaben zur Zahlung werden während der Anmeldung direkt auf der Webseite angezeigt.

Am Tagungssekretariat kann nur bar bezahlt werden (in CHF). Kreditkarten können leider nicht akzeptiert werden.

ACHTUNG: Tagungsgebühren können nicht zurückerstattet werden.

Payment details are shown directly during registration on the conference website.

At the registration desk you can only pay cash (CHF). We can unfortunately not accept any credit cards.

ATTENTION: Fees are not refundable in case of cancellation.

Kaffeepausen, Mittagessen

Kaffeepausen, Apéro (Dienstag) und Lunchbuffet (Mittwoch) finden in der Halle bei der Händlerausstellung statt. Diese Leistungen sind in der Konferenzgebühr enthalten.
Für das Mittagessen an den anderen Tagen können die Mensa sowie umliegende Restaurants genutzt werden.

Coffee Breaks and Lunch

The coffee breaks, aperitif (Tuesday evening) and the lunch buffet on Wednesday will take place near the exhibition. These services are covered by the conference fee.
The campus mensa as well as nearby restaurants are at your disposal for lunch on the other days.

Konferenz-Abendessen

Das Abendessen findet am Donnerstag im Restaurant *Zunfthaus zur Schmiden* im Anschluß an die Parallelsitzungen statt. Der Preis beträgt CHF 90.- pro Person (beinhaltet, 3-Gänge Menü und Getränke). Die Anzahl der Plätze ist limitiert, bitte registrieren Sie sich unbedingt im Voraus, damit wir disponieren können. Eine Anmeldung vor Ort ist nicht möglich !

Conference Dinner

The dinner will take place on Thursday in the restaurant *Zunfthaus zur Schmiden* after the parallel sessions. The fee is CHF 90.- per person (including 3-course meal and drinks). The number of places is limited. Please register in any case in advance so we can plan accordingly. A registration on site is not possible!

Spezialangebot für "Noch-Nicht" SPG Mitglieder

Planen Sie, an unserer Tagung teilzunehmen sowie Mitglied der SPG zu werden ? Sie können nun beides zum äusserst günstigen Preis von nur CHF 200.- (CHF 220.- nach dem 15. August). Dieser Betrag deckt die Konferenzgebühr sowie die Mitgliedschaft für 2024. Wählen Sie einfach bei der Online Registrierung die Kategorie "Special Offer", laden Sie das Anmeldeformular (*https://documents.sps.ch/openarea/SPG_Anmeldeformular_d-f-e.pdf*) für neue Mit-

Special offer for "not yet" SPS members

Do you plan to participate in our meeting and want also to become a member of the SPS ? Then take advandage of our special offer of CHF 200.- covering the conference fees and the membership for 2024. (CHF 220.- after 15 August) ! Just fill out the registration form, choose the option "Special offer", then download the admission form for new members (*https://documents.sps.ch/openarea/SPG_Anmeldeformular_d-f-e.pdf*), and return it filled and signed as soon as possible to the SPS Secretariat.

glieder herunter, und schicken es ausgefüllt an das SPG-Sekretariat zurück.
*Dieses Angebot gilt **nicht** für Studenten oder Doktoranden. Diese profitieren sowieso von der Gratis-Mitgliedschaft im ersten Mitgliedsjahr, und zahlen nur die in der Tabelle angegebene Konferenzgebühr.*

*(This offer does **not** apply for students and Ph.D. students. They still profit from the free first-year-membership and have only to pay the conference fee shown in the table .)*

Anreise und Unterkunft

Alle Informationen zur Anreise und Hotelreservation finden Sie auf unserer Webseite.
https://www.sps.ch/de/events/sps_annual_meeting_2024/arrival_and_accommodation

Arrival and Accomodation

All information on arrival and hotel reservation can be found on our webpage.
https://www.sps.ch/en/events/sps_annual_meeting_2024/arrival_and_accommodation

Internet

Während der gesamten Konferenz steht für die Teilnehmer Internet Zugang über das ***eduroam*** Netzwerk bereit.
Personen ohne Zugang zu ***eduroam*** können auch das ***public*** Netzwerk der ETH verwenden (Anmeldung benötigt).

Anleitung:
https://blogs.ethz.ch/id/2019/12/13/gaeste-wlan-public/

Internet

During the whole conference the ***eduroam*** wireless network is available for the participants.
Persons without access to ***eduroam*** can use the ETH ***public*** network (registration needed).

Instructions:
https://blogs.ethz.ch/id/2019/12/13/gaeste-wlan-public/

Aussteller - Exhibitors

Bruker Switzerland AG
CH-8117 Fällanden
www.bruker.com

COMSOL Multiphysics GmbH
CH-8005 Zürich
www.comsol.com

Dyneos AG
CH-8307 Effretikon
www.dyneos.ch

Eidg. Institut für Geistiges Eigentum
CH-3003 Bern
www.ige.ch

Keyence International NV/SA
BE-2800 Mechelen
www.keyence.eu

lino Biotech AG
CH-8134 Adliswil
www.lino-biotech.com

Lumibird SA
FR-91140 Villejust
www.lumibird.com

Quantum Design AG
CH-1723 Marly
https://qd-europe.com/ch/

SPECS Surface Nano Analysis GmbH
DE-13355 Berlin
www.specs.com

teltec systems AG
CH-5620 Bremgarten
www.teltec.ch

Inserate - Advertisements

APE Angewandte Physik & Elektronik GmbH
DE-13053 Berlin
www.ape-berlin.de

teltec systems AG
CH-5620 Bremgarten
www.teltec.ch

Bruker Switzerland AG
CH-8117 Fällanden
www.bruker.com

Zurich Instruments
CH-8005 Zürich
www.zhinst.com

Tagungsübersicht - Conference Overview

Generalversammlungen - General Assemblies

Montag 09. September 2024, 13:00h - Monday 9 September 2024, 13:00h

SPG - SSP - SPS	SSPh
ETZ E 6	*ETZ E 8*

Preisverleihungen - Award Ceremonies

SPG Preise, SGN Preis, Charpak-Ritz Preis
SPS Awards, SNSS Award, Charpak-Ritz Award

Dienstag 10. September 2024, 09:45h, ETA F 5 -
Tuesday 10 September 2024, 09:45h, ETA F 5

Preise für die besten Poster - Best Poster Awards

Donnerstag 12. September 2024, 10:30h, ETA F 5 -
Thursday 12 September 2024, 10:30h, ETA F 5

Montag, 09. September 2024 - Monday, 9 September 2024

TIME	ETA F 5	ETZ E 6	ETZ E 8	TIME
	Registration	*Registration*	*Registration*	
	Physics Funding in Switzerland	**Physics Funding in Switzerland**		
08:30		**SPS Board Meeting**		08:30
08:45				08:45
09:00				09:00
09:15				09:15
09:30				09:30
09:45				09:45
10:00				10:00
10:15	**Conference Opening**			10:15
10:30	1 Bernd Gotsmann (i),			10:30
10:45	Stephan Cludius-Brandt (i)			10:45
11:00	2 Jennifer McClung (i)			11:00
11:15	3 Christoph Falk (i)			11:15
11:30	4 *Discussion*			11:30
11:45				11:45
12:00	***Lunch***	***Lunch***	***Lunch***	12:00
12:15				12:15
12:30				12:30
12:45				12:45
13:00		**SPS GENERAL ASSEMBLY**	**SSPh GENERAL ASSEMBLY**	13:00
13:15				13:15
13:30				13:30
13:45				13:45
14:00	**Louis de Broglie: 100 years of**			14:00
14:15	**wave / particle dualism**			14:15
14:30	6 Friedrich-K. Thielemann (p)			14:30
14:45				14:45
15:00				15:00
15:15	7 Tilman Esslinger (p)			15:15
15:30				15:30
15:45				15:45
16:00	***Coffee Break***	***Coffee Break***	***Coffee Break***	16:00
16:15				16:15
16:30	8 Philipp Treutlein (p)			16:30
16:45				16:45
17:00				17:00
17:15	9 Henning Stahlberg (p)			17:15
17:30				17:30
17:45				17:45
18:00	***Break***			18:00
18:15	**Public Lecture**			18:15
18:30	10 Anne l'Huillier (p)			18:30
18:45				18:45
19:00				19:00
19:15				19:15
19:30				19:30
19:45				19:45

(p) = Plenary Talk, (i) = Invited talk

Dienstag, 10. September 2024 - Tuesday, 10 September 2024

TIME	*Rooms* ETA F 5	ETF C 1	ETF E 1	TIME
08:00	*Registration*			08:00
	PLENARY SESSION			
09:00	11 Mikhail Shaposhnikov (p)			09:00
09:15				09:15
09:30				09:30
09:45	**AWARD CEREMONY**			09:45
10:00				10:00
10:15				10:15
10:30	***Coffee Break***	***Coffee Break***	***Coffee Break***	10:30
10:45				10:45
11:00	12 Patrick Lenggenhager (i)			11:00
11:15				11:15
11:30	13 Alberto Rolandi (i)			11:30
11:45				11:45
12:00	14 Women in Physics: Introduct.			12:00
12:15	15 Petra Rudolf (p) (Keynote)			12:15
12:30				12:30
12:45				12:45
13:00	***Lunch***	***Lunch***	***Lunch***	13:00
13:15				13:15
13:30				13:30
13:45				13:45
	TASK	**Biophysics and Soft Matter**	**Neutron Science**	
14:00	301 Lucas Mollier	901 Christof Fattinger ***	701 Andrea Carminati (i)	14:00
14:15	302 Marianna Glazewska	902 Janos Vörös (i) ****		14:15
14:30	303 Una Helena Alberti	903 Morteza Aramesh	703 Viviane Lütz Bueno	14:30
14:45	304 Abderrahmane Ghimouz	904 Karol Kołątaj	705 Florencia Malamud	14:45
15:00	305 Shideh Davarpanah	905 Lucrezia Maini (i)	706 Artur Gregor Glavic	15:00
15:15	306 Nico Härringer		707 Boyang Zhou (i)	15:15
15:30	307 Amrutha Samalan	906 Phil Willmott (i)		15:30
15:45	308 Matteo Milanesio			15:45
16:00	***Coffee Break***	***Coffee Break***	***Coffee Break***	16:00
16:15				16:15
16:30	311 Thomas Christian Senger	911 Yang Yao (i)	711 Daniel Mazzone (i)	16:30
16:45	312 Yifeng Wang			16:45
17:00	313 Esteban Curras Rivera	912 Luca Rima	712 Victor Porée	17:00
17:15	314 Harvey Birch	913 Cécilia Siri	713 Arnau Romaguera-Camps	17:15
17:30	315 Miguel Hernandez	914 René Iseli	714 Jose A. Hernandez Sanchez	17:30
17:45	316 Johannes Martin Wüthrich	915 Astrid Southam	716 Marc Persoz	17:45
18:00		916 Tonghui Jin		18:00
18:15	**CERN 70**	917 Michele Griffa		18:15
18:30	16 Günther Dissertori (p) **			18:30
18:45				18:45
19:00				19:00
19:15	*17 Panel Discussion*			19:15
19:30				19:30
19:45	***Poster Session and Apéro***	***Poster Session and Apéro***	***Poster Session and Apéro***	19:45
20:00				20:00
20:15				20:15
20:30				20:30
20:45				20:45
21:00				21:00
21:15				21:15
21:30				21:30

(p) = Plenary talk, (i) = Invited talk, * = 20 min talk, ** = 40 min talk, *** = 5 min introduction, **** = 25 min talk

702 *cancelled*
704 *cancelled*
715 *cancelled*

TIME	ETZ E 6	ETZ E 7	ETZ E 8	TIME
	Rooms			
08:00	*Registration*			08:00
09:00				09:00
09:15				09:15
09:30				09:30
09:45				09:45
10:00				10:00
10:15				10:15
10:30	***Coffee Break***	***Coffee Break***	***Coffee Break***	10:30
10:45				10:45
11:00				11:00
11:15				11:15
11:30				11:30
11:45				11:45
12:00				12:00
12:15				12:15
12:30				12:30
12:45				12:45
13:00	***Lunch***	***Lunch***	***Lunch***	13:00
13:15				13:15
13:30				13:30
13:45				13:45
	Women in Physics Career Symposium	**KOND**	**Spintronics and Magnetism at the Nanoscale**	
14:00	41 Laura Bégon-Lours (i)	101 Roxana Capu	601 Pietro Gambardella (i)	14:00
14:15		102 Martina Basini		14:15
14:30	42 Anna Fontcuberta i Morral (i)	103 Rossella Acampora	602 Luca Berchialla	14:30
14:45		104 Askar Iliasov	603 Hugo Bocquet	14:45
15:00	43 Mentor-Mentee Introductions	105 Leonardo Martinelli	604 Michele Aldeghi	15:00
15:15		106 Rafael T. Winkler	605 Francisco Carrion Ruiz	15:15
15:30		107 Xuan Dang Dang	606 Samuel Harrison Moody	15:30
15:45		108 Kati Asikainen		15:45
16:00	***Coffee Break***	***Coffee Break***	***Coffee Break***	16:00
16:15				16:15
16:30	44 Mentor-Mentee Meet-Ups		611 Cinthia Piamonteze (i)	16:30
16:45				16:45
17:00			612 Martino Poggio (i)	17:00
17:15				17:15
17:30	45 Janine Haase (i)		613 Wei Chuang Lee	17:30
17:45			614 Boris Sorokin	17:45
18:00	46 Ilaria Zardo (i)		615 Jodok Happacher	18:00
18:15			*Intro Swiss Magnetics IEEE chapter*	18:15
18:30				18:30
18:45				18:45
19:00				19:00
19:15				19:15
19:30				19:30
19:45	***Poster Session and Apéro***	***Poster Session and Apéro***	***Poster Session and Apéro***	19:45
20:00				20:00
20:15				20:15
20:30				20:30
20:45				20:45
21:00				21:00
21:15				21:15
21:30				21:30

(i) = Invited talk

Mittwoch, 11. September 2024 - Wednesday, 11 September 2024

TIME	ETA F 5	ETF C 1	ETF E 1	TIME
08:00	*Registration*			08:00
	PLENARY SESSION			
09:00	18 Matthias E. Lauer (p)			09:00
09:15				09:15
09:30				09:30
09:45	19 Andreas Wallraff (p)			09:45
10:00				10:00
10:15				10:15
10:30	***Coffee Break***	***Coffee Break***	***Coffee Break***	10:30
10:45				10:45
11:00	20 Giacomo Indiveri (p)			11:00
11:15				11:15
11:30				11:30
11:45	21 Frédéric Mila (i)			11:45
12:00				12:00
12:15	22 Dirk Hegemann (p)			12:15
12:30				12:30
12:45				12:45
13:00	***Poster Session and Lunchbuffet***	***Poster Session and Lunchbuffet***	***Poster Session and Lunchbuffet***	13:00
13:15				13:15
13:30				13:30
13:45				13:45
14:00				14:00
14:15				14:15
	TASK	**Biophysics and Soft Matter**	**Electron and photon spectros-copies of quantum materials**	
14:30	321 Wenting Chen	921 Marcy Zenobi-Wong (i)	501 Anna Tamai (i)	14:30
14:45	322 Sergey Ermakov			14:45
15:00	323 Gian Luca Caratsch	923 Christoph Dumelin	502 Gianmarco Gatti	15:00
15:15	324 Victoria Kletzl	924 Andreas Frutiger	503 Enrico Della Valle	15:15
15:30	325 David Höhl		504 Saumya Mukherjee	15:30
15:45	326 Diego A. Sanz-Becerra	925 Milad Radiom	505 Yann Alexanian	15:45
16:00	327 Anastasia Doinaki	926 Michael Hennig (i)	506 Frédéric Chassot	16:00
16:15			507 Juan F. P. Mosquera	16:15
16:30	***Coffee Break***	***Coffee Break***	***Coffee Break***	16:30
16:45		**Physics Applied to Medicine**		16:45
17:00	331 Giovanni Dal Maso	201 Marco Stampanoni (i)	511 Stefan Mathias (i)	17:00
17:15	332 Nathalie Ziehl			17:15
17:30	333 Katharina von Schoeler	202 Roger Schibli (i)	512 Erik de Vos	17:30
17:45	334 Sophie Kollatzsch		513 Izabela Biało (i)	17:45
18:00	335 Aravind Remesan Sreekala	203 Anthony Lomax (i)		18:00
18:15			514 Yuan Wei	18:15
18:30		204 David Meer	515 Zhijia Zhang	18:30
18:45		205 *cancelled*	516 Yurii Pashkevich	18:45
19:00		206 Keegan McNamara	517 Xunyang Hong	19:00
19:15		207 Shubhangi Makkar		19:15
19:30		208 Cyril Alispach		19:30
19:45		209 Vladislav Stefanov		19:45
20:00				20:00

(p) = Plenary talk, (i) = Invited talk

922 *cancelled*

TIME	*Rooms*			TIME
	ETZ E 6	ETZ E 7	ETZ E 8	
08:00	*Registration*			08:00
09:00				09:00
09:15				09:15
09:30				09:30
09:45				09:45
10:00				10:00
10:15				10:15
10:30	***Coffee Break***	***Coffee Break***	***Coffee Break***	10:30
10:45				10:45
11:00				11:00
11:15				11:15
11:30				11:30
11:45				11:45
12:00				12:00
12:15				12:15
12:30				12:30
12:45				12:45
13:00	***Poster Session and Lunchbuffet***	***Poster Session and Lunchbuffet***	***Poster Session and Lunchbuffet***	13:00
13:15				13:15
13:30				13:30
13:45				13:45
14:00				14:00
14:15	**Startups: The role of physics and physicists in developing a product ?**			14:15
		History and Philosophy of Physics	**Gravitational Waves**	
14:30	51 Denys Sutter (i) *	71 Baptiste Le Bihan (i)	451 Spencer Collaviti	14:30
14:45	52 Riduan Khaddam Aljameh (i) *		452 Sarah Baimukhametova	14:45
15:00		72 Peter Ullrich (i)	453 Niccolò Muttoni	15:00
15:15	53 Thomas Kornher (i) *		454 Max Briel	15:15
15:30	54 Mohammad Bereyhi (i) *	73 Jean-François Loude	455 Thomas Moreau	15:30
15:45	55 Youri Popoff (i) *		456 Martin Pijnenburg	15:45
16:00		74 Claus Beisbart	457 Stefan Strub	16:00
16:15	56 Catalin Cris (i) *		458 Mudit Garg	16:15
16:30	***Coffee Break***	***Coffee Break***	***Coffee Break***	16:30
16:45		**TASK**		16:45
17:00	57 Mathieu Munsch (i) *	341 Daniel Charles Craik	461 Cecilio Garcia Quiros	17:00
17:15	58 Federico Paratore (i) *	342 Anni Kauniskangas	462 Niklas Houba	17:15
17:30		343 Raphael van Laak	463 Martin Pijnenburg	17:30
17:45	59 Manu Nair (i) *	344 Kerim Guseinov	464 Lara Bohnenblust	17:45
18:00	60 Philip Eib (i) *	345 Luis Miguel Garcia Martin	465 Nodens Koren	18:00
18:15		346 Alexandre Brea Rodriguez	466 Janis Fluri	18:15
18:30		347 Rita de Sousa Ataide da Silva		18:30
18:45		348 Pasquale Andreola		18:45
19:00		349 Martina Ferrillo		19:00
19:15				19:15
19:30				19:30
19:45				19:45
20:00				20:00

(i) = Invited talk, * = 20 min talk

Donnerstag, 12. September 2024 - Thursday, 12 September 2024

TIME	ETA F 5	ETF C 1	ETF E 1	TIME
	Rooms			
08:00	*Registration*			08:00
	PLENARY SESSION			
09:00	23 Sven Reiche (p)			09:00
09:15				09:15
09:30				09:30
09:45	24 Leonardo Senatore (p)			09:45
10:00				10:00
10:15				10:15
10:30	**POSTER AWARD SESSION**			10:30
10:45	***Coffee Break***	***Coffee Break***	***Coffee Break***	10:45
11:00				11:00
11:15	25 Kirsten Moselund (p)			11:15
11:30				11:30
11:45				11:45
12:00	26 Erik van Nimwegen (p)			12:00
12:15				12:15
12:30				12:30
12:45	***Lunch***	***Lunch***	***Lunch***	12:45
13:00				13:00
13:15				13:15
13:30				13:30
13:45				13:45
	TASK	**Biophysics and Soft Matter**	**Atomic Physics and Quantum Optics**	
14:00	351 Daniele Dal Santo	931 Jörg Stelling (i)	401 Juan Carasquilla (i)	14:00
14:15	352 Vilius Čepaitis			14:15
14:30	353 Carlos Moreno Martinez	932 Vojislav Gligorovski	402 Paolo Colciaghi (i)	14:30
14:45	354 Mario Alves Cardoso	933 Guillermina Ramirez-San-Juan (i)		14:45
15:00	355 Antti Pirttikoski		403 Tobias Kehrer	15:00
15:15	356 Jason Aebischer	934 Sangwoo Kim (i)	404 Arseni Goussev	15:15
15:30	357 Guillermo Hijano Mendizabal		405 Meng-Zi Huang	15:30
15:45	358 Tjark Miener	935 Mathieu Dedenon	406 Tobias Nadolny	15:45
16:00	359 Carlos Abellan Beteta	936 Juan Cruz Landoni	407 Florence Berterottière	16:00
16:15	360 Zhibin Yang	937 Eleonora Perego	408 Giovanni Finco	16:15
16:30	***Coffee Break***	***Coffee Break***	***Coffee Break***	16:30
16:45				16:45
17:00	361 Noshin Tarannum	941 Willi Leopold Stepp	411 Stefan Willitsch (i)	17:00
17:15	362 Jeremy Atkinson	942 Katerina M. Kourkoulou		17:15
17:30	363 Pantelis Kontaxakis	943 Friso Douma	412 Simon Scheidegger (i)	17:30
17:45	364 Meinrad Moritz Schefer	944 Matthew Domenic Lycas		17:45
18:00	365 Sumit Banik	945 Marco Labagnara	413 Alexander Baumgärtner	18:00
18:15	366 Guglielmo Coloretti	946 Pamina Martina Winkler	414 Michael Alex. Eichenberger	18:15
18:30	367 Xiafei Chang	947 Kathrin Laxhuber	415 Dominik Husmann	18:30
18:45	*-> moved to talk 349*	948 Sheda Ben Nejma	416 Gabriele Natale	18:45
19:00	***Transfer to Dinner***			19:00
19:15				19:15
19:30	***Conference Dinner***			19:30
19:45				19:45
20:00				20:00
22:30				22:30

(p) = Plenary talk, (i) = Invited talk

TIME	ETZ E 6	ETZ E 7	ETZ E 8	TIME
	Rooms			
08:00	*Registration*			08:00
09:00				09:00
09:15				09:15
09:30				09:30
09:45				09:45
10:00				10:00
10:15				10:15
10:30				10:30
10:45	***Coffee Break***	***Coffee Break***	***Coffee Break***	10:45
11:00				11:00
11:15				11:15
11:30				11:30
11:45				11:45
12:00				12:00
12:15				12:15
12:30				12:30
12:45	***Lunch***	***Lunch***	***Lunch***	12:45
13:00				13:00
13:15				13:15
13:30				13:30
13:45				13:45
		KOND	**Spintronics and Magnetism at the Nanoscale**	
14:00		111 Anna Nastruzzi	621 Alberto Morpurgo (i)	14:00
14:15		112 Valentin Goblot		14:15
14:30		113 Wenhao Huang	623 Hengli Duan	14:30
14:45		114 Changji Pan	624 Dmitry Lebedev	14:45
15:00	*SPS DEI Commission Meeting*	115 Joel Rehmann	625 Lebin Yu	15:00
15:15		116 Tancredi Thai Angeloni	626 *cancelled*	15:15
15:30		117 Ajla Karic		15:30
15:45		118 Aleksandra Siklitskaya		15:45
16:00				16:00
16:15				16:15
16:30	***Coffee Break***	***Coffee Break***	***Coffee Break***	16:30
16:45	**Biophysics and Soft Matter**	**Applied Physics / Plasma Physics**	**Magnetic fields for materials res.**	16:45
17:00	951 Santiago N. Rodriguez Alvarez	211 Lili Edes	181 Steffen Krämer (i)	17:00
17:15	952 Daphne Laan	212 Chizhou Wang		17:15
17:30	953 Ella Müller	213 Nicole Vadot	182 Julia Küspert (i)	17:30
17:45	954 Guido Narduzzi	214 Ewout Devlaminck		17:45
18:00	955 Lorenzo Scutteri	215 Pasquale Barbato	183 Gianmarco Bovone (i)	18:00
18:15	956 Ting Mao	216 Yves Marc Acremann		18:15
18:30	957 Cecilia Fruet			18:30
18:45	958 Christian Zimmerli			18:45
19:00	***Transfer to Dinner***			19:00
19:15				19:15
19:30	***Conference Dinner***			19:30
19:45				19:45
20:00				20:00
22:30				22:30

(i) = Invited talk

622 *cancelled*

Freitag, 13. September 2024 - Friday, 13 September 2024

TIME	*Rooms*		TIME
	ETA F 5	ETF E 1	
08:00	*Registration*		08:00
	Energy and Sustainability		
09:00	31 Gabriela Hug (p)		09:00
09:15			09:15
09:30	32 Lorenz Herrmann (p)		09:30
09:45			09:45
10:00	33 Thomas Justus Schmidt (p)		10:00
10:15			10:15
10:30	***Coffee Break***	***Coffee Break***	10:30
10:45			10:45
11:00	34 Sonja Kleiner (p)		11:00
11:15			11:15
11:30	35 Patrick Koppenburg (p)		11:30
11:45			11:45
12:00	36 *Panel Discussion*		12:00
12:15			12:15
12:30	***Lunch***	***Lunch***	12:30
12:45			12:45
13:00			13:00
13:15			13:15
	TASK	**Photon Science**	
13:30	371 Jennifer Maria Frieden	801 Jakub Vonka	13:30
13:45	372 Chiara Perrina	802 Nelson Nientsu Hua	13:45
14:00	373 Martina D'Arco	803 Linos Hecht	14:00
14:15	374 Vadym Voitsekhovskyi	804 Katharina Kolatzki	14:15
14:30	375 Leonid Burmistrov	805 Frederic Ussling	14:30
14:45	376 Sveva Castello	806 Moritz Seidel	14:45
15:00	377 Paloma Cimental Chávez	807 Benjamin Willenberg	15:00
15:15	378 Maximinio Adrover	808 Alexander M. Heidt	15:15
15:30		809 Carolin Bauer	15:30
15:45		810 Marco Gaulke	15:45
16:00	***END***		16:00

(p) = Plenary talk, (i) = Invited talk

TIME	ETZ E 6	ETZ E 7	ETZ E 8	TIME
	Rooms			
08:00	Registration			08:00
09:00				09:00
09:15				09:15
09:30				09:30
09:45				09:45
10:00				10:00
10:15				10:15
10:30	***Coffee Break***	***Coffee Break***	***Coffee Break***	10:30
10:45				10:45
11:00				11:00
11:15				11:15
11:30				11:30
11:45				11:45
12:00				12:00
12:15				12:15
12:30	***Lunch***	***Lunch***	***Lunch***	12:30
12:45				12:45
13:00			**Physics education and communication: Good practice examples within the Swiss Physics Community**	13:00
13:15				13:15
	Accelerator Science and Technology	**KOND**		
13:30	281 Douglas Martins Araujo	122 Ilaria Villa	91 Alice Gasparini; Matthieu Heller, Sebastien Murphy	13:30
13:45	282 Jaap Kosse	123 Pascal Vecsei		13:45
14:00	283 Carlos Gafa	124 Julian Schuhmacher	92 Gernot Scheerer *	14:00
14:15	284 Jaap Kosse	125 Alexander Miessen	93 Peter Kreuzer, Tomoko Muranaka *	14:15
14:30	285 Yi Wu	126 Glenn Wagner		14:30
14:45	286 Evan Ericson	127 Soohyeon Shin	94 Samuel Byland, M. Suter *	14:45
15:00	287 Thomas Geoffrey Lucas		95 Barbora Gulejova *	15:00
15:15	288 Elisabeth-Sena Welker			15:15
15:30	289 Elias Walter Waagaard		96 *Discussion*	15:30
15:45	290 Joséphine M. B. Potdevin			15:45
16:00	***END***			16:00

(i) = Invited talk, * = 20 min talk

121 *-> moved to talk 13*

Postersitzung, 10. - 11. September 2024 - Postersession, 10 - 11 September 2024

Postersession: Tue: 19:45 - 21:30 ; Wed: 13:00 - 14:30 It is expected that ALL posters are on display on both days !	
KOND	**Electron and photon spectros-copies of quantum materials**
141 Aaron Merlin Müller	531 Zia Macdermid
142 Ángel Labordet	532 Salony Mandloi
143 Enrique Aguilar-Mendez	533 Julia Ising
	534 Dimitrios Sapalidis
Applied Physics & Plasma Physics	
231 Bhanu Pratap Singh	**Spintronics and Magnetism at the Nanoscale**
	641 Laura van Schie
TASK	642 Stéphane Nils Nilsson
	643 Serni Toda Cosi
	644 Nestor Miguel Valdez Garduno
381 Aziza Zendour	645 Tianyue Wang
382 Chavdar Dutsov	
383 Erin Barillier	
384 Timothy Hume	**Neutron Science**
385 Dimitrios Kaminaris	
386 Bastien Lacave	731 Daniel Zeitz
387 *cancelled*	
388 Philipp Wagner	
389 Adrian-Antonio Petre	**Photon Science**
390 Lea Segner	
	821 Seyyed Jabbar Mousavi
	822 Alessandra Sabatti
Atomic Physics and Quantum Optics	823 Tristan Kuttner
431 Matthias Germann	
432 Jost Kellner	**Biophysics and Soft Matter**
	971 Nikolay Ryzhkov
Gravitational Waves	972 Philipp Cedro
	973 Peyman Soltani
481 Tassos Fragos	
482 Stefan Strub	

Sitzungen - Sessions

Special: Physics funding in Switzerland

Monday, 09.09.2024, Room ETA F 5

Time	ID	Official Conference Opening
10:20		**Welcome note** *Joël Mesot, President of ETH Zürich*
		Physics funding in Switzerland *Chair: Johan Chang, Universität Zürich*
10:30	1	**Funding Instruments within the Swiss National Science Foundation (SNF)** *Bernd Gotsmann and Stephan Cludius-Brandt*
10:55	2	**Funding Instruments within the European Research Council (ERC)** *Jennifer McClung*
11:10	3	**Industry-oriented Funding Instruments: Innosuisse** *Christoph Falk*
11:25	4	*Discussion*
12:00		***END; Lunch***
13:00	***General Assemblies of SPS * and SSPh ****	
14:00		***Buffer Time***

* SPS: Room ETZ E 6; ** SSPh: Room ETZ E 8

Public Symposium:
Louis de Broglie: 100 years of wave / particle dualism
& Public Lecture

Monday, 09.09.2024, Room ETA F 5

Time	ID	Louis de Broglie: 100 years of wave / particle dualism *Chair: Teresa Montaruli, Université de Genève*
14:30	6	**Matter and Light: Louis de Broglie and our current understanding of physics** *Friedrich-Karl Thielemann, Universität Basel and GSI Helmholtz Center for Heavy Ion Research; Darmstadt* Today's understanding of physics is not possible without the concept of quantum mechanics, but how did it all come about? Light had been understood in terms of waves since Huygen's wave interpretation in 1690 (and Fresnel's extension in 1818), but Planck (in 1900) and Einstein (in 1905) postulated particle behaviors (photons), where the frequency or wavelength of photons was related to their energy or momentum, confirmed by Compton's experiments in the early 1920s. The Bohr model of the atom (1913) still considered electrons as particles, but with quantized angular momentum. In 1924 de Broglie introduced the theory of electron waves, before understood as particles, and proposed (more generally) that particles are wave packets which move with group velocity, having an effective mass. Following de Broglie's proposal, leading to the wave-particle duality of electrons, modern quantum mechanics was born when in 1925 Werner Heisenberg, Max Born and Pascal Jordan developed matrix mechanics and Erwin Schrödinger invented wave mechanics as solutions of the Schrödinger equation in 1926. From the wider acceptance at the Fifth Solvay Conference in 1927 to further refinements and unified formalizations by David Hilbert, Paul Dirac, and John von Neumann until1930 only a few years had passed. Bohr won the Nobel prize in 1922, de Broglie in 1929, Heisenberg in 1932, Schrödinger in 1933, followed by many other quantum physicists since then. My colleagues in this symposium will discuss modern research and advances in this field, I focus on the role of de Broglie, a few main aspects and the history behind it.
		Chair: Johan Chang, Universität Zürich
15:15	7	**Waves of Quantum Matter** *Tilman Esslinger, ETH Zürich* The wave nature of matter materializes in interference experiments with Bose-Einstein condensates. Correspondingly, the particle nature can be made observable by detecting individual atoms. Yet, it is the interactions between the atoms and between atoms and light that give rise to intriguing phenomena and a multitude of phases, including superfluid, supersolid, Mott-insulating and topological phases. I will provide a perspective on quantum gas experiments and show how we can synthetically create quantum many-body systems with tailored interactions and topology. I will highlight recent experiments in which we investigate the interplay between non-trivial topologies and strong interactions.
16:00		***Coffee Break***

Time	ID	*Chair: Michel Calame, Empa & Universität Basel*
16:30	**8**	**Wave-particle duality in atom interferometers: precision measurements at the quantum limit** *Philipp Treutlein, Universität Basel* Atom interferometers are among the most precise measurement devices for inertial forces, electromagnetic fields and fundamental interactions. Their working principle is a beautiful embodiment of deBroglie's wave-particle duality of matter: while the wave nature of atoms gives rise to interference of the different paths through the interferometer, their particle nature gives rise to fundamental quantum noise in the detection of the resulting interference pattern. For uncorrelated atoms, this results in the so-called standard quantum limit of interferometric measurement, which is reached by today's best instruments. Surprisingly, another quantum phenomenon - entanglement - can be harnessed to overcome this limit. I will give an overview of the operating principle, applications and fundamental quantum limits of atom interferometers and show how we can use many-particle entangled states to improve their sensitivity, which promises significant advances for science and technology.
		Chair: Christof Fattinger
17:15	**9**	**Single electron imaging vs. coherent electron beam diffraction: Optimization of image contrast in cryo-electron microscopy** *Henning Stahlberg, Laboratory of Biological Electron Microscopy, EPFL and University of Lausanne* Cryo-transmission electron microscopy (cryo-EM) or tomography (cryo-ET) of frozen hydrated specimens is an efficient technique for analyzing the structure of proteins or tissue sections. However, both methods face challenges due to their very low signal-to-noise ratio. Efforts to enhance their efficacy focus on minimizing the initial damage caused by the electron beam on the sample and maximizing the recovery of phase contrast signal from electrons interacting with the sample. We are exploring whether employing stroboscopic imaging with individual electrons passing through the sample at precise nanosecond intervals could potentially reduce damage for a cryo-EM sample compared to a similarly intense barrage of electrons arriving randomly, a concept previously proposed for samples at room temperature. We are further advancing convergent beam electron diffraction with a probe aberration-corrected Titan Krios and an ultra-fast pixelated detector (4D-STEM), evaluating the data with ptychography and other data analysis methods, in order to maximize phase contrast signal recovery from a frozen hydrated cryo-EM specimen. Progress in these two approaches will be presented.
18:00		***END, Break***
		PUBLIC LECTURE *Chair: Lukas Gallmann, ETH Zürich*
18:30	**10**	**The route to attosecond pulses** *Anne l'Huillier, Lund University Sweden, Nobel Laureate 2023* When an intense laser interacts with a gas of atoms, high-order harmonics are generated. In the time domain, this radiation forms a train of extremely short light pulses, of the order of 100 attoseconds. Attosecond pulses allow the study of the dynamics of electrons in atoms and molecules, using pump-probe techniques. This presentation will highlight some of the key steps of the field of attosecond science.
19:45		***END***

Plenary Session

Tuesday, 10.09.2024, Room ETA F 5

Time	ID	PLENARY SESSION I *Chair: Philippe Jetzer, Universität Zürich*
09:00	11	**Physics of the early universe and the intensity frontier of particle physics** *Mikhail Shaposhnikov, EPFL* Cosmology and neutrino experiments provide the key evidence that the Standard Model of particle physics, although extremely successful in explaining existing accelerator data, is not a complete theory of Nature. In particular, it contradicts the observed neutrino oscillations, does not provide a dark matter, and does not explain the excess of matter over anti-matter in the Universe. Taking these facts as a guiding principle for the quest for a theory that lies beyond the Standard Model, I will overview the arguments for the existence of new particles with masses below the Fermi scale and discuss the experimental prospects to search for them at new high-intensity experiments in particle physics.
09:45		***Award Ceremony***
10:30		***Coffee Break***
		Chair: Thomas Christen, Hitachi Energy
11:00	12	**Hyperbolic lattices: from table-top simulators to non-Abelian band theory** *Patrick Lenggenhager, Max Planck Institute for the Physics of Complex Systems, Dresden* Negatively curved spaces arise in fields ranging from cosmology to condensed-matter physics, but are hard to probe experimentally. However, their discrete counterparts, hyperbolic lattices, can be realized, e.g., in electric-circuit networks, where we measured signatures of negative curvature. This might allow probing fundamental relationships between curved spaces and quantum theories in table-top experiments. Additionally, the interplay between lattice effects and curvature results in noncommutative translation symmetry with exotic non-Abelian Bloch states that have remained inaccessible to analytical treatments. We introduce an efficient method to construct those states by generalizing Brillouin-zone folding to hyperbolic lattices, paving the way to a complete hyperbolic band theory.
		Chair: Thomas Christen, Hitachi Energy
11:30	13	**Collective Advantages in Finite-Time Thermodynamics** *Alberto Rolandi, Université de Genève* A central task in finite-time thermodynamics is to minimize the excess or dissipated work W_{diss} when manipulating the state of a system immersed in a thermal bath. We consider this task for an N-body system whose constituents are identical and uncorrelated at the beginning and end of the process. In the regime of slow but finite-time processes, we show that W_{diss} can be dramatically reduced by considering collective protocols in which interactions are suitably created along the protocol. This can even lead to a sublinear growth of W_{diss} with N: $W_{diss} \propto N^x$ with $x < 1$; to be contrasted to the expected $W_{diss} \propto N$ satisfied in any noninteracting protocol. We derive the fundamental limits to such collective advantages and show that $x = 0$ is in principle possible; however, it requires long-range interactions. We explore collective processes with spin models featuring two-body interactions and achieve noticeable gains under realistic levels of control in simple interaction architectures. As an application of these results, we focus on the erasure of information in finite time and prove a faster convergence to Landauer's bound.

Time	ID	**WOMEN IN PHYSICS CAREER SYMPOSIUM** *Chair: Tobias Golling Université de Genève*
12:00	14	***Introduction***
12:15	15	***Keynote*** *Petra Rudolf, University of Groningen*
13:00		***Lunch***
14:00		***Topical Sessions***
		PUBLIC SPECIAL: 70TH ANNIVERSARY OF CERN *Chair: Hans Peter Beck, Universität Bern*
18:30	16	**CERN: Past, Present, and Future** *Günther Dissertori, ETH Zürich*
		Moderation: Florencia Canelli, Universität Zürich
19:10	17	***Panel Discussion*** ***Fabiola Gianotti**, CERN Director General* ***Michael Gerber**, SERI, Ambassador, Director General International Programmes & Organisations* ***Günther Dissertori**, ETH Zürich, Rector, past Swiss CERN Council delegate* ***Ben Kilminster**, Universität Zürich, CHIPP Chair*
19:45		***Postersession with Apéro Riche*** *including a special set of posters related to the* *70th Anniversary of CERN*
21:30		***END***

Wednesday, 11.09.2024, Room ETA F 5

Time	ID	**PLENARY SESSION II** *Chair: Christof Fattinger*
09:00	18	**Structural Biology and Interaction Analysis in Drug Discovery** *Matthias E. Lauer, Roche Innovation Center Basel* Along the discovery process, structural biology and biophysical analyses of drug target interactions inform medicinal chemists how to transform an extremely large space of unselective chemical matter into a potent medicine. The established workflows support target proteins which express in large quantities and can be purified at high quality. Therefore, the access to recombinant proteins constrains the experimental space that can profit from structurally informed optimization processes. Innovative technologies are reaching our horizon. Very tempting is a microfluidic preparation robot, which houses a magnetic bead purification trap to extract and represent minute amounts of proteins for structure determination with cryo-EM. Such data can be complemented with binding data gathered with focal molography (FM), a next generation optical biosensor, which enables researchers to record binding curves of drug target interactions directly in lysates and serum.

Time	ID	*Chair: Rachel Grange, ETH Zürich*
09:45	**19**	**Quantum Science with Superconducting Circuits** *Andreas Wallraff, Department of Physics, ETH Zurich* Superconducting electronic circuits are ideally suited not only for studying the foundations of quantum physics but also for exploring applications in quantum information science. Since complex circuits containing hundreds or thousands of elements can be designed, fabricated, and operated with relative ease, superconducting circuits are one of the prime contenders for realizing quantum computers, a goal vigorously pursued by both academic and industrial labs. In this presentation, I will begin by briefly introducing the basic concepts enabling the exploration of quantum physics with superconducting circuits [1] and then comment on the state of the art of the field. After that, I will present two examples of recent research results from our lab at ETH Zurich, touching on both fundamental and applied aspects of quantum science with superconducting circuits. Using two superconducting qubits entangled over a distance of 30 meters we have recently succeeded in performing a loophole-free Bell test [2], one of the foundational experiments to be performed on macroscopic quantum systems. Using a set of 17 superconducting qubits integrated on a single device, we have demonstrated repeated quantum error correction in the surface code [3]. This is an essential advance in the realization of fault-tolerant quantum computation, which requires the correction of errors occurring due to unavoidable decoherence and limited control accuracy. This and similar demonstrations of repeated, fast, and high-performance quantum error correction support our understanding that fault-tolerant quantum computation will be practically realizable. [1] A. Blais, A. L. Grimsmo, S. M. Girvin, and A. Wallraff, Rev. Mod. Phys. 93, 025005 (2021). [2] S. Storz et al., Nature 617, 265-270 (2023) [3] S. Krinner et al., Nature 605, 669–674 (2022).
10:30		***Coffee Break***
		Chair: Valeria Bragaglia, IBM Rüschlikon
11:00	**20**	**Neuromorphic Intelligence: spiking neural network and on-line learning circuits for brain-inspired technologies** *Giacomo Indiveri, University of Zurich and ETH Zurich* For many practical tasks that involve real-time processing of sensory data and closed-loop interactions with the environment, conventional and artificial intelligence technologies cannot match the performance of biological ones. One of the reasons for this gap is that neural computation in biological systems is organized in a way that is very different from the way it is implemented in today's deep networks. In biological neural systems computation is tightly linked to the properties of their computational embodiment, to the physics of their computing elements and to their temporal dynamics. A promising approach that closely emulates principles of computation of animal brains is that of neuromorphic intelligence. In this talk I will show how this approach can provide useful tools for investigating computational models of neural processing while at the same time offering a technology that can complement standard AI approaches for low-power sensory processing at the edge. I'll present examples of analog circuits that faithfully reproduce the dynamics of real neurons and synapses, including plasticity and learning. I'll demonstrate how the circuits presented can be used to carry out robust computation, in real-world applications, despite their variability and heterogeneity.

Time	ID	*Chair: Tomáš Bzdušek Universität Zürich*
11:45	**21**	**New challenges in quantum magnetism** *Frédéric Mila, Ecole Polytechnique Fédérale de Lausanne* Quantum magnetism has played a very important role in the twentieth century, with milestones such as Bethe's solution of the spin-1/2 Heisenberg chain in 1931, spin-wave theory in 1952, or the discovery of the Haldane gap in spin-1 chains in 1983. The field is far from closed however, and several basic models of frustrated quantum magnetism are still heavily debated. In view of their potentially quite exotic properties, quantum magnetism has emerged as one of the favourite platforms to investigate quantum matter, with already several successes among which the discovery of new quantum phases such as spin nematics, spin supersolids, or fractional magnetization plateaus. Yet the best is still probably to come, and after a quick review of these successes, I will discuss some of the challenges the field is still facing, including the definitive solution of some paradigmatic models of frustrated quantum magnetism such as the Kagome spin-1/2 antiferromagnet or the experimental identification of quantum spin liquids with non-trivial topological properties.
		Chair: Andreas Müller, Université de Genève
12:15	**22**	**Physics and Education - A Journey into Plasma Physics** *Dirk Hegemann, Empa, St.Gallen* More than 99% of all visible matter in the universe is in the plasma state, and plasmas are present in a wealth of interesting phenomena from astrophysics to medical physics. Yet, this is an area completely underrepresented in physics teaching at schools and in physics teacher education. In the present talk, an outlook is provided on some of the reasons why the topic of plasma is important for a "general culture" in physics (e.g., importance in applied science; "space weather," linking life on Earth to astrophysical processes; fusion for its societal importance, etc.). Plasma is considered as an additional state of matter next to solid, liquid, and gas. Plasma activation occurs when electrons are ripped off their atoms or molecules by receiving energy, which can be delivered by heating, electromagnetic fields, chemical reactions, or friction. Since sufficient energy is provided for ionization, numerous inelastic collisions occur to excite atoms and to dissociate molecules. A plasma thus triggers non-spontaneous chemical reactions. While these plasma chemical reactions play a role in natural phenomena such as lightning and auroras, plasma technology provides a powerful tool to modify materials, to conduct chemical reactions at low temperature, or to use thermal plasma applications. Several examples and milestones will be demonstrated.
13:00		***Postersession with Lunchbuffet***
14:30	***Topical Sessions***	
19:30		

Thursday, 12.09.2024, Room ETA F 5

Time	ID	**PLENARY SESSION III** *Chair: Leonid Rivkin, PSI Villigen*
09:00	**23**	**Attosecond Pulses from X-ray Free-electron Lasers: Status and Outlook** *Sven Reiche, Paul Scherrer Institut Villigen* Free-electron Lasers provide coherent radiation with a tunable central wavelength. The driving mechanism is the self-interaction of a relativistic electron beam with its own radiation field, coupled by oscillating electron orbit in the periodic magnetic field of an undulator. One main activity in FEL development is to reduce the pulse duration below a femtosecond for resolving the fastest processes in biology, chemistry and material science. This presentation gives an overview over the current status of attosecond pulses at FEL facilities and possible strategies to further reduce the pulse duration or to increase the pulse energy.

Time	ID	*Chair: Philippe Jetzer, Universität Zürich*
09:45	24	**Questions in Theoretical Cosmology** *Leonardo Senatore, ETH Zürich* I will review several open questions in Cosmology, such as the nature of Inflation and of Dark Energy, and how to address them. For example, I will focus on the primordial non-Gaussianity of the initial density fluctuations and how to further investigate it by observations of the distribution of galaxies at long distances.
10:30		***Poster Award Session***
10:45		***Coffee Break***
		Chair: Jean-Philippe Brantut, EPFL
11:15	25	**Hybrid III-V/Silicon photonics** *Kirsten Moselund, Paul Scherrer Institut Villigen & EPF Lausanne* Our modern interconnected society is built upon two foundational technologies; the compute power of silicon CMOS and the capability of photonics for transmitting vast amounts of data in telecommunication networks. The seamless integration of silicon electronics and III-V photonics has been a long-standing goal to merge these two worlds on a single chip. There's interest in combining passive silicon waveguides with other materials in hybrid devices and systems. Here, I will cover the work done at IBM research on developing novel epitaxial techniques for the monolithic integration of III-Vs on Si. I will focus on waveguide coupled high-speed III-V photodetectors, where we explore inverse design optimization together with DTU, and on hybrid III-V/Silicon photonic crystal lasers based on topological designs.
		Chair: Sahand Jamal Rahi, EPFL
12:00	26	**How do single bacterial cells think?** *Erik van Nimwegen, Universität Basel* The functioning of genome-wide gene regulatory networks in bacteria presents us with an apparent paradox. On the one hand, bacterial populations successfully coordinate their gene expression patterns and phenotypes to allow them to grow in a huge variety of environments, including complex combinations of nutrients and stresses that natural selection cannot possibly have specifically prepared them for. For example, bacteria can even adapt their phenotype to grow in fully deuterated water. On the other hand, the more we study gene regulation in bacteria at the single cell level, the more noisy and haphazard it appears. Moreover, given the low molecule numbers involved, there are severe thermodynamic limitations on the accuracy of both sensing and regulation of gene expression in single bacterial cells, which seem to preclude the robust adaptation that is observed at the population level. In this talk, I will present a new picture that is emerging from recent joint experimental and theoretical studies of gene regulation at the single-cell level in bacteria, suggesting a subtle stochastic strategy for phenotypic adaptation in which noise and regulation are deeply entangled. The key experimental observations that form the main ingredients of this picture include: 1. That gene expression fluctuations are largely driven by propagation of noise through the gene regulatory network, 2. That, through the effects of dilution, growth rate controls the sensitivity of gene regulatory circuits to fluctuations, and 3. That gene expression noise and phenotypic fluctuations systematically decrease with growth rate. I will discuss how these observations combine into a stochastic strategy by which bacterial populations successfully adapt their phenotypes to complex unpredictable environments, in spite of highly noisy and inaccurate regulation at the single cell level.
12:45		***Lunch***
14:00		***Topical Sessions***
19:00		***Transfer to Dinner***

19:30		*Conference Dinner*

Friday, 13.09.2024, Room ETA F 5

Time	ID	ENERGY AND SUSTAINABILITY: RESEARCH NEEDS FOR A SUSTAINABLE ENERGY TRANSITION *Chair: Thomas Christen, Hitachi Energy*
09:00	31	**The Future of the Electrical Energy System: from Rotating Masses to Power Electronic** *Gabriela Hug, Head of Power Systems Laboratory, ETHZ* The electrical energy system is in a transition from traditional resources such as nuclear power, hydropower or coal-fired power plants to new resources such as PV and wind. Hence, synchronous machines which give the system a natural inertia are replaced by inverter connected resources. This raises various new challenges that go beyond the variability of the available energy. For example, the system inertia is reduced which leads to faster system dynamics. This presentation will show how the future electrical energy system in Switzerland could look like and the challenges that need to be solved to realize such a system and what role new control approaches can play.
09:30	32	**The Swiss Energy Transition to NetZero** *Thomas J. Schmidt, Head of Energy & Environment Research Division, Paul Scherrer Institute, CH-5232 Villigen PSI & Institute of Molecular Physical Sciences, ETH Zürich, CH-8093 Zürich* The Swiss Federal Council as well as many other governments set the ambitious goal to reach net-zero greenhouse gas (GHG) emissions by mid of the century. As the required systemic and societal transitions will take decades, urgent action is imperative, as highlighted by the recent IPCC Report. Despite the well-defined target, many questions remain concerning transition pathways, social acceptance, technology developments, regulatory frameworks, and business cases. The diversity of these challenges clearly shows that only an integrated and trans-disciplinary approach can generate the required impact and guide stakeholders toward the NetZero target. This presentation will guide you through a short journey of energy efficiency in the energy transition, energy storage necessities, and possible pathways to reach the NetZero goal
10:00	33	**From Materials to Devices: The importance of physics in material science & technology for sustainable energy application** *Lorenz Herrmann, Head of Advanced Materials and Surfaces Department, EMPA* A safe and sustainable energy supply as well as sustainable material cycles are two of the most urgent needs of our times. In all of these questions material science plays a pivotal role. At Empa we understand material science as an interdisciplinary approach bringing together chemistry, physics, biology and the engineering sciences in order to create innovations of industrial and societal relevance. One example for this is our initiative "Materials2Devices": By combining material synthesis and characterization on the nanoscale with research on upscaling and manufacturing processes, we are accelerating the adoption of basic science in real devices. Thereby the physical understanding of our new materials on the nanoscale plays a key role. During this talk, this will be illustrated by giving insights into different examples ranging from batteries & photovoltaics all the way to quantum heat engines.
10:30		*Coffee Break*

Time	ID	*Chair: Tomoko Muranaka, EPFL*
11:00	**34**	**CERN's strategy for an environmentally responsible research** *Sonja Kleiner, Head of the CERN HSE Environment Group* As the World's largest particle physics research laboratory, CERN strives to deliver world-class scientific results and knowledge, while embedding environmental responsibility and sustainability in its activities. This contribution will present CERN's approach for environmentally responsible research. It will outline the present footprint of the Organization and the current projects, with a particular focus on energy related matters, aimed at minimising the laboratory's impact on the environment across its accelerators, experiments as well as its site and campus facilities. How CERN contributes to the development of technologies that may help to mitigating the impact of society on the environment will also be discussed.
11:30	**35**	**A sustainable future in High-Energy physics** *Patrick Koppenburg, Nikhef, Amsterdam & CERN, LHCb and future collider experiments* The climate crisis and the degradation of the world's ecosystems require humanity to take immediate action. The international scientific community has a responsibility to limit the negative environmental impacts of basic research. The HECAP+ communities (High Energy Physics, Cosmology, Astroparticle Physics, and Hadron and Nuclear Physics) make use of common and similar experimental infrastructure, such as accelerators and observatories, and rely similarly on the processing of big data. Our communities therefore face similar challenges to improving the sustainability of our research. This talk will reflect on our work practices and research infrastructure and identify the opportunities and challenges, with a particular emphasis on the long-term future of particle physics.
		Moderation: Hugo Zbinden, Université de Genève
12:00	**36**	***Panel Discussion***
12:30		***End; Lunch***
13:30		***Topical Sessions***
16:00		***CONFERENCE END***

Women in Physics Career Symposium

This event is supported by Universität Zürich, PSI Villigen, SPS, SCNAT, and Université de Genève.

Tuesday, 10.09.2024, Room ETZ E 6

Time	ID	Women in Physics Career Symposium *Chair: Tobias Golling Université de Genève*
14:00	**41**	Career Talk 1: ***Laura Bégon-Lours***
14:30	**42**	Career Talk 2: ***Anna Fontcuberta i Morral***
15:00	**43**	*Mentors and Mentees introduce themselves*
16:00		***Coffee Break***
16:30	**44**	*Mentor - Mentee Meetups*
17:30	**45**	Career Talk 3: ***Janine Haase***
18:00	**46**	Career Talk 4: ***Ilaria Zardo***
18:30		***END; CERN 70***
19:45		***Postersession with Apéro***

Startups: The role of physics and physicists in developing a product ?

Wednesday, 11.09.2024, Room ETZ E 6

Time	ID	STARTUPS: THE ROLE OF PHYSICS AND PHYSICISTS IN DEVELOPING A PRODUCT ? *Chair: Gian Salis, IBM Rüschlikon, Valeria Bragaglia, IBM Rüschlikon*
14:30	**51**	**From Lab to Startup: The Journey of condenZero** *Denys Sutter, CondenZero* In this talk, Denys will discuss his journey from researching quantum materials in the physics lab to co-founding and building the startup condenZero. The company now supports an international community of material scientists using transmission electron microscopy with liquid helium cryogenic sample holders. Key topics will include the major challenges the team encountered during their venture, the difficulties scientists may face in such endeavors, and the unique strengths physicists bring to these initiatives.
14:50	**52**	**Axelera AI: Technology Deep Dive** *Riduan Khaddam Aljameh, Axelera.AI* This presentation will delve into Axelera AI's cutting-edge technology, which combines proprietary Digital In-Memory Computing (D-IMC) and RISC-V controlled dataflow to revolutionize computer vision on edge devices. Our innovative platform integrates in-memory processing with SRAM cells that perform in-place matrix-vector multiplications, dramatically enhancing speed and efficiency. Additionally, leveraging the open-source RISC-V ISA, we enhance our platform's capabilities for Edge AI applications. We will demonstrate how this technology achieves superior performance at a lower cost and energy consumption, setting new standards in AI acceleration.
15:10	**53**	**BTO-enhanced silicon photonics – PICs for communication and switching based on the Pockels effect** *Thomas Kornher, Lumiphase AG* Controlling light with electrical signals is one of the most critical functions in a photonic integrated circuit for optical communication, sensing, and switching. Lumiphase develops and manufactures photonic chips powered by a unique BTO Pockels technology. The BTO material properties translate into electro-optical modulation functionalities with benefits in cost, speed, transparency, power-consumption, and footprint compared to standard silicon solutions. Pockels-enhanced chips enable next-generation transceivers and a wide range of other photonic applications ranging from sensing, over data processing to switching, where large numbers of ultra-efficient, integrated phase shifters are needed.
15:30	**54**	**Luxtelligence: Illuminating faster datacenters with ferroelectrics** *Mohammad Bereyhi, Luxtelligence* Photonic integrated circuits (PICs) are compact, efficient and can be manufactured in scale. Several materials have been explored, showing strengths in different fields. Si and InP are known for their electro-optic activities yet suffer from large optical losses and large electronic powers to operate. Today's photonic industry needs a material that is efficient, fast and consumes less power. Thin-film Lithium Niobate (TFLN) is a material that solves these challenges. TFLN offers low optical loss, 2× higher bandwidth and reduces the power consumption by 2×. Luxtelligence offers foundry services for TFLN using its proprietary technology for the next generation telecommunication systems.

15:50	**55**	**From concept to market: the role of a scientist at Polariton Technologies** *Youri Popoff, Polariton Technologies* Transforming an idea into a mature product is a daily challenge in industry. This talk will showcase how Polariton Technologies, a startup, successfully achieved this by harnessing the combined effort of scientists and engineers, whilst highlighting the crucial role of physicists in this environment. The team brought the theoretical concept of plasmonics from research to reality, resulting in a competitive product – a high-speed, low footprint and low energy electro-optical modulator.
16:10	**56**	**Intellectual Property (IP) as an important asset for your Start-up** *Catalin Cris, Swiss Federal Institute of Intellectual Property, 3003 Bern* Intellectual Property (IP) represents an important asset for any company, in particular for Start-ups. Start-ups foster the creative potential of their founders an co-workers and, therefore, should strive at protecting their technological solutions, which build the foundation of their products. In addition to protection of potential products, strong intellectual property builds an asset when negotiating with larger companies. The current talk gives an overview of the possibilities to build a strong Intellectual Property portfolio, which consists of e. g. patents, trademarks and patents. It also exemplifies how these tools may be combined for obtaining most broad protection in a competitive environment.
16:30		***Coffee Break***
17:00	**57**	**Building great products from fundamental research** *Mathieu Munsch, QNAMI* Qnami is a pioneer in the development and commercialization of quantum technologies. Since its foundation in 2017, Qnami has collaborated with a number of academic and industry partners to deploy quantum sensing technologies and make them accessible to a wide audience. In this presentation, we talk about moving from academia to start-up, building a deep-tech product from cutting edge science and finding a market.
17:20	**58**	**Membrane-less Redox Flow Batteries using Liquid/Liquid Interfaces** *Federico Paratore, Unbound Potential GmbH* Energy storage systems are enabling the energy transition by buffering the intermittent nature of renewable sources. In this talk, I will introduce a novel concept of a membrane-less redox flow battery for long-duration energy storage. Unlike Li-ion systems, our solution does not rely on mined materials, is safe—without any fire hazards, is scalable and cost-effective. I will share the story of our company, including the technical steps we are undertaking to scale up our solution, and outline the roadmap for translating a technology from a physics lab into a market-leading product.
17:40	**59**	**Navigating the Conservative Chip Industry:** **Strategies for Introducing Disruptive Technologies** *Manu Nair, Synthara.AI* The chip industry is traditionally slow to adapt to new technologies due to the high stakes and substantial investments required for innovation. However, the industry is currently at an inflection point driven by the surging demand for AI. This creates an opportunity to introduce new products/technologies to the industry. This talk explores how startups can successfully introduce disruptive technologies into this conservative market.

18:00	**60**	**Making dirt shine - contamination analysis for semiconductor manufacturing** *Philip Eib, UNISERS* As semiconductor feature sizes decrease, controlling contamination in manufacturing processes becomes increasingly important. UNISERS builds tools for contamination detection and classification using a unique combination of optical microscopy and Raman spectroscopy, quantifying contaminants on wafers and in liquids. This talk highlights our techniques and their applications, while giving insight into a workplace for physicists at the intersection of fundamental physics, data science, and product development.
18:20		***END***

History and Philosophy of Physics

Wednesday, 11.09.2024, Room ETZ E 7

Time	ID	History and Philosophy of Physics *Chair: Claus Beisbart, Universität Bern, NN*
14:30	**71**	**Philosophical Implications of Quantum Gravity** *Baptiste Le Bihan, Université de Genève, Département de Philosophie* Although extremely successful in their domains of description, general relativity and the Standard Model of particle physics rest on very different conceptual foundations, making it extremely difficult to describe phenomena involving gravity and high energies, such as black holes. The talk will provide a brief description of the most popular approaches to quantum gravity being investigated and will show how philosophical arguments can be applied in contexts where very different alternative research programs coexist in theoretical physics. Focusing on the concept of spacetime emergence, it will be shown that even in the absence of a complete theory of quantum gravity, one can already draw interesting implications regarding the nature of spacetime, for example such as whether spacetime could have failed to exist according to the laws of nature.
15:00	**72**	**Quantum mechanics in a course on "Higher algebra": Wolfgang Pauli, Emil Artin, and the representation theory of semi-simple systems** *Peter Ullrich, University of Koblenz* Bartel Leendert van der Waerden's (1903–1996) 1932 book Die gruppentheoretische Methode in der Quantenmechanik (translated as Group theory and quantum mechanics) benefited from his contacts with Werner Heisenberg (1901–1976) at the University of Leipzig and documents the early collaboration between quantum mechanics and the – then – "modern" algebra. However, personal relationships had already played an important role before: In the winter semester of 1927/28, Wolfgang Pauli (1900–1958) attended a lecture course on "Ausgewählte Kapitel der höheren Algebra" (= "Selected chapters of higher algebra") which Emil Artin (1898–1962) gave at the University of Hamburg and in which he dealt with representation theory. That Artin cared about Pauli's need to apply this theory to quantum mechanics is shown by studying a set of notes which Pauli took during the lecture course and which he later referred to several times.
15:30	**73**	**Dichroic Light Polarizers from Tourmaline to Polaroid and Bernotar Filters** *Jean-François Loude, EPFL* The surprising optical properties of tourmaline were studied soon after the discovery of the polarization of light. Thin slices worked as polarizers, enabling the construction of simple, handheld polariscopes. The tourmaline tongs described by Karl Michael Marx in 1828 were a great success, especially after Nörrenberg simplified their construction. The fortuitous discovery in 1852 of almost colourless herapathite aroused great interest. However, efforts to produce crystals exceeding about one square centimetre remained unsuccessful until the early 1930s, when Edwin Land in the USA and Ferdinand Bernauer in Jena succeeded in manufacturing large sheets, thus extending the field of applications beyond mineralogy.ge sheets, thus extending the field of applications beyond mineralogy.

16:00	**74**	**Can machine learning models provide an understanding of physical systems?** *Claus Beisbart, Universität Bern* These days, machine learning (ML) is all the rage in physics and other disciplines. While there is agreement that ML can be strong at classification and prediction tasks, it has remained controversial what it can contribute to the understanding of real-world phenomena. Some authors claim that the opacity of ML is an obstacle to the use of ML for understanding, while others have given examples in which ML seems to have contributed to understanding. In my talk, I try to negotiate between these opposing views. I argue that ML models as such do not provide humans with understanding unless humans can tell what the explanation is – and this requires transparency. However, ML models can be used to identify difference makers at the level of known variables and thus contribute to causal understanding. I illustrate my argument with examples from physics.
16:30		***END; Coffee Break***

Physics education and communication: Good practice examples within the Swiss Physics Community

Friday, 13.09.2024, Room ETZ E 8

Time	ID	Physics education and communication: Good practice examples within the Swiss Physics Community *Chair: Andreas Müller, Université de Genève*
13:30	**91A**	**A Course on General Relativity and Cosmology for High School Students** *Alice Gasparini, Université de Genève* We will present the results of the project initiated by SwissMAP, which aims to introduce the themes of cosmology and general relativity at upper secondary level (senior high school). After an overview of the motivations and challenges inherent in this educational effort, we will provide illustrative examples of activities, as well as the feedback collected during field implementation and the resulting impact on students.
	91B	**A hands-on test module in schools on astrophysics and computer science** *Matthieu Heller, Sebastien Murphy, Université de Genève* Based on simulated data from the SST-1M observation system, a former prototype for an international gamma-ray telescope experiment (CTAO) involving the University of Geneva, we've created a Python data analysis project suitable for high school students. This project is part of an interdisciplinary learning approach that combines physics and computer science and is intended to be completed over the course of one week. By using their prior knowledge in computer science and physics, this novel pedagogical sequence aims at immersing students in the world of scientific research, focusing on an authentic and meaningful topic. This presentation covers the project, focusing on programming from the students' viewpoint and making a complex physicist-designed environment more accessible. It also reviews educational choices and their didactic reasoning. We've tested this project with 47 third year students from the College Rousseau in Geneva, analysing the outcomes and feedback gathered on Moodle. Based on these findings, we also outline potential improvements.
14:00	**92**	**Physics in Advent** *Gernot Scheerer, CHUV* With about 70‘000 registered participants and over 1 million clicks on the web page every year, Physics in Advent (PiA for short) is one of the major physics outreach projects in Europe. PiA is an playful physcis Advent calendar of the Georg-August University in Göttingen. From 1 to 24 December, an experiment riddle will be posted on the PiA homepage every day. The goal of PiA is to foster pupils' curiosity and interest in physics and science and to help understand natural physical phenomena without complex formulas, to make science alive in the living room. We will give a short overview on the Physics in Advent project and how the Swiss Physical Society is fostering its impact in Switzerland.
14:20	**93A**	**Physics and Sustainability at School** *Peter Kreuzer, Université de Genève* In this contribution, we present an innovative physics course on the topic of energy for upper secondary school students, contextualized within the Earth’s environment and climate change. By immersing students in real-world climate issues and encouraging both critical thinking and problem-solving, this course aims to foster a generation of environmentally conscious individuals equipped to address the challenges of our changing planet. The content of the course is mapped to the official physics curriculum and delves into climate related topics such as the greenhouse effect. Among others, students engage in order of magnitude calculations concerning key climate phenomena, such as the projected sea level rise attributed to global temperature increases, or the aviation industry’s contribution to global greenhouse gas

		emissions. Practical activities involve climate-oriented laboratory experiments and computer simulations. In addition, students are provided with an overview of recent scientific findings, encouraging advancements and innovative technology concerning sustainable development. An early version of this course has already been tested on a class of 16 high-school students in Geneva in 2022, accompanied by a study on its effects on motivation of students. We will report the outcomes of this teaching experience and the related motivation study and describe how this teaching project has been evolving since, as well discussing its future perspectives.
	93B	**Physics and Sustainability at University** *Tomoko Muranaka, EPFL* Starting fall 2024, all EPFL departments will introduce sustainability-oriented topics into both bachelor's and Master's classes with a focus on real-world applications. What are the challenges for students and for professors? In this flash talk, three pillars for integrating sustainability in physics education will be shared.
14:40	**94**	**International Physicists' Tournament and International Young Physicists' Tournament** *Samuel Byland, VSMP: IYPT, Mathieu Suter, ETHZ: IPT* The International (Young) Physicists' Tournament, short I(Y)PT, is a physics competition for students (IYPT: pre-university, IPT: university) with a strong focus on project and teamwork. In contrast to most other science competitions, the problems are published about a year before the tournament. An ideal I(Y)PT problem should allow for experimental and theoretical investigations on different levels and aspects of an interesting phenomenon (see https://www.iypt.org/problems/problems-iypt-2024/ and https://iptnet.info/problems/ for lists of current problems). Students get the opportunity to develop their own models and setups working on these open problems, engaging them with the process of real research. At the competition, teams present, discuss and review the solutions in so-called physics fights. This interactive format mimics a research conference and is an excellent experience for young scientists. Over the last twenty years a national competition (Swiss Young Physicists' Tournament, SYPT) has been established with the intention to promote more project-based physics teaching at Swiss high schools.
15:00	**95**	**Youth@STEM4SF** *Barbora Gulejova, CERN* The interest of youth in STEM, particularly physics and engineering studies, is experiencing a decline, despite the pressing need for a new generation of specialists to drive cutting-edge research crucial for innovation, economic progress, and sustainable development. To address this challenge, innovative approaches are needed to inspire more students to pursue STEM careers. Contextualizing STEM disciplines within real-life scenarios, especially those related to sustainable development, proves to be a potent tool for fostering students' interest and appreciation. The pioneering project Youth@STEM4SF (Youth at STEM for Sustainable Future), initiated in Switzerland in May 2023 with support from SPS, SCNAT, and education21, offers a unique high school program integrating physics and STEM subjects with real-life scenarios and sustainable development contexts. Through applied R&D in physics-based industries and inspirational role models in these fields, the program in form of a thematic school day aims to engage young talents, especially girls, in physics and basic sciences. It also seeks to educate future society leaders on the importance of science for sustainability. Initial assessments show promising changes in interest and attitude. The project aspires to have a broad national and international impact by aligning with educational plans and gaining recognition from educational authorities.
15:20	**96**	*Discussion*
15:45		***END***

KOND

Tuesday, 10.09.2024, Room ETZ E 7

Time	ID	KOND I: Coupled degrees of freedom *Chair: Thomas Greber, Universität Zürich*
14:00	101	**Coupled magnetism and ferroelectricity in magnetic high entropy oxide** *Roxana Capu [1], Subhrangsu Sarkar [2], Ryan Thompson [2], C. Willem Rischau [3], Marli R. Cantarino [4], Stefan Schuppler [5], Sergey Budko [6], Stefano Gariglio [3], Zaher Salman [7], Yurii Pashkevich [2,8,9], Christian Bernhard [2]* *[1] West University of Timisoara, Romania,* *[2] Department of Physics, University of Fribourg, CH-1700 Fribourg, [3] Université de Genève,* *[4] ESRF, Grenoble, France,* *[5] Institute for Quantum Materials and Technologies (IQMT), Karlsruhe Institute of Technology (KIT), Germany* *[6] Ames Laboratory, U.S.A, [7] Paul Scherrer Institut* *[8] Fribourg Center for Nanomaterials, University of Fribourg, CH-1700 Fribourg* *[9] O. Galkin Donetsk Institute for Physics and Engineering, NAS of Ukraine* Using low energy Muons spin rotation spectroscopy, measurement of dc/ac magnetic susceptibility and measurement of capacitance, we show that epitaxially grown Nd-based perovskite high entropy oxides exhibit significant ferromagnetism, spin-glass behaviour, high dielectric constant at RT and a temperature-dependent ferroelectric hysteresis that are intricately coupled to each other. X-ray absorption spectroscopy at 3d transition metal edges indicates a mixed valence state – possibly originating from the off-centring of the B-sites – that helps to explain these properties. These materials could be useful for exploiting magnetostriction and other related properties leading to next-generation sensors.
14:15	102	**Terahertz electric-field-driven dynamical multiferroicity in $SrTiO_3$** *Martina Basini [1], Matteo Pancaldi [2], Björn B. Wehinger [3], Alexander V. Balatzky [4,5], Stefano Bonetti [6], Matthias C. Hoffmann [7], Terumasa Tadano [8], Mattia Udina [9], Vivek Unikandanunni [10]* *[1] ETH Zürich, Physics Department, [2] Elettra-Sincrotrone Trieste S.C.p.A., Basovizza, Italy* *[3] European Synchrotron Radiation Facility, Grenoble, France, [4] NORDITA, Stockholm, Sweden* *[5] Department of Physics, University of Connecticut, Storrs, CT, USA* *[6] Department of Molecular Sciences and Nanosystems, Ca'Foscari University of Venice, Italy* *[7] Linac Coherent Light Source, SLAC National Accelerator Laboratory, Menlo Park, CA, USA* *[8] Research Center for Magnetic and Spintronic Materials, National Institute for Materials Science, Tsukuba, Japan* *[9] Department of Physics and ISC-CNR, 'Sapienza'University of Rome, Italy* *[10] Bern University* The emergence of collective order in matter is among the most fundamental and intriguing phenomena in physics. Recently, the theoretical concept of dynamical multiferroicity has been introduced to describe the emergence of magnetization due to time-dependent electric polarization in non-ferromagnetic materials. Here we provide experimental evidence of room-temperature magnetization in the archetypal paraelectric perovskite $SrTiO_3$ due to this mechanism. We resonantly drive the infrared-active soft phonon mode with an intense circularly polarized terahertz electric field and detect the time-resolved magneto-optical Kerr effect. Our findings show a new path for the control of magnetism, for example, for ultrafast magnetic switches, by coherently controlling the lattice vibrations with light.

14:30	103	**Phonon-Polariton Nonlinearities in Ferroelectric $LiNbO_3$** *Rossella Acampora [1], Megan Biggs [2], Elsa Abreu [1], Jeremy Johnson [2], Steven Johnson [1]* *[1] ETH Zürich, [2] BYU* In ferroelectric $LiNbO_3$, THz light couples with low-frequency optical phonons and form phonon polaritons. Recent studies have shown that is possible to probe nonlinearities at specific points along the phonon-polariton dispersion curve with different probe wavelengths after broadband excitation with strong THz transients. However, extensive measurements of lattice anharmonicities in $LiNbO_3$ are still lacking. To bridge this gap, we characterised the nonlinear behaviour of phonon-polaritons in $LiNbO_3$ using nonlinear THz spectroscopy. We mapped the $LiNbO_3$ phonon polariton E branch by varying the probe wavelength and observed a strong dependence of the nonlinear response on the wavelength of the near-optical pulse, which arises from the momentum selection of the detection process.
14:45	104	**Strong enhancement of superconductivity in fractal lattices** *Askar Iliasov [1], Andrey Bagrov [2], Mikhail Katsnelson [2]* *[1] University of Zurich, [2] Radboud University* Using the Sierpinski gasket as an example, we theoretically study the properties of fractal superconductors. We focus on the phenomenon of s-wave superconductivity in the Hubbard model with attractive on-site potential and employ the Bogoliubov-de Gennes approach. For the case of the Sierpinski gasket, we demonstrate that fractal geometry of the underlying crystalline lattice can be strongly beneficial for superconductivity, not only leading to a considerable increase of the critical temperature as compared to the regular triangular lattice but also supporting macroscopic phase coherence of the Cooper pairs.
15:00	105	**Decoupled static and dynamical charge correlations in $La_{2-x}Sr_xCuO_4$** *Leonardo Martinelli [1], Izabela Biało [1], Johan Chang [1], Jaewon Choi [2], Mark Fischer [1], Mirian Garcia-Fernandez [2], Xunyang Hong, Tohru Kurosawa [3], Chun Lin [1], Migaku Oda [4], Jens Oppliger [1], Qisi Wang [5], Ke-Jin Zhou [2]* *[1] University of Zurich, [2] Diamond Light Source, [3] Muroran Institute of Technology* *[4] Hokkaido University, [5] The Chinese University of Hong Kong* The physics of charge order in high-temperature superconducting cuprates is still largely unexplained. Recent experiments revealed the presence of strong quantum fluctuations, whose doping and temperature dependence suggest the closeness to a quantum critical point and a relation to the strange-metal phase. We used ultra-high-resolution Resonant Inelastic X-ray Scattering in combination with uniaxial strain to investigate the stripe-ordered cuprate $La_{2-x}Sr_xCuO_4$. This allowed us to investigate the properties of the associated quantum fluctuations and phonon softening in an artificially detwinned striped state. We discover a clear connection between quantum charge fluctuations and bond-stretching phonons, and an apparent de-coupling between the static charge order and its fluctuations, which display a different symmetry.
15:15	106	**Investigation of the phase transition driven by ultrashort laser pulses in the charge-density-wave material $K_{0.3}MoO_3$** *Rafael T. Winkler [1], Elsa Abreu [1], Christopher Arrell [2], Danylo Babich [2], Paul Beaud [2], Simone Biasco [1], Larissa Boie [1], Jure Demsar [3], Yunpei Deng [2], Edwin J. Divall [2], Sabina Gurung [1], Steven Johnson [1], Henrik Lemke [2], Roman Mankowsky [2], Abhishek Nag [2], Samuel Norton [1], Alexander R. Oggenfuss [2], Vladimir Ovuka [1], Mathias Sander [2], Matteo Savoini [1], Davide Soranzio [1], Urs Staub [2], Tim Suter [1], Janine Zemp (Dössegger) [1], Serhane Zerdane [2]* *[1] ETH Zürich, [2] SwissFEL, Paul Scherrer Institute, Villigen,* *[3] Faculty Institute of Physics, Johannes Gutenberg-University Mainz* Blue Bronze ($K_{0.3}MoO_3$) is a quasi 1D material exhibiting a charge-density-wave (CDW) with a periodic lattice distortion (PLD). In a time resolved x-ray experiment at SwissFEL, we study the dynamics of the PLD by pumping $K_{0.3}MoO_3$ with short laser pulses and probing it using x-ray diffraction. We construct reciprocal space maps (RSM) of superlattice reflections at different delays. The RSMs indicate a transient but not persistent flip of the phase of the CDW. We attribute the suppression of the diffracted x-ray intensity after this flip to a fast decoherence of the CDW driven by pinning of the phase of the CDW in the material indicating an order-disorder like phase transition.

15:30	**107**	**Resonant Ultrasound Spectroscopy Study of the Vortex Lattice Phase Diagram of Niobium** *Xuan Dang Dang, Jonas Philippe, Marek Bartkowiak, Marc Janoschek, Paul Scherrer Institut* Here, we will present the development of a novel resonant ultrasound spectroscopy (RUS) setup. Subsequently, we report our investigation of the superconducting vortex lattice of a commercially available single crystal of high purity (Nb - 99.999%). Based on our measurements, we determine the vortex lattice phase diagram, and compare it to results from electrical resistivity and neutron scattering studies.
15:45	**108**	**Tuning the Electronic Properties of Two-Dimensional Lepidocrocite Titanium Dioxide-Based Heterojunctions** *Kati Asikainen, Matti Alatalo, Marko Huttula, Assa Sasikala Devi, University of Oulu* This study investigates a 2D Janus heterostructure made by combining lepidocrocite TiO_2 and MoSSe, focusing on the energetic stability and change in electronic properties with respect to varied interface terminations. Using state-of-the-art density functional theory simulations, we show that TiO_2-MoSSe heterostructures are energetically feasible to form. The results indicate that by varying the atomic species at the interface, the electronic structure can be considerably altered due to the differences in charge transfer arising from the inherent electronegativity of the atoms. The work demonstrates that the Janus interface enables the tuning of electronic properties, providing an understanding of the possible applications of the TiO_2-MoSSe heterostructure.
16:00		***Coffee Break***
18:30		***CERN 70***
19:45		***Postersession with Apéro***

Thursday, 12.09.2024, Room ETZ E 7

Time	ID	KOND II: Advances in Methodology *Chair: Daniel Mazzone, PSI Villigen*
14:00	**111**	**Characterization of high-purity nickel single crystals by mechanical spectroscopy** *Anna Nastruzzi, Weibin Jiang [2], Daniele Mari [3], Manuel Pouchon [1,3]* *[1] PSI, [2] CAS, [3] EPFL* Mechanical spectroscopy tests of high-purity nickel single crystal, with different lattice orientations, were performed in a forced oscillation pendulum, under high vacuum, at different frequencies. The temperature was varied from room temperature up to 500 °C. A periodic strain of amplitude 5×10^{-5} was applied. Internal friction spectrum reveals 3 mechanical loss peaks: P0 (transient peak), P1 and P2. P1 and P2 might be related to a motion of dislocations controlled by the migration of 2 types of jogs. Activation energies in the range 1.5 - 2 eV were found for both P1 and P2 peaks. These are comparable to pipe diffusion. TEM analyses confirmed the presence of dislocation jogs.

14:15	**112**	**Imaging heat transport in suspended diamond nanostructures with integrated spin defects thermometers** *Valentin Goblot [1], Kexin Wu [1], Enrico Di Lucente [1], Elena Losero [1], Yuchun Zhu [1], Claudio Jaramillo [1], Nicola Marzari [1], Michele Simoncelli [2], Christophe Galland [1]* *[1] EPFL, [2] University of Cambridge* Diamond offers excellent prospects for the study of phonon transport phenomena beyond Fourier's law at room temperature. Here, we investigate heat transport properties of suspended diamond microstructures using NV centers in the diamond lattice as in-situ temperature sensors. We present diffraction-limited spatially resolved measurements of temperature across suspended cantilevers, with a temperature resolution below 100mK using frequency-modulated lock-in readout of the spin resonance. We extract the effective thermal conductivity of each cantilever and reveal a surprisingly steep dependence on the cantilever lateral dimension, highlighting the need for further experiments and theoretical refinement to fully understand boundary and confinement effects.
14:30	**113**	**Electronic Viscous Flow in Hexagonal Boron Nitride Encapsulated Graphene FETs** *Wenhao Huang, Michel Calame [1,2], Tathagata Paul, Mickaël Lucien Perrin [1]* *[1] Empa, [2] University of Basel* Conventional electron transport in conductors involves diffusive scattering and interactions with lattice vibrations, resulting in Ohmic behavior. However, a distinct regime arises when electron-electron interactions induce correlated, momentum-conserving flow akin to classical fluid dynamics. Our study delves into charge hydrodynamic transport, revealing width-dependent conductivity and reduced resistivity at higher electron temperatures. We observe charge vortices and validate viscous effects over a broad temperature range, including room temperature, particularly notable in graphene compared to other systems. Finite element calculations confirm our findings and suggest geometries to enhance viscous effects, promising applications like geometric rectifiers and charge amplifiers. This research advances our understanding and utilization of charge hydrodynamics in graphene-based systems.
14:45	**114**	**Laser induced structural dynamics in colloidal gold nanoparticles** *Changji Pan [1], Klaus Sokolowski-Tinten [2], Albert Thies [2], Laurenz Kremeyer, Anton Plech [3], Anna Ziefuss [2]* *[1] ETH Zürich, [2] University of Duisburg-Essen, [3] Karlsruher Institut für Technologie* Laser induced energy transfer and dissipation in nanoparticles within a liquid environment are of specific interest due to their relevance in photochemical and biomedical applications. In particular a quantitative understanding of electron-phonon coupling (EPC) is required for determining the life-time of hot electrons and heat generation. Currently, most related studies are based on optical pump-probe experiments, which only provide information related to electron dynamics. Here, we use time-resolved X-ray scattering at SwissFEL to characterize laser induced structural dynamics in colloidal gold nanoparticles. Our measurements provide direct and quantitative information on structural response, indicating a chemical environment-dependent EPC process.
15:00	**115**	**Ultrafast EBIC: A new technique for semiconductor device characterization with ps time resolution** *Joel Rehmann, Matthias Röllin, Nikolaus von Schickh, Francisco Carrion Ruiz, Andreas Vaterlaus, Yves Marc Acremann, ETH Zürich* For the first time we demonstrate an ultrafast scanning electron (USEM) microscope with electron-beam-induced current (EBIC) capability. This novel technique allows for in-situ observation of depletion layers in fast semiconductor devices. We demonstrate micrometer spatial and picosecond temporal resolution on an avalanche photodiode. EBIC is a well established method in semiconductor analysis. Paired with a pump probe approach in a USEM the method provides a new tool for developing milimeter-wave electronics.

15:15	**116**	**Growth by pulsed laser deposition of $SrVO_3$ thin films for optical applications** *Tancredi Thai Angeloni, Ian Aupiais, Andrea Caviglia, Stefano Gariglio, Alexey Kuzmenko, Clémentine Thibault, Javier Toboada-Gutierrez, University of Geneva* Light-matter interaction can be strongly enhanced by confining the electric field in optical cavities. These require a well-suited stacking of reflecting and transparent materials selected for the frequency range of interest. In our study, we target the Terahertz spectrum and have chosen the $SrVO_3$ compound for its high reflectivity in this frequency range. We report results on the growth of $SrVO_3$ thin films by pulsed laser deposition unraveling the complex dependence of resistivity and crystalline quality on the Ar/O_2 growth atmosphere as well as laser fluence and target-substrate distance. Optical measurements performed by Fourier Time-domain InfraRed spectroscopy show that the reflectivity window is within the scope of our applications.
15:30	**117**	**Increasing the dynamical range of a scanning tunneling microscope** *Ajla Karic, Carolina Marques, Fabian Natterer, University of Zurich* A method for increasing the dynamical range of scanning tunneling microscopes (STM) is introduced. We first transform the nonlinear current-voltage characteristic into a time-dependent current via AC excitation and then actively cancel dominant current harmonics using a driven compensating capacitor. The placement of the compensating capacitor allows us to create removal currents precisely opposing the currents that would otherwise saturate the preamplifier. Eliminating DC currents has no effect on the local density of states measurements, and removing the first harmonic only rigidly shifts the conductivity by a known amount.
15:45	**118**	**Analytical redefinition of the adsorbate-induced surface response of a metal** *Aleksandra Siklitskaya, Tomasz Bednarek, Adam Kubas, Institute of Physical Chemistry PAS* We introduce an innovative analytical framework for analyzing the interaction of charged perturbations with a three-dimensional (3D) half-infinite conductive space. Our method merges the quasi-3D expansion of the one-dimensional (1D) Kronig-Penney metal with Tamm's surface states, offering a comprehensive analysis tool for multipole molecule-conductive surface interactions. Validated against density functional theory (DFT) results on CO adsorption on Pt(111) slabs, our model accurately predicts changes in adsorption site preference with increasing coverage, aligning with experimental findings. Notably, our model maintains scalability with reported CO-CO interaction potentials on Pt(111) surfaces, reducing computational costs by a factor of 1000 compared to quantum chemical calculations, while delivering precise surface response solutions.
16:00		
16:30		***Coffee Break***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Friday, 13.09.2024, Room ETZ E 7

<table>
<tr><th>Time</th><th>ID</th><th>KOND III: Many-body systems
Chair: Aline Ramires, PSI Villigen</th></tr>
<tr><td></td><td><s>121</s></td><td>⇒ moved to talk 13</td></tr>
<tr><td>13:30</td><td>122</td><td>Magnetostriction measurements of quantum spin ice candidates at ultra-low temperatures

Ilaria Villa, Marek Bartkowiak, Michel Kenzelmann, Romain Franck Sibille, Paul Scherrer Institut

Rare-earth pyrochlores frequently exhibit spin ice correlations and, therefore, can potentially host quantum spin ice (QSI) phases. In these systems, the spin-orbital ground state doublet can be represented as an effective pseudo-spin 1/2. In addition to dipolar moments, multipoles are allowed, which can stabilise ice or ordered phases, or introduce quantum fluctuations on a dipolar spin ice manifold.
Magnetostriction can reveal hidden multipolar orders and is proposed for distinguishing dipolar and octupolar QSI. This study presents magnetostriction measurements at ultra-low temperatures on QSI candidates based on cerium and praseodymium.</td></tr>
<tr><td>13:45</td><td>123</td><td>Quantum Phase Transitions with a Lee-Yang Method and Many-Body Algorithms

Pascal Vecsei, Christian Flindt, Jose L. Lado, Department of Applied Physics, Aalto University

Predicting the phase diagram of interacting quantum many-body systems is a central problem in quantum matter. Here, we show that a Lee-Yang method, combined with numerical quantum many-body methods such as matrix product states and neural network quantum states, can be used to investigate quantum phase transitions and predict the critical points of correlated spin and fermion models. Specifically, we implement our approach for quantum phase transitions in the transverse-field Ising model on different lattice geometries, as well as an interacting fermionic chain. As such, our results provide a starting point for determining the phase diagram of more complex quantum many-body systems.</td></tr>
<tr><td>14:00</td><td>124</td><td>Hybrid Tree Tensor Networks for quantum simulation

Julian Schuhmacher [1,2], Alberto Baiardi [2], Marco Ballarin [3], Giuseppe Magnifico [4], Simone Montangero [3], Francesco Tacchino [2], Ivano Tavernelli [2]
[1] EPFL, [2] IBM Research Zurich, [3] University of Padova, [4] University of Bari

Hybrid Tensor Networks (hTNs) offer a promising solution for encoding variational quantum states beyond the capabilities of efficient classical methods or noisy quantum computers alone. However, their practical usefulness and many operational aspects of hTN-based algorithms have not been thoroughly investigated yet. In this contribution, we introduce a novel algorithm to perform ground state optimizations of hybrid Tree Tensor Networks (hTTNs), discussing its advantages and roadblocks. We benchmark our approach on two paradigmatic models, namely the Ising model at the critical point and the Toric code Hamiltonian. In both cases, we successfully demonstrate that hTTNs can improve upon classical equivalents with equal bond dimension in the classical part.</td></tr>
<tr><td>14:15</td><td>125</td><td>Benchmarking digital quantum simulations and optimization above hundreds of qubits using quantum critical dynamics

Alexander Miessen [1,2], Daniel Egger [1], Ivano Tavernelli [1], Guglielmo Mazzola [2]
[1] IBM Quantum, IBM Research –Zurich, [2] Institute for Computational Science, University of Zurich

We utilize known theoretical results about many-body quantum critical dynamics to benchmark quantum hardware and various error mitigation techniques on up to 133 qubits. In particular, we benchmark against known universal scaling laws in the Hamiltonian simulation of a time-dependent transverse-field Ising Hamiltonian. Incorporating basic error mitigation and suppression, our study shows coherent control up to a two-qubit gate depth of 28, featuring a maximum of 1396 two-qubit gates, before noise becomes prevalent. These results are transferable to applications such as digitized quantum annealing and match the results of a 133-site optimization, where we identify an optimal working point in terms of both circuit depth and time step.</td></tr>
</table>

14:30	**126**	**Fractional Topological Insulators in Twisted Transition Metal Dichalcogenides** *Glenn Wagner [1], Andrei Bernevig, Kouta Dagnino, Yves Kwan, Titus Neupert [2], Jiabin Yu* *[1] ETH Zürich, [2] Universität Zürich* The recent experimental observations of fractional Chern insulators in moiré systems without an applied magnetic field prompt the question of whether their time-reversal invariant generalization, fractional topological insulators (FTIs), can also be realized in these platforms. Using comprehensive exact diagonalization calculations on twisted bilayer $MoTe_2$ at nu = -4/3 and an idealized Landau level model, we conjecture that FTIs can be obtained under realistic conditions, and extract general principles for engineering such exotic phases. Our analysis accounts for microscopic details such as band-mixing and anisotropic non-local dielectric screening.
14:45	**127**	**Ferromagnetic quantum critical point protected by nonsymmorphic symmetry in a dense Kondo metal $CeSi_{1.97}$** *Soohyeon Shin, Aline Ramires, Vladimir Pomjakushin, Igor Plokhikh, Ekaterina Pomjakushina, Paul Scherrer Institut* Quantum critical points (QCPs) are windows to fundamental quantum mechanical phenomena associated with universal behaviour. Recently, antisymmetric spin-orbit coupling in noncentrosymmetric systems was suggested to protect ferromagnetic QCPs. A dense Kondo lattice $CeSi_{2-}$, crystallising in a centrosymmetric structure, exhibits ferromagnetic order when Si is replaced with Ag. We report that the Ag-substitution to $CeSi_{1.97}$ linearly suppresses the ferromagnetic order towards a QCP, accompanied by concurrent strange-metal behaviour. Herein, we suggest that, despite the centrosymmetric structure, spin-orbit coupling arising from the local noncentrosymmetric structure, in combination with nonsymmorphic symmetry, can protect ferromagnetic QCPs. Our findings offer a general guideline for discovering new ferromagnetic QCPs.
15:00		***END***

ID	KOND Poster
141	**The three-dimensional multiferroic domain structure of hexagonal manganites** *Aaron Merlin Müller, Manfred Fiebig, Lukas Heckendorn, Thomas Lottermoser, ETH Zürich* We simulate and visualize the three-dimensional domain structure of multiferroic hexagonal manganites using phase-field simulations. Due to the improper nature of their ferroelectric order, hexagonal manganites exhibit unconventional six-fold vortices in their ferroelectric domain patterns. In 3D, these domain patterns are characterized by vortex lines, which are 1D topological defects that form loops. Below the Néel temperature, an additional antiferromagnetic order rigidly coupled with the ferroelectric order emerges, forming vortex domain patterns of its own. In our simulations, we observe new types of antiferromagnetic three-fold, four-fold and six-fold vortex lines in addition to ferroelectric six-fold vortex lines. We relate the existence of these vortex lines to rigid coupling between orders.
142	**Identification of Defect-Sensitive Raman Modes in 9-Atom-Wide Armchair Graphene Nanoribbons** *Ángel Labordet [1], Mickaël Lucien Perrin [1], Roman Fasel [1], Michel Calame [1,2], Gabriela Borin Barin [1], Mirjana Dimitrievska [1]* *[1] Empa, [2] University of Basel* Graphene nanoribbons (GNRs) are narrow strips of graphene with width-dependent electronic bandgaps, making them promising building blocks for nanoelectronic devices. However, structural defects can alter their electronic and optical properties, making defect characterization in GNRs a crucial step towards their further development. We use angle-resolved polarized Raman spectroscopy and density functional theory calculations to identify defect-sensitive Raman modes in 9-atom-wide armchair GNRs. Our results demonstrate that specific Raman peaks, namely the D and CH modes, exhibit distinct deviations from theoretically predicted angular dependence, serving as fingerprints for defect presence. These results provide valuable insights for non-destructive characterization of GNR quality and pave the way for defect engineering in GNR-based devices.

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Symmetry broken phases of field biased Bernal bilayer graphene

Enrique Aguilar-Mendez, Glenn Wagner, ETH Zürich

Using Hartree-Fock calculations we explored the possibility of spin,valley and translational symmetry breaking in Bernal bilayer graphene. Our aim is to explain the phases present near the van Hove singularity that arises in the band structure when an out-of-plane electric field is applied. A displacement field versus carrier density phase diagram was obtained in good agreement with experimental data. A slight tendency towards a valley coherence wave was found.

Magnetic fields for materials research

This session is supported by the EU project Isabel.
(https://emfl.eu/isabel/h2020-project/)

Thursday, 12.09.2024, Room ETZ E 8

Time	ID	**Magnetic fields for materials research** *Chair: Stefano Gariglio, Université de Genève*
17:00	**181**	**Instrumentation and experimental techniques for high magnetic field research at the European Magnetic Field Laboratory** *Steffen Krämer* *LNCMI-EMFL, CNRS, Univ. Grenoble Alpes, INSA-T and UPS, FR-38042 Grenoble Cedex 9* Strong magnetic fields are an extremely powerful tool for investigating, modifying and controlling different states of matter on microscopic and macroscopic length scales. Whereas commercial superconducting magnets reach magnetic fields up to 28.3 T, stronger fields are only available at specialized large-scale facilities. Due to very high acquisition and operating costs, such facilities currently only exist in a few places in the world (Europe, USA, China and Japan). The four sites of the EMFL at Dresden (Germany), Grenoble (France), Nijmegen (The Netherlands) and Toulouse (France) offer the scientific and industrial community continuous fields in variable geometry, from 10 T at 376 mm diameter to 38 T at 32 mm, as well as pulsed fields up to almost 100 T during 20 milliseconds and up to 200 T during a few microseconds. Moreover, the magnetic fields can be combined with very low temperatures, high pressure as well as with neutrons, X-rays and free-electron lasers. A large number of macroscopic and microscopic experimental techniques have been developed, with the required instrumentation adapted to the particular constraints of the high magnetic field environment. In the presentation, the potential of the EMFL will be reviewed using selected projects from basic and applied research.
17:30	**182**	**Engineering Phase Competition Between Stripe Order and Superconductivity in $La_{1.88}Sr_{0.12}CuO_4$** *Julia Küspert [1], Izabela Biało [1,2], Ruggero Frison [1], A. Morawietz [1], Leonardo Martinelli [1], Jaewon Choi [3], D. Bucher [1], O. Ivashko [4], M. v. Zimmermann [4], Niels B. Christensen [5], Daniel G. Mazzone [6], Gediminas Simutis [7], Alexandra Angeline Turrini [6], L. Thomarat [7,8], D. W. Tam [6], Marc Janoschek [1,7], Tohru Kurosawa [9], N. Momono [9,10], Migaku Oda [9], Qisi Wang [1,11], Johan Chang [1]* *[1] Physik-Institut, Universität Zürich, Winterthurerstrasse 190, CH-8057 Zürich* *[2] AGH University of Krakow, Faculty of Physics and Applied Computer Science, PL-30-059 Krakow* *[3] Diamond Light Source, Harwell Campus, Didcot OX11 0DE, United Kingdom* *[4] Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, DE-22607 Hamburg* *[5] Department of Physics, Technical University of Denmark, DK-2800 Kongens Lyngby* *[6] Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institut, CH-5232 Villigen-PSI* *[7] Laboratory for Neutron and Muon Instrumentation, Paul Scherrer Institut, CH-5232 Villigen PSI* *[8] Ecole normale supérieure Paris-Saclay, FR-91190 Gif-sur-Yvette* *[9] Department of Physics, Hokkaido University, Sapporo 060-0810, Japan* *[10] Department of Applied Sciences, Muroran Institute of Technology, Muroran 050-8585, Japan* *[11] Department of Physics, The Chinese University of Hong Kong, Shatin, Hong Kong, China* Unconventional superconductivity often couples to other electronic orders in a cooperative or competing fashion. Identifying external stimuli that tune between these two limits is of fundamental interest. We show that strain perpendicular to the CuO_2-planes couples directly to the competing interaction between charge stripe order and superconductivity in $La_{1.88}Sr_{0.12}CuO_4$ (LSCO). Compressive c-axis pressure amplifies stripe order within the superconducting state, while having no impact on the normal state. Further, we applied magnetic fields up to 10 T. We find that strain dramatically diminishes the magnetic field enhancement of stripe order in the superconducting state.

		These results suggest that c-axis strain acts as tuning parameter of the competing interaction between charge stripe order and superconductivity. This interpretation implies a uniaxial pressure-induced ground state in which the competition between charge order and superconductivity is reduced.
18:00	**183**	**Influence of Oxygen Source on the High Magnetic Field Behavior of Nb_3Sn Wires Manufactured via Internal Oxidation** *Gianmarco Bovone [1], Florin Buta [1], Francesco Lonardo [1], Marco Bonura [1], D. Le Boeuf [2], Cecilia N. Borca [4], T. Huthwelker [4], S. C. Hopkins [3], Thierry Boutboul [3], Carmine Senatore [1,5]* *[1] Department of Quantum Matter Physics, University of Geneva* *[2] LNCMI-CNRS, EMFL, Grenoble, France* *[3] Paul Scherrer Institut, PSI, Villigen* *[4] European Organization for Nuclear Research CERN, Geneva* *[5] Department of Nuclear and Particle Physics, University of Geneva* Enhancing J_c and B_{c2} in Nb_3Sn wires is crucial for developing the 16 T dipole magnets needed for the Future Circular Collider (FCC-hh). A refinement of the Nb_3Sn grain size is the most straightforward strategy to obtain an improved J_c performance. To this end we implemented an internal oxidation process that controls the Nb_3Sn grain growth via oxides nanoparticles formed during the synthesis. The process consists in adding an oxygen source (OS, typically SnO_2) into the wire layout, which decomposes during heat treatment. The oxygen reacts with electropositive atoms in the Nb alloy (Hf or Zr) to form oxide nanoparticles that impede Nb_3Sn grain growth. We manufactured simplified multifilamentary wires containing an OS that showed Nb_3Sn grain size down to 50 nm (compared to 110 nm without OS) and enhanced J_c exceeding the FCC-hh specifications (non-Cu J_c of 1500 A/mm^2 at 16 T, 4.2 K). Through resistive measurements performed at the Laboratoire National des Champs Magnétiques Intenses (LNCMI) in Grenoble, we measured at 4.2 K record-high B_{c2} values of 29.2 T and 29.3 T for Zr and Hf additions, respectively (99 % criterion of the superconducting transition). Magnetic measured in a VSM-SQUID showed that oxide precipitates also contribute to the vortex pinning as point defects. As a complement to the test of the superconducting properties we performed advanced structural characterization to investigate formation and role of the oxide precipitates. X-ray Absorption Near Edge Structure (XANES), performed at the Phoenix beamline in PSI, showed that oxide precipitation occurs at the reaction front, while no oxides were found in the alloy after the heat treatment. Using transmission electron microscopy (TEM) we studied the dimensions of the oxide precipitates, on average in the 4–8 nm range after synthesis at 650 °C. Enhancing synthesis temperature from 650 to 700 °C coarsens the precipitates, that become less effective pinning centers at 4.2 K. This study highlights the crucial role of incorporating OS to enhance J_c through the combined effect of grain refinement and a modified pinning mechanism. Our final goal is to achieve full control of the internal oxidation process in order to transfer the results obtained so far to application-ready wires scalable for industrial production.
18:30		***END***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Applied Physics

Wednesday, 11.09.2024, Room ETF C 1

Time	ID	Applied Physics I: Physics Applied to Medicine *Chair: Leonid Rivkin, PSI Villigen*
17:00	**201**	**Advanced X-ray imaging: from the nanoscale at synchrotrons to clinical applications in hospitals** *Marco Stampanoni, Paul Scherrer Institut* Imaging leverages significantly on the unique properties of synchrotron radiation, in particular with the recent introduction of 4^{th} generation facilities. In this lecture, I will showcase some of the latest results, including ptychographic nanoimaging and time-resolved tomographic microscopy and discuss related challenges. I will further elaborate on how some of the tools originally designed for machine diagnostics purposes have developed into powerful, potentially game-changing instruments with a clinical impact, specifically for breast and lung imaging. The talk has been conceived to provide an “easy-entry” into the fascinating world of modern X-ray imaging.
17:30	**202**	**Isotopes for diagnostics and therapy of cancer** *Roger Schibli, Robert Eichler, Cristina Mueller, Nicholas Philip van der Meulen Paul Scherrer Institute* Radioactive compounds are important role in the diagnosis and treatment of cancer. Accelerator facilities are used to produce diagnostic radionuclides (β+ and γ-emitters). Most therapeutic nuclides are produced via neutron irradiation. The production route via nuclear spallation reaction after bombardment with high-energy protons is an innovative way of producing medically interesting radionuclides but is underdeveloped. We will present the concept TATTOOS (”Targeted Alpha Therapy using Terbium and Other Oncological Solutions”) proposed by PSI together with the UZH/USZ. With TATTOOS we will produce isotopically and radiochemically pure radionuclides for medical purposes using the world’s most powerful proton accelerator HIPA at PSI.
18:00	**203**	**Proton therapy developments at PSI** *Anthony Lomax, Centre for Proton Therapy (CPT), PSI and Department of Physics, ETH* Proton therapy is already becoming a mature approach to treating cancers using radiation, whereby their physical characteristics (the Bragg peak) allow for much improved sculpting of the delivered radiation dose to the tumour than conventional radiotherapy using high energy photons. Nevertheless, many technical improvements can still be made, many of which are being pursued at CPT. Main current areas of research are 1) adaptive therapy, 2) FLASH irradiations, 3) On-line imaging of PET activation and 4) biological outcomes analysis, all of which will be explained in more detail during this presentation.
18:30	**204**	**FLASH therapy** *David Meer, Paul Scherrer Institut* In biological experiments for radiotherapy, irradiation at ultra-high dose rates demonstrated a protective effect on the healthy tissue. The so-called FLASH effect, originally explored with electrons, is now being studied with other beams such as protons. The presentation will discuss the experience of upgrading a proton beamline for FLASH experiments at the Center for Proton Therapy. It includes the technical changes to the beam line hardware, challenges in dosimetry and different beam delivery options. Results of first biological experiments will be reported as well as the implementation of a randomized FLASH study for first animal patients.
18:45	**~~205~~**	*cancelled*

19:00	**206**	**In-vivo range verification of proton therapy treatment with the PETITION PET scanner** *Keegan McNamara [1], Marina Béguin [2], Günther Dissertori [2], Judith Flock [2], Cristian Fuentes [2], Antony Lomax [1], Shubhangi Makkar [1], Christian Ritzer [2], Carla Winterhalter [1]* *[1] Paul Scherrer Institute, Center for Proton Therapy* *[2] ETH Zurich, Department of Physics* Validation of the range of protons delivered during proton therapy is important to ensure that there is no overdosage of healthy tissue or underdosage of the tumour. Positron emission tomography can image isotopes, e.g. ^{15}O and ^{11}C, produced by nuclear interactions of the protons within the patient, giving a surrogate for delivered dose. The PETITION PET detector has been developed for in-vivo range verification. Using a rotating open-ring design, equivalently a fixed design with a movable upright patient couch, for in-beam and post-irradiation imaging of the patient we show the ability to detect anatomical changes within the patient, as well as induced shifts of < 2 mm, without interruption to clinical workflows.
19:15	**207**	**PETITION PET scanner for biological adaptation of the proton treatment plan** *Shubhangi Makkar [1], Marina Béguin [2], Günther Dissertori [2], Judith Flock [2], Cristian Fuentes [2], Jan Hrbacek [1], Keegan McNamara [1], Christian Ritzer [2], Damien C. Weber [1], Antony Lomax [1], Carla Winterhalter [1]* *[1] Center for Proton Therapy, Paul Scherrer Institute* *[2] Department of Physics, ETH Zürich* A positron emission tomography (PET) scanner has been developed within the PETITION collaboration, for online adaptation and verification purposes in proton therapy. It can be used for biological adaptation of the treatment plan by imaging hypoxia daily on-the-table. Hypoxic cells within the tumours are radio-resistant and not accounting for it can result in a suboptimal treatment. A retrospective treatment planning study was performed in this context to first translate voxel-wise PET intensities into equivalent proton doses and thereby into an adapted treatment plan. This indicated a median improved tumour control probability of 10% amongst the cohort of ten patients without any significant increase in proton dose to the healthy organs.
19:30	**208**	**POSiCS a handable gamma-camera for radio-guided surgery** *Cyril Alispach, Domenico Della Volpe, Aramis Raiola, Universitè de Genève* At the frontier between research and innovation, POSiCS is a project aiming to build a scalable and handable gamma-camera for Radio-Guided Surgeries. Targeting the imaging of lymph nodes for biopsies in the context of breast cancer and cutaneous melanoma, the camera aims at reducing the invasiveness of the surgical procedure while improving the surgery success probability. The camera is based on an innovative position-sensitive SiPM with reduced number of channels over a large area. We use Deep Neural Networks to enhance the resolution of the gamma-camera yielding an increase in the number of distinguishable regions by a factor 10. The device performances and its use-case will be presented.

19:45	209	**Advantages and drawbacks of a back-scattering Mueller polarimetric setup comparing with surface imaging one** *Vladislav Stefanov, Bhanu Pratap Singh, Andre Stefanov,* *Institute of Applied Physics, University of Bern* Mueller polarimetry is a strong experimental tool for characterizing the optical properties of samples. Nowadays, polarimetry-based devices represent one of the most promising directions for recognizing various types of a cancer during surgical procedures for example. While polarimetric reflection surface imaging is popular, we focus on the back-scattering setup, where the light penetrates deeply into highly scattering media. This enables the study of the internal structure of a sample rather than just its surface, making it useful for cases beyond histological analysis. In the presentation we will discuss the advantages and drawbacks of each setup's configuration based on the experimental study of a human brain sample.
20:00		***END***

Thursday, 12.09.2024, Room ETZ E 7

Time	ID	Applied Physics II: Applied Physics & Plasma Physics (combined session) *Chair: Laurie Porte, EPFL*
17:00	211	**Analysis of natural disruptions on JET with JOREK** *Lili Edes, Jonathan Graves, Mengdi Kong, Swiss Plasma Center, EPFL* Tokamak disruptions pose significant challenges in fusion research. Although it has been widely accepted that natural disruptions are caused by the growth of tearing or neoclassical tearing modes[1], studies have shown that the finite resistivity of the wall can have a significant effect on the thermal loss of the plasma[2]. This study investigates the chain of events leading to disruptions, focusing on the role of tearing modes and their dependence on wall resistivity. JOREK-STARWALL[3] simulations are being conducted based on a JET discharge in which natural disruption was observed. These simulations serve to benchmark previous studies based on M3D simulations and to conduct further analysis of Resistive Wall Tearing Modes.
17:15	212	**MHD simulations of runaway electron avalanche in ITER mitigated disruptions** *Chizhou Wang [1], Javier Artola [2], Vinodh Bandaru [3], Jonathan Graves [1], Matthias Hoelzl [4], Mengdi Kong [1], Eric Nardon* *[1] Swiss Plasma Center, EPFL, [2] ITER Organiation, [3] Indian Institute of Technology Guwahati, [4] Max Planck Institute for Plasma Physics* The avalanche of high-energy runaway electrons (RE) during ITER disruptions could potentially generate several MA's of RE current which might damage the plasma-facing components. Previous studies have suggested that avoiding the formation of such a large RE current would be difficult. However, before their quantity increases to a large value, some REs might be lost due to the scraping-off of the flux surfaces on the wall during the plasma's vertical displacement or the magnetic stochasticity from the growth of MHD instabilities. In our work, this process is simulated with the JOREK code, using a reduced MHD model self-consistently coupled to a RE fluid description.

17:30	**213**	**Kinetic simulations of the magnetized plasma-wall boundary layer in fusion devices** *Nicole Vadot [1], S. Zeegers [2], Alessandro Geraldini [1], Stephan Brunner [1]* *[1] École Polytechnique Fédérale de Lausanne, [2] Eindhoven University of Technology* Considering conditions relevant to magnetic fusion plasmas, a code is being developed for solving in a kinetic framework the steady state solution of the plasma-wall boundary layer, comprising both the collisionless magnetic presheath and the Debye sheath. For a given electrostatic potential profile, discretized on a finite element basis, the ion density in each element is calculated by summing the contributions of a set of particle trajectories whose initial conditions are sampled from a given incoming distribution function. An iterative scheme is used to correct the electrostatic potential profile until Poisson's equation is satisfied, thus bypassing a computationally expensive time evolution. The code currently assumes a Boltzmann distribution of electrons, and generalization towards kinetic electrons is being developed. Initially written in C+OpenMP [S. Zeegers, master thesis, Eindhoven Univ. of Tech.], the code is being rewritten in Chapel, a modern task and node-parallel programming language.
17:45	**214**	**Turbulence-inclusive Modelling of Electron-Cyclotron Wave-Plasma Dynamics in Tokamaks** *Ewout Devlaminck [1], Jean Cazabonne [2], Stefano Coda [1], Joan Decker [1], Omar Maj [3], Emanuele Poli [3]* *[1] Swiss Plasma Center, EPFL, [2] CEA Cadarache, [3] Max Planck Institute for Plasma Physics* Electron-cyclotron waves are widely used for plasma heating and current drive in tokamaks. The possibility of very localised deposition renders them appealing for instability mitigation and tailored control. However, previous work1 indicates that simulations overlooking turbulence effects tend to significantly overestimate the method's efficiency. The discrepancy with experimental results is believed to stem from two effects2: microwave beam broadening due to turbulent plasma density fluctuations and wave-enhanced turbulent transport of suprathermal electrons. This project aims to couple two codes, WKBeam3 and LUKE4, to simulate both effects simultaneously for the first time, yielding a comprehensive understanding of the combined dynamics. Experimental validation at the TCV tokamak is also envisioned.
18:00	**215**	**Sub-micrometric hollow channels in bulk fused silica** *Pasquale Barbato [1], Rebeca Martínez Vázquez [2], Roberto Osellame [2]* *[1] Paul Scherrer Institut, [2] CNR - IFN* Ultrafast lasers are outstanding tools for glass processing. When focused inside a transparent substrate, a train of femtosecond pulses can be absorbed via non-linear interactions resulting in a permanent modification of the sample. In this work, we show how an extremely focused femtosecond laser beam followed by wet chemical etching can be used to create sub-micrometric channels in fused silica, realizing three-dimensional hollow structures in bulk material with an unprecedent resolution.
18:15	**216**	**Detection of land mines and unexploded ordnance** *Yves Marc Acremann, Robert Früh, Joel Rehmann, Yiming Li, Matthias Röllin, Francisco Carrion Ruiz, Andreas Vaterlaus, ETH Zürich* Land mines and unexploded ordnance (UXO) are a wide-spread humanitarian problem in former war zones. Different techniques are used for the detection, but a main problem is the high false positive rate. For the detection of UXO we developed portable electromagnetic induction spectrometer, which is able to distinguish the size of metal objects in the ground. At low frequencies of less than 1 kHz the skin depth in metals is in the range of centimeters and allows for distinguishing small metal fragments from UXO. Further perspectives of UXO and land mine detection will be discussed.
18:30		***END***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

ID	Applied Physics Poster
231	**Calibration of reflection and back-scattering Mueller Polarimetric setups** *Bhanu Pratap Singh, Vladislav Stefanov, Andre Stefanov, Institute of Applied Physics, University of Bern* Mueller Polarimetry is a technique that can differentiate areas with distinct optical structures, such as tumorous and healthy tissue, or identify complex optical structures like fiber orientation in the brain. The well-established calibration methods of Mueller Polarimetric setups in transmission cannot be straightforwardly applied to reflection or back-scattering configurations. In our presentation, we provide a brief overview of the development of Mueller Polarimetric setups, and we demonstrate the implementation of a calibration procedure utilizing a novel configuration of reference samples. This approach enhances accuracy compared to standard methods, as demonstrated in our results.

Accelerator Science and Technology

Friday, 13.09.2024, Room ETZ E 6

Time	ID	**Accelerator Science and Technology** *Chair: Mike Seidel, PSI Villigen*
13:30	**281**	**High Field Magnet Roadmap at PSI/CHART** *Douglas Martins Araujo [1], Bernhard Auchmann [1], André Brem [1], Michal Duda [1], Henrique Garcia Rodrigues [1], Ariel Haziot [2], Jaap Kosse [1], Thomas Uli Michlmayr [1], Colin Mueller [1], Dmitry Sotnikov [1], Anna Stampfli [1]* *[1] Paul Scherrer Institut, [2] CERN* In the framework of the European High Field Magnet (HFM) program, hosted at CERN, and the CHART program hosted at Paul Scherrer Institute, the MagDev Laboratory at PSI pursues multiple projects for the advancement of high-field magnet technology for accelerators like the Future Circular Collider (FCC) require a substantial increase in magnetic field strength while maintaining high field quality. The PSI HFM R&D roadmap includes stress-managed low-temperature superconducting (LTS) magnet designs, the development of computational models for high-temperature superconducting (HTS) magnets, as well as the design and production of subscale hybrid (LTS-HTS) magnets. The outcomes of each program step shape the future direction of high-field magnet R&D at PSI.
13:45	**282**	**NI magnet projects at PSI** *Jaap Kosse [1], Bernhard Auchmann [1,2], André Brem [1], Michal Duda [1], Henrique Garcia Rodrigues [1], Thomas Uli Michlmayr [1], Stephane Sanfilippo [1]* *[1] Paul Scherrer Institut, [2] CERN* We present the work on non-insulation (NI) high-temperature superconductor (HTS) magnets at PSI as part of the CHART framework. Supported by modeling and small-scale experiments, we are building several NI solenoids which are to be installed in PSI's experimental facilities. These include a 72 mm warm bore 15 T solenoid for proof-of-principle positron production, a 18 T split coil for neutron scattering, and a very compact 6 T solenoid for X-ray scattering experiments. The high current density, high stability, and relatively straightforward cooling at 10-15 K make NI HTS magnets ideally suited for these DC applications.
14:00	**283**	**Optimization and Shimming of a High Temperature Superconducting Bulk Undulator** *Carlos Gafa [1], Alexandre Arsenault [1], Marco Calvi [1], Anthony Dennis [2], John Durrell [2], Andrew Sammut [3], Nicholas Sammut [3]* *[1] Paul Scherrer Institut, [2] University of Cambridge, [3] UoM* A novel short period, high-temperature superconducting bulk undulator is being developed at the Paul Scherrer Institute. It has been shown that a staggered array bulk configuration may be magnetized, via a field-cooling procedure, to generate more than a factor of two increase of the peak on-axis field when compared to permanent magnet undulators. However, to be useful at high harmonics it must also be shimmed to an acceptable level of phase error. This presents with some challenges as the differences between the bulks are more significant than those between permanent magnets. In this work we present our progress to reduce these field errors.

14:15	**284**	**Energy-efficient FCC-ee operation via HTS nested magnets** *Jaap Kosse [1], Bernhard Auchmann [1,2], M. Koratzinos [1], Jürgen Schmidt [1], Adrien Thabuis [2]* *[1] Paul Scherrer Institut, [2] CERN* We present our work on energy-efficient nested high-temperature superconducting (HTS) magnets for FCC-ee. By replacing the normal-conducting sextupole and quadrupole magnets in the 2900 short-straight-sections by HTS nested variants, and by including dipole coils, significant energy can be saved, estimated at 20 - 30 % of the total FCC-ee energy consumption. The optimum operating temperature, 4 K, of such an HTS magnet system is found by balancing the operational costs (dominated by electricity use for cooling) with capital costs (dominated by HTS conductor). The end goal of the project, a 1 m prototype, is supported by demonstrators manufactured at CERN and PSI. This work is part of the CHART framework and the FCC Feasibility Study.
14:30	**285**	**Lattice correction and polarization estimation for the Future Circular Collider e^+e^-** *Yi Wu [1], Felix Simon Carlier [2], Werner Herr [1], Tatiana Pieloni [1], Mike Seidel [3], Leon van Riesen-Haupt [1]* *[1] EPFL, [2] CERN, [3] PSI* Precise determination of the center-of-mass energy in the Future Circular Collider e^+e^- (FCC-ee) at Z and W energies can be achieved by employing resonant spin depolarization techniques, for which a sufficient level of transverse beam polarization is demanded under the presence of machine imperfections. In this study, the FCC-ee lattice has been modeled and simulated with a variety of realistic lattice imperfections, including misalignments, angular deviations, BPM errors, long-range errors, etc., along with refined orbit correction and tune matching procedures. The equilibrium polarization is calculated within the context of realistic machine models, aiming to understand the underlying reason for polarization loss and potentially improve polarization by lattice manipulation.
14:45	**286**	**Controlling the electron beam energy at SwissFEL** *Evan Ericson [1,2], Paolo Craievich [2], Rasmus Ischebeck [2], Eduard Prat Costa [2], Sven Reiche [2], Mike Seidel [2], Fabio Marcellini [2]* *[1] EPFL, [2] Paul Scherrer Institut* SwissFEL at the Paul Scherrer Institute provides femtosecond X-ray pulses for experiments by accelerating electron beams up to 6 GeV before they are sent to undulators where they produce coherent, narrow bandwidth X-rays. The correlated energy spread of the beam is finely controlled using passive dielectric structures or structures with corrugated surfaces separated by an adjustable gap. These structures are routinely used to perform beam manipulations that optimize the FEL bandwidth or control the X-ray pulse duration down to 1 femtosecond. We compare experimental and simulation results for our dielectric structure to show short-range wakefields are responsible for tuning the central energy and energy spread of the SwissFEL beam.
15:00	**287**	**High Gradient Photoguns for a Potential Upgrade to the SwissFEL** *Thomas Geoffrey Lucas, Paolo Craievich, Paul Scherrer Institut* In the aim of boosting the performance of the Swiss Free-Electron Laser (SwissFEL), two new high gradient radiofrequency photo-emission electron sources are under development as part of an international collaboration between Paul Scherrer Institut (PSI) and INFN Frascati. These electron sources aim to increase the cathode electric field through the use of higher frequencies and shorter filling times, achieved through novel RF designs. In this work, we present the design and first high power tests of these new electron sources at PSI and illustrate how they could enhance the performance of SwissFEL.

15:15	**288**	**Development and Optimization of a Field-Emission based Electron Gun for Low Energy Electron Cooling at ELENA** *Elisabeth-Sena Welker, Technische Universität Wien, Gerard Alain Tranquille, CERN* This study explores Carbon Nanotubes (CNTs) as a colder electron source for electron cooling in the ELENA decelerator. Currently, a thermionic tungsten-doped BaO cathode limits the cooling efficiency due to a high transverse energy spread. Investigating field emission (FE) aims to achieve a colder antiproton beam, enhancing trapping efficiency for antimatter experiments. Although CNT-based FE feasibility is studied, full characterization for this application is missing. Multi-walled, vertically aligned (VA) CNT arrays with a honeycombed pattern show promising current densities. A Cold Cathode Test Bench (CCTB) was built to fully characterize different samples and to measure the properties of an electron gun using a larger (4 x 4 cm) VACNT array as its source.
15:30	**289**	**Beam dynamics studies of performance reach of future ion species in the CERN accelerator complex** *Elias Walter Waagaard, EPFL, Mike Seidel, PSI* The current ion physics programme at CERN is mainly based on lead (Pb) ion beams. Untested lighter ion species have been requested as a possible way to reach higher nucleon-nucleon luminosities. In order to identify the ion species with the highest luminosity performance in the Large Hadron Collider (LHC), a series of beam dynamics studies have been performed to characterize beam loss mechanisms caused by space charge and intra-beam scattering. Here we present benchmarking studies for the Super Proton Synchrotron (SPS), which will be used to develop an accurate model of the beam degradation mechanisms for future ion species.
15:45	**290**	**Muon Collider Feasibility Studies: Collective effects and muon cooling** *Joséphine Marie Bénédicte Potdevin [1], Xavier Buffat [2], Tatiana Pieloni [1]* *[1] EPFL, [2] CERN* Muon colliders have a great potential for high-energy physics. They can offer collisions of point-like particles at very high energies, since muons can be accelerated in a ring without limitation from synchrotron radiation. However, the need for high luminosity faces challenges, which arise from the short muon lifetime at rest, and the difficulty of producing large numbers of muons in bunches with small emittance. Addressing these challenges requires the development of innovative concepts and demanding technologies. In this study we will present the challenges linked to the transverse collective effects in the muon collider cooling system.
16:00		***END***

Nuclear, Particle and Astrophysics (TASK)

This session has been organised in collaboration with CHIPP.

Tuesday, 10.09.2024, Room ETA F 5

Time	ID	TASK I: Detector and Performance I *Chair: Ben Kilminster, Universität Zürich*
14:00	301	**Tests and results of the power components of the ATLAS Inner Tracker detector readout system.** *Lucas Mollier, Universität Bern* The LHC at CERN will undergo significant upgrades to enhance the collision rate in the High Luminosity LHC (HL-LHC), necessitating improvement of the ATLAS detector regarding higher resolution and efficiency. The Inner Detector will be replaced by the Inner Tracker. The transmission of the data signal will be handled by the Optosystem, managing the data and responsible for the opto-electrical conversion to send the data efficiently from the ATLAS high radiation area. The Powerboard was designed to power the Optosystem by converting the provided voltage to lower levels, suitable for other Optosystem's components. Tests performed on the Powerboard to ensure its good functionality during the HL-LHC runs will be presented.
14:15	302	**Performance tests of the ATLAS Inner Tracker Pixel detector opto-electrical conversion system** *Marianna Glazewska, Universität Bern* The High Luminosity LHC will commence operation in 2029. A projected pileup of around 200 will result in consequences for data analysis complexity and radiation environment severity. The latter necessitates the replacement of the ATLAS Inner Detector with the all-silicon Inner Tracker (ITk). The Optosystem is a crucial part of the ITk readout system, performing data serialization, equalization and opto-electrical conversion with dedicated ASICs mounted on Optoboards, which are housed in Optopanels. This talk will summarize work carried out at CERN and the University of Bern, including: the final Optoboard version irradiation campaign, the development of a setup for methodical Optoboard testing, and Optopanel mechanical tests.
14:30	303	**Data transmission tests of the ATLAS Inner Tracker Detector opto-electrical conversion system.** *Una Helena Alberti, Universität Bern* Following Run III of the LHC, the ATLAS Inner Detector will undergo a series of upgrades to cope with the high radiation environment of the High Luminosity LHC. The Optosystem is the opto-electrical conversion system dedicated to the readout of the ATLAS Inner Tracker (ITk) Pixel detector that will replace the pixel detector of the Inner Detector. The testing of electrical characteristics of the components of the Optosystem and the full data transmission chain is crucial. In this talk, I will present results of the data transmission and time-domain reflectometer measurements of the Optosystem as well as the current status of Optosystem tests at Bern.
14:45	304	**Timing measurement ASIC using LGAD for possible HL-LHC upgrade** *Abderrahmane Ghimouz, Paul Scherrer Institut* The Compact Muon Solenoid (CMS) experiment at CERN will undergo a major upgrade for the high-luminosity phase of the LHC (HL-LHC) starting in 2029. In addition to improving the detector rate capabilities and performance at higher luminosities, precision timing measurements are added to mitigate pile-up effects. We plan the extension of the timing capabilities to cover the full tracker acceptance up to $\eta = 4$ using Low Gain Avalanche Detectors (LGAD). Here, we present the design efforts towards a readout Application-specific integrated circuit (ASIC) capable of operating with LGAD pixel detectors. It is designed in a 28 nm CMOS technology, to process efficiently the signals from the LGADs.

15:00	**305**	**Radiation hardness and annealing, strategies for space application of silicon photomultiplier technologies on a quasi-polar LEO orbit** *Shideh Davarpanah, DPNC, Université de Genève* While silicon photomultipliers (SiPMs) offer advantages over traditional photomultipliers, their adoption into space missions undergo challenges due to induced degradation by cosmic radiation. The University of Geneva, GSSI and FBK Research Foundation collaborate to define SiPMs for Terzina Cherenkov telescope by studying radiation hardness and light noise in situ. Using 50 MeV proton-beam and beta-radioactive source, we estimate radiation damage on SiPMs and compare results with simulated ionizing and non-ionizing effects via SPENVIS-Geant4. We developed an annealing approach suitable for a space-based middle-size satellite to limit effect of radiation damage while efficiently lowering SiPM's energy detection threshold. We will describe the mission and focus on this aspects critical for its success.
15:15	**306**	**CMS ECAL on-detector readout electronics radiation tests** *Nico Härringer [1], Günther Dissertori [1], Tomasz Gadek [1], Christian Haller [1], Nikitas Loukas [2], Werner Lustermann [1], Alexander Singovski [2], Krzysztof Stachon [1]* *[1] ETH Zürich, [2] University of Notre Dame (US)* In preparation of the operation of the CMS electromagnetic calorimeter (ECAL) barrel at the High Luminosity Large Hadron Collider (HL-LHC) the entire on-detector electronics will be replaced. The new readout electronic comprises 12240 very front end (VFE), 2448 front end (FE) and low voltage regulator (LVR) cards arranged into readout towers (RTs) of five VFE, one FE and one LVR cards. The results of testing one RT of final prototype cards at CERN's CHARM mixed field facility and PSI's proton irradiation facilities are presented. They demonstrate the proper functioning of the new electronics in the expected radiation conditions.
15:30	**307**	**TEPX Detector for the CMS Inner Tracker Upgrade:** **Module Production Status and Plans** *Amrutha Samalan, Paul Scherrer Institute* As part of the Phase-2 upgrade of the Compact Muon Solenoid (CMS) experiment for the upcoming High Luminosity phase of LHC (HL-LHC), the Inner Tracker (IT) of CMS will be replaced with a new detector featuring increased rate capability, higher granularity, and improved radiation hardness. Furthermore the tracking coverage is extended up to $\lvert\eta\rvert \approx 4$ by the Tracker Extended PiXel (TEPX) system consisting of four large double disks on each end. The status of the production of the TEPX sensor modules at the assembly sites, results of module testing, and the roadmap toward installation in 2028 will be presented.
15:45	**308**	**MONOLITH - picosecond capability in a high granularity monolithic silicon pixel detector** *Matteo Milanesio, Giuseppe Iacobucci, Lorenzo Paolozzi, Université de Genève* The MONOLITH H2020 ERC Advanced project aims at producing a high-granularity monolithic silicon pixel detector with picosecond-level time stamping. To obtain such extreme timing the project exploits: i) a fast and low-noise SiGe BiCMOS electronics; ii) a novel sensor concept, the Picosecond Avalanche Detector (PicoAD), that uses a patented multi-PN junction to engineer the electric field and produce a continuous gain layer deep in the sensor volume. The proof-of-concept monolithic PicoAD demonstrator provided full efficiency and 13 ps at the center of the pixel. A batch of PicoAD prototypes with different geometries and gain-layer implant doses was delivered in January 2024; testbeam results will be shown.
16:00		***Coffee Break***

Time	ID	**TASK II: DETECTOR AND PERFORMANCE II** *Chair: Marcelle Soares-Santos, Universität Zürich*
16:30	**311**	**Production and Qualification of the Vertex Detector for the Mu3e Detector** *Thomas Christian Senger, University of Zurich* The Mu3e experiment aims to detect charged lepton flavor violation through the decay chain $\mu^+ \rightarrow e^+ e^- e^+$. With sensitivities of 10^{-15} in its initial phase and 10^{-16} in the final phase, it improves upon prior experiments by four orders of magnitude. The innovative experimental concept is based on a tracking detector built from novel ultra-thin silicon pixel sensors and scintillating fibres and tiles. The upcoming discussion will spotlight the production of the Vertex detector and the qualification of Mupix 11 pixel sensor modules. It will delve into the challenges associated with data transmission, particularly concerning connections via micro-twisted pair cables.
16:45	**312**	**Construction and Commissioning Status Report on Mu3e Experiment** *Yifeng Wang, ETH Zurich* Mu3e is an experiment under construction at the Paul Scherrer Institute dedicated to the search for the charged lepton flavor violating muon decay, $\mu \rightarrow eee$, at branching fractions of 10^{-16}, extending the results from SINDRUM by four orders of magnitude. To track low momentum particles while maintaining good vertex and timing resolution, a combined 4D tracking system integrating HV-MAPS, scintillating fiber and tile technology is employed. Furthermore, to tackle the high data rate of 100 Gbits/s the DAQ chain uses FPGA boards and a farm equipped with GPUs for track reconstruction and rate reduction. Construction and commissioning status of the scintillating fiber detector will be reported.
17:00	**313**	**Cryogenic Characterization of Neutron-Irradiated SiPMs** *Esteban Curras Rivera, Guido Haefeli, EPFL* The current tracker detector of the LHCb experiment, based on Scintillating Fibres (SciFi) coupled to silicon photomultipliers (SiPMs), will be upgraded for the HL-LHC operations. The SiPMs will be exposed to a radiation environment, mainly dominated by fast neutrons, that will reach 3×10^{12} neq/cm^2 at the end of their lifetime. This will degrade their performance and compromise the overall efficiency of the whole experiment. To cope with this problem, cryogenic cooling with liquid Nitrogen is being investigated as a possible solution to mitigate the performance degradation of the SiPMs induced by radiation damage. The effect of the cryogenic operation on key parameters of neutron-irradiated SiPMs is going to be presented.
17:15	**314**	**The Outer Detector of the LUX ZEPLIN dark matter direct detection experiment** *Harvey Birch, University of Zurich* LUX-ZEPLIN (LZ) is centered on a liquid xenon time projection chamber (LXe-TPC) searching for nuclear recoils induced by Weakly Interacting Massive Particles. One of the backgrounds for LZ are neutrons, as they result in nuclear recoils in the TPC. Surrounding the TPC is an Outer Detector which is used to veto neutron events in the TPC. The Outer Detector consists of 17 t of gadolinium-loaded liquid scintillator confined in acrylic tanks surrounding the TPC and 238 t of high purity water as the outermost layer. This volume is monitored by 120 PMTs to detect light from particle interactions. I will present an overview of the LZ Outer Detector and its performance.
17:30	**315**	**Outer Detector Energy Calibration of the LUX-ZEPLIN Experiment** *Miguel Hernandez, Universität Zürich* The LUX-ZEPLIN (LZ) experiment is a dual-phase liquid xenon time projection chamber aiming to make direct observation of weakly interacting massive particles (WIMPs). LZ published first results of data taken from December 2021 to May 2022, finding it consistent with background only, no WIMP hypothesis. Ensuring the accuracy of detector response with calibrations is vital. In the case of the neutron veto, the Outer Detector (OD), three calibration source deployment tubes are employed to ensure sufficient spatial calibration. I will present an overview of the OD energy calibration, with gamma sources ranging from 122 keV to 4.44 MeV, used to ensure the accuracy of the gadolinium neutron capture response.

17:45	**316**	**Results from low temperature wafer-wafer bonded pad-diodes for particle detection** *Johannes Martin Wüthrich, André Rubbia, ETH Zurich* Low-temperature covalent wafer-wafer bonding enables the creation of novel types of semiconductor particle detectors, including the monolithic integration of high-Z materials with conventional CMOS sensors. To investigate the influence of the bonding interface on the signal formation within such structures simple bonded pad diodes have been fabricated. We present results from two different fabrication runs. Initial results showed that these types of structures are very sensitive to trace contaminations which can distort their depletion behaviour. But we show that even under non-ideal bonding conditions, the resulting signals can be fully predicted from first principles based on the extended Shockley-Ramo theorem.
18:00		
18:30		***CERN 70***
19:45		***Postersession with Apéro***

Wednesday, 11.09.2024, Room ETA F 5

Time	ID	TASK III: Low energy I *Chair: Luis Miguel Garcia Martin, EPF Lausanne*
14:30	**321**	**The n2EDM experiment - A search for new physics at the precision frontier** *Wenting Chen, PSI Villigen, on behalf of the nEDM Collaboration* The permanent neutron electric dipole moment (nEDM) is a very sensitive probe for exploring physics beyond the standard model at the low energy frontier, particularly regarding charge-parity (CP) violation. With the ultracold neutron (UCN) source at the Paul Scherrer Institut providing high neutron statistics and the new apparatus, the n2EDM experiment aims to measure the nEDM with a sensitivity an order of magnitude higher than the current best measured limit of 1.8×10^{-26} e·cm. This talk will present an overview of the experiment and preliminary results from the first commissioning measurements. Supported by SNF #204118
14:45	**322**	**An Active Magnetic Shield for the n2EDM Experiment - Simulation and Optimization** *Sergey Ermakov [1], Vira Bondar [1], Klaus Stefan Kirch [1,2], Patrick Mullan [1], Nathalie Ziehl [1]* *[1] ETH Zürich, [2] PSI Villigen* The n2EDM experiment at PSI aims to improve upon the best sensitivity measurements of the neutron electric dipole moment. This requires a stable and uniform magnetic field environment. To achieve this, a large system of coils surrounding the experimental area is implemented, called the Active Magnetic Shield (AMS). The AMS is engineered to counteract magnetic disturbances via a feedback loop mechanism. This system effectively compensates static and variable fields up to the sub-hertz frequency range, with magnitudes of up to 50 μT. This talk introduces the operational principle of the AMS and discusses simulations and optimizations via genetic algorithms to enhance the system's performance. Research supported by SNSF grant: 200441.

15:00	**323**	**An efficient spin transport system for ultracold neutrons in the n2EDM experiment** *Gian Luca Caratsch, PSI Villigen, for the n2EDM collaboration* The n2EDM experiment at the Paul Scherrer Institut (PSI) aims to improve the sensitivity of the measurement of the neutron electric dipole moment by a factor of ten. The neutron polarization must be conserved all along their path in the apparatus. To rotate the spin of the ultracold neutrons adiabatically with the magnetic field vector, spin transport coils (STC) are installed. We present the characterization of the magnetic fields produced by these coils, and the determination of the spin transport efficiency. To compensate background fields, the STC will be extended with additional coils. The research is funded by SNF 200021_212754.
15:15	**324**	**A high-sensitivity Cesium magnetometer array for the n2EDM experiment** *Victoria Kletzl, Paul Scherrer Institut, on behalf of the NEDM Collaboration* To increase the sensitivity of the neutron electric dipole moment (nEDM) by at least a factor of 10, next generation experiments will require corresponding improvements in statistics and systematics. The n2EDM experiment, currently being commissioned at the Paul Scherrer Institut, will employ an array of 112 optically pumped Cesium vapor magnetometers, measuring the magnetic field map with pT sensitivity. This will help to characterize and reduce field gradients in the central apparatus up to seventh order, largely improving systematics. This talk will give an introduction to the systematic effects induced by magnetic field inhomogeneities, as well as an overview and status report on the Cesium magnetometer array. Supported by SNF#188700.
15:30	**325**	**The muEDM experiment at PSI** *David Höhl, Philipp Schmidt-Wellenburg, Paul Scherrer Institut* At PSI a high precision experiment is being set up to search for the muon electric dipole moment (muEDM) employing the frozen-spin technique. A muEDM larger than the Standard-Model prediction would be a sign for new physics. The search is conducted in two phases with a final precision of $6 \cdot 10^{-23}$ e·cm. Eventually, this will improve the current best limit by three orders of magnitude. The EDM signal is measured by detecting an emission asymmetry of decay positrons from stored muons in a solenoid. This talk covers the basic principles of the experiment, the experimental setup and its development, test measurements towards the final experiment, and gives an outlook onto the experiment.
15:45	**326**	**Preliminary Results for the Injection Studies at Low Magnetic Fields for the muEDM Experiment** *Diego A. Sanz-Becerra, Paul Scherrer Institut, on behalf of the muEDM collaboration* The muEDM experiment at PSI aims to directly measure the electric dipole moment (EDM) of antimuons. In December 2023, a test beam was conducted to test the injection of muons at low magnetic fields for the muEDM experiment. The focus was to validate detector prototypes for use in the experiment and to assess changes in the momentum of the injected muons after altering the magnetic conditions, which are crucial for the muEDM experiment. Preliminary results confirm the performance of the detector prototypes and the control of the momentum of the injected muons within the systematic limits needed for the experiment. This presentation will outline the experimental approach, data analysis, and the implications of the preliminary results of the test beam.

16:00	**327**	**Muonic Atom Spectroscopy of ^{238}U** *Anastasia Doinaki, Paul Scherrer Institut, for the MuX collaboration* Muonic atom spectroscopy can be used to determine nuclear charge radii as muons orbit close to the nucleus, making them highly sensitive to nuclear properties. The muX experiment aims to determine the nuclear charge radius of Radium-226. However, radioactive isotopes are available only in microscopic quantities. To address this, the muX collaboration developed a novel technique based on transfer reactions in a high pressure hydrogen/deuterium gas mixture. Once captured, the muons cascade down to their ground state, emitting characteristic X-rays whose energy provides insights into nuclear properties. In the case of Uranium-238, the muonic spectrum has been analyzed, studying the cascade behaviors associated with direct and transfer muon capture.
16:15		
16:30		***Coffee Break***
		TASK IV: Low energy II *Chair: Klaus Kirch, PSI Villigen & ETH Zürich*
17:00	**331**	**Measurement of the X17 anomaly with the MEG II detector** *Giovanni Dal Maso, Paul Scherrer Institut, for the MEG II Collaboration* In 2016 the ATOMKI collaboration measured an anomaly in the angular distribution of the pair produced by the M1 transition of the isoscalar 1+ state on ^{8}Be, which might be explained by creation and decay of a boson, the X17, with mass 17.0 MeV/c^{2}. The result was later confirmed in the 0-/0+ transition in Helium. The apparatus of the MEG II experiment has been employed at the beginning of 2023 to measure such anomaly with a LiPON target and a different detection technique based on the COBRA spectrometer and the Cylindrical Drift Chamber. We present the status of the measurement.
17:15	**332**	**Results of the neutron to mirror-neutron oscillations at PSI** *Nathalie Ziehl, ETH Zürich, on behalf of the nn' collaboration* Mirror-particles as hidden-sector copies of standard model particles could provide answers for several standing issues in particle physics. Mirror neutrons, for instance, could provide baryon number violation and be viable candidates for dark matter. The mirror-neutron experiment at PSI was designed to search for anomalous disappearances of ultracold neutrons in the presence of varying non-zero magnetic field. It completed operation in 2021, testing a mirror magnetic field from 5 μT to 109 μT, and found no evidence for anomalous neutron losses. We provide an in-depth look at the data analysis based on Monte Carlo simulations and precise magnetic field maps and present new limits on the oscillation time.
17:30	**333**	**High-Resolution Spectroscopy of Muonic Lithium - First Steps and Prospects of the QUARTET Experiment** *Katharina von Schoeler [1], Andreas Abeln [2], Thomas Elias Cocolios [3], Marie Deseyn [3], Ofir Eizenberg [4], Andreas Fleischmann [2], Loredana Gastaldo [2], Cesar Godinho [5], Michael Heines [3], Paul Indelicato [6], Klaus Stefan Kirch [1,7], Andreas Knecht [7], Daniel Kreuzberger [2], Jorge Machado [5], Ben Ohayon [4], Nancy Paul [8], Randolf Pohl [9], Daniel Unger [2], Stergiani Marina Vogiatzi, Frederik Wauters [9], Aziza Zendour [7] [1] ETH Zürich, [2] Heidelberg University, [3] KU Leuven, [4] Technion IIT, [5] NOVA, [6] CNRS, [7] Paul Scherrer Institut, [8] Laboratoire Kastler Brossel, [9] Johannes Gutenberg University Mainz* Accurate measurements of nuclear charge radii are essential for QED tests and benchmarking nuclear structure theory. Muonic atom spectroscopy is a particularly suited tool for measuring the RMS radii of nuclear charge distributions and has successfully provided data for very light and heavier nuclei. However, the energy range (~ 20 - 200 keV) for elements from lithium to neon remains poorly studied, due to technological limitations in conventional spectroscopy methods. Addressing this, the QUARTET collaboration uses cryogenic metallic magnetic calorimeters (MMCs) for high-resolution spectroscopy of light muonic atoms. A pivotal test beam in October 2023 at the Paul Scherrer Institute demonstrated the potential of MMCs, showcasing the first high-resolution spectra of muonic lithium.

17:45	**334**	**Radiative corrections and Monte Carlo tools for low-energy $e^+ e^-$ experiments** *Sophie Kollatzsch, Paul Scherrer Institut* The development of radiative corrections and Monte Carlo tools for low-energy e^+e^- experiments is relevant for high-precision tests of the Standard Model, such as the determination of the leading hadronic contribution to the muon (g – 2) or the electroweak precision fits. Recently, there has been a renewed initiative to compare Monte Carlo tools. The main aim is to compare the available codes for benchmark scenarios relevant to both scan experiments (such as CMD) and radiative return experiments (such as KLOE). These codes include QED corrections at fixed order and/or resummation effects for $e^+e^- \to X^+X^-(\gamma)$ for $X \in \{e, \mu, \pi\}$. We will present their findings.
18:00	**335**	**Probing neutrinoless double beta decay with LEGEND** *Aravind Remesan Sreekala, Matteo Agostini, Abigail M. Alexander, Gabriela Rodrigues Araujo, University of Zurich* The dominance of matter over antimatter is one of the most puzzling questions in particle physics and cosmology. Since the Standard Model prohibits reactions violating the lepton number, the answer may lie in Beyond SM processes. The LEGEND experiment is designed to probe one such reaction: the neutrinoless double beta ($0\nu\beta\beta$) of ^{76}Ge. Observing this decay would shed light on the matter-antimatter asymmetry, the absolute neutrino mass scale and order, and definitively prove the Majorana nature of neutrinos. Since 2023, LEGEND has been operating 142 kg of ^{76}Ge detectors placed in an active LAr shield, aiming to achieve a half-life sensitivity exceeding 10^{27} years after an exposure of 1 tonne-year.
18:15		

Wednesday, 11.09.2024, Room ETZ E 7

Time	ID	TASK V: Physics at LHCb *Chair: Paolo Crivelli, ETH Zürich*
17:00	**341**	**Heavy flavour spectroscopy at LHCb** *Daniel Charles Craik, University of Zurich* Spectroscopy of hadrons containing heavy-flavour quarks provides essential inputs to test models of quantum chromodynamics. I will present some of the latest spectroscopy results from LHCb, covering both conventional and exotic hadrons.
17:15	**342**	**Measurement of the branching ratio of $B^+ \to K^+\pi^+\pi^-\mu^+\mu^-$ at LHCb** *Anni Kauniskangas, EPFL* Precision measurements of rare particle decays have gained significant interest as a way of indirectly searching for new physics. In these indirect searches, the properties of the rare decays are measured to a high precision in order to look for discrepancies between the experiment and the SM predictions that could be caused by new particles intervening with the decay. This contribution describes an ongoing measurement of the branching ratio of the rare decay $B^+ \to K^+\pi^+\pi^-\mu^+\mu^-$ using data from the LHCb experiment at CERN.

17:30	343	**Search for the $B_s^0 \to \mu^+\mu^-\gamma$ decay with photon conversions** *Raphael van Laak, EPFL* Flavor-changing neutral currents, forbidden at tree level in the Standard Model, serve as sensitive indicators of new physics. A particularly promising channel is the decay $B_s^0 \to \mu^+\mu^-\gamma$, which is unaffected by chiral suppression, unlike its nonradiative counterpart. Leveraging recent studies at LHCb, we introduce a novel detection technique that employs photon conversion in the VELO detector to analyze proton-proton collision data, corresponding to an integrated luminosity of 5.4 fb^{-1} at $\sqrt{s}$ = 13 TeV. This method aims to refine and extend the existing limits on the branching fraction, enhancing our understanding of the underlying physics.
17:45	344	**Measurement of BR($B_s \to K_S K_S$) with Run 2 LHCb data** *Kerim Guseinov, Luis Miguel Garcia Martin, Radoslav Marchevski, EPFL* The decays $B_{(S)}^0 \to K_S^0 K_S^0$ proceed via flavor-changing neutral currents that are suppressed in the Standard Model and therefore provide greater sensitivity to new physics. And the latest measurements of their branching fractions exhibit some tension with the SM. Since the time of the existing measurement, the LHCb experiment has collected a large amount of data and had several improvements to its online selection. This allows one to significantly improve the precision using Run 2 data. The current work presents a status report on the ongoing measurement of the $B_S^0 \to K_S^0 K_S^0$ and $B^0 \to K_S^0 K_S^0$ branching fractions.
18:00	345	**Search for $K^0 \to \pi^+\pi^-\mu^+\mu^-$ decays with the Run II LHCb data** *Luis Miguel Garcia Martin, EPFL* Rare Kaon meson decays serve as highly sensitive probes for both heavy and light New Physics. Notably, the $K_S \to \pi^+\pi^-\mu^+\mu^-$ process, which is of order 10^{-14} in the Standard Model (SM), holds the potential to be enhanced by up to a factor of 100 in exotic Beyond the Standard Model (BSM) scenarios. The analysis of the $K_S \to \pi^+\pi^-\mu^+\mu^-$ decay is anticipated to exhibit high cleanliness owing to the exceptional performance of the LHCb experiment in pion and muon reconstruction. Results for $K_L \to \pi^+\pi^-\mu^+\mu^-$ will also be provided, for which there are no SM predictions. Herein, we present the current progress on the exploration of the $K_S \to \pi^+\pi^-\mu^+\mu^-$ decay utilizing data from 2016-2018 of the LHCb experiment.
18:15	346	**Search for violation of leptonic universality in Semileptonic Hyperon Decays in LHCb** *Alexandre Brea Rodriguez, EPFL - LPHE* Theoretical studies have demonstrated that Semileptonic Hyperon Decays (SHD) can be sensitive to BSM dynamics that break lepton flavour universality (LFU). The LFU test observable, defined as the ratio between muon and electron modes, is sensitive to non standard contributions. This talk will present the current status of the $\Lambda \to p\mu^-\bar{\nu}_\mu$ branching ratio measurement using Run 2 LHCb data. Additionally, prospects for other SHD measurements will be discussed.
18:30	347	**Search for the $B_{(c)}^+ \to \tau^+\nu_\tau$ decay at LHCb** *Rita de Sousa Ataide da Silva, Fred Blanc, Alexandre Brea Rodriguez, EPFL - LPHE* The decay process $B_{(c)}^+ \to \tau^+\nu_\tau$ offers a direct experimental determination of the CKM element V_{ub} (V_{cb}), contributing to precision tests of the Standard Model. Additionally, the observation of this decay holds potential for probing extensions of the Standard Model, e.g. the two-Higgs doublet model and supersymmetry. We aim to measure the $B_{(c)}^+ \to \tau^+\nu_\tau$ branching fraction using the decay mode $\tau^+ \to \pi^+\pi^-\pi^+\bar{\nu}_\tau$ at LHCb, which poses a significant challenge due to the presence of two neutrinos in the final state. In this presentation we introduce novel techniques designed for the study of this decay in the challenging hadronic environment of the LHCb experiment.

18:45	**348**	**Search for axion-like particles at LHCb** *Pasquale Andreola, University of Zurich* Axion-like particles (ALPs) are hypothetical particles predicted in many extensions of the Standard Model (SM). ALPs can mediate the interactions between dark and ordinary matter, coupling to the different SM bosons. Thanks to its full software trigger and excellent vertex resolution, the LHCb experiment has excellent sensitivity for different ALPs, even at low masses, thus playing a unique role in the search for ALPs at LHC. Some results from searches for ALPs will be presented. An outlook on searches for ALPs coupling to gluons, such as axion-like particles decaying into pions, will be discussed.
19:00	**349**	**BDF/SHiP at the SPS ECN3 high-intensity beam facility** *Martina Ferrillo, University of Zurich* The SHiP experiment is a pioneering initiative proposed at the CERN ECN3 to establish a general-purpose fixed target facility. Its primary objective is to explore the Hidden Sector portals domain and the potential discovery of novel particles envisaged in extensions of the Standard Model with unprecedented sensitivity. The central aim of the SHiP experiment is to unveil the existence of Feebly Interacting Particles (FIP) within the mass spectrum below 10 GeV, by directing a high-intensity 400 GeV/c proton beam onto a hybrid thick target to probe elusive particles. In this talk I will discuss the experimental proposal and detector layout.
19:15		

Thursday, 12.09.2024, Room ETA F 5

Time	ID	**TASK VI: Machine Learning** *Chair: Alexandre Brea Rodriguez, EPFL*
14:00	**351**	**Machine Learning Methods for Top Reconstruction using the ATLAS Experiment** *Daniele Dal Santo, Universität Bern* The application of state-of-the-art machine learning (ML) techniques based on graph or transformer architectures for LHC collision event reconstruction and classification will be presented. A focus is put on the application of ML methods to events which feature 2 top quarks and a large missing transverse momentum. Those events are especially interesting for searches beyond the standard model. ML helps to overcome the combinatorial challenge of matching each top decay product with the correct parent particle. As a benchmark, these techniques are applied to the search for a scalar partner of the top quark in all-hadronic tt-MET final states with data collected during Run-2 and Run-3 with the ATLAS detector.
14:15	**352**	**Anomaly detection techniques for ATLAS calorimeter data quality monitoring** *Vilius Čepaitis, Steven Schramm, Université de Genève* The ATLAS detector at the LHC records vast amounts of data. To ensure excellent detector performance, a number of checks are performed both during and after data-taking. This study introduces a prototype algorithm designed to automatically identify detector anomalies in ATLAS liquid argon calorimeter data. The data is represented as a multi-channel time series, corresponding to average calorimeter energy cluster properties. In this work, we investigate the capability of unsupervised machine learning techniques, such as autoencoders, to detect transient detector issues. Such tools are planned to be implemented to identify previously-unknown detector issues and significantly facilitate data quality shifter work.

14:30	353	**Pileup for physics: building a novel hadronic physics dataset** *Carlos Moreno Martinez, Mario Alves Cardoso, Antti Pirttikoski, Steven Schramm, Vilius Čepaitis, Université de Genève* Pileup, or the presence of multiple independent proton-proton collisions within the same bunch-crossing, is critical to the production of enormous datasets at the LHC. However, the typical LHC physics analysis only considers a single collision in each bunch crossing; the pileup collisions are viewed as an annoyance to be rejected. By reconstructing these pileup collisions, it is possible to access an enormous dataset of hadronic physics processes. In this contribution, we motivate this new approach, and describe the procedure used to reconstruct pileup collisions. We then use data recorded by the ATLAS Detector during Run 2 of the LHC to demonstrate the validity of this approach to traditional datasets.
14:45	354	**Mitigating experimental challenges in using pileup for physics** *Mario Alves Cardoso, Carlos Moreno Martinez, Antti Pirttikoski, Steven Schramm, Vilius Čepaitis, Université de Genève* Pileup, or the presence of multiple independent proton-proton collisions within the same bunch-crossing, is critical to the production of enormous datasets at the LHC. However, the typical LHC physics analysis only considers a single collision in each bunch crossing; the pileup collisions are viewed as an annoyance to be rejected. By reconstructing these pileup collisions, it is possible to access an enormous dataset of hadronic physics processes. In this contribution, we detail some experimental challenges associated with the pileup dataset as recorded by the ATLAS Detector. Examples include selection biases and the treatment of physics objects that overlap in the detector, but which originate from different proton-proton collisions.
15:00	355	**Extracting the jet energy resolution from pileup collisions** *Antti Pirttikoski, Mario Alves Cardoso, Carlos Moreno Martinez, Steven Schramm, Vilius Čepaitis, Université de Genève* Pileup, or the presence of multiple independent proton-proton collisions within the same bunch-crossing, is critical to the production of enormous datasets at the LHC. However, the typical LHC physics analysis only considers a single collision in each bunch crossing; the pileup collisions are viewed as an annoyance to be rejected. By reconstructing these pileup collisions, it is possible to access an enormous dataset of hadronic physics processes. In this contribution, we demonstrate the extraction of a physical quantity, the jet energy resolution, using data recorded by the ATLAS Detector during Run 2 of the LHC. Comparisons of results using pileup collisions with those from the traditional dataset are presented.
15:15	356	**Machine Learning in b → s ll** *Jason Aebischer, University of Zurich* Short-distance (SD) effects in b → s ll transitions can give large corrections to the SM prediction. They can however not be computed from first principles. In my talk I will present a neural network, that takes such SD effects into account, when inferring the Wilson coefficients C9 and C10 from b → s ll angular observables. The model is based on likelihood-free inference and allows to put stronger bounds on new phyiscs scenarios than conventional global fits.
15:30	357	**Leveraging transformers and RL to identify key b-hadron backgrounds** *Guillermo Hijano Mendizabal, William Sutcliffe, University of Zurich* Experimental measurements of b-hadron decays encounter a broad spectrum of backgrounds due to the numerous possible decay channels with similar final states. Additionally, computational limitations necessitate simulating only the most significant backgrounds. Identifying the leading backgrounds requires a careful analysis of the final state particles, potential misidentifications and kinematic overlaps. This talk introduces an innovative approach utilizing transformer networks and reinforcement learning to determine the critical backgrounds impacting measurements of b- hadron decays.

15:45	**358**	**Towards an AI-based trigger system for the next-generation of imaging atmospheric Cherenkov telescope cameras** *Tjark Miener, Université de Genève* Imaging atmospheric Cherenkov telescopes (IACTs) observe extended air showers (EASs) initiated by the interaction of very-high-energy gamma rays and cosmic rays with the atmosphere. Besides the Cherenkov light emitted by the EAS, the IACT cameras continuously record light from the night sky background (NSB). The trigger and data acquisition system of IACT cameras is designed to reduce the NSB and electronic noise by carrying out an on-the-fly event selection process. We present some prospective studies for an application of an Artificial-Intelligence-based trigger system for the next-generation of IACT cameras. As a high-level step of the novel trigger system, we show that gamma/hadron separation could be performed at trigger-level.
16:00	**359**	**Deep Learning-Based Data Processing in Large-Sized Telescopes of the Cherenkov Telescope Array: FPGA Implementation** *Carlos Abellan Beteta, Iaroslava Bezshyiko, University of Zurich* The Large-Sized Telescope (LST) is one of the three telescope types being built as part of the Cherenkov Telescope Array Observatory (CTAO). A next-generation camera that can be used in future LSTs is currently being developed. One of the main challenges is the 1 GHz sampling rate baseline. After filtering events, the data rate must be reduced to around 30 kHz. To achieve such a large reduction, several trigger stages will be designed and implemented in FPGA. The final trigger stage is a real-time deep learning algorithm.We will focus on porting this algorithm to FPGAs by using two different approaches: the Intel AI Suite and the hls4ml packages.
16:15	**360**	**Neutrino interaction classification in SND@LHC based on Graph Neural Network** *Zhibin Yang, EPFL* The SND@LHC is a compact experiment that aims to observe and measure high flux of energetic neutrinos of all flavours from the LHC. Identifying neutrino interaction against the large background from neutral hadrons and muons is one of the main challenges. Current identification methods are based on reconstructing muon tracks and hit multiplicity, and only consider events that are in a fiducial region of the target. We investigate the use of Graph Neural Network (GNN), where each hit is considered as a node and their relation can be learned as edge feature, to the specific use case of neutrino interaction classification with only electronic data. We evaluated our End-to-End classification method using simulated events, and the performance of identifying muon neutrinos and electron neutrinos is promising.
16:30		***Coffee Break***
		TASK VII: NEW PHYSICS SEARCHES AT CERN *Chair: Daniel Craik, Universität Zürich*
17:00	**361**	**Search for Axion-Like Particles in Photonic Final States with the FASER Detector at the LHC** *Noshin Tarannum, Université de Genève* FASER, an experiment at the LHC, aims to search for light, weakly interacting particles produced in proton-proton collisions at the ATLAS interaction point and travel in the far-forward direction. First search of detecting a light, long-lived particle decaying into photon pairs, using 2022 and 2023 collision data will be reported. Targeting axion-like particles (ALPs) primarily coupling to weak gauge bosons, the analysis identifies one event against an expected background of 0.42 ± 0.38 events, largely due to neutrino interactions. This yields world-leading constraints on ALPs of masses up to 300 MeV and coupling strengths of around 10^{-4} GeV^{-1}, exploring previously unexplored region of parameter space.

17:15	**362**	**LHC Neutrinos at FASERν and Neutrino Energy Reconstruction Methods** *Jeremy Atkinson, Universität Bern* FASER, operating at the CERN-LHC throughout Run 3, has a dedicated high-energy neutrino physics programme using a 1.1-tonne tungsten target. The FASERν detector, composed of interleaved emulsion films and tungsten plates, is designed for neutrino interaction measurements. Using a sub-sample of 2022 data, the first electron neutrinos at the LHC have been observed, and cross-sections in the TeV regime for both electron and muon neutrinos were measured. To improve future results, incident neutrino energy must be reconstructed from topological and kinematic variables of charged final state particles. Different Machine Learning techniques are investigated for this purpose. Recent FASER results and the development of neutrino energy reconstruction methods will be presented.
17:30	**363**	**Exploring the hadronic landscapes, a novel search in multijet Events at the ATLAS Experiment** *Pantelis Kontaxakis, Stefano Franchellucci, Université de Genève* In this talk I will present a new search for Beyond Standard Model (BSM) physics at the ATLAS experiment in an all-hadronic final state. The latter poses major challenges: the QCD interactions have the highest cross-sections at LHC, and are remarkably complex to simulate. Two analysis strategies were developed to deal with this difficult background, a cut-and-count analysis approach and a search for resonances using Transformers. These methods were used to search for resonant pair production of massive particles decaying into SM quarks each. SUSY gluinos decaying via RPV couplings were considered as benchmark models. I will discuss the results obtained, showing how sensitivity was improved from previous ATLAS searches.
17:45	**364**	**Search for Top Squark Pair Production with zero Lepton Final States using ATLAS Run 3 Data** *Meinrad Moritz Schefer, Universität Bern* A search for direct top squark pair production is presented using ATLAS Run 2 and Run 3 data containing no leptons in the final state. The mass of this supersymmetric partner of the top quark is suggested to be at the TeV scale due to naturalness considerations and could therefore be produced at the LHC. Different scenarios are considered where the top squark eigenstates decay into final states with many jets and missing transverse momentum. A strict veto on any leptons together with a high missing transverse momentum and specific criteria on the various jets are strong tools to discriminate our signal against Standard Model events background.
18:00	**365**	**Growing Evidence for a Higgs Triplet at the LHC** *Sumit Banik [1,2], Saiyad Ashanujjaman [3], Guglielmo Coloretti [1,2], Andreas Crivellin [1], Bruce Mellado [4]* *[1] University of Zurich, [2] Paul Scherrer Institut, [3] SGTB Khalsa College, [4] University of Wisconsin (ATLAS)* Several LHC searches with multiple leptons in the final state point towards the existence of a new Higgs boson with a mass in the 140 - 160 GeV range, decaying mostly to a pair of W bosons. This dominant decay mode motivates a Higgs triplet with zero hypercharge, which also predicts a heavier-than-expected W-boson as indicated by the CDF-II measurement. Within this simple and predictive model, we simulate and combine channels of associated di-photon production. Considering the run-2 results of ATLAS, a significance of 4.3 sigma is obtained for a mass of 152 GeV. This is the largest statistical evidence for a new narrow resonance observed at the LHC.

18:15	366	**New Higgses at the Electroweak Scale** *Guglielmo Coloretti, University of Zurich (UZH) & Paul Scherrer Institute (PSI)* Many LHC measurements with multi-lepton final states and missing energy, in particular top differential distributions, show strong tensions with the SM predictions. I discuss how they can be explained by new physics within the Δ2HDMS and show the correlations to the hints for narrow resonances at the electroweak scale. Based on: 2312.17314, 2308.07953.
18:30	367	**Recent results from the NA62 experiment at CERN SPS** *Xiafei Chang, EPFL* The NA62 experiment, located at CERN SPS, is designed to study the ultra-rare decay $K^+ \rightarrow \pi^+ \nu\bar{\nu}$. It has collected the world larges charged koan decay sample with a decay in flight technique. In this talk, the result with the data set collected in Run 1 (2016-2018) will be presented, which is the most accurate measurement achieved so far. Updates with Run 2 (2021 onwards) data set will also be discussed. Thanks to the design of this experiment, other rare koan decays and hidden sector searches are also performed in NA62 and are introduced in this talk.
18:45	~~368~~	⇒ *moved to talk 349*
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Friday, 13.09.2024, Room ETA F 5

Time	ID	**TASK VIII: Astroparticle physics and Dark matter** *Chair: Teresa Montaruli, Université de Genève*
13:30	371	**Search for gamma-ray spectral lines from dark-matter annihilation with the DAMPE satellite** *Jennifer Maria Frieden, EPFL* The annihilation of dark-matter particles may lead to the production of monochromatic gamma rays. In this contribution, the search for spectral lines in the gamma-ray spectrum using eight years of data collected with the space-borne Dark Matter Particle Explorer (DAMPE) is presented. To improve the event selection, we developed two machine-learning algorithms that outperform all the standard methods. No line signal is found between 5 GeV and 1 TeV in several regions of interest (ROI) for different dark-matter density profiles. The constraints on the velocity-averaged cross-section for the neutralino annihilation are estimated and compared with those obtained with the Fermi-LAT data.
13:45	372	**MiniFIT, The Small-Scale Version of the HERD Tracking System, From Design to Performance** *Chiara Perrina, EPFL* The High-Energy cosmic-Radiation Detection facility (HERD) will be the largest calorimetric experiment for the direct detection of cosmic rays. HERD aims at probing dark-matter signatures in the electron and photon spectra up to 100 TeV. It will also measure the flux of cosmic protons and heavier nuclei up to a few PeV. HERD will be equipped with a scintillating-fiber tracker (FIT) for the reconstruction of charged particle trajectories, the measurement of their absolute charge, and the enhancement of photon conversion into electron-positron pairs. A miniature version of the FIT sector, MiniFIT, was designed, built, and tested with particle beams. Its design and physics performance will be presented in this contribution.

14:00	**373**	**Terzina Telescope: Pioneering the Detection of Cherenkov Light from Extensive Air Showers in Space** *Martina D'Arco, Université de Genève* Detecting UHECRs above 100 PeV involves observing the Cherenkov light that their induced extensive air showers (EAS) produce in crossing the Earth's limb. Upping showers are caused by rare Earth-skimming neutrino-induced EAS, which are high-energy events of interest for multi-messenger astronomy. The NUSES space mission, featuring Terzina and ZIRÈ payloads, serves as a precursor. In this contribution, we describe Terzina detection goals, geometry and optical design and its photon detection camera composed of silicon photomultipliers. Moreover, we describe the work to understand the nighttime city light backgrounds. Terzina sets the stage for future missions like POEMMA, dedicated to UHECR and UHE neutrino astronomy, or a cost-effective constellation of synchronised satellites
14:15	**374**	**A comprehensive study of muons detected by the Large-Sized Telescope during its commission phase.** *Vadym Voitsekhovskyi, Université de Genève* The Large-Sized Telescope (LST) detects very high-energy gamma rays from 20 GeV to several TeV. The first prototype, LST-1, has been operational since November 2019 at La Palma's Roque de los Muchachos Observatory. Its calibration, essential for precision, utilizes the analysis of ring-shaped images from muons to determine optical throughput and point spread function. This involves reconstructing muon rings and fitting them to an analytical model to assess the mirrors' reflectivity. This work will cover an analysis of all muon data collected by LST-1, examining the physical characteristics of muon rings, the impact of quality cuts on parameter distributions, and their correlation with simulations to validate the telescope's calibration accuracy.
14:30	**375**	**The next generation cameras for the Large-Sized Telescopes of the Cherenkov Telescope Array Observatory** *Leonid Burmistrov, University of Geneva* Large-Sized Telescope target low-energy gamma rays, starting at 20 GeV. New silicon photomultiplier (SiPM) camera detect twice as much light as photomultiplier tube ones. This reduce detectable energy threshold, but separating signal from background remains a challenge. The SiPM-camera pixels are about 1/4 of the current camera allowing for higher-detail images which can be captured by AI methods. State-of-the-art SiPMs offer endless lifespan, robustness, low noise, crosstalk, and power consumption. Ideal for long-term, low-maintenance cameras. This work details telescope simulation with new camera, performance, and introduces low and high-level triggers. Early signal digitization enables sophisticated low-level trigger with density-based clustering algorithm. Convolutional neural network serves as high-level trigger and analysis.
14.45	**376**	**Testing gravity through the distortion of time** *Sveva Castello, University of Geneva* In 1998, observations of distant stellar explosions provided evidence that the expansion of the Universe is accelerating. The cosmology community has struggled to find an explanation for this ever since, postulating the existence of a form of "dark energy" driving the expansion. However, the lack of theoretical understanding of its properties motivates the search for other explanations, most notably the possibility that our theory of gravity, General Relativity, should be modified on cosmological scales. In my work, I illustrate how this hypothesis can be tested from the observed distribution of galaxies, focusing on measurements of the distortion of time that will be provided by the coming generation of galaxy surveys.

15:00	**377**	**Latest results from the XENONnT dark matter experiment** *Paloma Cimental Chávez, Universität Zürich* The XENONnT detector, hosted at the Laboratori Nazionali del Gran Sasso in Italy, is at the forefront of direct dark matter searches in the form of Weakly Interacting Massive Particles (WIMPs). Instrumented with an active target of 5.9 tonnes of liquid xenon (LXe), XENONnT employs a dual-phase time projection chamber designed to detect dark matter particles through its interactions with LXe atoms. Due to its exceptionally low background level, the physics reach of XENONnT has expanded from direct detection of dark matter to a variety of rare event searches such as solar neutrinos, bosonic dark matter, solar axions and rare nuclear decays. In this contribution, I will present an overview of the XENONnT detector and its latest scientific results.
15:15	**378**	**XLZD: The Future of Direct Dark Matter Detection** *Maximinio Adrover, Universität Zürich* Dual-phase time projection chambers (TPCs) provide the strongest constraints on the spin-independent WIMP-nucleon cross-section and great sensitivity towards other dark matter candidates. With greater exposure, this technology is expected to be able to probe dark matter cross-sections down to the neutrino fog, where coherent elastic neutrino-nucleus scattering processes pose an irreducible background. This also opens the possibility to further explore astrophysical neutrino sources. To achieve this goal, the XENON, LUX-ZEPLIN, and DARWIN (XLZD) collaborations plan to build a next-generation detector: a TPC employing about 60 t of xenon. This talk will introduce the broad physics reach of the XLZD detector and focus on the ongoing R&D needed to achieve these ambitious goals.
15:00		***END***

ID	TASK POSTER
381	**Towards Precision X-Ray Spectroscopy of Muonic low-Z Atoms Using Metallic Magnetic Calorimeters** *Aziza Zendour, PSI & ETH, for the QUARTET Collaboration* To improve existing theoretical models and obtain accurate values for fundamental constants, precise measurements of absolute nuclear charge radii are necessary. These can help in improving our knowledge of bound-state QED and aid in exploring new physics beyond the Standard Model. While muonic atom spectroscopy is known for its precision, measuring 2p–1s transition energies for low-Z nuclei of 20 – 150 keV has proven to be challenging, due to the energy resolution limitations of solid-state detectors. The QUARTET collaboration aims to improve these measurements by using a new metallic magnetic calorimeters detector to conduct high-precision X-ray spectroscopy of low-lying states in muonic atoms.
382	**Detector system to study early-to-late stability of the muEDM experiment** *Chavdar Dutsov, Paul Scherrer Institut, on behalf of the muEDM collaboration* At the Paul Scherrer Institute we are developing a high precision instrument to measure the electric dipole moment (EDM) of the muon by trapping particles in a compact storage ring. A muon EDM is a background free sign of new physics and would lead to a time-dependent directional asymmetry of decay positrons, measured by detectors close to the storage ring. The strong magnetic pulse used to trap the muons might interfere with the detectors and lead to systematic changes in their response and thus to a false EDM signal. We present a scintillation-based positron detector that is used to study early-to-late stability and control of systematic effects in the experiment.

383	**Initial Results From the Michigan Xenon Experiment (MiX)** *Erin Barillier [1], Wolfgang Lorenzon [2], Björn Penning [2], Greg Rischbieter [2]* *[1] Universität Zürich, [2] University of Michigan* Dual-phase xenon Time Projection Chambers (TPCs) have been the leading technology in dark matter direct detection for the last several decades. Many questions remain regarding the responses from interactions within the liquid xenon (LXe). The Michigan Xenon experiment (MiX) is a 10 kg LXe TPC designed to study the microphysics of LXe, including measuring the W-value, or the mean energy required to produce observable quanta in LXe. Over the last several years, there has been tension between different W-value measurements. Here, I present the initial results of the MiX experiment in our effort to achieve a definitive measurement of the LXe W-value in order to aid dark matter detection experiments.
384	**Electric and magnetic field studies towards muon storage in the search for a muon electric dipole moment** *Timothy Hume, Philipp Schmidt-Wellenburg, Paul Scherrer Institut* A precise configuration of electric and magnetic fields will be essential to realise the yet-undemonstrated frozen-spin technique [Farley et al. (2004), PRL:93:052001]. The apparatus under development at PSI relies on storing muons within a 3 T solenoid. The trapping scheme involves a pulsed magnetic field to kick their longitudinal momentum upon entry into a weakly-focusing magnetic field which thereafter provides longitudinal confinement. The electric field tuned to satisfy the frozen-spin condition must be highly uniform within this storage region. Simulation studies demonstrate that the proposed design suitably constrains systematic effects [Cavoto et al. (2024), EPJ.C:84:262] and permits sufficient storage efficiency to undertake a search for the muon EDM with unprecedented precision.
385	**Precision 3D monitoring of the LHCb SciFi tracker alignment using BCAMs** *Dimitrios Kaminaris [1], Fred Blanc [1], Maria Vieites Diaz [2]* *[1] EPFL, [2] CERN* A new SciFi tracker was added to the LHC during the second Long Shutdown (2019-2022). It consists of three stations, each with four detection layers of around 6 m x 5 m. Real-time 3D alignment monitoring is provided by opto-electronic BCAM sensors, which detect movements caused by magnet cycles, SciFi detector powering, or environmental changes. Triangulation provides positions for 14 points on three detection layers, monitored by 8 cameras. High-index refractive glass-balls serve as detection targets. With an intrinsic resolution of about 50 microns, preliminary results indicate enhanced sensitivity at the level of 10 - 20 microns by data averaging. Initial findings on magnetic field and operational impacts on detector alignment are presented.
386	**SST-1M Telescopes, Preliminary Results and Deep Learning Event Reconstruction with CTLearn** *Bastien Lacave, Université de Genève* SST-1M is a single-mirror small size Cherenkov telescope prototype developed by a consortium among institutes in Switzerland, Poland, and the Czech Republic. Currently undergoing commissioning at the Ondřejov Observatory in the Czech Republic, two SST-1M telescopes are actively collecting data of astrophysical gamma-ray sources. This poster provides an overview of the tele- scope and camera designs, and analysis pipeline, including evaluations of the instrument's responses. Preliminary results derived from ongoing observations are presented. Focus is made on the implementation of deep learning with CTLearn for event reconstruction, utilizing Convolution Neural Networks to classify gammas and hadrons primaries.
~~387~~	*cancelled*

388	**An external array of remote magnetometers for the n2EDM experiment** *Philipp Wagner [1], Sergey Ermakov, Klaus Stefan Kirch [1,2], Patrick Mullan [1], Nathalie Ziehl [2]* *[1] ETH Zürich, [2] Paul Scherrer Institut* The n2EDM experiment aims to improve the most accurate measurement of the neutron electric dipole moment (nEDM), which requires a stable and uniform magnetic field. Our Remote Magnetometer System (RMS) uses 14 Raspberry Pis to continuously measure the magnetic field around the n2EDM experiment. The acquired data can provide real-time information for other subsystems of the experiment. Various methods are explored to identify and interpret magnetic disturbances. To enhance the reliability of this process, we employ COMSOL simulations to examine the effect of the experiment's Active Magnetic Shielding on the measurements of the RMS. This work is supported by SNF grant 200441.
389	**Generate parton-level events from reconstructed events with Conditional Normalizing Flows** *Adrian-Antonio Petre, Mauro Donega, Davide Valsecchi, Rainer Wallny, ETH Zürich* In High-Energy Physics, generating meaningful parton configurations from a collision reconstructed within a detector is a critical step for many complex tasks like the Matrix Element Method computation and Bayesian inference on parameters of interest. We propose to tackle this problem from a new perspective by using a Transformer network to analyze the full event at the reconstruction level (including jets and leptons). This approach extracts a latent vector which is used to condition a Flow network. The full architecture generates probable sets of partons that are compatible with the observed objects. Our strategy is applicable to events with multiple jets multiplicity and can model additional radiation at parton level.
390	**Production and characterization of the Cesium magnetometer cells for the n2EDM experiment** *Lea Segner, Georg Bison, Vira Bondar, Victoria Kletzl, Paul Scherrer Institut, for the nEDM collaboration* The n2EDM experiment, currently under commission at the Paul Scherrer Institute, aims to improve the sensitivity of the neutron electric dipole moment measurement by an order of magnitude. Achieving this sensitivity requires precise magnetic field measurements to control adverse systematic effects resulting from magnetic field inhomogeneities. An array of 112 optically-pumped cesium magnetometers will be used to measure the magnetic-field gradients and correct associated systematic shiPs. This contribution introduces the concept of cesium magnetometry and details the produc'on and characterization of the core component of a magnetometer: the anti-spin-relaxation-coated glass cells containing the cesium vapor. Supported by SNF grant 200441

Atomic Physics and Quantum Optics

Thursday, 12.09.2024, Room ETF E 1

Time	ID	Atomic Physics and Quantum Optics I *Chair: Jean-Philippe Brantut, EPFL*
14:00	401	**Language models for the simulation of quantum many-body** *Juan Carasquilla, ETH Zürich* In this talk, I will discuss our work on using models inspired by natural language processing in the realm of quantum many-body physics. I will demonstrate their utility in solving ground states of quantum Hamiltonians, particularly for ground states of arrays of Rydberg atoms on the Kagome lattice. Our findings highlight the potential of using language models to explore many-body physics on exotic lattices and beyond.
14:30	402	**Einstein-Podolsky-Rosen experiment with two Bose-Einstein condensates** *Paolo Colciaghi, Uni Basel* Much of the current push in quantum technologies relies on one assumption: Quantum mechanics is valid for complex and macroscopic systems. Although recent experiments have demonstrated the entanglement of mesoscopic objects, there are some aspects of quantum mechanics that are yet to be tested beyond the few-atoms level. We observed for the first time the famous Einstein-Podolsky-Rosen paradox with two spatially separated, massive many-particle systems – two atomic Bose-Einstein condensates. Our results show that the conflict between quantum mechanics and the classical understanding of reality and locality does not disappear when the system size is increased to more than 1000 massive particles.
15:00	403	**Quantum synchronization through the interference blockade** *Tobias Kehrer, Christoph Bruder, Tobias Nadolny, University of Basel* Quantum synchronization occurs in systems of quantum limit-cycle oscillators that are stabilized by both gain and damping processes. Single maxima (1:1/in-phase locking) emerge in (a) the phase probability distribution of a quantum oscillator if it is driven externally or (b) in the distribution of the relative phase of two coupled oscillators. If the gain and damping rates are equal, so-called interference blockades emerge and inhibit 1:1 phase locking for both drive-spin and spin-spin interactions. In this work, we describe higher order 1:1 phase locking for two (where one spin is driven) and three (undriven) coupled, blockaded spin-1 oscillators.
15:15	404	**Quantum backflow within circular geometry** *Arseni Goussev, University of Geneva* Quantum backflow (QB) is a counterintuitive phenomenon where a particle's probability density moves against its momentum. Despite being first recognized three decades ago, QB remains largely unexplored, presenting theoretical and experimental challenges. QB still awaits its inaugural experimental observation. In my talk, I will present novel theoretical insights into QB within circular geometry, establishing precise lower and upper bounds for the probability current. Additionally, I will demonstrate that the current-versus-time function associated with states maximizing backflow probability transfer forms a fractal curve with a dimension of 7/4, potentially offering an experimentally relevant signature near the probability-transfer bound.
15:30	405	**Universal entropy transport far from equilibrium across the BCS-BEC crossover** *Meng-Zi Huang, Jeffrey Mohan, Philipp Fabritius, Mohsen Talebi, Simon Wili, Tilman Esslinger, ETH Zürich* The transport properties of strongly interacting fermionic systems can reveal facets of their unknown nature, but experiments and theory have mostly focused on the hydrodynamic limit. However, a ballistic channel connecting two superfluid reservoirs of unitary Fermi gases can reach a

		far-from-equilibrium regime where particle and entropy currents respond nonlinearly to biases of chemical potential and temperature. Here, we explore the coupled transport of particles and entropy tuning the interaction across the BCS-BEC crossover. Surprisingly, the entropy advectively transported per particle depends only on the interactions and reservoir degeneracy and not on the details of the channel, suggesting that this property originates from the universal equilibrium properties of the reservoirs.
15:45	**406**	**Nonreciprocal synchronization of active quantum spins** *Tobias Nadolny, Christoph Bruder, Matteo Brunelli, University of Basel* Nonreciprocal interactions between two agents, A and B, indicate that A exerts an influence on B different from the influence that B exerts on A. For instance, A may chase B which in turn runs away from A. We present a quantum model of two spin species that interact in a nonreciprocal way. One species tends to synchronize in phase with the other species which in contrast tends to synchronize with a phase shift of π. We show that a dynamical state analogous to chase-and-run-away dynamics emerges. Our work extends the study of nonreciprocal interactions to the quantum domain.
16:00	**407**	**Towards a two-qubit gate with grid states encoded in the motion of a trapped ion** *Florence Berterottière [1,2], Moritz Fontboté-Schmidt [1,2], Martin Wagener † [1,2], Stephan Welte [1,2], Ivan Rojkov [1,2], Florentin Reiter [1,2], Daniel Kienzler [1,2], Jonathan Home [1,2]* *[1] Institute for Quantum Electronics, ETH Zürich, CH-8093 Zürich* *[2] Quantum Center, ETH Zürich, CH-8093 Zürich* Gottesman-Kitaev-Preskill (GKP) states, also known as grid states, can encode a logical qubit into a quantum harmonic oscillator. Motional modes of a trapped ion are naturally accessible harmonic oscillators. They have coherence times of tens of milliseconds, and can be controlled by their coupling to the electronic degree of freedom of the ion. This enables the preparation and readout of GKP states in these modes. Quantum error correction of GKP states and a universal single-qubit gate set have already been shown in trapped ions and in superconducting circuits. A two-qubit gate remains to be experimentally demonstrated. Following a recent theory proposal from our research group, a controlled-NOT between two logical GKP states can be decomposed into a product of squeezing and beamsplitter operators. We experimentally prepare two grid states encoded in the motional modes of a single ion of Calcium, by applying quantum error correction. We demonstrate the ability to squeeze them and couple them via a beamsplitter interaction. This showcases the necessary ingredients for an entangling gate for GKP qubits.
16:15	**408**	**On-chip time-bin-entangled quantum state generation and tomography for optical quantum communication** *Giovanni Finco, Robert J. Chapman, Rachel Grange, Jost Kellner, Tristan Kuttner, Andreas Maeder, Filippo Miserocchi, Alessandra Sabatti, ETH Zürich* Lithium niobate-on-insulator is a photonic platform gaining interest due to its wide transparency range, strong second-order nonlinearity and large electro-optic bandwidth. While lithium niobate photonics has made a significant impact in high-speed classical communication, its potential in quantum communication, particularly in entangled quantum key distribution, remains largely untapped. Leveraging the second-order nonlinearity, we generate energy-time entangled quantum states by spontaneous parametric down-conversion, and perform quantum state tomography on chip to reconstruct the density matrix with over 90 % fidelity to a Bell state. Our results underscore the suitability of the platform for applications in optical communication beyond the classical domain, including high-rate and unconditionally secure quantum key distribution.
16:30		***Coffee Break***

Time	ID	**Atomic Physics and Quantum Optics II** *Chair: NN*
17:00	**411**	**Quantum technologies for trapped molecular ions** *Stefan Willitsch, Department of Chemistry, University of Basel* Molecules are quantum systems of prime significance in a variety of contexts ranging from physics over chemistry to biology. In spite of their importance, the development of quantum technologies for molecules has remained a long-standing challenge due to their complex energy-level structures. Trapped molecular ions are particular attractive in this context as it is possible to observe, manipulate and control single isolated molecules under precisely controlled conditions. In the talk, we will highlight new experimental methods for the detection, preparation and manipulation of the quantum states of single trapped molecular ions and discuss applications of these techniques in the realms of precision molecular spectroscopy, quantum science and chemistry.
17:30	**412**	**Metrology of highly excited states of the hydrogen atom** *Simon Scheidegger, ETHZ / JILA, University of Colorado* Precision measurements in the H atom play an important role in atomic physics and are used to determine the Rydberg constant R_∞ and the proton charge radius r_p. In 2010, measurements in muonic hydrogen indicated that the values of R_∞ and r_p determined from H-atom spectroscopy at low principal quantum number ($n < 13$) might be in error by several standard deviations, a discrepancy known as the proton-size puzzle. To resolve this puzzle, I determined during my dissertation an independent value of R_∞ from measurements of transitions to states of the H atom with $n > 20$.
18:00	**413**	**Progress towards multi-particle entanglement generation and manipulation in an optical tweezer array of ^{171}Yb nuclear-spin qubits** *Alexander Baumgärtner, Adam Kaufman, Joanna Lis, Aruku Senoo, Gaurav Vaidya, CU Boulder* Recent progress with optical tweezer arrays has shown that Ytterbium-171 has several favorable features for quantum computing and entanglement generation. The naturally two-level nuclear spin qubit is highly robust in both the ground electronic state (1S0) and metastable clock state (3P0), due to a lack of hyperfine coupling in J = 0 states. Recently, we also have demonstrated mid-circuit measurement, where we store ancilla atoms in the optical clock state which is dark to the measurement beam. In this talk, we describe our progress in generating and manipulating entangled Ytterbium atom arrays. We report the result of a fast, high-fidelity two-qubit gate using purely optical fields.
18:15	**414**	**A cavity-microscope for micrometer-scale control of atom-photon interactions** *Michael Alexander Eichenberger [1], Francesca Orsi [1], Rohit Prasad Bhatt [1], Ekaterina Fedotova [1], Nick Jacob Sauerwein [1], Jonas Faltinath [2], Gaia Bolognini [1], Jean-Philippe Brantut [1]* *[1] EPFL, [2] UKE Hamburg* A principal limitation of current experiments employing methods based on cavity quantum electrodynamics lies in the fixed nature of the mode structure of the cavity field. This forces applications to trade between spatial resolution and enhanced sensitivity. Here, we demonstrate a new single-axis cavity-microscope device, capable of controlling in space and time the atom-light coupling in a single mode high-finesse cavity. Our device reaches micrometer-scale spatial resolution, achieved through local Floquet engineering of the atomic level structure. This technique opens a wide range of perspectives from ultra-fast, cavity-enhanced mid-circuit readout to the quantum simulation of fully connected models of quantum matter such as the Sachdev-Ye-Kitaev model.

18:30	**415**	**Exploiting frequency metrology fiber networks for earthquake sensing** *Dominik Husmann [1], Jacques Morel [1], Andreas Fichtner [2], Sebastian Noe [2], Nils Müller [2]* *[1] METAS, [2] ETH Zürich* Beyond their main purpose of state-of-the-art frequency dissemination for atomic physics, phase-stabilized fiber-optic networks promise versatile applications as environmental sensors, in particular for seismology. Here we present how such a fiber network can be exploited as an earthquake sensor. We analyze the phase correction signal on a 126 km long fiber leg connecting METAS in Bern to the University of Basel during an M3.9 earthquake in the Mulhouse region. Further, we model the propagation of the seismic waves and simulate their impact onto the fiber, finding a quantitative match between observation and simulation. This validates our system as a quantitative seismic sensor and opens up possiblities for fiber-based earthquake sensing.
18:45	**416**	**Bragg-spectroscopy of a dissipation-induced instability in an atom-cavity system** *Gabriele Natale, Alexander Baumgärtner, Justyna Stefaniak, Simon Hertlein, David Baur, Tobias Donner, Tilman Esslinger, ETH Zürich* The study of collective excitations is a powerful tool to gain insight into a many-body system. By examining the low-lying energy spectrum, we can identify imminent phase transitions and understand the nature of the different phases. In our experiment, we load a Bose-Einstein Condensate (BEC) into a high-finesse cavity. The BEC-cavity coupling produces long-range interactions, which can result in two roton-like excitation modes. Due to dissipation, these two modes couple when their energies are close. Using Bragg-spectroscopy, we observe the individual softening of the two modes as they approach their respective phases. We found a regime where the two modes coalesce, causing an exceptional point and the associated dynamical instability.
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

ID	**Atomic Physics and Quantum Optics Poster**
431	**Towards laser cooling of negative molecular ions** *Matthias Germann, Fredrik Olof Andre Parnefjord Gustafsson, Michael Doser, CERN* The AEgIS experiment aims at measuring the gravitational acceleration of antihydrogen ($\bar{H}$). A key limitation is the $\bar{H}$ temperature because the thermal motion blurs the $\bar{H}$ free-fall trajectories. Sympathetic cooling of antiprotons by co-trapped laser-cooled negative ions would enable synthesis of $\bar{H}$ at mK temperatures – three to four orders of magnitude below the currently achieved ones. Laser cooling of anions, however, has not yet been achieved. We aim at realizing Doppler laser cooling of C_2^- ions. We have produced, mass-selected and trapped C_2^-. Currently, the capture efficiency of the trap and the lifetime of trapped C_2^- ions are improved and in-beam spectroscopic studies of C_2^- are prepared.
432	**Counter-propagating spontaneous parametric down-conversion source** *Jost Kellner, Alessandra Sabatti, Rachel Grange, ETH Zürich* Lithium niobate on insulator is a promising platform for integrated quantum photonics. Its strong nonlinear coefficient and electro-optic effect allow the integration of photon pair sources and fast reconfigurable interferometers for boson sampling. The photons are generated via spontaneous parametric down-conversion (SPDC). Two key aspects of the photon pairs are their bandwidth and the possibility to split them deterministically. Here we present a new source type where the generated photons travel in opposite directions and feature a narrow bandwidth of 5 nm. The reduction of bandwidth and the separability are big advantages over the type-0-SPDC sources. The counter-propagating source efficiency outperforms the well-known type-2-SPDC sources.

Gravitational Waves

Wednesday, 11.09.2024, Room ETZ E 8

Time	ID	Gravitational Waves I *Chair: Steven Schramm, Université de Genève*
14:30	451	**Observational Prospects of Self-Interacting Scalar Ultralight Boson Clouds with Next-Generation Gravitational-Wave Detectors** *Spencer Collaviti [1], Masha Baryakhtar [2], Marios Galanis [3], Ling Sun [4]* *[1] EPFL, [2] University of Washington, [3] Perimeter Institute, [4] Australian National University* Ultralight (< 10^{-10} eV/c^2) bosons are a broad category of theoretical particles naturally introduced by symmetry-breaking at the Planck scale (such as in quantum-gravity theories). Owing to their low mass, they are predicted to bind to black holes in rotating, hydrogen-like clouds, extract the rotational energy of their host black hole, and then generate continuous, quasi-monochromatic gravitational waves. These gravitational waves have detection prospects at current and future detectors, like aLIGO and Einstein Telescope, and here we discuss the sensitivity which could be achieved in directed (one black hole) searches for self-interacting scalar ultralight bosons. These searches are of particular interest as they function even without any coupling to the Standard-Model.
14:45	452	**Fast identification of GW signals at the future Einstein Telescope** *Sarah Baimukhametova, Steven Schramm, Université de Genève* The Einstein Telescope, the proposed next-generation European ground-based GW observatory, will dramatically increase our capability to detect GW signals. The number of detections is expected to grow from the current O(1/week) to O(1/minute), which will have a revolutionary impact on both our ability to study the dark universe and on multi-messenger science. In order to fully benefit from this potential, it is important to quickly detect GW signals, with sufficient fidelity to inform the wider multi-messenger community. Such an objective necessitates the development of new algorithms for fast signal identification; this contribution will discuss our efforts towards addressing this challenge.
15:00	453	**Bright siren cosmology with the Einstein Telescope** *Niccolò Muttoni, University of Geneva* The European project for a third-generation gravitational-wave detector – the Einstein Telescope (ET) – is currently being developed, and detailed studies have been performed to investigate the science output achievable with different detector configurations. In the context of this study, I will focus on the role of ET in the field of standard siren cosmology, specifically with multimessenger observations, and I will review the forecasts predicted for different sets of cosmological parameters.
15:15	454	**Mass transfer stability shaping the merging BBH mass distribution** *Max Briel, University of Geneva* With the remarkable success of the LVK consortium in detecting binary black hole mergers, it has become possible to use the population properties to constrain our understanding of the progenitor stars' evolution. The most striking features of the observed primary black hole mass distributions are the extended tail up to 100 solar masses and an excess of masses at 35 solar masses. In this talk, we discuss how detailed treatment of the donor's response to mass loss is essential for the formation of the 35 $M_{\odot}$ excess and the extended tail from isolated binary evolution.

15:30	**455**	**Coupling elastic media to gravitational waves: an effective field theory approach** *Thomas Moreau, Enis Belgacem, Michele Maggiore, University of Geneva* We develop a generally covariant theory of elasticity, using the methods of modern effective field theory, and provide a consistent derivation of the interaction between a gravitational wave (GW) and an elastic body. The field-theoretical results, derived in the transverse-traceless (TT) frame, are valid for all GW frequencies and provide corrections to the already existing results in the literature. Beside an intrinsic conceptual interest, these results are relevant to the computation of the sensitivity of the recently proposed Lunar Gravitational Wave Antenna. We also discuss the transformation between these results in the TT frame and the standard equations in the proper detector frame.
15:45	**456**	**Using anisotropies in the distribution of GW sources as a cosmological probe** *Martin Pijnenburg, Nastassia Grimm, Camille Bonvin, Giulia Cusin, Université de Genève* I present two ways in which anisotropies in the distribution of GW sources may be used for cosmology. I first demonstrate how next-generation ground-based GW detectors can measure our velocity through the observation of a dipole, providing an independent test of the cosmic kinematic dipole tension and thus of the Universe isotropy. This method combines the observer's velocity effects on event distribution, luminosity distance, and redshifted chirp mass in GW waveforms. Second, I explore the anisotropy introduced by galaxy clustering in the context of an astrophysical GW stochastic background in the PTA band. I show how this anisotropy impacts the pulsar timing signal, leading to additional contributions to the variance of the Hellings-Downs correlation.
16:00	**457**	**Global Fit of LISA Data with Galactic Binaries and Massive Black Hole Binaries** *Stefan Strub, Luigi Ferraioli, Domenico Giardini, Cédric Schmelzbach, Simon Stähler, ETH Zürich* The Laser Interferometer Space Antenna (LISA) is a planned space-based observatory to measure gravitational waves in the millihertz frequency band, expected to capture signals from millions of Galactic binaries and tens of merging massive black hole binaries. We introduce a novel, cost-effective global fit pipeline for extracting and characterizing these signals. The pipeline performs a time-evolving weekly analysis from 1 week to 1 year of observation. Additionally, we present a novel maximum likelihood algorithm for extracting multiple massive black hole binaries and demonstrate a signal extraction considering higher harmonic modes in a noisy data set.
16:15	**458**	**Astrophysical imprints on the LISA data stream from Massive Black Hole Binaries** *Mudit Garg, Universität Zürich* One primary source for the future space-based gravitational wave (GW) mission LISA is massive black hole binaries (MBHBs) of 10^4 - 10^8 solar masses formed mainly due to the merger of galaxies. GWs from an MBHB carry information about the binary's parameters and also about their environment, which can reveal their formation channels. I focus on gas-assisted MBHB evolution that non-negligibly torques the binary and excites measurable orbital eccentricity. I will use analytical and numerical techniques to show the minimum measurable eccentricity and gas-induced perturbation. I also show how population inference would help to unlock the mysteries of MBHBs' formation channels.
16:30		***Coffee Break***

Time	ID	**Gravitational Waves II** *Chair: Philippe Jetzer, Universität Zürich*
17:00	**461**	**LISA Parameter Estimation with Time Domain Waveforms** *Cecilio Garcia Quiros, University of Zurich* Parameter estimation with full Bayesian inference remains one of the outstanding challenges for the LISA data analysis infrastructure. The current approach requires the development of approximate transfer functions that replicate the TDI response in the Fourier domain, posing a theoretical challenge for complex waveforms. In this work, we explore the use of waveforms in the time domain. We will present the status of current parameter estimation runs with a novel GPU implementation of the IMRPhenomT waveform family and the LISA response.
17:15	**462**	**Detection and Mitigation of Glitches in LISA Data: A Machine Learning Approach** *Niklas Houba, Luigi Ferraioli, Domenico Giardini, ETH Zürich* The proposed LISA mission is tasked with detecting and characterizing gravitational waves from various sources in the universe. This endeavor is challenged by transient displacement and acceleration noise artifacts, commonly called glitches. Uncalibrated glitches impact the interferometric measurements and decrease the signal quality of LISA's TDI data used for astrophysical data analysis. The paper introduces a novel calibration pipeline that employs a neural network ensemble to detect, characterize, and mitigate transient glitches of diverse morphologies. The research highlights the critical role of machine learning in advancing methodologies for data calibration and astrophysical analysis in LISA.
17:30	**463**	**Wave optics lensing of gravitational waves in the LISA band** *Martin Pijnenburg, Université de Genève* One of the major predictions of Einstein's general relativity is gravitational lensing, the deflection or amplification of light by mass distributions. In my talk, I focus on the phenomenology of gravitational wave lensing in wave optics (long wavelength), as opposed to the standard geometric optics. I show how a supermassive black hole acts as a wave optics lens, in the regime of the LISA mission. Keeping track of the tensorial structure of the signal, the lensing process shows rich physical features in wave optics, such as non-preservation of the GW helicity and polarization content, making black holes particularly interesting gravitational lenses that may be probed in the next decades.
17:45	**464**	**Waveforms in the Post-Minkowskian Expansion** *Lara Bohnenblust, Universität Zürich* Current and future gravitational wave detectors provide the possibility to detect gravitational waves emitted by hyperbolic encounters. Such scattering binaries are well captured by the post-Minkowskian (PM) approximation, which has been computed to high orders by employing scattering amplitude methods. In this talk, I will review the relation between scattering amplitudes and the gravitational waveform and present our computation of the next-to-leading order PM waveform, including the spin-orbit coupling. Special emphasis is put on the implementation of causality and the treatment of divergences in the amplitude.

18:00	**465**	**Data-Driven Analysis of Gravitational-Wave Source Progenitors Using Flow Matching** *Nodens Koren [1], Max Briel [2], Janis Fluri [1], Tassos Fragos [2]* *[1] ETH Zürich, [2] Université de Genève* In this work we present a data-driven machine learning approach to extract and analyze the progenitor properties of individual gravitational-wave sources. Our method combines the likelihood generated from the gravitational-wave signal and models the posterior distributions to describe the population of stellar binaries and the universe's star formation by employing a cutting-edge simulation-based inference method called flow matching. The training data come from the state-of-the-art, gravitational-wave progenitor population synthesis code POSYDON. This approach allows us to perform efficient yet robust inference on binary evolution with varying conditions observed from different gravitational waves and provides a more accurate quantitative description of the progenitors relevant to each potential formation channel.
18:15	**466**	**Towards Gravitational Wave Multi-Source Parameter Inference** *Janis Fluri [1], Anastasios Fragkos [2], Thomas Hofmann [1]* *[1] ETH Zürich, [2] Université de Genève* It is expected that the data collected from future gravitational wave interferometers such as the Einstein telescope will contain many overlapping signals. Ignoring these overlaps can significantly bias the inferred source parameters of individual signals, such that a joint analysis becomes necessary. We examine the challenges of multi-source parameter inference and discuss potential extensions of current inference methods. Finally, we demonstrate a pipeline based on the DINGO code that can perform fully correlated two-source parameter inference.
18:30		***END***

ID	Gravitational Waves Poster
481	**Supermassive Stars in proto-globular clusters: Investigating Runaway Collisions and Mass Loss** *Tassos Fragos [1], Laura Ramirez-Galeano [1], Jaime Roman Garza [1], Corinne Charbonnel [2]* *[1] Université de Genève, [2] Geneva Observatory & CNRS* Globular clusters, as observed, host various stellar populations with distinct abundance patterns of light elements but the underlying mechanisms remain elusive. The existing literature explores the formation of these populations and their abundances, with one of the proposed scenarios being the creation of supermassive stellar objects via protostar collisions during cluster formation. Inspired by previous studies, this work focuses on the consequences of mass loss induced by collisions between supermassive and protostellar objects of different masses. This work considers an implicit hydrodynamic stellar evolution framework to follow the effects of these collisions on the structure and evolution of the SMS and on the resulting mass loss.
482	**Low Latency Merger Time Prediction of Massive Black Hole Binaries of LISA Data with Neural Posterior Estimation** *Stefan Strub, Domenico Giardini, Niklas Houba, ETH Zürich* The Laser Interferometer Space Antenna (LISA) is an upcoming space-based observatory designed to detect gravitational waves (GWs) in the millihertz frequency range, expecting to observe 1 - 20 massive black hole binaries (MBHBs) annually. Precise estimation of both the merger time and sky location of MBHBs is critical for capturing the electromagnetic signals enabling multi-messenger astronomy. LISA receives low-latency data within an 8-hour daily communication window; therefore, accurate merger time predictions are vital to schedule additional low-latency periods beyond this window to improve the accuracy of sky location estimates close to the merger. In this study, we demonstrate the application of neural posterior estimation for making predictions of merger times.

Electron and photon spectroscopies of quantum materials

Wednesday, 11.09.2024, Room ETF E 1

Time	ID	ELECTRON AND PHOTON SPECTROSCOPIES OF QUANTUM MATERIALS I *Chair: Luc Patthey, PSI Villigen*
14:30	501	**Fast and furious: the fate of quasiparticles at high temperature** *Anna Tamai, DQMP, University of Geneva* Strongly interacting Fermi liquids often turn into bad metals at elevated temperature. How this crossover proceeds is largely unknown, as is the nature of the bad metal state. Here, we address this question by studying the temperature dependence of quasiparticles in the model Fermi liquid Sr_2RuO_4. In contrast to common ARPES beliefs, our experiments show that quasiparticles do not disappear via a vanishing quasiparticle residue Z. To the contrary, we find that the residue Z increases with increasing temperature. Quasiparticles eventually disappear not by losing spectral weight but by dissolving via excessive broadening. These findings are in semi-quantitative agreement with dynamical mean field theory calculations.
15:00	502	**Interfacial electron-phonon coupling at a WS_2/hBN interface** *Gianmarco Gatti [1], Felix Baumberger [1,2], Christophe Berthod [1], Julia Issing [1], Salony Mandloi [1], Michael Straub, Anna Tamai [1]* *[1] Department of Quantum Matter Physics, University of Geneva, 24 Quai Ernest-Ansermet, CH-1211 Geneva* *[2] Swiss Light Source, Paul Scherrer Institut, CH-5232 Villigen PSI* The interfacial coupling between electronic states in a two-dimensional system and bosonic excitations in an adjacent substrate are still poorly characterized in van der Waals heterostructures. Here, we investigate the nature of such interactions in the electronic states of a WS_2/hBN stack via angle-resolved photoelectron spectroscopy. We resolve dispersing satellites separated from the intense quasiparticle WS_2 valence band by energies comparable to Γ phonon modes in hBN. We derive a spectral function model to describe the interfacial coupling between charges in the WS_2 layer and the lattice vibrations of the polar hBN substrate, which we employ to provide a qualitative estimation of the interaction strength.
15:15	503	**Electronic band structure of strained germanium: bridging theory with direct experimental evidence** *Enrico Della Valle [1,2], Gabriel Aeppli [2], Miki Bonacci [2], Nicola Colonna [3], Andrea Hofmann [4], Nicola Marzari [3], Arianna Nigro, Michael Schüler [2,5], Vladimir Strokov [2], Ilaria Zardo [4]* *[1] ETH Zürich, [2] PSI, [3] EPFL, [4] Uni Basel, [5] Uni Fribourg* Planar Ge/SiGe heterostructures are integral to quantum technologies, particularly as platforms for quantum computation using hole-spin qubits. Compressive strain applied to germanium alters the energy dispersion of holes at the Γ-point, lifting the degeneracy between heavy and light holes by 130 meV. This results in two two-fold degenerate bands, characterized by effective spins $\lvert j_z \rvert$ = 3/2 and $\lvert j_z \rvert$ = 1/2. We confirm this energy diagram using soft X-ray ARPES, providing direct access to momentum-resolved energy levels. First-principles calculations quantitatively reproduce the experimental band structure and energy splittings, enhancing our understanding of the quantum functionality of Ge/SiGe heterostructures. Additionally, we explore the utility of soft X-ray ARPES in studying semiconductor/superconductor heterostructures, such as Al/Ge/SiGe.

15:30	**504**	**New Developments in Deflector Analyzer Technology for ARPES** *Saumya Mukherjee, Stefan Böttcher, Michael Meyer, Sven Mähl, Thorsten Kampen, Oliver Schaff* *SPECS Surface Nano Analysis GmbH, Voltastrasse 5, 13355 Berlin, Germany* Electron-optical deflectors in the lenses of hemispherical analyzers have been changing the data acquisition strategies of ARPES significantly. Among other benefits, keeping the experimental conditions constant (the sample light geometry stays fixed) and enhanced acquisition precision (no mechanical movement is involved) have increased the data quality and acquisition speed. However, several aspects of the electron-trajectory manipulation have been unaddressed so far, such as field inhomogeneities in the deflector sections and distortions induced by deflecting the angular image. We present a new type of deflector technology for APRES measurements, enhancing the deflector precision and simultaneously overcoming existing limitations of deflector analyzers, such as angular acceptance, reliability of mechanical parts and electron optical distortions. We have characterized the analyzer in lab-based environments using well established standard samples and compared the results to cutting edge literature from synchrotron experiments.
15:45	**505**	**Doping and temperature dependence evolution of the electronic properties of electron-doped Sr_2IrO_4 seen by ARPES** *Yann Alexanian [1], Robin Perry [2,3], Anna Tamai [1], Felix Baumberger [1,4]* *[1] Department of Quantum Matter Physics, University of Geneva, 24 Quai Ernest-Ansermet, CH-1211 Geneva* *[2] ISIS Pulsed Neutron and Muon Source, STFC Rutherford Appleton Laboratory, Harwell Campus, Didcot, Oxon OX11 0QX, United Kingdom* *[3] London Centre for Nanotechnology and Department of Physics and Astronomy, University College London, London WC1E 6BT, United Kingdom* *[4] Swiss Light Source, Paul Scherrer Institut, CH-5232 Villigen PSI* Sr_2IrO_4 is a layered perovskite isostructural to the cuprate La_2CuO_4. The combination of strong spin-orbit coupling inherent to Ir^{4+} ions and modest Coulomb interaction induces a Mott insulating ground state. Theses similarities with cuprates extend to the unusual metallic state of lightly doped Sr_2IrO_4 characterized by Fermi arcs and a pseudogap. Here, I will present new ARPES data on bulk crystals with higher doping than reached previously. Our results show that nodal states become more coherent with increased doping. At the same time, the antinodal pseudogap persists up to highest doping and up to high temperature, in contrast to previous results on surface doped Sr_2IrO_4.
16:00	**506**	**Unveiling the Electronic Properties of α-SnTe:** **From Ferroelectric Distortion to Unexpected Topological Surface State** *Frédéric Chassot [1], Hugo Dil [2,3], Geoffroy Kremer [4], Juraj Krempaský [3], Jan Minár [5], Claude Monney [1], Aki Pulkkinen [5], Gunther Springholz [6], Chennan Wang [1]* *[1] Université de Fribourg, CH-1700 Fribourg, [2] EPFL, [3] Paul Scherrer Institut, 5232 Villigen PSI* *[4] Institut Jean Lamour, CNRS-Université de Lorraine, FR-54011 Nancy* *[5] New Technologies-Research Center University of West Bohemia, CZ-30614 Pilzen* *[6] Johannes Kepler Universität, AT-4040 Linz* α-SnTe(111), a semiconducting and ferroelectric material, exhibits unique topological behavior. At room temperature, its rocksalt structure enables a metallic topological surface state. However, below a critical temperature, a structural distortion suppresses this state, leading to a macroscopic ferroelectric polarization and significant Rashba splitting. Firstly, using ARPES, we can follow the thermal evolution of the Rashba splitting as an indicator of the distortion to provide insights into the ferroelectric transition. Secondly, using time-resolved ARPES, we can also restore an ultra-short-lived topological state while the atomic structure remains distorted, photoinducing this way a topological state that coexists with a ferroelectric structure.

16:15	**507**	**Characterization of Excitons for bulk Black Phosphorus** *Juan F. P. Mosquera [1,2], Geoffroy Kremer [2,3], Claude Monney [2], Michael Schüler [1,2]* *[1] Paul Scherrer Institut, Laboratory for Materials Simulations (LMS)* *[2] University of Fribourg, Centre for Nanomaterials* *[3] Institut Jean Lamour, CNRS-Université de Lorraine* Excitons (coupled electron–hole pairs) in semiconductors can form collective states that exhibit spectacular nonlinear properties and possible applications in future optoelectronic devices. We present here some theoretical methods and a workflow for determining the excitonic wave functions and the corresponding excitonic binding energies for bulk Black Phosphorus. We solve the Bethe-Salpeter equations for coherent and incoherent excitations. The theoretical/numerical results are compared to the experimental ones of angle resolved photoemission spectroscopy (ARPES) to understand the nature and characteristics of these two-particle bound states, being challenging due to the stronger screened potential for 3D materials, resulting in short time excitations.
16:30		***Coffee Break***
		ELECTRON AND PHOTON SPECTROSCOPIES OF QUANTUM MATERIALS II *Chair: Claude Monney, Université de Fribourg*
17:00	**511**	**Exciton dynamics in two-dimensional quantum materials in space and time** *Stefan Mathias, I. Physical Institute, University of Göttingen, Germany* In 2D semiconducting quantum materials, organic semiconductors and their heterostructures, the energy of absorbed light is stored in Coulomb-bound electron-hole pairs, i.e. excitons. In our research, we have built a new photoemission-based experiment that is capable studying excitons at the space-time limit (nanometers and femtoseconds). In my talk, I will present the ultrafast formation dynamics of dark interlayer excitons in twisted WSe_2/MoS_2 heterostructures in space and time. Furthermore, I will present photoemission exciton tomography that allows us to study multiorbital contributions in the exciton formation in an organic semiconductor.
17:30	**512**	**The Balance Between Independent and Correlated Electron Dynamics in Transition Metals** *Erik de Vos [1], Shunsuke Sato [2], Sergej Neb [1], Marko Hollm [1], Florence Burri [1], Lukas Gallmann [1], Ursula Keller [1]* *[1] Department of Physics, ETH Zürich, 8093 Zürich* *[2] Center for Computational Sciences, University of Tsukuba, Ibaraki 305-8577, Japan* Attosecond transient absorption spectroscopy studies are presented to provide a systematic overview of the electronic and phononic response of optically excited thin-film transition metals on timescales ranging from a few femtoseconds to hundreds of picoseconds. Special emphasis is placed on understanding the balance between independent-electron population dynamics and correlated electron dynamics. It is found that collective effects dominate the response in first-row transition metals through a modification of local screening dynamics. However, due to the more delocalised nature of the valence orbitals of third-row transition metals, independent-electron phenomena such as Pauli state-blocking become most prominent in this class of materials.

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<tr><td>17:45</td><td>513</td><td>

Anomalous magnetic excitations in the half-filled Tl-based cuprate

Izabela Biało [1], Qisi Wang [2], Julia Küspert [1], Karin von Arx [1], Chun Lin [1], Wojciech Radoslaw Pudelko [3], Davide Betto [4], Nicholas Brookes [4], Nicholas Clark Plumb [3], Kaori Tanaka, Johan Chang [1]
[1] University of Zurich, [2] The Chinese University of Hong Kong, [3] Paul Scherrer Institut
[4] European Synchrotron Radiation Facility, Grenoble, FR

Manifestations of quantum fluctuations on ground states and their excitations are at the heart of condensed matter physics. Electronic two-dimensional square-lattice systems are in the moderate coupling limit extremely complex. Here, we introduce an ultra-clean half-filled cuprate system with moderate correlation strength. Using high-resolution resonant inelastic x-ray scattering, we probe the magnon excitations and their dispersion. We show that the dispersion is associated with a discontinuous “band” velocity. Within a Heisenberg-Hubbard model, this discontinuity is assigned to the presence of strong quantum fluctuations.
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<tr><td>18:15</td><td>514</td><td>

Exploring Low-Energy Excitations and Magnetic Dichroism in Resonant Inelastic X-ray Scattering of the Ferromagnetic van der Waals Material VI_3

Yuan Wei [1], Wenliang Zhang [1], Zhen Tao [1], Teguh Citra Asmara [1], Tianlun Yu [1], Mirian Garcia-Fernandez [2], Cedomir Petrovic [3], Ke-Jin Zhou [2], Thorsten Schmitt [1]
[1] Paul Scherrer Institut, [2] Diamond Light Source, UK, [3] Brookhaven National Laboratory, USA

The ferromagnetic van der Waals Material VI_3 is proposed as a Mott insulator with S = 1 state. A distinct symmetry breaking indicative of the FM transition is observed in the Raman spectra of monolayer samples. This study investigates low-energy excitations in VI_3 using high-resolution resonant inelastic X-ray scattering (RIXS). We identify the spin wave, revealing insights into the spin dynamics and exchange interactions, and unveil an orbital redistribution through the RIXS magnetic circular dichroism (MCD), underscoring the significance of orbital degrees of freedom in the magnetism. Our findings illustrate the sensitivity of RIXS-MCD in probing ferromagnetic van der Waals materials.
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<tr><td>18:30</td><td>515</td><td>

Spin-orbital correlations in the van der Waals magnet $CrPS_4$ revealed by resonant inelastic X-ray scattering

Zhijia Zhang, Yuan Wei, Carlos Galdino, Wenliang Zhang, Tianlun Yu, Thorsten Schmitt, Paul Scherrer Institut

Exfoliable magnetic van der Waals (vdW) materials have enabled the study of magnetism at the true two-dimensional limit. Bulk $CrPS_4$ is an A-type vdW antiferromagnet with strong correlation between the electronic, orbital, structural properties and the magnetic state. I will present our temperature-dependent resonant inelastic X-ray scattering (RIXS) data: the linear-dichroic RIXS intensity of one of the orbital excitations shows an order-parameter-like temperature dependence around the Néel temperature (38 K). I will discuss this temperature-dependent orbital asymmetry in relation to our multiplet simulations, and how the RIXS dichroism of this orbital excitation will allow access to the magnetic state in future RIXS investigations of exfoliated flakes of this topical material.
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<tr><td>18:45</td><td>516</td><td>

Altermagnetism at mangantite/cuprate interface

Yurii Pashkevich [1,2], Subhrangsu Sarkar [1], Christian Bernhard [1], Davide Betto [3], Nicholas Brookes [3], Roxana Capu [4], Jarji Khmaladze [1], Jonas Knobel [1], Kurt Kummer [3], Claude Monney [1], Abhishek Nag [5], Marli R. Cantarino [3], Roberto Sant [3], Christhoper W. Nicholson [1], Ke-Jin Zhou [6]
[1] University of Fribourg
[2] O. O. Galkin Donetsk Institute for Physics and Engineering NAS of Ukraine
[3] European Synchrotron Radiation Facility: Grenoble, FR
[4] West University of Timisoara, Romania, [5] Technische Universität Dresden (DE)
[6] Diamond Light Source, Oxford, UK

We report a resonant inelastic X-ray scattering study of multilayers made from a cuprate high-T_c superconductor and a magnetic perovskite manganite. Our study reveals combined spin and orbital order at the interfacial cuprate monolayer constituting a 2D altermagnetic state. Our findings significantly advance state of the art in the field of altermagnets that are of great current interest since they enable new kinds of spintronic and magnonic devices.
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19:00	517	**Charge order fluctuations in a stripe-ordered cuprate superconductor** *Xunyang Hong [1], Karin von Arx [1], Jaewon Choi [2], Yasmine Sassa [3], S. Pyon [4], T. Takayama [4], H. Takagi [4], Mirian Garcia-Fernandez [2], Ke-Jin Zhou [2], Johan Chang [1], Qisi Wang [5]* *[1] University of Zurich, [2] Diamond Light Source, [3] Chalmers University of Technology* *[4] University of Tokyo, [5] The Chinese University of Hong Kong* This study reports direct observation of charge order fluctuations in the unconventional superconductor $La_{1.675}Eu_{0.2}Sr_{0.125}CuO_4$ (LESCO) using resonant inelastic x-ray scattering (RIXS). Charge order is linked to and competes with superconductivity in cuprates, making its fluctuations key to understanding the low-energy physics in these materials. Past studies mainly focused on indirect methods, but this study uniquely separates out these fluctuations directly. We used numerical simulations to isolate charge order fluctuations from other low-energy signals. Our findings enhance the understanding of these fluctuations in superconductivity and introduce a new method for studying quantum materials.
19:15		***END***

ID	Electron and photon spectroscopies of quantum materials Poster
531	**Quantum Material Dynamics Under Pressure** *Zia Macdermid, Elsa Abreu, Tim Suter, ETH Zürich* This poster showcases development of an experimental setup for time-resolved THz time-domain spectroscopy with tunable temperature and pressure capabilities, down to 10 K and up to 10 GPa. Ultrafast dynamics experiments typically excite materials from their equilibrium ground state to investigate various properties. Pressure control enables direct manipulation of this state. Combining tunable pressure with THz TDS is challenging due to the large THz beam spot size and small sample sizes in diamond anvil cells. To optimize signal acquisition, we investigated parameters like pressure medium and aperture size. We further added an 800 nm optical pump for optical pump-THz probe measurements, enhancing our ability to study phase transitions with sub-picosecond resolution.
532	**Probing mono- and few-layer 1T-$TaSe_2$ with ARPES** *Salony Mandloi [1], Felix Baumberger [1,2], Anna Tamai [1]* *[1] Department of Quantum Matter Physics, University of Geneva, 24 Quai Ernest-Ansermet, CH-1211 Geneva* *[2] Swiss Light Source, Paul Scherrer Institut, CH-5232 Villigen PSI* Physical properties can change significantly when bulk materials are thinned down to a few atomic layers. Here, we study the intriguing example of the metallic charge density wave system 1T-$TaSe_2$. Previous transport experiments on 1T-$TaSe_2$ found a metal to insulator transition at a thickness of 5 layers. Monolayer 1T-$TaSe_2$ was proposed to be a Mott insulator and is a candidate quantum spin liquid. We perform Angle resolved photoelectron spectroscopy (ARPES) measure- ments on ultra clean exfoliated few layer 1T-T aSe_2 to study this intriguing phase of matter.
533	**Electronic structure of encapsulated mono-, bi- and trilayer Td-$MoTe_2$** *Julia Issing [1], Ignacio Gutiérrez-Lezama [1], Fabian von Rohr [1], Alberto Morpurgo [1], Marco Gibertini [2], Anna Tamai [1], Felix Baumberger [1]* *[1] University of Geneva, [2] University of Modena and Reggio Emila* Bulk Td-$MoTe_2$ is a type-II Weyl semimetal and becomes superconducting at a critical temperature of T_c = 0.1, K. Remarkably, superconductivity becomes far more robust in the 2D-limit, contrary to the trend in ultrathin metal-films. Recent transport measurements reported an increase in T_c for decreasing thickness, with T_c = 7.6, K in the monolayer. The reasons for the strong increase in T_c remains unknown. Here, we present the electronic structure of exfoliated mono-, bi- and trilayer Td-$MoTe_2$ probed by ARPES. The electron pocket of monolayer $MoTe_2$ shows signatures of strong coupling to optical phonons with $\lambda \approx 1.5$. In bi- and trilayer $MoTe_2$ electron-phonon coupling is weaker consistent with thickness dependence of T_c.

534

Integrated Synchrotron X-ray and Raman Techniques for the Determination of the Fill Factor and Thickness of III-V Semiconductor Nanowire Layers grown on a Substrate

Dimitrios Sapalidis [1], Maria Katsikini [2], Eleni Paloura [2], Eleni Pavlidou [2], Fani Pinakidou [2], Matthew Zervos [3]
[1] Empa, Center for X-ray Analytics
[2] Aristotle University of Thessaloniki, School of Physics
[3] University of Cyprus, School of Engineering

The primary objective of this study is to propose a methodology for determining the fill factor and thickness of III-V semiconductor nanowire layer grown on a substrate. To achieve this goal, we utilized the surface phonon-peak positions in the Raman spectra, which correspond to the perturbation of the GaN nanowire (NW) surface, to model the dielectric environment near the surface and thus estimate the fill factor of the layer. The average radii of the nanowires were obtained through Small-Angle X-ray Scattering modeling, and employing the effective medium approximation, a quantitative analysis using Synchrotron X-ray Fluorescence was performed to ascertain the thickness of the nanowire layer. SEM images verified the results.

Spintronics and Magnetism at the Nanoscale

Tuesday, 10.09.2024, Room ETZ E 8

Time	ID	SPINTRONICS AND MAGNETISM AT THE NANOSCALE I *Chair: Jeffrey A. Brock, ETH Zürich & PSI Villigen*
14:00	**601**	**Orbital spin-offs** *Pietro Gambardella, ETH Zürich* Recent theories have shown that an electric field can induce a net flow of orbital momentum in common metals and semiconductors, even when crystal field and band structure effects completely quench the orbital magnetism at equilibrium. Specifically, an electric field applied to 3d metals such as Ti, Cr, and Mn can generate a substantial non-equilibrium orbital accumulation, which is comparable to or even larger than the spin accumulation caused by the spin Hall effect and the Rashba-Edelstein effect in the 5d elements. In this talk, I will discuss methods to detect this orbital accumulation. Additionally, I will present evidence of significant orbital Hall and orbital Rashba-Edelstein effects in elemental and alloyed 3d systems, illustrating how orbital-to-spin conversion results in the generation of spin-orbit torques with tuneable magnitude and sign. Accordingly, orbital currents provide new avenues for controlling the magnetization of diverse material systems, potentially enhancing the efficiency of spintronic devices for memory and logic applications.
14:30	**602**	**Phase Transitions and Magnetic Order in a Ruby Lattice Artificial Spin Ice** *Luca Berchialla [1], Peter Derlet [1,2], Laura Heyderman [1,2], Gavin Macauley [1,2], Valerio Scagnoli [1,2], Tianyue Wang [1,2], Anja Weber [1]* *[1] Paul Scherrer Institut, [2] ETH Zürich* Artificial spin ice are arrangements of dipolar coupled nanomagnets, which exhibit a range of interesting behaviour. Here, we study an artificial spin ice based on the ruby lattice. This pattern has a complex unit cell with 12 nanomagnets and two lattice constants that define it. By varying the two lattice constants independently, we can change the interaction between nanomagnets. Using x-ray photoemission electron microscopy we observed different ordering mechanisms depending on the lattice constants. Moreover, the system can order in one or two steps as shown by Monte Carlo simulations.
14:45	**603**	**Reversal time of a magnetic Cobalt nanoparticle with defects** *Hugo Bocquet [1,2], Peter Derlet [1,2], Armin Kleibert [2]* *[1] ETH Zürich, [2] Paul Scherrer Institut* The long magnetic reversal time measured for selected nanoparticles cannot be rationalized with crystal, shape and surface anisotropies, suggesting the relevance of structural defects which are observed experimentally. We demonstrate here that the presence of stacking faults or twin boundaries in Co nanoparticles leads to the calculation of a transition rate, the inverse of the reversal time, that has the form of an Arrhenius law. The Arrhenius exponential as well as the prefactor present a dependence in particle diameter and number of defects which allow us to predict the experimental reversal times.
15:00	**604**	**Micro- and nanomagnet stray field investigation for manipulation of spin qubits** *Michele Aldeghi [1], Rolf Allenspach [1], Andriani Vervelaki [2], Daniel Jetter [2], Floris Braakman [2], Martino Poggio [2], Gian Salis [1]* *[1] IBM Research Zurich, [2] University of Basel* The stray field of micromagnets is currently exploited to manipulate the spin state of electrons confined in semiconductor quantum dots. The manipulation performance depends on the magnetization pattern, which is often assumed to be uniform in the development of micromagnet designs. We question this assumption by comparing micromagnetic simulations and spin qubit experiments and analyze the effect of fabrication-induced defects and material properties. We also map the out-of-plane stray field of iron micromagnets by SQUID microscopy, finding large driving gradients (> 1 mT/nm) but also non-negligible variations (> 5 mT) along the surface of the magnets due to magnetocrystalline anisotropy, surface roughness and incomplete magnet saturation.

15:15	**605**	**Observation of Ultrashort Spin Voltage and -Accumulation** *Francisco Carrion Ruiz, Yves Marc Acremann, Kevin Bühlmann, Gregoire Saerens, Andreas Vaterlaus, ETH Zürich* The generation of spin current pulses by laser-driven demagnetization links the field of ultrafast magnetism to spintronics. This work presents the study of spintronic quantities (spin voltage, spin current and spin transport) on the femtosecond time scale by spin and time resolved photoemission experiments. A thin iron sample is excited by an 800 nm laser pulse to measure the chemical potentials of the minority- and majority spins, which form the "spin voltage". Depositing a thin gold film onto iron samples allow us to observe spin injection and -accumulation, which can be described as a "spin capacitance".
15:30	**606**	**The magnetoelectric deflection effect** *Samuel Harrison Moody [1], Geetha Balakrishnan [2], Peter Hatton [3], Matthew Littlehales [3], Daniel Mayoh [2], Diego Venero [4], Jonathan White [1]* *[1] Paul Scherrer Institut, [2] Warwick University, [3] Durham University, [4] ISIS Neutron Source* Magnetoelectric materials exhibit a coupling between their magnetic and electric order parameters, which has lead to a manifestation of different magnetoelectric-driven behavior. Novel magnetoelectric responses now at the forefront of scrutiny for augmenting next-generational technological devices. Here, we present a unique magnetoelectric response. Specifically, we report the ability to reliably deflect the propagation direction of an entire incommensurate magnetic spiral structure. Theoretical modelling suggests the mechanism of the magnetoelectric spiral deflection is due to competing anisotropies together with the symmetry-breaking of the applied electric field, and predicts the onset of diverse behavioural regimes which can be dynamically selected by varying the strength of an applied magnetic field.
15:45		
16:00		***Coffee Break***
		SPINTRONICS AND MAGNETISM AT THE NANOSCALE II *Chair: Lauren Riddiford, ETH Zürich & PSI Villigen*
16:30	**611**	**Investigation of oxide heterostructures and 2D van der Waals materials through x-ray dichroism** *Cinthia Piamonteze, Paul Scherrer Institut* Complex transition metal oxides exhibit a correlation among their crystal magnetic and electronic orderings. Using advanced growth techniques one can tunee one ordering and influence other correlated ones, creating new macroscopic behaviors not existing in bulk. van der Waals magnetic materials naturally exhibit low dimensional magnetic, optical and transport properties. The novel physical properties appearing at low dimensions has led to a large interest in these systems. These two material classes are intensely investigated on the quest for new functionalities which could be used in devices. In this talk I'll show some results of my research in the investigation of complex oxides heterostructures and 2D van der Waals materials. My investigation is done by using primarily x-ray dichroic spectroscopy techniques which allow probing orbital anisotropy and magnetic moment resolved by chemical specimen. I'll show how x-ray dichroism can give important insights in the understanding of these fascinating materials.
17:00	**612**	**Scanning SQUID-on-tip microscopy of 2D and chiral magnetism** *Martino Poggio, University of Basel* The ability to map magnetic field sensitively and on the nanometer-scale – unlike global magnetization or transport measurements – overcomes ensemble or spatial inhomogeneity in systems ranging from arrays of nanometer-scale magnets, to superconducting thin films, to strongly correlated states in van der Waals heterostructures. Local imaging of nanometer-scale magnetization, Meissner currents, or current in edge-states is the key to unraveling the microscopic mechanisms behind a wealth of new and poorly understood condensed matter phenomena.

		I will discuss efforts in our group aimed at developing and applying high-sensitivity, high-resolution, non-invasive magnetic scanning probes. In particular, we have been developing superconducting sensors, based on nanometer-scale superconducting quantum interference devices fabricated at the apex of a scanning probe tip. I will discuss recent imaging experiments with these tools on 2D and chiral magnets, including $Cr_2Ge_2Te_6$, CrSBr, Cu_2OSeO_3, which yield new insights into their underlying magnetism.
17:30	**613**	**Observation of gating-induced conformational changes of CeTi@C_{80} on graphene by x-ray absorption spectroscopy** *Wei Chuang Lee [1], Bernard Delley [2], Thomas Greber [1], Zhanxin Jiang [3], Matthias Muntwiler [2], Ari Paavo Seitsonen [4], Shangfeng Yang [3], Lebin Yu [1]* *[1] University of Zürich, [2] Paul Scherrer Institut, [3] University of Science and Technology of China, [4] Département de Chimie, École Normale Supérierue de Paris* Remote control of molecular conformation is a challenge in nanotechnology. We realized this on gateable graphene on a SiO_2/Si (MOS) structure, where the work function is changed reversibly. The conformation of CeTi endohedral dimers in C_{80} evaporated on the graphene was measured with linear dichroism at the Ce_M4,5-edge. The change in orientation of the Ce-Ti ligand field axis is inferred from simulated XA spectra for different angles between the x-ray polarization and the Ce-Ti axis. Intriguingly, Ce displays mixed valency. The mechanism for change in conformation is attributed to the change in the density of states in graphene upon gating. This paves the way for magneto-electric applications of single molecules.
17:45	**614**	**Ultrafast soft X-ray magnetic holography at SwissFEL** *Boris Sorokin, Andre Al Haddad, Simone Finizio, Jörg Raabe, Kirsten Schnorr, PSI* X-ray imaging at synchrotrons have enabled a significant advancement in the understanding of the physics driving magnetic systems. Nevertheless, for X-ray imaging at ultrafast timescales, free-electron lasers become a necessity. In my talk, I will present the first results of the X-ray holography magnetic imaging setup recently commissioned at the Maloja endstation at SwissFEL (PSI, Switzerland). This is a lensless imaging technique that allows the retrieval of both amplitude and phase information of the sample transmission function. The first static images of the labyrinth magnetic domain structures will be presented, as well as the attempt at the soft X-ray time-resolved magnetic imaging at FEL.
18:00	**615**	**Integration of a near-field coupling device with scanning probes for Nitrogen-Vacancy magnetic imaging** *Jodok Happacher, Juanita Bocquel, Brendan Shields, Patrick Maletinsky, University of Basel* We present the design and implementation of a new type of scanning Nitrogen-Vacancy magnetic imaging probe with an integrated microwave near-field coupling device for optimized spin manipulation. The microwave coupling loop is directly integrated onto the attachment structure of the scanning probe eliminating the need for external MW delivery solutions. The characterization and the proof-of-principle scanning NV magnetometry experiment demonstrate that this new devices match the performance of state-of-the-art MW delivery solutions, making it a compelling alternative. This holds particularly true for low-temperature experiments but is also anticipated to reduce the technical barriers for the broader adoption of NV magnetometry across a larger research community.
18:15		*Get to know the Swiss Magnetics IEEE chapter*
18:30		***CERN 70***
19:45		***Postersession with Apéro***

Thursday, 12.09.2024, Room ETZ E 8

Time	ID	Spintronics and Magnetism at the Nanoscale III *Chair: Jeffrey A. Brock, ETH Zürich & PSI Villigen*
14:00	621	**2D Magnetic Materials** *Alberto Morpurgo, University of Geneva* The ability to exfoliate van der Waals crystals of magnetic compounds is giving access to a vast, unexplored family of two-dimensional magnetic materials, with a variety of different magnetic ground states. Most of these compounds are semiconductors that offer –besides the possibility to explore magnetism in highly controlled 2D crystals— a new playground to combine magnetic and semiconducting functionalities. In this talk I will discuss how magnetotransport experiments allow the investigation the magnetic phase diagram of 2D magnetic material down to the ultimate limit of individual monolayers, to reveal phenomena that are difficult –or cannot—be accessed with other existing experimental techniques.
	~~622~~	*cancelled*
14:30	623	**Anomalous magnetic domain pattern in kagome semimetal $Co_3Sn_2S_2$** *Hengli Duan, Sandy Adhitia Ekahana, Yona Soh, Paul Scherrer Institut* Investigating magnetism in topological materials reveals intriguing correlations between magnetic and electronic states, notably in the magnetic Weyl semimetal $Co_3Sn_2S_2$. This work employs Lorentz MEM and XMCD-PEEM to explore the temperature- and field-dependent dynamics of magnetic domains in $Co_3Sn_2S_2$. We observe spontaneous magnetic bubbles of tens of micrometers under zero-field, illustrating an intrinsic exchange bias effect in M-H curves. The asymmetric domain evolution during field-cooling and warming processes offers a microscopic view into the thermomagnetic hysteresis observed in M-T curves. Furthermore, the field-dependent behaviors of these magnetic bubbles suggest the existence of hybrid domain walls. This research contributes to our understanding of the complex magnetic phenomena in $Co_3Sn_2S_2$.
14:45	624	**Nature of 2D XY antiferromagnetism in van der Waals monolayer** *Dmitry Lebedev, Cheol-yeon Cheon, Alberto Morpurgo, Volodymyr Multian, Université de Genève* Studies of ultrathin antiferromagnets are highly challenging due to difficulties in probing atomically thin samples with no net magnetization. Here, we present a systematic investigation of magneto-transport in 2D layered van der Waals XY-type antiferromagnet. We observe spin-flop transition and anisotropic magnetoresistance down to bilayer thickness, which are clear indications of long-range magnetic order with weak in-plane easy-axis magnetic anisotropy. We find that monolayer samples undergo a phase transition from the paramagnetic phase but show no magnetoresistance or in-plane magnetic-field-driven phase transitions unlike thicker counterparts. We interpret such behavior as the absence of the long-range magnetic order, which points towards the Berezinskii-Kosterlitz-Thouless transition in monolayer 2D XY antiferromagnet.
15:00	625	**Single-Molecule Magnetism and Room Temperature Ferromagnetic Crystals of $Tb_3N@C_{80}$** *Lebin Yu [1], Hans-Benjamin Braun [2], Huaimin Jin [3], Laurent Bigler [1], Sam Therampilly [1], Shangfeng Yang [3], Urs Stalder [1], Thomas Greber [1]* *[1] University of Zürich, [2] ETH Zürich, [3] University of Science and Technology of China* $Tb_3N@C_{80}$ is promising for investigating the magnetism of compressed lanthanides. The ligand field of the N^{3-} anion in C_{80} causes the anisotropic alignment of the magnetic moments of the Tb^{3+}, resulting in a frustrated magnetic ground state. A Hamiltonian allowing for tunneling of the Tb^{3+} magnetic moments better explains the paramagnetic behavior of $Tb_3N@C_{80}$, especially in the sub-Kelvin regime. Remarkably, in cubic microcrystals we observed room temperature ferromagnetism, which is surprising since the dipolar interaction between molecules implies no magnetic order above 3 K. We applied mass spectrometry, energy dispersive x-ray spectroscopy, and inductively coupled plasma spectroscopy to ferromagnetic and paramagnetic samples to find differences in chemical composition.

	~~626~~	*cancelled*
15:15		***END***
16:30		***Coffee Break***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

ID	SPINTRONICS AND MAGNETISM AT THE NANOSCALE POSTER
641	**Variation in Domain Wall Properties in Ferrimagnetic Thin Films** *Laura van Schie, Christian Degen, Pietro Gambardella, ETH Zürich* Ferrimagnetic materials have emerged as promising candidates for spintronic applications due to the ultrafast domain wall motion observed at the magnetization compensation point. Although there is an intrinsic explanation of this, the changes in the characteristics of the domain wall over this transition have not been observed. To probe these changes over the compensation point we measure domain walls in alloyed rare earth-transition metal ferrimagnets over varying temperature using the high resolution and high sensitivity scanning technique NV magnetometry. Revealing these changes would allow us to better engineer magnetic materials for future spintronic applications.
642	**Thermally superactive artificial kagome spin ice structures** *Stéphane Nils Nilsson [1,2], Laura Heyderman [1,2], Ales Hrabec [1,2], Lauren Riddiford [1,2]* *[1] Paul Scherrer Institut, [2] ETH Zürich* Artificial spin ices are lithographically defined arrangements of dipolar-coupled nanomagnets, which are engineered to mimic various phenomena occurring in complex materials or theoretical models. An open challenge is the direct imaging of the low temperature phases in artificial kagome spin ice. Due to the high frustration associated with the kagome lattice, the moments freeze before the low temperature phases can be reached. Here, I will demonstrate strategies to tailor the energy barriers of magnetic reversal by optimizing the magnetic materials. The strategies rely on exploiting the Dzyaloshinskii-Moriya interaction and introducing out-of-plane uniaxial anisotropy in magnetic multilayers, effectively reducing the energy barrier.
643	**Intra-atomic exchange and adsorption sites of Ln atoms on NaCl thin films** *Serni Toda Cosi [1], Andres Arnau Pino [2], Maria Blanco-Rey [2], Harald Brune [1], Fernando Delgado [3], François Patthey [1], Marina Pivetta [1]* *[1] EPFL, [2] UPV-EHU, CFM/MPC, DIPC, [3] IUDEA Institute* In this experiment, we study Er, Dy, Gd and Ho deposited on NaCl thin films grown on Ag(100) using STM, IETS and DFT simulations. The studied lanthanide atoms adsorbed as both adatoms and substitutional atoms. These two species present different adsorption sites, apparent height, and stability. These results agree with the performed DFT simulations. The dI/dV spectra for Er, Dy and Ho adatoms are the only ones to exhibit symmetric steps in the range of 75-100 meV, corresponding to the intra-atomic exchange coupling between the spin the 4f shell spin and the 5d6s shell.

644	**Magnetically actuated angular dependent metasurfaces** *Nestor Miguel Valdez Garduno [1], Luca Berchialla [1,2], Henning Galinski [1], Laura Heyderman [1,2], Aleš Hrabec [1,2]* *[1] ETHZ, [2] Paul Scherrer Institut* Our recent developments in magnetically controlled micromachines enable precise angular motion control and device reconfigurability. Pairing this capability with metasurfaces exhibiting angular-dependent optical responses generates devices with a magnetically controlled coloration, opening avenues for advancements in angular-dependent optical properties. We will present our approach that integrates shape-morphing systems composed of silicon nitride panels incorporating reprogrammable nanomagnets and structurally colored components. Taking advantage of the reprogrammability of the nanomagnet arrays, we envision a new generation of reconfigurable optical devices that exploit the angular-dependent optical properties in micro-electromechanical systems (MEMS).
645	**Ordering and Thermalization of an Artificial Spin Ice based on the aperiodic Einstein Tiling** *Tianyue Wang [1,2], Luca Berchialla [1], Felix Flicker [3], Laura Heyderman [1,2], Gavin Macauley [1,2], Flavien Museur [1,2], Henrik Røising [4], Shobhna Singh [3]* *[1] Paul Scherrer Institut, [2] ETH Zürich,* *[3] H. H. Wills Physics Laboratory, Cardiff University, [4] Niels Bohr Institute* Artificial spin ices are nanomagnet arrays whose coupled behaviour can be tailored by modifying the nanomagnet arrangement. Recently the Einstein "hat" tiling has been discovered, which includes the first non-trivial aperiodic monotile and can be obtained by deleting certain links in the deltoidal trihexagonal tiling. We have fabricated such artificial spin ices, which span the continuum between the periodic tiling and the Einstein tiling. Using magnetic force microscopy and Monte Carlo techniques, we uncover a transition in magnetic order. While all systems develop some form of long-range order, we observe important differences in their magnetic ground states.

Neutron Science

This session has been organised in collaboration with the Swiss Neutron Science Society.

Tuesday, 10.09.2024, Room ETF E 1

Time	ID	**Neutron Science I** *Chair: Fanni Juranyi, PSI Villigen*
14:00	701	**Quantitative imaging and understanding of water dynamics and flow in soil and roots** *Andrea Carminati [1], Sara Di Bert, Pascal Benard, Pavel Trtik [2], Anders Kaestner* *[1] ETH Zürich, [2] Paul Scherrer Institut* Roots have long been considered the “hidden half” of plants. Due to the opaqueness of soils, root research has focussed on roots growing in artificial growth media, such as agar or hydroponics. Recent advances in imaging methods has led to unprecedented progresses in studying root functions in soils. Neutron imaging, thanks to the high sensitivity of neutrons to water, has been particularly useful for revealing root water uptake patterns and for identifying new mechanisms of how plants take up water from the soil. This talk will show examples of neutron imaging of water dynamics in soils, roots, and at their interface.
	~~702~~	*cancelled*
14:30	703	**Exploring Microfluidic-Small Angle Neutron Scattering for Soft Matter Physics** *Viviane Lütz Bueno, Paul Scherrer Institut* Our contribution to non-equilibrium soft matter physics involves developing an in situ method for studying structural changes under flow, impacting materials properties and processing. Our research spans various model systems, from wormlike micelles to 3D printing ink. We tackle challenges in flow studies with microfluidic-small-angle neutron scattering (microfluidic-SANS), enhancing visibility and control. Using selective laser-induced etching (SLE), we create neutron-transparent fused silica microchannels in parallel, increasing sample volume exposure while maintaining the resolution. We explore techniques to reduce reflection signals and present in situ contrast matching and flow mapping experiments. This work advances understanding of soft matter structures under flow, with applications in pharmaceuticals, cosmetics, and 3D printing.
	~~704~~	*cancelled*
14:45	705	**Texture analysis capabilities at the neutron strain diffractometer POLDI at PSI** *Florencia Malamud, Steve Gaudez, Ezequiel Fogliatto, Markus Strobl, Paul Scherrer Institut* Neutron strain scanners have been proven to be a key tool for non-destructively determining the crystallographic texture at selected locations within a macroscopic object. Here we will present the implementation of a novel data analysis methodology to perform spatially resolved texture analyses in bulk specimens at POLDI, the Pulse Frame Overlap diffractometer at Paul Scherrer Institute. The method is based on the determination of several incomplete pole figures after splitting POLDI’s diffraction detector, with an angular range of 30°, into several units of smaller angular coverage. We will present demonstration experiments on additive manufacturing specimens and Zr-based components of nuclear power plants.

15:00	706	**AMPLIFY - A Novel Neutron Instrument for Surface Scattering** *Artur Gregor Glavic, Jochen Stahn, Paul Scherrer Institut* Grazing incidence small angle neutron scattering is a powerful techniqu to investigate surface-near lateral structures on the nanometer scale. We develop a novel instrument concept as part of an investigation into a new guide hall at the PSI SINQ neutron source. The Adjustable Monochromator to Perform Liquid grazing Incidence, Focused or magnetic Yoneda scattering (AMPLIFY) makes use of two parabolic multilayer monochromators to provide a tunable wavelength resolution between 2 % and 10 %. We have compared the expectec instrument performance with a SANS-like configuration. For collimations in the range of 5 m to 20 m AMPLIFY can reach similar or better angular resolution with slightly higher intensity and more homogenous beam profile.
15:15	707	**Effect of Softness and Charges on the Volume Phase Transition of Colloidal Microgels and Macrogels studied via SANS** *Boyang Zhou, PSI Villigen* Microgels and macrogels, due to their stimuli-sensitive nature and tunability, are of great interest in both applications and fundamental research. However, their softness increases the number of degrees of freedom compared to hard colloidal particles and gives rise to a more complex behavior. So far, there is no generally accepted model to describe microgel interactions, especially for concentrated microgel suspensions. In this project, we delve into the study of the effect of counterions on the microgel periphery resulting from the use of ionic initiators in the synthesis. Using small-angle neutron scattering (SANS), we confirm the presence of counterion clouds at the particle periphery. More importantly, we observe that counterions can delocalize and control the swelling of the microgel. Using confocal microscopy, we show that delocalized counterions lead to noncentral many-body forces between microgels, controlling the elasticity of the crystals—a behavior also observed in metals and crystals of charged, hard colloids. Our results not only contribute valuable insights for developing a model to describe microgel interactions but also showcase the capability of SANS in studying soft matter. Furthermore, we explore the thermodynamic instability of macrogels using SANS, neutron imaging, and rheology. We conduct a detailed examination of the characteristics of the polymer-dense skin that forms on the gel surface upon rapid heating and arrests the gel in a metastable coexistence of swollen and deswollen phases. These results are valuable for developing hydrogels that exploit thermodynamic instabilities for shape actuation in various applications.
15:45		
16:00		***Coffee Break***
		NEUTRON SCIENCE II *Chair: Romain Franck Sibille, PSI Villigen*
16:30	711	**Determination of skyrmion-hosting transition metal-oxide Hamiltonian with predictive guidance from ab-initio quantum chemistry** *Daniel Mazzone [1], L. Yu, R. Yadav, Priya Ranjan Baral [2], Romain Sibille [1], J. Lass [1], Christoph Niedermayer [1], Victor Ukleev, A. Magrez, J.-R. Soh, I. Živković, Henrik M. Rønnow [2], Bruce Normand [1], Oleg V. Yazyev [2], Jonathan. S. White [1]* *[1] Paul Scherrer Institut, [2] EPFL* The remarkable tunability and inherent functionality of many quantum materials stem from intricate many-body states in which several degrees of freedom are entangled. These microscopic complexities manifest in collective excitations, forming the basis of their distinct properties. Inelastic neutron scattering is pivotal in testing theoretical predictions to unravel emergent quantum effects. However, in many cases it is challenging to find appropriate microscopic Hamiltonian candidates that can be refined against experimental observations. In this talk I will show that ab-initio quantum chemistry is a promising tool that can guide us in determining the microscopic interactions in transition metal-oxides.

17:00	**712**	**Dipolar-octupolar correlations in $Ce_2Hf_2O_7$ quantum spin ice candidate** *Victor Alexis Porée [1], Romain Franck Sibille [1], Anish Bhardwaj [2], Hitesh Changlini [3], Elsa Lhotel [4], Andriy Nevidomskyy [5], Sylvain Petit [6], Han Yan [7]* *[1] Paul Scherrer Institut, [2] St. Bonaventure, [3] Florida State University, [4] CNRS, [5] Rice, [6] CEA, [7] The University of Tokyo* Pyrochlore oxides incorporating magnetic Ce^{3+} have been the subject of intense experimental and theoretical efforts over the past few years. Their rich physics is related to their dipole-octupole magnetic degrees of freedom and possibility to stabilise a quantum spin ice (QSI) ground state – the prototype three-dimensional quantum spin liquid. While all studied materials show continua of excitations attributed to the fractionalized spinon excitations of QSI, the nature of the underlying correlations has been subject to debates. Here we show using neutron scattering that $Ce_2Hf_2O_7$ develops hybrid dipolar-octupolar correlations. The large contrast between dipolar and octupolar form factors allows to determine the weak dipolar-octupolar exchange of the Hamiltonian.
17:15	**713**	**The spiral magnetic order in $YBaCuFeO_5$ single crystals** *Arnau Romaguera-Camps [1,2], Marisa Medarde [2], M. Ciomaga Hatnean [2,3], O. Fabelo [4], N. Qureshi [4], J. A. Rodríguez-Velamazán [4], José Luis García-Muñoz [5]* *[1] Lab. for Advanced Spectroscopy and X-ray sources, Paul Scherrer Institute, 5232 Villigen PSI* *[2] Laboratory for Multiscale Materials Experiments, Paul Scherrer Institute, 5232 Villigen PSI* *[3] Materials Discovery Laboratory, Department of Materials, ETH Zürich, 8093 Zürich* *[4] Institut Laue-Langevin, CS 20156, FR-38042 Grenoble Cedex 9* *[5] Institut de Ciència de Materials de Barcelona (ICMAB-CSIC), ES-08193 Bellaterra, Barcelona* The low ordering temperatures of most non-collinear cycloidal magnets (typically $<$ 50 K) limit their use in ambient temperature devices. The layered perovskites $LnBaCuFeO_5$ are a rare case of frustrated oxides where a novel "spiral order by disorder" mechanism appears to account for the existence of a spiral order with extraordinary stability, but direct evidence of the chiral nature of this incommensurate phase is lacking. This presentation aims to fill this gap by providing proofs of the magnetic structures through spherical neutron polarimetry and crystal neutron diffraction, highlighting critical features relevant to the search for high temperature magnetoelectric response induced by the spiral phase.
17:30	**714**	**Extreme Quantum Fluctuations of the Heisenberg Antiferromagnet on the Honeycomb Lattice** *Jose Abraham Hernandez Sanchez, Bertrand Roessli, K. W. Krämer, M. Schüler, A. A. Eberharter, Bruce Normand, Andreas M. Läuchli, Michel Kenzelmann, Paul Scherrer Institut* Enhanced quantum fluctuations are believed to give rise to new ground states and magnetic excitations in electronic insulators. I will present the effect of strong quantum fluctuations in the honeycomb van der Waals antiferromagnet $YbBr_3$. Quantum fluctuations are believed to be enhanced in $YbBr_3$ due to the two-dimensional nature of the exchange interactions. The low-energy spin dynamics of the system measured with inelastic neutron scattering are excellently reproduced by the spin-½ Heisenberg model treated with the matrix-product states (MPS) numerical method. The coexistence of magnon-like and continuum excitations are spectacularly reproduced by the method.
	~~715~~	*cancelled*

17:45	716	**A High Visibility Grating Deflectometer for the Measurement of the Neutron Electric Charge** *Marc Persoz, Universität Bern* Neutron grating interferometers are powerful tools for high-precision measurements of deflection angles and scattering. A novel symmetric Talbot-Lau interferometer, utilizing three identical absorption gratings in a time-of-flight mode, is currently under development at the University of Bern. The ultimate goal of this project is to conduct a sensitive measurement of the neutron electric charge and improve the current upper limit: $Q_n < (-0.4 \pm 1.1) \cdot 10^{-21}$ e [Baumann, 1988]. A proof-of-principle apparatus has been characterized at the cold neutron beamline PF1b at the Laue-Langevin Institute in Grenoble, France. A general description of the setup, alignment procedures and initial findings regarding the setup stability and neutron electric charge measurements will be presented.
18:00		***END***
18:30		***CERN 70***
19:45		***Postersession with Apéro***

ID	NEUTRON SCIENCE POSTER
731	**Characterisation of high-energy neutron fields at the Swiss spallation neutron source (SINQ) using a Bonner sphere spectrometer** *Daniel Zeitz [1,2], Uwe Filges [1], Eike Hohmann [1], Marc Janoschek [1,2], Sabine Mayer [1]* *[1] PSI, [2] Uni Zürich* At the BOA beamline at SINQ, neutron imaging and scattering experiments are conducted using cold polarised neutrons, which are obtained via moderation of spallation neutrons in a cold D_2 moderator. Nevertheless, fast scattered neutrons can penetrate the beamline shielding, resulting in undesired noise for experiments. The presence of fast neutrons in the BOA cave is demonstrated using an experimental technique based on a Bonner sphere spectrometer in combination with a shadow cylinder. Identifying the high-energy neutron flux at key locations while blocking out the beam allows for an estimation of the fast neutron background in the BOA cave and provides key information for future upgrades of the SINQ facility.

Photon Science

This session has been organised in collaboration with the Swiss Society for Photon Science.

Friday, 13.09.2024, Room ETF E 1

Time	ID	**Photon Science** *Chair: Lukas Gallmann, ETH Zürich*
13:30	**801**	**Hard X-ray scattering in the millikelvin domain at the SwissFEL Cristallina-Quantum endstation** *Jakub Vonka, Alexander Steppke, Maël Clémence, Maria Szola, Gabriel Aeppli, Simon Gerber, Bill Pedrini, Paul Scherrer Institut* Quantum fluctuations dominate over thermal fluctuations at low temperatures, as manifested by the emergence of quantum many-body ground states and new phases of matter. One of the goals of the new Cristallina-Quantum endstation at SwissFEL is to image these states with hard X-ray pulses, outrunning the beam heating thanks to femtosecond pulse duration. In this talk I will review our commissioning progress on a new dilution refrigerator instrument that has recently entered early pilot user program. I will describe some of the results demonstrating resonant X-ray scattering from magnetic orders down to sub-100 mK temperatures, and elaborate on the path towards full scientific exploitation of this unique experimental environment.
13:45	**802**	**Imaging Ultrafast Electronic Domain Fluctuations in a Nonequilibrium X-Ray Speckle Visibility Experiment** *Nelson Nientsu Hua [1], Surya Teja Botu [2], Maël Clémence [1], Vincent Esposito [3], Eric E. Fullerton [4], Simon Gerber [1], Shih-Wen Huang [1], Spencer Jeppson [2], Patrick Kramer [3], Roopali Kukreja [2], Erik Lamb [4], Henrik Lemke [1], Meera Madhavi [2], Roman Mankowsky [1], Aidan Mcconnell [1], Pooja Rao [2], Mathias Sander [1], Takahiro Sato [3], Oleg G. Shpyrko [4], Sanghoon Song [3], Boyan Stoychev [4], Yanwen Sun [3], Serhane Zerdane [1], Nanna Zhou Hagström [2], Diling Zhu [3]* *[1] Paul Scherrer Institut, [2] University of California Davis,* *[3] SLAC National Accelerator Laboratory, [4] University of California San Diego* We employed a novel coherent X-ray technique that uses a split-and-delay line in a pump-double-probe experimental scheme to measure ultrafast domain fluctuations for the first time at an X-ray free electron laser. By accessing the speckle pattern of a resonant charge order peak in Fe_3O_4, we imaged electronic domain fluctuations with sub-picosecond temporal resolution. Here we also demonstrate how a standard time-resolved x-ray diffraction experiment in a pump-probe setup complements the coherent X-ray experiment by revealing how the average and local domain structures evolve in Fe_3O_4, offering a unique perspective on the ultrafast dynamics of the lattice structure and electronic heterogeneities.
14:00	**803**	**Two-Color Diffractive Imaging of Helium Nanodroplets** *Linos Hecht [1], Jakob Asmussen [2], Björn Bastian [2], Thomas Baumann [3], Ltaief Ben Ltaief [2], Alessandro Colombo [1], Alberto Defanis [3], Simon Dold [3], Robert Hartmann [4], Sivarama Krishnan [5], Asbjorn Laegdsmand [2], Suddhasattwa Mandal [5], Christian Medina [6], Michael Meyer [3], Robert Moshammer [3], Marcel Mudrich [2], Yevheniy Ovcharenko [3], Thomas Pfeiffer [7], Daniela Rupp [1], Björn Senfftleben [3], Keshav Sishodia [5], Frank Stienkemeier [6], Rico Tanyag [2], Sergey Usenko [3]* *[1] ETH Zürich, [2] Aarhus University, [3] European XFEL, [4] Fa. PN Sensor, [5] IIT Madras* *[6] Universität Freiburg, [7] MPI für Kernphysik* A recent feature of X-ray free electron lasers is the ability to produce two ultrashort pulses at different photon energies with a controlled time delay. We utilize these capabilities for X-ray pump X-ray probe coherent diffraction imaging to investigate ultrafast dynamics in nanoscale matter. This simultaneously yields information on the pristine sample and its evolved state with high spatial and temporal resolution.

		Still, the challenge is to separate the two superimposed images on the detector. We developed algorithms for separating images of individual helium nanodroplets taken at the EuXFEL by analyzing single photon events in combination with two-color Mie modeling.
14:15	**804**	**Coherent diffraction imaging with micrometer-sized liquid helium droplets** *Katharina Kolatzki [1], David Carey [1], Alessandro Colombo [1], José Gómez Torres [1], Linos Hecht [1], Joshua Laux [1], Jannis Lehmann [1], Carole Michellod [1], Mario Sauppe [1], Björn Senfftleben [2], Frederic Ussling [1], Daniela Rupp [1]* *[1] ETH Zürich, [2] SQS, European XFEL, Germany* Coherent diffraction imaging (CDI) allows to track a single nanoparticle's shape and ultrafast laser-induced dynamics. In our experiments, we illuminate liquid helium droplets of sizes ranging between hundreds of nanometers and a few micrometers with intense XUV pulses created by our lab-based high-harmonic generation (HHG) source. Simultaneous to recording the CDI pattern, our setup allows us to monitor the spectrum and profile of the transmitted XUV beam after the interaction. I will present results from our recent experiments and discuss possibilities for ultrafast absorption spectroscopy and simultaneous scattering on free-flying single particles towards spatiotemporally resolving ultrafast electron dynamics.
14:30	**805**	**Combined electron and ion spectroscopy of atomic and molecular clusters** *Frederic Ussling, Yves Marc Acremann, David Carey, Alessandro Colombo, Moritz Heinemann, Linos Hecht, Katharina Kolatzki, Jannis Lehmann, Changji Pan, Mario Sauppe, José Gómez Torres, Angela Vidoni, Michael Wenger, Daniela Rupp, ETH Zürich* Understanding the interaction of high-intensity extreme ultraviolet and soft X-ray pulses with matter is essential to fully utilize the novel experimental capabilities of short-wavelength free-electron lasers and high-harmonic generation (HHG) sources. However, the complex and intertwined dynamics of ionization, plasma formation, and relaxation in condensed matter are not yet fully understood. We investigate clusters in the gas phase as ideal model systems by combining the measurement of electrons and ions from individual clusters interacting with single intense HHG pulses. This provides unprecedented insight into all relevant light-induced processes on femtosecond to nanosecond time scales.
14:45	**806**	**High average power SESAM modelocked laser oscillator exceeding 500 W** *Moritz Seidel, Ursula Keller, Lukas Lang, Christopher R. Phillips* *Department of Physics, ETH Zürich, 8093 Zürich* We present an ultrafast SESAM modelocked thin-disk laser oscillator providing 550 W of average output power with 100-μJ, 852-fs-long pulses at a repetition rate of 5.5 MHz. This presents a record for average output power and pulse energy from a modelocked oscillator. Key developments are a new cavity design and high-power ion-implanted sapphire-bonded SESAMs. This oscillator can enable new frontiers in nonlinear optics. For example, using it to drive high-harmonic generation at megahertz repetition rates offers a route to enhanced sensitivity in attosecond pump-probe studies. The laser is also well suited for industrial micromachining of metals, glasses and semiconductors.
15:00	**807**	**Single-cavity dual-comb lasers and applications** *Benjamin Willenberg, Justinas Pupeikis, Lukas Lang, Sandro Camenzind, Carolin Bauer, Alexander Nussbaum-Lapping, Christopher R. Phillips, Ursula Keller* *Department of Physics, ETH Zürich* Dual-comb laser sources are of high interest for many scientific and industrial applications. During the presentation we will highlight the latest advances in high performance single-cavity dual-comb modelocking, critically examining the potential challenges of single-cavity designs and exploring their prospective impact. The high mutual coherence and average powers directly obtainable from carefully designed laser oscillators provide the capability for coherent averaging in Fourier transform spectroscopy, ultra-low noise supercontinuum generation and efficient wavelength conversion via nonlinear processes. This renders these simple and compact sources highly interesting for practical dual-comb applications. We will discuss some latest experimental demonstrations involving precision ranging, pump-probe spectroscopy, and gas sensing.

15:15	**808**	**Shot-Noise Limited Dual-Comb Supercontinuum Source** *Alexander M. Heidt [1], Sandro L. Camenzind [2], Benoît Sierro [1], Benjamin Willenberg [2], Alexander Nussbaum-Lapping [2], Anupamaa Rampur [1], Ursula Keller [2], Christopher R. Phillips [2]* *[1] Institute of Applied Physics, University of Bern, [2] Department of Physics, ETH Zurich* Dual frequency comb systems offer unique capabilities for spectroscopy, hyperspectral imaging, and ultrafast photonics, combining high temporal and spectral resolution with rapid electronic measurements. Despite their potential, challenges in simultaneously achieving broad spectral bandwidth, low noise, and high power have limited their applications. In this work we overcome these issues and introduce the first shot-noise limited, coherently averaged dual-comb interferometry from a supercontinuum source, featuring 450 nm bandwidth, gigahertz pulse repetition rate, and output power exceeding 1 W. Both combs are generated in a compact setup using a single free-running solid-state laser cavity and a single polarization-multiplexed photonic crystal fiber, making the system well-suited for field applications.
15:30	**809**	**High-sensitivity cross-comb spectroscopy enabled by a single-cavity dual-comb optical parametric oscillator** *Carolin Bauer, Zofia Bejm, Michelle Bollier, Ursula Keller, Christopher R. Phillips, Justinas Pupeikis, Benjamin Willenberg, Department of Physics, ETH Zürich, 8093 Zürich* We present a novel configuration of a light source and a detection scheme optimized for high-sensitivity dual-optical frequency comb gas absorption spectroscopy in the mid-infrared. Using our free-running wavelength-tunable single-cavity dual-comb optical parametric oscillator and our simple intra-cavity upconversion-based detection scheme, we demonstrate heterodyne measurements with a signal-to-noise ratio of 50 dB $Hz^{1/2}$ and a figure of merit of 3.5 x 10^8 $Hz^{1/2}$. These results are enabled by a low-noise laser source, high-power per comb line, the usage of low-noise InGaAs-detectors, and a time-gating effect in the up-conversion process limiting the instantaneous shot-noise. In a 10-ms long proof-of-concept measurement, we detect 2 ppm of ambient methane over a 3-m path length.
15:45	**810**	**SWIR optically pumped semiconductor lasers** *Marco Gaulke [1], Maximilian C. Schuchter [1,2], Nicolas Huwyler [1], Matthias Golling [1], Ursula Keller [1]* *[1] Department of Physics, ETH Zürich, 8093 Zürich* *[2] Optoelectronics Research Centre, Physics Unit, Faculty of Engineering and Natural Sciences, Tampere University, P.O. Box 692, FI-33104, Tampere* Vertical-emitting, optically pumped semiconductor lasers (OPSL) are known for their high-power performance and excellent beam quality, primarily developed using the GaAs material system which restricts emission to the near-infrared. Our research focuses on extending OPSL into the short-wave-infrared (SWIR) region by employing the GaSb material system through molecular beam epitaxy. We achieved significant advancements in continuous wave operation through enhanced backside-cooling, refined gain characterization, and the first GaSb-based membrane-external cavity surface emitting laser. Additionally, we investigated SESAM modelocked emitters, integrated gain and absorber on single chips, and demonstrated dual-comb operation through spatial multiplexing. These developments mark substantial progress in the field of OPSL, expanding their utility in broader spectral applications.
16:00		***END***

ID	Photon Science Poster
821	**Enhancement of single-shot THz detection using a small bias detection scheme** *Seyyed Jabbar Mousavi, Jan Sauter, Elnaz Zyaee, Vivek Unikandanunni, Thomas Feurer* *Institute of Applied Physics, University of Bern, Sidlerstrasse 5, 3012 Bern* This work presents a single-shot THz detection technique utilizing optically chirped probe pulses combined with a small bias detection scheme to enhance the detected THz signals. By measuring the THz signals at opposite optical biases ±θ, where θ is a small angle of the quarter waveplate (QWP) near zero, an 18-fold enhancement factor is achieved compared to the standard electro-optic sampling (EOS) scheme.

822	**Small footprint integrated optical parametric oscillator with a Fabry-Perot resonator** *Alessandra Sabatti, Jost Kellner, Rachel Grange, ETH Zürich* Optical parametric oscillators (OPOs) are key components for applications like squeezing and random number generation. Their dense integration on-chip would allow the realization of computational networks such as Ising machines. However, integrated OPOs to date feature millimeters long quasi-phase matching regions that are located inside racetrack resonators, resulting in large footprint devices. Here we present a thin film lithium niobate on insulator OPO for which the nonlinear region is placed in a linear Fabry-Perot cavity formed by two Bragg reflectors, which is more compact and greatly reduces the occupied area. The device features a 30 mW threshold power and a 30 nm bandwidth, limited by the mirrors reflection band.
823	**Integrated lithium niobate on insulator high purity spontaneous parametric downconversion source** *Tristan Kuttner, Rachel Grange, Robert J. Chapman, ETH Zürich* Integrated quantum photonics poses some essential requirements a material needs to fulfil to be able to provide a fully integrated platform, among those is the ability of creating and interfering single photons. Given its second order non-linearity lithium niobate on insulator (LNOI) stands out among the contenders in integrated quantum photonics since it enables spontaneous parametric down-conversion (SPDC) as a process of creating pairs of single photons and allows for fast electro-optical tunability of integrated interferometric networks. We engineer the dispersion relations inside integrated periodically poled LNOI waveguides, thereby tuning the SPDC phase-matching to create pure photons which can be used as a resource for bosonic quantum experiments.

Biophysics and Soft Matter

This session has been organised in collaboration with the Swiss Soft Days and Life Sciences Switzerland (LS²).

Tuesday, 10.09.2024, Room ETF C 1

Time	ID	Biophysics and Soft Matter I: New Concepts and Methods *Chair: Christof Fattinger*
14:00	901	**Introduction: The new focus of contributions to Biophysics and Soft Matter @ SPS** *Christof Fattinger*
14:05	902	**A physicist's approach to neuroscience** *Janos Vörös, ETH Zürich* The traditional way of addressing questions related to the function of the brain is by studying the nervous system of various organism. Due to the complexity of these systems, it is very difficult to address fundamental questions. This leads to a lack of consensus even on seemingly basic questions such as "what is information"and "how is information stored and processed" in the brain. A new, bottom-up approach will be presented that uses small networks of neurons with the advantage that the position and connections of the neurons can be precisely defined and the cells have a good accessibility for recording tools.
14:30	903	**Nanopore microscopy for single-cell protein profiling** *Morteza Aramesh, ETH Zürich* Nanopore sensors quantify protein levels but face challenges in live cell detection, such as portability, precise pore size control, and improved specificity. We aim to advance nanopore microscopy for single-cell profiling and explore its potential in cell biology. This presentation introduces interface nanopores as microscopic windows for real-time cellular process analysis, like protein secretion. By addressing these challenges and expanding nanopore microscopy capabilities, we seek transformative applications in single-cell biology and immunology studies.
14:45	904	**Orienting fluorophores for highly efficient plasmonic nanoantennas** *Karol Kołątaj, Aleksandra Adamczyk, Guillermo Acuna* *Department of Physics, University of Fribourg, Chemin du Musée 3, CH-1700 Fribourg* The DNA origami is an excellent breadboard to accommodate and manipulate nanoparticles and small molecules with a nanometer precision. Just recently, an orientation of covalently bound molecules has been realized through stretching the fluorophores incorporated into DNA origami structures. Here, we utilize this method to produce highly efficient plasmonic system. Investigated photonic nanoantennas were composed of two gold nanoparticles with a single fluorophore in a hot-spot, oriented either parallel or perpendicular to the dimer main axis. We observed that by orienting the dye along this axis we obtained a remarkable 250-fold fluorescence enhancement, fivefold higher than for the other orientation.
15:00	905	**Acoustic metamaterials for biomedical applications: measuring temperature with ultrasounds** *Lucrezia Maini, ETH Zürich* In my PhD project, we pioneer a novel passive sensor concept that leverages the tunable properties of acoustic metamaterials for medical implants, unlocking the potential of acoustic metamaterials in the biomedical domain. Specifically, we have developed an implantable high-resolution temperature sensor that reaches the mK level. Such resolution enables ultrasound detection of

		thermal gradients comparable to the ones expected in intracorporeal infections. This study was supported by extensive simulations to investigate the physical mechanism of the sensor, opening the way to new designs for next-generation passive implantable devices.
15:30	**906**	**The SLS upgrade and its impact on structural biology and drug discovery** *Phil Willmott, Swiss Light Source, Paul Scherrer Institute* The Swiss Light Source at PSI is undergoing an upgrade to a so-called diffraction-limited storage ring (DLSR), promising a reduction in beam emittance (the product of the electron-beam divergence and cross-section) from 5500 pm.rad to 157 pm.rad. The brilliance of 'SLS 2.0' will increase at some beamlines by well over 1000, thanks also to novel undulator and optics technologies. This heralds a sea change in macromolecular crystallography (MX), complemented by the burgeoning technique of cryogenic electron microscopy (cryoEM). Nonetheless, membrane proteins and G-protein coupled receptors (GPCRs) have remained relatively unexplored, despite their high impact in the pharmaceutical industry - approximately two thirds of all medications operate through GPCRs. The main obstacles are the difficulty in preparing them as crystals much larger than a micron; and their relatively small molecular weight, resulting in low contrast images in cryoEM. DLSR beams allow one to investigate micron-sized crystals. Furthermore, their high intensity and nanosecond time structure enables sub-microsecond dynamical studies, complementing information on the nanosecond to femtosecond timescale offered by x-ray free-electron lasers, such as the SwissFEL at PSI. Thus, modern MX, combined with cryoEM and revolutionary predictive AI systems, opens new vistas in macromolecular biology and biomolecular dynamics. This talk covers basics of DLSR technology and details the impact these machines will have on macromolecular biology and drug discovery in the pharmaceutical industry.
16:00		***Coffee Break***
		BIOPHYSICS AND SOFT MATTER II: MATERIALS PREPARATIONS AND INVESTIGATIONS *Chair: Christof Aegerter, Universität Zürich*
16:30	**911**	**Water in soft confinement of lipidic mesophase** *Yang Yao [1], Tao Zhou [2], Johannes Hunger [3], Sara Catalini [4], Bence Kutus [3], Raffaele Mezzenga [2]* *[1] Department of Chemistry, University of Basel* *[2] Department of Health Sciences and Technology, ETH Zurich* *[3] Max Planck Institute for Polymer Research, MPIP, Germany* *[4] European Laboratory for Non-Linear Spectroscopy, LENS, Italy* We study water state in lipidic mesophase. First, we investigated water in an unfrozen lamellar phase (La). Through the combination of differential scanning calorimetry and dielectric spectroscopy, we understood the crystallization and the dynamics of water in L[g. At a lower hydration, the nanoconfined water remains in liquid down to -120 °C. In addition, the phase structure of lipidic mesophase varies depending on the water content and the temperature of the system. We used Fourier transform infrared spectroscopy and dielectric radiation spectroscopy to explore state of water during the phase transition from bicontinuous cubic phases to a reverse hexagonal phase.
17:00	**912**	**The cryoWriter – a controlled, automated cryo-EM preparation tool** *Luca Rima [1], Patrick Frederix [1], Nadia Antoniadis [1], Thomas Braun [2], Nicolás Candia [1], Andreas Engel [1], Alejandro Lorca Mouliaá [1], Armin Ruf [1]* *[1] cryoWrite AG, [2] University of Basel* The cryoWriter is a robot for cryoEM sample preparation. It transfers samples with microcapillaries on grids and vitrifies them. The system can handle globular, membrane, or filamentous proteins, as well as small cells. The whole procedure takes less than 2 minutes per grid, of which the integrated glow discharge takes up most of this time. A high level of control results in repeatedly written grids, that have tens, sometimes even over hundred grid squares with well vitrified sample. Finally, the use of capillaries provides the basis for modularity. It for example allows for integration of an inline purification step, to isolate proteins from cell lysate.

17:15	**913**	**Elucidating the ubiquitin-proline interaction by NMR** *Cécilia Siri, Francesco Stellacci, EPFL* Recent study has reignited interest in the physiological implications of protein interaction with intracellular small molecules, particularly their weak non-specific interaction believed to influence many protein properties. Here, we take ubiquitin as a model to examine in depth by NMR its interaction with proline, an amino acid present prevalently in cellular environment. Our findings show that proline interacts weakly with ubiquitin but at specific hotspots consistent with a patchy model. The results are used to explain the enhancement of colloidal stability of ubiquitin by proline.
17:30	**914**	**Large-Scale Ordered Block Copolymer Gyroid Films by Solvent Evaporation Annealing** *René Iseli, Doha Abdelrahman, Viola Vogler-Neuling, Matthias Saba, Ilja Gunkel, Ullrich Steiner, Adolphe Merkle Institut, Universität Fribourg* The development and research on metamaterials opens the doors for futuristic technologies using their custom-designed properties to interact with and manipulate the flow of light. The effectiveness of such materials depends vastly on the size of the interactive material and research is driving into the direction of fabricating larger connected and homogeneous surfaces of metamaterials. Here we present a two-step block copolymer self- assembly method enabling large-sized homogeneous domains of nanostructures. Voiding the polymer templates and the replication with specific metals gives rise to intriguing optical polarization and magnetic properties.
17:45	**915**	**Understanding oleophobicity through plasma polymer substitutes for PFAS** *Astrid Southam [1], Manfred Heuberger [1], Michal Gora [1,2]* *[1] Empa, [2] ETH Zürich* Per- and polyfluoroalkyl substances (PFAS) are employed extensively for their amphiphobic properties, but are being banned for environmental and health reasons. No competitive alternatives exist; one key reason is that oleophobicity is not well understood. Here, the surface force apparatus (SFA) is used to explore physical and interfacial properties of a promising substitute: hexamethyldisiloxane plasma polymer films (PPF), the surface properties of which can be tuned by adjusting chemical conditions in the reactor. The SFA measures changes in free energy across a medium as a function of separation between two PPF-coated confining surfaces. Measurements are made across various liquids to show how PPF composition and topography affect surface forces.
18:00	**916**	**Structural Colors from Amyloid-Based Liquid Crystals** *Tonghui Jin, Yuan Ye, Massimo Bagnani, Chao Wu, Bin Liu, Raffaele Mezzenga, ETH Zürich* The helical periodicity and layered structure in cholesteric liquid crystals (CLCs) may be tuned to generate structural color according to the Bragg's law of diffraction. Here, the possibility of using amyloid CLCs is reported to prepare films with iridescent color reflection and opposite handedness. Right-handed CLCs assembled by left-handed amyloid fibrils are dried into layered structures with variable pitch controlled by the addition of glucose. Circularly polarized light with the same handedness of amyloid CLCs helix is reflected in the Bragg regime. Varying the drying speed leads to the switching between films with a rainbow-like color gradient and large area uniform color.
18:15	**917**	**Infrared spectroscopy at the nanoscale –AFM-IR of soft materials** *Michele Griffa, Nico Kummer, Peter Nirmalraj, Empa* AFM-IR, or photothermal infrared nanospectroscopy, combines atomic force microscopy (AFM) and infrared (IR) spectroscopy, enabling chemical analysis with a spatial resolution in the order of 10 nm. Tapping mode AFM-IR is well-suited for the analysis of soft matter systems such as nanoparticles, biological macromolecules and polymers. The method allows mapping of the samples at specific wavenumbers and recording IR spectra at points of interest. The measured local IR spectra can be compared to Fourier-transfom infrared (FTIR) spectra from bulk samples. Possessing one of only two AFM-IR instruments in Switzerland, Empa would like to welcome researchers working in the fields of materials science, biomedicine, and beyond for collaborative AFM-IR measurements.

18:30		*CERN 70*
19:45		*Postersession with Apéro*

Wednesday, 11.09.2024, Room ETF C 1

Time	ID	**Biophysics and Soft Matter III: From Molecules and Cells to Medicines** *Chair: Lucio Isa, ETH Zürich*
14:30	921	**Engineering tissues with architected scaffolds** *Marcy Zenobi-Wong, ETH Zürich* Musculoskeletal tissues develop under the influence of dynamic mechanical loading regimes, which is reflected in the highly anisotropic organization of the tissues. In order to engineer tissue such as cartilage, tendon and muscle for use in regenerative medicine, my laboratory uses architected hydrogel scaffolds to provide relevant cell-instructive cues. Our approaches are based either on secondary annealing of microgel materials to produce macroporous scaffolds or the use of speckled laser light projected into photosensitive resin to initiate crosslinking of microfilaments. In both cases, the void space of hydrogel scaffolds provides a unique environment to the resident cells to direct engineering of living tissues.
	~~922~~	*cancelled*
15:00	923	**Ligand identification with DNA-encoded chemical libraries** *Christoph Dumelin, Novartis* The identification of ligands to biologically relevant targets is a central aspect of pharmaceutical research. Traditional methods such as high-throughput screening probe individual compounds in single reaction vessels for biological function and are typically limited to max. 10^6 compounds. In contrast, DNA-encoded chemical libraries are pooled collections of $>10^9$ compounds and allow for identification of ligands through biophysical interactions with the target of interest. This parallel screening of millions to billions of compounds greatly facilitates the identification of tools and starting points for drug discovery projects.
15:15	924	**Focal Molography: From Fundamentals to DNA-Encoded Library Screenings and Membrane Protein Target Characterization** *Andreas Frutiger, lino Biotech AG* Focal Molography (FM) is an emerging label-free method for real-time molecular interaction analysis in complex environments. This contribution will cover the basic physics of FM and explain its advantages over established techniques due to its operating principles. We will then explore the application of FM for rapid and multiplexed kinetic characterization of small molecule hits from DNA-encoded library screenings. Additionally, the talk will address the use of FM in characterizing membrane protein targets, including GPCRs, showcasing its ability to provide real-time interaction data without labels in living cells. This presentation aims to provide a comprehensive overview of the potential of FM in revolutionizing drug discovery processes.

15:45	**925**	**Improving oral vaccine efficacy through the study of antibody–bacterial glycan interactions and gut dynamics** *Milad Radiom [1], Yagmur Turgay [1], Suwannee Ganguillet [1], Tom Kloter [1], Anna Huhn [2], Omer Dushek [2], Raffaele Mezzenga [1], Emma Slack [1]* *[1] ETH-Zürich, [2] University of Oxford* Interactions between mucosal secretory IgA (sIgA) and bacterial surface glycan (O-antigen) protect against Salmonella Typhimurium (S. Tm) infection. sIgA binding induces “enchained growth,” reducing the number of single bacteria and enhancing enchained pathogen clearance in fecal stream. Half-life of long bacterial chains depends on detailed force-dependent kinetics of sIgA–O-antigen interactions, mechanical gut stress, and bacterial division rate. Using AFM and SPR, we quantified sIgA–O-antigen interactions parameters which were then integrated into a model that simulated bacterial chain stability against gut stress. By relating sIgA variants’ binding characteristics to bacterial chain stability, we aim to optimize oral vaccine effectiveness against bacterial surface glycans.
16:00	**926**	**Advanced Instrumentation Enables Structure-based Drug Discovery on Challenging Membrane Protein Targets** *Michael Hennig, on behalf of the leadXpro team,* *leadXpro AG, Park Innovaare, Parkstr. 1, CH-5234 Villigen* Integral membrane proteins are drug targets for the majority of all approved drugs. Structure-based drug discovery on soluble proteins is managed well within the project timelines and portfolio changes in pharmaceutical industry, but transmembrane proteins are still underexplored because of their challenges to be expressed, purified and get high resolution structures or enable biophysical methods to investigate target engagement and ligand binding kinetics. The presentation includes recent advances in the technologies and their application to relevant drug targets with an emphasis on technologies such as the cryo-EM and X-ray structure determination. The talk will show examples how structural dynamics can experimentally be investigated to improve the understanding of ligand recognition and drug action. The Cryo-EM structures of human TRPV4 ion-channel with bound small molecule agonist activating the channel opening with a significant structural change enabling direct observation of agonist pharmacology by high resolution cryo-EM analysis. Application of serial X-ray crystallography using synchrotron (SLS) and femtosecond pulsed Free Electron Lasers (SwissFEL) for determination of room temperature structures and observation of structural dynamic of ligand binding and associated conformational changes will be the second part of the talk. Using the model system A2A receptor and a photosensitive ligand, the ligand unbinding and the associated structural change (induced fit of the ligand and ligand binding pocket) can directly be observed and analysed. Together with advanced drug design software this opens the opportunity for enhanced impact of structure knowledge to the design of candidate drug compounds resulting in better treatments for patients.
16:30		***Coffee Break***

Thursday, 12.09.2024, Room ETF C 1

Time	ID	BIOPHYSICS AND SOFT MATTER IV: PHYSICS OF BIOLOGICAL SYSTEMS I *Chair: Sahand Jamal Rahi, EPFL*
14:00	931	**Biophysical models for molecular motors in vivo** *Jörg Stelling, ETH Zürich* The cytoskeleton and molecular motors play a critical role in the spatial and functional organization of living cells. However, the corresponding molecular interactions are often not directly observable in vivo. Here, we use two examples to discuss how biophysical models can help inferring biological mechanisms from experimental observations. The first example in budding yeast demonstrates how special cellular structures can remotely control the dynamics of cytoskeletal components, motors, and their cargos, to individualize cytoskeletal structures and thereby support asymmetric cell division. The second example describes an experimentally supported, multiscale kinetics model that elucidates mechanisms of influenza A virus infection in cells, where molecular motors can physically break the viral capsid in a tug-of-war mechanism. By elucidating a crucial coordination of physical and chemical processes, the identified mechanisms and models could help formulate novel strategies for fundamental biological research and for antiviral treatment, respectively.
14:30	932	**Cell-cycle coupled evolution of dynamic, multi-state and computational protein functionalities** *Vojislav Gligorovski, EPFL* Existing approaches in directed evolution are suited for evolving steady-state properties such as enzymatic activity or protein binding. A fundamental problem remains how to evolve dynamic proteins. As a solution, we present coupling such proteins to a dynamic system essential for cell survival. We first evolved mutants of a LOV transcription factor that were stronger, less leaky, or red-responsive. Evolving the PhyB-Pif3 dimerization system, we discovered mutations that make the exogenous chromophore unnecessary. Finally, to demonstrate the generality of the method, we evolved an AND gate with a chemical input. Our method represents new paradigm for evolution of dynamic proteins.
14:45	933	**Patterning, waves and synchronization in arrays of active filaments** *Guillermina Ramirez-San-Juan, EPFL* Living organisms rely on flows to perform essential functions that range from swimming and feeding in unicellular organisms to mucus clearance in humans. These flows are generated by the integrated activity of thousands of micrometer scale active filaments, known as cilia. Collections of cilia exhibit highly stereotypical temporal patterns, namely metachronal waves. While temporal patterns of cilia coordination have been observed in cells for decades, the mechanisms underlying their formation and their contribution to flow generation remain unclear. In my talk I will discuss measurements of the geometric and dynamic properties of metachronal waves in ciliated swimmers. Performing precise measurements and perturbations of temporal patterning in cilia arrays will enable the identification of the mechanisms underlying metachronal wave and macroscopic flow generation. An integrated view that seeks to link cilia dynamics with flow structure will significantly increase our understanding of the physiology of cilia arrays. Beyond their physiological significance, arrays of cilia provide an accessible experimental platform to explore the physics of multi scale pattern formation.
15:15	934	**A nuclear jamming transition in embryonic tissues** *Sangwoo Kim [1], Rana Amini [2], Arthur Boutillon [2], Otger Campàs [2], Ilker Ali Deniz [2], Petr Pospisil [2], Shuo-Ting Yen [2]* *[1] EPFL, [2] TU Dresden* Tissue physical states and rigidity transitions are known to be controlled by various cellular properties but the impact of sub-cellular organelles on tissue states remains unexplored. By combining theoretical modeling with in-vivo experiments, we uncover a novel nuclear jamming transition. Introducing nuclei as soft particles in the model, we investigate how nuclei affect tissue states. Tissue dynamics gradually decelerate and tissue structure becomes more ordered as nuclear volume

		fraction increases. Structural and mechanical measurements within retinal tissues of zebrafish embryos reveals a nuclear jamming transition during embryonic development. Our findings highlight a novel rigidity transition governed by nuclei, potentially serving as a crucial mechanism in embryonic tissues.
15:45	**935**	**Agent-based model for active nematics of cellular tissues** *Mathieu Dedenon [1], Carles Blanch-Mercader [2], Karsten Kruse [1], Jens Elgeti [3]* *[1] University of Geneva, [2] Curie Institute, France, [3] Forschungszentrum Jülich, Germany* Biological cellular tissues often exhibit domains of orientational order, separated by topological defects where order vanishes. Those regions concentrate active stresses generated by cell force dipoles and give rise to spontaneous flows. We use an agent-based model to describe cells as multi-particle filaments and incorporate mechanical activity in terms of individual cell force dipoles. This framework is designed to capture hydrodynamic modes at large scales. In agreement with the continuum theory, we recapitulate the active flow transition beyond a critical activity threshold in two dimensions, and confirm the influence of activity on the onset of nematic order. In the future, we plan to explore those features in more complex geometries.
16:00	**936**	**Mitochondrial Pearling Distributes mtDNA Nucleoids** *Juan Cruz Landoni [1], Roméo Jaccard [1], Matthew Domenic Lycas [1], Suliana Manley [1], Wallace Marshall [2], Willi Leopold Stepp [1], Gabriel Sturm [2]* *[1] Institute of Physics, EPFL* *[2] Department of Biochemistry and Biophysics, University of California, San Francisco, CA, USA* The dynamic mitochondrial network functions as the cellular energetic and signaling hub. Its essential multi-copy genome is packaged in nucleoids, regularly distributed along the mitochondrion, and surrounded by an intricate inner membrane that restricts movement. Each nucleoid's integrity affects local mitochondrial fitness, and dysfunctional regions are peripherally ejected for degradation. However, the mechanisms maintaining nucleoid regular spacing and sensing and isolating damaged contents in such constrained system remain largely unknown. Enabled by fast super-resolution and adaptive microscopy, we characterize mitochondrial "pearling" as a frequent, spontaneous and reversible biophysical instability. We propose its emergent roles in nucleoid distribution and mediating the rapid local biochemistry changes required for mitochondrial quality control.
16:15	**937**	**Characterizing protein interactions and dynamics in transcription factor condensates in early embryonic Zebrafish** *Eleonora Perego, Nadine Vastenhouw, UNIL* Transcription factors (TFs) organize within the nucleus in clusters. These clusters play a crucial role in regulating transcription activity. In zebrafish, two large Nanog clusters form soon after fertilization. Nanog proteins possess a DNA-binding-domain, for proper condensate assembly, alongside with two disordered domains, facilitating protein-protein interactions. However, the contributions of these domains remain elusive. Here, we propose a quantitative study to investigate Nanog dynamics using microscopy techniques. Through FCS, we will elucidate Nanog mobility, while, FRET will enable to measure Nanog-chromatin interactions, providing insights into gene expression regulation. We aim to create a model describing the contributions of distinct Nanog domains to condensate dynamics, advancing our understanding of transcription activity.
16:30		***Coffee Break***

Time	ID	**Biophysics and Soft Matter V: Physics of Biological Systems II** *Chair: Sahand Jamal Rahi, EPFL*
17:00	**941**	**Event-driven acquisition for content-enriched microscopy** *Willi Leopold Stepp, Suliana Manley, Martin Weigert, EPFL* Fluorescence microscopy stands as an indispensable tool in biology, offering unparalleled specificity and resolution. However, every advanced experiment is limited by phototoxicity and photobleaching. To address this limitation, we integrate phase-contrast imaging for event detection in an adaptive acquisition that uses fluorescence only during events of interest. This requires detecting specific events of interest in phase-contrast images, a task complicated by its low specificity and complex context. To overcome this challenge, we devised a novel dynamic-aware approach to event detection. Serving as a blueprint for future implementations, this approach paves the way for highly optimized multi-modal microscopy, emphasizing correlative and targeted acquisitions.
17:15	**942**	**Probing the role of hydrodynamic interactions in metachronal wave formation in dense ciliary arrays** *Katerina M. Kourkoulou, Iolène Bouzdine, Guillermina R. Ramirez-San Juan, EPFL* Self-organization in biological systems is crucial for coordinating vital functions. One such example is the collective motion of slender cellular appendages called cilia. In dense arrays, neighboring cilia beat with a phase shift, forming metachronal waves essential for large-scale flow generation. Despite their prevalence, the mechanisms governing cilia patterns and their connection to flow parameters remain unclear. Using high spatio-temporal imaging and quantitative image analysis, we characterize metachronal patterns in the living unicellular organism *Didinium nasutum*. By manipulating external flow properties like viscosity, we aim to quantify the extent of cilia responses to hydrodynamic forces, shedding light on the interplay between cilia coordination and fluid dynamics.
17:30	**943**	**Symmetry breaking and number control at the onset of centriole duplication** *Friso Douma, Pierre Gönczy, EPFL* Having the correct number of centrioles is crucial for the cell and this is ensured by duplicating centrioles strictly once every cell cycle. While three important proteins have been identified, the mechanism by which these provide incredibly robust control of organelle copy number remains unknown. I will discuss Turing-based theoretical approaches to understand how self-organization and patterning control centriole assembly. To constrain models with experimental data, I will show how interdependencies of the three key proteins are revealed using super-resolution microscopy. Together, these approaches provide key insights in centriole duplication and demonstrate how self-assembly can be precisely controlled in biology.
17:45	**944**	**In situ stoichiometry and organization of human respiratory chain super-complexes** *Matthew Domenic Lycas, Juan Landoni, Suliana Manley, EPFL* Respiratory chain super-complexes (SC) are naturally occurring assemblies of oxidative phosphorylation protein complexes. Their role in facilitating mitochondrial ATP production remains debated. While altered metabolic conditions affect SC occurrence and isolated SC have been structurally characterized, their spatial organization and stoichiometry within mitochondria remain unclear. In this study, we employed expansion microscopy (ExM) combined with stimulated emission depletion microscopy (STED) to resolve the individual protein complexes that together form SCs in human cells. Our results provide novel insights into the organization and stoichiometry of SCs in situ, allowing us to propose hypotheses regarding their functional impact on mitochondrial physiology.

18:00	**945**	**Resection of DNA in response to permanent DSBs in S.cerevisiae** *Marco Labagnara, EPFL* When double-strand breaks happens to the DNA, the cell arrests at the DNA damage checkpoint, preventing its entry into mitosis until the breaks are eventually repaired and the cell can proceed to mitosis. If the breaks persist, cells may bypass the checkpoint, this is called override. It is known that the override time depends on the number of breaks, but how the cell measure this number isn't still unknown. The most accepted model claims that cells measure the amount of resected DNA, but it was observed that mutants with less single-strand DNA take longer to override which contradicts the current model. We aim to demonstrate or deny the current model.
18:15	**946**	**Amino Acids Effect on Protein-Protein Interactions** *Pamina Martina Winkler, Cécilia Siri, Francesco Stellacci, EPFL* Despite being used for decades as stabilizers, amino acids (AAs) remain mysterious components of many medical and biological formulations. In this talk, I show that AAs have a general ability to stabilize weakly interacting proteins in solution. By precicely measuring the second osmotic virial coefficient we demonstrate that AAs are able to modulate protein interactions at mM concentrations. For cross-interactions we show a detectable change in interaction strength at protein: AA stoichiometric ratios as low as 1:1. We observe one order of magnitude change in binding affinity between proteins in presence of 10 mM AAs. Interestingly, this modulation of protein interactions by AAs does not alter the protein's secondary structure.
18:30	**947**	**Spatial organisation of the cell's metabolic engine** *Kathrin Laxhuber, Frank Jülicher, Max Planck Institute for the Physics of Complex Systems* Cell metabolism is the engine that fuels all living processes. Recent experimental results highlight that it dynamically self-organises in space, including via phase separation. We use minimal theoretical models to study the energetics and spatial organisation of cell metabolism, with a focus on glycolysis. Specifically, we discuss efficiency and power of this metabolic engine and motivate why it may organise dynamically in space. We further investigate this by building a framework to study metabolic biochemical networks in spatially inhomogeneous systems. This should allow us to model the spatial profiles that arise in different conditions and understand how they affect properties such as efficiency and power.
18:45	**948**	**Elucidating Distinct Effects of Branching Processes on Mitochondrial Networks** *Sheda Ben Nejma, Juan Landoni, Suliana Manley, EPFL* Mitochondria orchestrate vital cellular processes such as metabolism, signaling, and apoptosis, all of which depend on the dynamics and connectivity of the mitochondrial network. Disruptions by fragmentation or hyper-fusion of the networks are observed in dysfunctional cells and in various neurodegenerative disorders. Branching patterns within mitochondrial networks can emerge from membrane pulling or fusion. Because of their characteristic properties, each of these two processes influences the structure and function of mitochondrial networks in its specific way. Through live-cell imaging, we investigate these disparities to offer insights into the mechanisms governing mitochondrial dynamics and their implications in cellular health and disease.
19:00		***END; Transfer to Dinner***
19:30		***Conference Dinner***

Thursday, 12.09.2024, Room ETZ E 6

Time	ID	BIOPHYSICS AND SOFT MATTER VI: PHYSICS OF BIOLOGICAL SYSTEMS III *Chair: Christof Fattinger*
17:00	951	**Maximum likelihood estimation of moments in molecular density optical nanoscopy** *Santiago Nicolas Rodriguez Alvarez, Kyle Michael Douglass, Suliana Manley, Giorgio Tortarolo, EPFL* Single molecule localization techniques offer a direct measurement of the position of individual molecules, which can be computationally combined to reconstruct objects of interest. On the other hand, the Single-Pixel Imaging (SPI) concept allows to capture an image using just a single pho- todetector. Remarkably, in both techniques, a geometric description of the sample is typically obtained through post-processing. Here, I present molecular density optical nanoscopy (MOON), a method to infer moments of a fluorophore distribution from fluorescence microscopy images acquired under sequential structured illumination. In this talk, I will present a framework to estimate the moments of the sample up to second order and discuss MOON precision and photon efficiency.
17:15	952	**Connecting cilia organization to collective cilia dynamics in Paramecium** *Daphne Laan, Guillermina Ramirez-San-Juan, EPFL* Cilia are hair-like organelles on the surface of many cells beating collectively in a metachronal wave pattern creating essential fluid flows. The mechanisms behind cilia coordination remain poorly understood. We use *Paramecium*, a unicellular organism containing a few thousand cilia to study how metachronal waves emerge. By quantifying the cilia density, characterizing networks connecting the cilia, and measuring the metachronal wave properties, we are able to connect the structure of the cilia array to the emerging dynamics. This allows us to investigate the importance of mechanical coupling by networks underneath the cell surface in the formation of metachronal waves.
17:30	953	**Deciphering mechanisms of symmetry breaking in C. elegans embryos** *Ella Müller [1], Ludovic Dumoulin [2], Karsten Kruse [2], Pierre Gönczy [1]* *[1] EPFL, [2] University of Geneva* Symmetry breaking in living systems is a fundamental process for building complexity across different scales. In *Caenorhabditis elegans*, symmetry breaking in the one-cell stage embryo results in anterior-posterior polarization defined by the PAR proteins. The actomyosin cortex is a key component in this process, where a local relaxation in actomyosin contractility triggers cortical flows that induce PAR polarization. Using a combination of experiments and theory, we decipher to what extent this symmetry breaking in the actomyosin network is necessary and sufficient to polarize the embryo, and how the ellipsoidal cell geometry relates to other symmetry breaking cues in the embryo.
17:45	954	**Crowding induced phase separation in the yeast proteome** *Guido Narduzzi, ETH Zürich* Protein based supramolecular assemblies have been shown to play an important functional role in many biological processes. Some proteins that undergo phase separation have been extensively characterized, helping us understand the general principles of this process. However, we have limited information on which portion of the proteome can undergo phase transitions, especially under physiological conditions. To answer these questions and to understand how cells respond to altered crowding conditions, we developed a platform to investigate which proteins are more prone to organize into supramolecular assemblies by combining concentrated yeast lysate with a synthetic crowding agent.

18:00	**955**	**Chronobiology of DNA Damage Checkpoint Override** *Lorenzo Scutteri, EPFL* When faced with chromosomal double-strand DNA breaks, cells activate a complex DNA Damage Checkpoint response that arrests the cell cycle and reprograms gene expression. Although the regulators of the core network have been intensively explored, the mechanism of checkpoint override remains poorly understood. To address this gap, we developed novel strategies to shed light on how the DNA Damage Checkpoint signaling events are coordinated with high temporal resolution. Through perturbation of engineered checkpoint proteins at the single-cell level, we aim to establish a quantitative model of DNA Damage Checkpoint override in Saccharomyces cerevisiae. This research project holds incredible potential for the development of novel therapeutic strategies and cancer treatments.
18:15	**956**	**Stabilizing effect of small molecules on colloidal and protein dispersions** *Ting Mao, Quy Ong, Francesco Stellacci, École polytechnique fédérale de Lausanne* Small-molecules like amino acids have been known to be stabilizers for proteins for decades yet their working mechanism remains disputed. We demonstrate a direct interaction description, potential of mean force (PMF), of such phenomenon in both non-biological colloids and protein dispersions. Our results suggest this effect to be of fundamental colloidal nature as opposed to a protein specific one. Investigations on PMFs on concentration series show that the such molecules changes interactions of higher cocentrations comparable to a that of a diluted dispersion and the effect does not extend to the low concentration regime. Aggregation states obtained from the colloid dispersion also confirms the change corresponds to the interaction change.
18:30	**957**	**Impact of spatial structure on bacterial resistance evolution** *Cecilia Fruet [1,2], Anne-Florence Bitbol [1,2], Claude Loverdo [3]* *[1] Institute of Bioengineering, School of Life Sciences, EPFL* *[2] SIB Swiss Institute of Bioinformatics, Lausanne* *[3] Laboratoire Jean Perrin, Sorbonne Université/CNRS, Paris, France* A population composed only of drug-sensitive bacteria cannot survive the addition of a biostatic drug at a sufficiently high concentration and for sufficiently long. However, if at least one resistant bacterium is present before drug addition, it can lead to population rescue through resistance. How does spatial structure impact the survival of a bacterial population upon biostatic drug addition? We considered a minimal individual-based model, starting with only sensitive bacteria, and focused on *de novo* appearance of resistance, with resistant mutants arising from mutations upon division. Overall, we found that spatial structure can favor the survival of a bacterial population by de novo resistance upon application of a biostatic drug.
18:45	**958**	**Structure and function of intermitochondrial junctions in primary human T cells** *Christian Zimmerli [1], Caroline Arber [2], Jean Daraspe [2], Christel Genoud [2], Suliana Manley [1], Jan Rath [2]* *[1] EPFL, [2] UNIL* Homotypic mitochondrial contact sites are rare and some exhibit a regular lattice-like bridging pattern between neighboring mitochondria, called intermitochondrial junctions (IMJs). In human T cells IMJs occur in a subpopulation of cells but their function, protein identity and structure remain unknown. T cell activation and memory cell formation is controlled by mitochondrial activity and dynamics. Here we use cryo-ET, sub tomogram averaging and super-resolution microscopy to characterize the structure and function of IMJs in primary human T cells. We currently develop super-resolution live-cell microscopy approaches to functionally characterize the effect of IMJs on mitochondrial dynamics its control of T cell activation and memory formation.
19:00		***END; Transfer to Dinner***
19:30		***Conference Dinner***

ID	Biophysics and Soft Matter Poster
971	**Photosynthetic vs Photovoltaic Efficiency of Limnospira indica, Perspective Cyanobacteria Strain for Space Mission Live Support Systems.** *Nikolay Ryzhkov, Essraa Ahmed, Artur Braun, Nora Colson, Ken Haenen, Paul Janssen, Paulius Pobedinskas, Empa* Cyanobacteria play a vital role in carbon and nitrogen cycles via photosynthesis, making them significant subjects for investigating factors affecting light utilization efficiency. Photosynthetic microorganisms hold promise for sustainable energy conversion in photovoltaics. Previous studies have shown that applying an external electric field to microbial biofilms or cells enhances electron transfer andpower generation efficiency. This study examines how cyanobacterial absorbance responds to electrical polarization.Light utilization efficiency of cyanobacteria was also evaluated utilizing Pulse Amplitude Modulation (PAM) fluorometry under influence of external polarization.This entailed monitoring cyanobacterial absorbance and measuring photocurrents under varying wavelengths of illumination utilizing the bioelectrode as either an anode or a cathode.
972	**Focal Molography - a new biophysical method** *Philipp Cedro, Roche pRED, in collaboration with ETH Zürich, Department BSSE* Focal Molography is a new label-free method for real-time molecular interaction analysis in buffers, as well as in complex media, such as cell lysate. Here, we show an applied project from drug discovery research of an interaction between a protein and a peptide. The kinetic rate constant (KD) of the interaction was determined in buffer and in cell lysate (1 Mio cells / mL). We have shown that Focal Molography is able to reproducibly measure the KD without any interference of non-specific binding. This new tool will lift drug discovery to new levels of interaction studies.
973	**Investigating the homochirality of Jousselini beetles through polarization-resolved Hyperspectral Imaging** *Peyman Soltani, Milan ten Hacken, Michiel J. A. de Dood* *Huygens-Kamerlingh Onnes Laboratory, Leiden University, Niels Bohrweg 2, NL-2333 CA Leiden* Natural chiral structures, such as those found in scarab beetle, characterized by objects that cannot be superimposed onto their mirror images, is a fundamental yet mysterious property observed from the molecular to the cosmic scale. Natural chiral structures, is significant progress in chiral photonics and the creation of synthetic photonic systems. The cuticle of jewel scarabs features twisted nanofibrils that reflect left-handed circularly polarized light through circular Bragg reflection. In our research, we developed a Hyperspectral-Stokes imager to obtain detailed polarization and spectral images of the Protaetia speciosa jousselini beetle's cuticle. This advanced imaging tool allows for an in-depth analysis of the beetle's chiral nanostructures, offering new perspectives on their optical properties. These discoveries not only enhance our knowledge of natural photonic materials but also have potential applications in the development of future chiral photonics technologies.

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