Plenary Session

Tuesday, 05.09.2023, Room Aula 033

Time	ID	**Plenary Session I** *Chair: Teresa Montaruli, Université de Genève*
09:00	**11**	**Looking forward to new physics with the LHC** *Anna Sfyrla, Université de Genève* The Large Hadron Collider (LHC) experiments are currently gathering massive amounts of data to study the Standard Model and search for new physics that could unlock the secrets of matter and interactions. In a few years, the upcoming high-luminosity LHC phase will deploy upgraded detectors of unparalleled precision, allowing us to collect data that is at least 10 times larger than our current dataset. At the same time, innovative experiments investigating uncharted areas of the parameter space in the forward direction of LHC collisions offer tantalizing potential for discovering new physics. This talk will provide an overview of recent progress and results in the search for new physics at the LHC, and will discuss thrilling prospects that lie ahead.
		Chair: Andreas Fuhrer, IBM Rüschlikon
09:45	**12**	**Sensirion: From start-up to a global player** *Felix Mayer, Sensirion* 25 years ago, Sensirion was founded by Moritz Lechner and me as a spin-off company of ETH Zurich. What started with two physicists and two measurement parameters is today a company that employs more than 1'200 people worldwide (700 of them in Switzerland). Around 100 of the employees originally studied physics. Today we offer around 15 sensor families which have many different variants covering a multitude of physical and chemical sensing applications. Every year Sensirion produces and sells more than 200 million sensors. Each sensor is individually calibrated. This means, that we “do a lot of physics”, before we can sell our products. In my presentation, I will introduce individual measuring parameters and measuring principles and use some examples to show where physicists contribute to our success.
10:30		***Coffee Break***
11:00		***Award Ceremony***
		Chair: Henri Mariette, Société Française de Physique
12:15	**13**	**From Z to Higgs, and beyond!** *Bruno Mansoulié, Université Paris-Saclay* Hadron collisions at large accelerators have proven amazingly efficient in exploring the elementary particles and their interactions. The first important milestone was the discovery at CERN in 1984 of the W and Z bosons, mediators of the electroweak interaction. Then in 1995 the TeVatron, at Chicago, found the last known constituent of matter: the top quark. Finally at CERN, after a long design and construction period, the largest ever particle accelerator, the LHC, was commissioned in 2010. After a short operation period, the large collaborations ATLAS and CMS were able to announce the discovery of the Higgs boson, in 2012. With the ever-increasing performances of the LHC, this new particle is now observed in many production and decay modes. The wealth of data gathered and combined by powerful statistical methods allows to verify the theory of the Standard Model with an excellent accuracy. It also offers many possibilities to hunt for deviations, which would indicate a sign of new physics.
12:45		***Lunch***
14:00	***Topical Sessions***	
19:00		***Postersession with Apéro***
20:30		***END***

Wednesday, 06.09.2023, Room Aula 033

Time	ID	PLENARY SESSION II *Chair: Roland Resel, TU Graz*
09:00	**14**	**High-resolution and operando analysis for understanding surface and interface processes** *Markus Valtiner [1], M. Olgiati [2], P. Bilotto [2], Laura L. E. Mears [1], A. T. Celebi [1]* *[1] Vienna University of Technology, Institute of Applied Physics, Wiedner Hauptstraße 8-10/E134, AT-1040 Vienna* *[2] CEST Competence Center of Electrochemical Surface Technology GmbH, Viktor-Kaplan Str. 2, AT-2700 Wiener Neustadt, and Stahlstr. 2-4, AT-4020 Linz* Function and properties of electrified interfaces are controlled by a complex and concerted competition of specific and unspecific interaction of reactive surfaces with ions and water in an electrolyte. For instance, the local interface structure determines transition state barriers for electrocatalytic reactions and controls electron transfer from a surface toward a solution species, or vice versa. Further, properties such a lubrication and friction are controlled by molecular interfacial structures. Atomic force microscopy techniques provide an unprecedented resolution of complex surface structures, in both gaseous and recently also liquid environments. In this contribution I will discuss our understanding of ion exchange processes, and competitive molecular interaction at the interface of Muscovite mica, and will show first results on electrochemical interfaces. Starting from highly resolved data interfacial ion/water adsorption, it is possible to understand an predict competitive adsorption, and to derive quantitative thermodynamic information of molecular interactions at a complex solid/liquid interface. I will show different examples, how molecular resolution studies can provide an understanding of the emerging properties such as friction, reactivity or adhesion at electrified interfaces.
		Chair: Philippe Jetzer, Universität Zürich
09:45	**15**	**A journey to the Sun: why, how and what is being discovered** *Louise Harra, Physikalisch-Meteorologisches Observatorium Davos / World Radiation Center (PMOD/WRC), Dorfstrasse 33, CH-7260 Davos Dorf & ETH Zürich* The ESA Solar Orbiter space mission's goal is to observe close into the Sun and then slowly climb out of the ecliptic to view the solar poles for the first time. The first science perihelia took place in March 2022. Solar Orbiter aims to make significant breakthroughs in our understanding both of how the inner heliosphere works, and of the effects of solar activity on it. The spacecraft is taking in situ measurements will be used alongside remote sensing close to the Sun to uncover the source regions of the solar wind. I will summarise the latest results of the mission and look to future opportunities.
10:30		***Coffee Break***
		Chair: Maurizio Musso, Universität Salzburg
11:00	**16**	**Amorphous photonic networks in insects** *Bodo Wilts [1,2], Viola Bauernfeind [1], K. Djeghdi [1], Alessandro Parisotto [1], Ulrich Steiner [1]* *[1] Adolphe Merkle Institute, University of Fribourg, Switzerland* *[2] Department of Chemistry and Physics of Materials, University of Salzburg, Austria* Photonic nanostructures can vary in their degree of local order and their final optical appearance is the result of light interacting with these nanostructures that can further vary in their chemical composition. Insect are particularly interesting due to their large diversity of colored displays and their associated nanostructures. Here, we will show recent results on the research of weevils and longhorn beetles that all display vivid colors and rely on varying degrees of (dis)order combined with pigments. Using light microscopy, FIB-SEM tomographyand FDTD simulations, we investigated the mechanisms underlying the angle-independent color patterns and highlight the important contributions of disorder to the final appearance of the animals. This work illustrates the complex interplay of structural and pigmentary color and show pathways to use this in synthesizing novel optical materials.

Time	ID	*Chair: Christian Teichert, Montanuniversität Leoben*
11:45	**17**	**From self-starting frequency combs to optical solitons in semiconductor lasers** *Nikola Opačak, TU Wien, Institute of Solid State Electronics, AT-1040 Wien,* *Harvard University, School of Engineering and Applied Sciences, Cambridge, MA 02138, USA* Optical frequency combs (OFCs) stand as the cornerstone of modern optics, with applications ranging from fundamental science to sensing and spectroscopy. Semiconductor lasers are especially appealing as OFC generators due to their compactness, electrical driving, and broadband gain. Beyond this, the fast carrier dynamics of these lasers yields a large resonant Kerr nonlinearity, which can be several orders of magnitude greater when compared to the bulk material. The giant optical nonlinearity is exploited to form self-starting frequency combs without the need of any external optical elements. When the laser active material is embedded in a monolithically-integrated ring cavity, it forms a new type of optical dissipative soliton, called the Nozaki-Bekki (NB) soliton. It forms spontaneously with the tuning of the laser bias and eliminates the need of an external optical pump. The NB soliton emerges as a traveling localized dark pulse, which is extensively characterized using both phase-sensitive measurements and numerical simulations. The solitonic nature of these confined waveforms is additionally corroborated by demonstrating multisoliton states as well. We explain the appropriate dispersive and nonlinear conditions that lead to NB solitons. Ring semiconductor lasers offer an electrically-driven platform for direct soliton generation, targeting applications in the mid-infrared spectral region.
		Chair: Marc Janoschek, PSI Villigen
12:15	**18**	**A Comprehensive Experimental Approach to Multifunctional Quantum Materials & their Physical Properties: Geometry and Physics in Condensed Matter.** *Elisabetta Nocerino, Stockholm University & PSI Villigen* This thesis ranges within the vast framework of experimental condensed matter physics, producing results on several different systems and their characteristic physical phenomena, which are collected and presented here in a structuralist perspective. In fact, we show how, in solid condensed matter, the underlying arrangement of atoms, the symmetry of their structure, and their mutual interactions, underpin the form and the nature of their collective emergent properties. Our effort in this work was focused on unveiling complex magnetic ground states in newly synthesized materials (such as the low-dimensional colossal magnetoresistance compound $NaCr_2O_4$, and the triangular lattice antiferromagnets $LiCrSe_2$ and $LiCrTe_2$), as well as in the clarification of unconventional symmetry breaking phenomena in highly debated systems (such as the superconductor $LiTi_2O_4$, the charge density wave system $LaPt_2Si_2$, and the topological insulator $ZrTe_5$). In all cases, we could understand the physics of such systems only when we elucidated the details, and temperature dependent evolution, of their structures. To explore these structure-properties relationships, extensive experimental studies using large-scale research facilities were employed, with particular relevance given to neutron scattering.
12:45		***Postersession with Lunchbuffet***
14:30		***Topical Sessions***
19:30		

Thursday, 07.09.2023, Room Aula 033

Time	ID	**Plenary Session III** *Chair: Markus Aichhorn, TU Graz*
09:00	**19**	**Photoemission orbital tomography: imaging molecular orbitals at intrinsic length and time scales** *Peter Puschnig* *Institut für Physik, FB Theoretische Physik, Universität Graz, Universitätsplatz 5, AT-8010 Graz* Photoemission orbital tomography has emerged as a powerful technique that relates measured pho- toemission angular distributions from oriented films of organic molecules with the molecular or- bitals from which the electrons have been emitted. I will highlight its recent applications including the imaging of orbitals in three dimensions, the in-depth characterization of molecule/substrate hy- bridizations and the identification of surface reaction products. Finally, using femtosecond pump- probe spectroscopy, a new window into the dynamics of excited states has recently been opened. It brings us one step closer to the dream of directly watching in slow-motion videos how electrons move in quantum mechanical orbitals and how this motion shapes the functionalities of condensed matter.
		Chair: Bruno Besser, ÖAW Graz
09:45	**20**	**Out of nowhere: The emergence of spacetime in quantum gravity** *Christian Wüthrich, Université de Genève* Quantum gravity attempts to fuse insights from quantum physics, which has so successfully contributed to our understanding of the constitution of matter, and from general relativity, our best theory of gravitation. This is necessary in order to describe the physics of black holes and the very early universe. Such a theory is of great interest to the philosopher of nature: the conceptions of space and time arising from our manifest image of the world have already been challenged by general relativity, and adding quantum effects to the mix promises to add significant complications. As it turns out, most approaches to quantum gravity suggest that our world is ultimately neither spatial nor temporal. How can one conceptualize such a non-spatiotemporal world? May necessary conditions for empirical research in a such world even be violated? How can space and time not be fundamental, but instead emerge from a non-spatiotemporal structure just as the liquidity of water emerges from molecules which are themselves not liquid? Using a concrete example of a theory of quantum gravity, I will explain - and answer - these questions.
10:30		***Coffee Break***
		Chair: Christian Teichert, Montanuniversität Leoben
11:00	**21**	**Classical and Quantum Information** *Anton Zeilinger, Universität Wien* In the talk an overview will be given of experiments which led from single particle interference to quantum entanglement. That finally led to realizations of basic primitives of quantum information. In the end I will present my arguments for quantum states as representations of logical propositions.
		Chair: Hugo Zbinden, Université de Genève
11:45	**22**	**Electromagnetic processes of nuclear excitation** *Simone Gargiulo, EPFL* Since their first identification in 1921, long-lived nuclear excited states, known as isomers, have held promise for realization of compact energy storage as they can hold these excitations for millions of years and beyond, also surpassing the age of the Universe; however, a process that could efficiently exploit their potential has yet to be discovered. We explore and propose several electromagnetic processes of nuclear excitation, including those that use the atomic surrounding, as possible tools that may enable the activation of isomers and the indirect manipulation of their lifetime.

Time	ID	*Chair: Maurizio Musso, Universität Salzburg*
12:15	**23**	**Educational considerations on the physics of global warming** *Franz Embacher, Faculties of Mathematics & Physics, University of Vienna* One of the goals of school education is to familiarize the younger generation with basic facts about climate and climate change, and to stimulate their independent thinking about these issues. For physics teachers, this is not an easy task and raises numerous didactic questions. After all, phenomena and concepts needed in order to explain why the earth is warming (such als thermal radiation, absorption and emission by invisible gases, and the Stefan-Boltzmann law) are not really prominent among the traditional topics of physics education. Moreover, when it comes to address the inertia of the climate system, the role of the oceans as a huge heat reservoir, and the future of the earth's climate, as measured in centuries and millennia, we encounter the problem that thermodynamics as usually taught in school does not tell us much about time scales of equilibration processes. In the talk, some contact points between school physics and the physics of global warming are identified.
12:45		***Lunch***
14:00		***Topical Sessions***
19:00		***Transfer to Dinner***
19:30		***Conference Dinner***

Friday, 08.09.2023, Room Aula 033

Time	ID	**PLENARY SESSION IV** *Chair: Christian Teichert, Montanuniversität Leoben*
09:00	**24**	**Tailoring the environment to steer laser-driven reactions at surfaces: Solvation, confinement, and more** *Karina Morgenstern* *Physical Chemistry I, Ruhr University of Bochum, Universitätsstr. 150, DE-44803 Bochum* Laser pulses are an intriguing tool for driving non-adiabatic processes at surfaces. Amongst others, they may be utilized for tailoring adsorbed molecules or the surfaces themselves with the aim of custom-made properties that cannot be achieved under equilibrium conditions. We advance the microscopic understanding of the fundamental steps involved in such processes and the details of the dynamics induced by fs-lasers on specific surface sites by a real-space analysis of the resulting products and structures on the sub-nanometer scale, combining short-pulse lasers with scanning tunnelling microscopes. The microscale understanding of the influence of the immediate environment on laser-driven processes, may be used to tailor it for a desired outcome. In this talk, I will present our recent advances in the field.
		Chair: Christof Aegerter, Universität Zürich
09:45	**25**	**Science Education in an International Context** *Sascha Marc Schmeling, Head of Teacher and Student Programmes, CERN, Geneva* CERN is one of the oldest European intergovernmental organisations. In summer 1953, the final draft of the CERN Convention was agreed upon and it laid out the ways its Member States would contribute, as well as its commitment to the dissemination of the research results, international peaceful collaboration, and the education of the scientists of tomorrow. From Mach's first definition of the "Nature of Science" to today's challenges, the field of science education has evolved significantly and its importance for future generations has grown. This presentation will highlight the Organization's current involvement in education and its research including links to national efforts, as well as science outreach, and give a personal outlook and ideas for science education on an international scale.

10:30		***Poster Award Session***
10:45		***Coffee Break***
		SUSTAINABLE RESEARCH IN PHYSICS *Moderation: Hugo Zbinden, Université de Genève*
11:15	**26**	***Panel Discussion*** **Introduction, the carbon footprint of research in Switzerland, sustainability at EPFL** *Muranaka Tamoko, EPFL* **Particle Physics, Technologies for sustainable accelerators** *Mike Seidel, PSI Villigen + EPFL* **The efforts at ETHZ** *Anna Soter, ETH Zürich* **A grassroot approach to sustainable research** *Philipp Treutlein, Universität Basel*
12:00		***Topical Sessions***
14:30		***CONFERENCE END***