What's new
May - September 2024

Dear readers of the IUPAP Newsletter

I have been IUPAP President, since October 2019, due to the early resignation of Professor Kennedy Reed for health problems, at a time when I was President Designate. **It is a long mandate (record since the end of second world war). Many things happened.**

1. We moved the IUPAP Headquarters from Singapore to Geneva, giving for the first time to IUPAP, a legal status of a non-governmental organization, with an association under Swiss law, in Geneva. We decided to install the secretariat of IUPAP in the International Foundation of Trieste, with offices at ICTP (the famous International Center for Theoretical Physics). To keep the global character of IUPAP, instead of moving the headquarters from one continent to another from time to time, we tried to distribute the tasks worldwide in an hopefully more permanent manner: the IUPAP conferences are managed from South Africa, the IT support comes from India, the action and strategic plan are coordinated from Argentina!

2. During the past 5 years, we put a **great effort to increase the role of women in IUPAP and to increase diversity, by giving more visibility and tasks to women and to people from the global majority**. This can be seen in commissions, in commission chairs, in the Executive Council, in IUPAP Officers, in the IUPAP presidency and last but not least in our members.

3. Covid 19 and on-line meetings. **The Covid 19 period, prevented us to hold many scheduled in person meetings**: Executive Council and Commission chairs meetings, commission meetings, General Assemblies. However, by having such meetings in person only every 3 years and in between annual on-line hybrid meetings (the organizers, meeting in person, connected on-line to the others), this facilitates the organization, is more inclusive, costs less, and has a smaller environmental impact. Hybrid formats of various kinds are also recommended for IUPAP sponsored conferences for the same reasons. All in all, Covid 19 was a positive transformative period in the way IUPAP works.

4. **2022 was marked by the celebration of the IUPAP centenary** all over the world and especially in Trieste with a great colloquium event, organized with brio by Monica

Pepe-Altarelli. A book on the history of IUPAP has been edited by Roberto Lalli and Jaume Navarro, which we recommend you read. You will appreciate the rich history of IUPAP, which was the theme of the colloquium in Trieste, as well as the basis for IUPAP to enter a new 100-year period.

5. **At that occasion of the IUPAP centenary, the mission of IUPAP has been reaffirmed: to assist in the worldwide development of physics, to foster cooperation in physics and to help in the applications of physics towards solving problems of concern to humanity.** To that end, we reaffirmed that no physicist a priori from whatever country, culture, religion, should be prevented to attend global IUPAP sponsored conferences, and we offered the possibility of an IUPAP affiliation, to overcome difficulties. We created the status of Corporate Associate Members, to enhance the participation to IUPAP of Physics outside Academia and that way put more emphasis on the applications of Physics. We also rejuvenated IUPAP by welcoming IAPS (the International Association of Physics Students) as a major partner of IUPAP!

6. **IUPAP promoted and was proactive in many initiatives advertising science for peace and science for sustainable development**: global IUPAP sponsored conferences, working groups, SESAME (Synchrotron-light for Experimental Sciences and Applications in the Middle-East, LAAAMP (Light sources for Africa, the Americas, Asia and Middle East Project), IYBSSD (International Year of Basic Sciences for Sustainable Development 2022 – 2023), IDSSD (International Decade of Sciences for Sustainable Development 2024 - 2033, with the Earth – Humanity Coalition, sciences for equitable well-being on a Healthy Planet). For the two last initiatives, IUPAP is serving as the host organization till the end of 2024.

Many other things happened during this period October 2019 to October 2024, which I have not the place to report. **But for me, what was most important was the spirit of competence, dedication, stimulation, inventiveness, openness, kindness which presided to all the interactions I had with the IUPAP colleagues I worked with. This is what I will remember most. I wish my successor to have the same pleasure I had to work for and with IUPAP.**

Michel Spiro, President IUPAP

IUPAP EC&CC meeting and 33rd IUPAP General Assembly

More than a hundred delegates from all over the world will gather next week in Haikou, China, **for the annual IUPAP Executive Council and Commission Chairs meeting and for the 33rd IUPAP General Assembly, which will take place on 7-10 November and 11-13 November**, respectively.

The program of the meetings will include the presentation of the IUPAP Kennedy Reed Medal for outstanding contributions to the enhancement of physics in developing countries to Malik Maaza and the presentation of the IUPAP Interdisciplinary Prize to Evelyn Tang and Stefano Martiniani. The General Assembly will elect the new members of the Executive Council, including the new IUPAP President, as well as the new members of the Commissions for the term 2024-2027.

In parallel to the IUPAP meetings, the Chinese Physical Society (CPS) Fall Meeting 2024 will be held in Haikou from 11 to 13 November. Joint activities will be organized between the IUPAP General Assembly and the CPS Fall Meeting, including the Women in Physics Forum, a Workshop on "Physics Research for a Sustainable Planet", and Special Public Lectures. The three Special Public Lectures will be given by Nobel Laureates Barry Barish, Takaaki Kajita, and Samuel Ting. The Inter-Commission Symposium "Physics Research for a Sustainable Planet" will be opened by a keynote lecture by Nobel Laureate Giorgio Parisi which will be followed by talks on climate modelling, geohazards, fusion energy, and solar, hydrogen and green fuels.

A special forum on equity, diversity, and inclusion in physics will celebrate on 11 November the 25th anniversary of IUPAP Working Group 5 (Women in Physics).

Full program

Meet our team

Monica Pepe Altarelli

Vice President Elected at Large

- **Could you please introduce yourself?**

My name is Monica Pepe Altarelli. I am an experimental high energy particle physicist. I have worked in several experiments at CERN throughout my career. As a postdoctoral researcher in the ALEPH experiment at the LEP accelerator, I worked in a small group led by Nobel laureate Jack Steinberger and was one of the main authors of the first measurement of the number of light neutrino species. Since 2000, I have been a member of the LHCb collaboration at the Large Hadron Collider. My main scientific interest is the search for new physics beyond the Standard Model through the study of very rare decays of charm and beauty hadrons and precision measurements of CP-violating observables with the LHCb detector.

- **What is your role within the IUPAP?**

Cecilia Jarlskog, who was IUPAP President from 2011 to 2014, convinced me to join IUPAP ten years ago. I joined as a Vice President elected at large, which means that I was not attached to a

specific scientific commission.
As a member of the IUPAP Council, I was involved in all major policy and practical decisions of the Union. I also had the special responsibility of organizing all the activities around the IUPAP Centenary in 2022, culminating in a very successful symposium at ICTP, Trieste, in July 2022.

- **What did you enjoy most in your collaboration with IUPAP?**

What I enjoyed most was meeting so many interesting people from all over the world, working in all areas of physics. Some of these people have become very good friends of mine. IUPAP is really unique in this respect.
One memory that I still cherish is a brilliant and very entertaining physics "live performance" by Nobel Laureate Bill Phillips, organized in the context of the General Assembly held in Sao Paulo, Brazil, in 2017. Bill has been very active in the Scientific Commission on Units (C2). He appeared before a packed audience of attentive and enthusiastic "Paulista" high school students. I loved it!

- **What do you think is the greatest potential of IUPAP?**

IUPAP has been very successful in stimulating and promoting international cooperation in physics, mainly by sponsoring international conferences. Through many crises, from the Cold War to the current war in Ukraine, IUPAP has steadily and consistently supported the free movement of scientists and helped to keep open the channels of scientific cooperation. It has a unique role and potential in this regard.
Over the years, IUPAP has broadened its activities to include support for early career physicists, the participation and recognition of women in physics and the promotion of diversity, the improvement of physics education, and the promotion of physics in developing countries. IUPAP has a fantastic worldwide network of exceptionally competent and dedicated people who run the Union through their voluntary work. However, if more resources were available, its impact on the physics community and society could be even greater.

Obituary: Tsung-Dao Lee (1926–2024), Nobel Laureate and Pioneer of International Scientific Collaboration

Tsung-Dao Lee, one of the most influential theoretical physicists of the 20th century and a trailblazer in international scientific collaboration, passed away on August 4th at the age of 97. A Nobel laureate whose work fundamentally changed our understanding of particle physics, Lee's legacy extends far beyond his research, embodying a vision of global scientific cooperation.
*"P*rofessor Tsung-Dao Lee was perfectly illustrating the guiding principles of IUPAP", says IUPAP President Michel Spiro, adding that "he advanced the frontiers in several different fields of physics and promoted scientific collaboration across geographical boundaries*"*.
Born in 1926, in Shanghai, China, Tsung-Dao Lee showed a precocious talent for mathematics and science from an early age. After the outbreak of the Second Sino-Japanese War, he moved to the United States to further his education, earning his Ph.D. from the University of Chicago under the mentorship of Enrico Fermi. By 1957, at the age of just 31, Lee, along with his colleague Chen-Ning Yang, won the Nobel Prize in Physics for their discovery of parity violation in weak interactions, a result that defied long-held assumptions about the symmetry of fundamental forces.

While his scientific contributions are immense—ranging from particle physics, statistical theory of equations of states and phase transitions, fluid dynamics, and astrophysics —Lee will also be remembered for his commitment to fostering international collaboration. As a visionary leader in the scientific community, Lee worked tirelessly to strengthen scientific ties between East and West, especially during an era of heightened geopolitical tensions.

In the 1970s, as China sought to reintegrate itself into the global scientific community, Lee played a crucial role in bridging the gap between Chinese and Western physicists. He helped to establish programs that allowed Chinese students to study and work with top scientists in the United States and Europe, many of whom returned to China to establish research institutes and foster innovation.

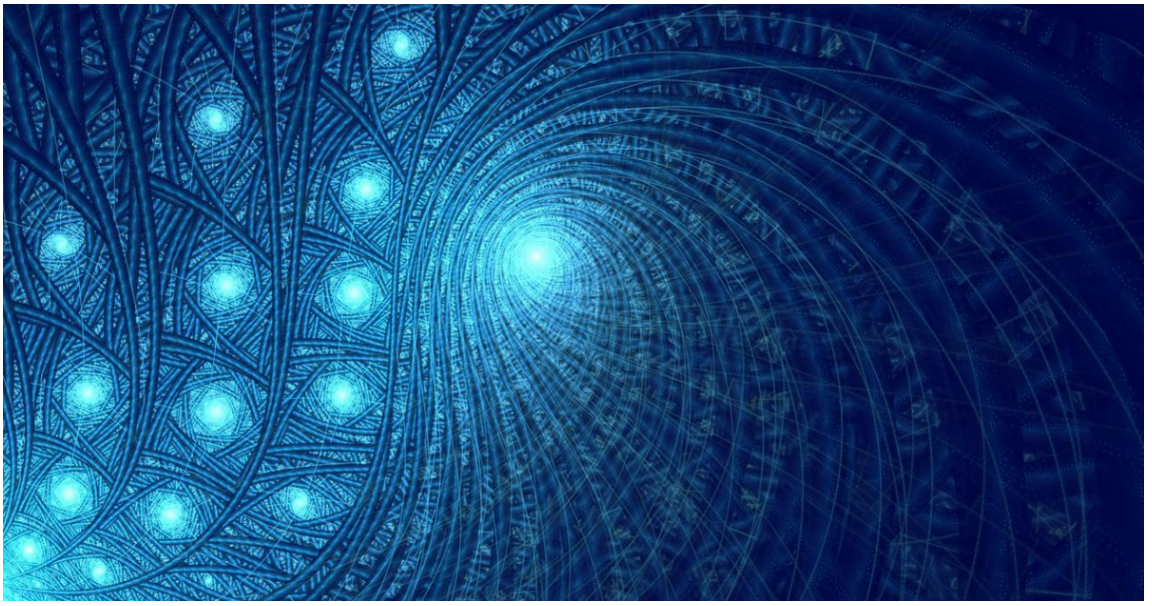
In 1998, he founded the Tsung-Dao Lee Institute in Shanghai, a premier research institution aimed at promoting fundamental research in physics and related disciplines. This institute became a hub for scientists from all over the world. Throughout his career, Lee also remained a strong advocate for young physicists, mentoring countless students and encouraging them to engage in cross-border collaborations.

T.-D. Lee's contributions to science and international collaboration will continue to inspire generations of scientists, not only in their quest to understand the universe but in their pursuit of shared knowledge across national boundaries.

A memorial service was held on August 25, 2024, at the the T.-D. Lee Institute in Shanghai. The service was jointly organized by Shanghai Jiao Tong University, IUPAP, and several other institutions.

"Topology protects robust function in biology"

by Evelyn Tang, IUPAP Interdisciplinary Early Career Scientist Prize 2023



Understanding how the underlying components of proteins, RNAs, metabolites, and other biologically relevant molecules give rise to biological function would enable precise targeting of interventions to enhance health. However, we still do not have a good theory for how structure leads to function in these complex and noisy systems. As just one example, despite successful sequencing of the human genome, it remains challenging to predict the behavior of resulting proteins and macromolecules due to the large space of possible configurations and reactions causing transitions between them. This large phase space of possible configurations also renders unfeasible exhaustive searches using other approaches like experiment or numerical simulation, underscoring the need for simple conceptual methods to provide insight.

I employ geometric and topological tools to understand how robust function emerges in complex biological and stochastic systems. In particular, topological invariants have proved useful for analyzing emergent function as they characterize a property of the entire system, and are insensitive to local details, disorder, and noise. They support edge states, which reduce the system response to a lower dimensional space and offer a mechanism for the emergence of global cycles within a large phase space. Topological invariants have been heavily studied in quantum electronic systems and been observed in other classical platforms such as mechanical lattices. The characterization of topological phases stem from random matrix theory, which yields a systematic classification based on symmetry groups.

I build on my graduate work in quantum condensed matter where I developed novel realizations of topological phases such as when proposing a Chern insulator or flat-band superconductivity [1]. This provided a basis for my development of topological models in stochastic systems that exhibit edge states and currents [2]. In stochastic systems, such models describe distinct chemical or mechanical configurations with a global pattern of transition rates between them that supports edge states. Powerfully, this edge response is insensitive to local details, disorder, and noise, and can describe robust biological oscillations or growth cycles (see Fig. 1a). Such theories could shed light on the fundamental question of why biological function is so robust, e.g. during development or when maintaining stable dynamics over long times, even in the presence of stochasticity or changing external conditions and stimuli.

My group at Rice University has demonstrated the biophysical mechanisms for a topological model of a clock, in the KaiABC system that governs the circadian rhythm of cyanobacteria (see Fig. 1b). Our work provides a robust mechanism for the emergence of a long period, much longer than the underlying chemical reactions [3]. Our topological model naturally produces the cyclic ordering of chemical phosphorylation observed in the KaiABC system with just a few parameters, in contrast to typical models that require many more parameters to create this ordering. This and other works provide a theoretical framework for the dimensional reduction seen in biological networks, for which there is a paucity of analytical tools. Indeed, I had previously studied human learning to show that fast learners exhibit more compact and efficient neural representations, compared to slow learners, and demonstrated the increased controllability of brain networks of adults compared to those of children [4]. The ability to formalize robust dimensional reduction in biology using the theoretical framework of a phase transition to the topological phase, is gratifying and fun.

Developing topology for biological systems has spurred novel discoveries in my group, such as novel theoretical results or pathways for control of synthetic systems [5]. In the first, we proved that unlike quantum topological phases, stochastic topological phases must be non-Hermitian to exhibit edge localization (or any non-uniform behavior) in the steady state. This is surprising as it had appeared that stochastic topological systems inherit similar properties as their quantum counterparts, when described by the same lattice. However, we showed that this is not always true, as well as the necessary conditions and mechanisms. More recently, my group collaborated with experimentalists to identify topological edge flows in self-assembling clusters and voids of magnetic colloids, where these flows drive macroscopic re-organization of domains over very different timescales. More broadly, our topological models provide simple principles for the engineering of reconfigurable materials. These emerging developments shed light on fundamental principles for non-equilibrium systems and how topology can protect robust biological function [6].

[1] Phys Rev Lett 2011; Nature Physics 2014. [2] Phys Rev X 2021. [3] Nature Communications 2024. [4] Nature Neuroscience 2019; Nat Communications 2017; Rev Mod Phys 2018. [5] Phys Rev B 2024; arXiv:2409.15068. [6] Invited review for Rep Prog Phys, also arXiV: 2406.03925.

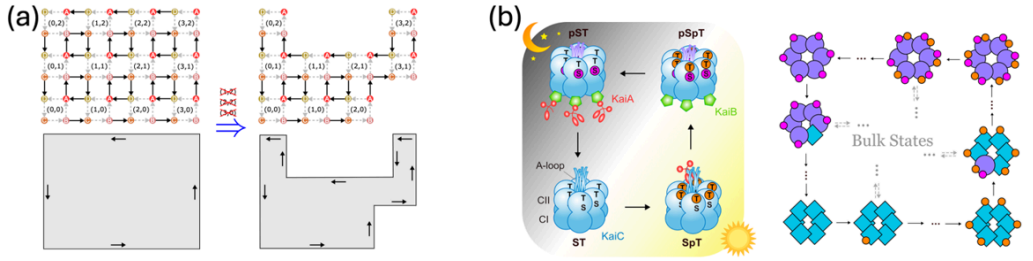


Figure 1: (a) *Left*: Topological model for stochastic systems supports an edge state when the black rates are larger than the grey rates. *Right*: This system is robust to missing states or imperfections, as the edge state always moves around the maximal available geometry. Adapted from [6]. (b) *Left*: The KaiABC system displays a sequential ordering of phosphorylation that governs the circadian rhythm of cyanobacteria. *Right*: Our topological model displays an edge state that reproduces this sequential ordering of phosphorylation, with much fewer parameters than other typical models. Adapted from [3].

Experiences applying for US Visas: a survey of the US National Academies of Sciences, Engineering, and Medicine Networks

The U.S. National Academies' Board on International Scientific Organizations (BISO) has launched a project to assess the experiences of our international colleagues in applying for a short-term business visa to visit the United States. As a valued member of the international scientific community, we need your help with this important project.

If you are a scientist, engineer, or medical professional who does not currently reside in the United States and has applied for or considered applying for a short-term business visa to visit the United States in the past 10 years for a collaboration, convention, conference, or seminar, **we invite you to complete a brief online survey about your visa application experience.** The survey is anonymous and will take approximately 10 minutes to complete. BISO has hired a specialist agency, KGL Consulting, to collect data on this issue.

Your responses will help us understand how current visa processes impact international meetings and international collaborations. Your experiences and views are vital for shaping discussions on this issue and achieving positive outcomes for the global scientific community. BISO is a unit of the National Academies, a non-governmental organization with no control over U.S. visa regulations or processes.

Thank you for your participation. If you have questions prior to taking the survey, please reach out to KGL Consulting at annette.hager@kwglobal.com
Please forward this invitation to any colleagues who may be interested in sharing their thoughts about their visa application experience. **The deadline for responses is 12:00 (UTC) on 31 October 2024. Input from the survey will be summarized in a public report to be released in 2025.**

Survey about your visa application experience

IUPAP Early Career Scientist Prize

C15 - Commission on Atomic, Molecular And Optical Physics- 2024

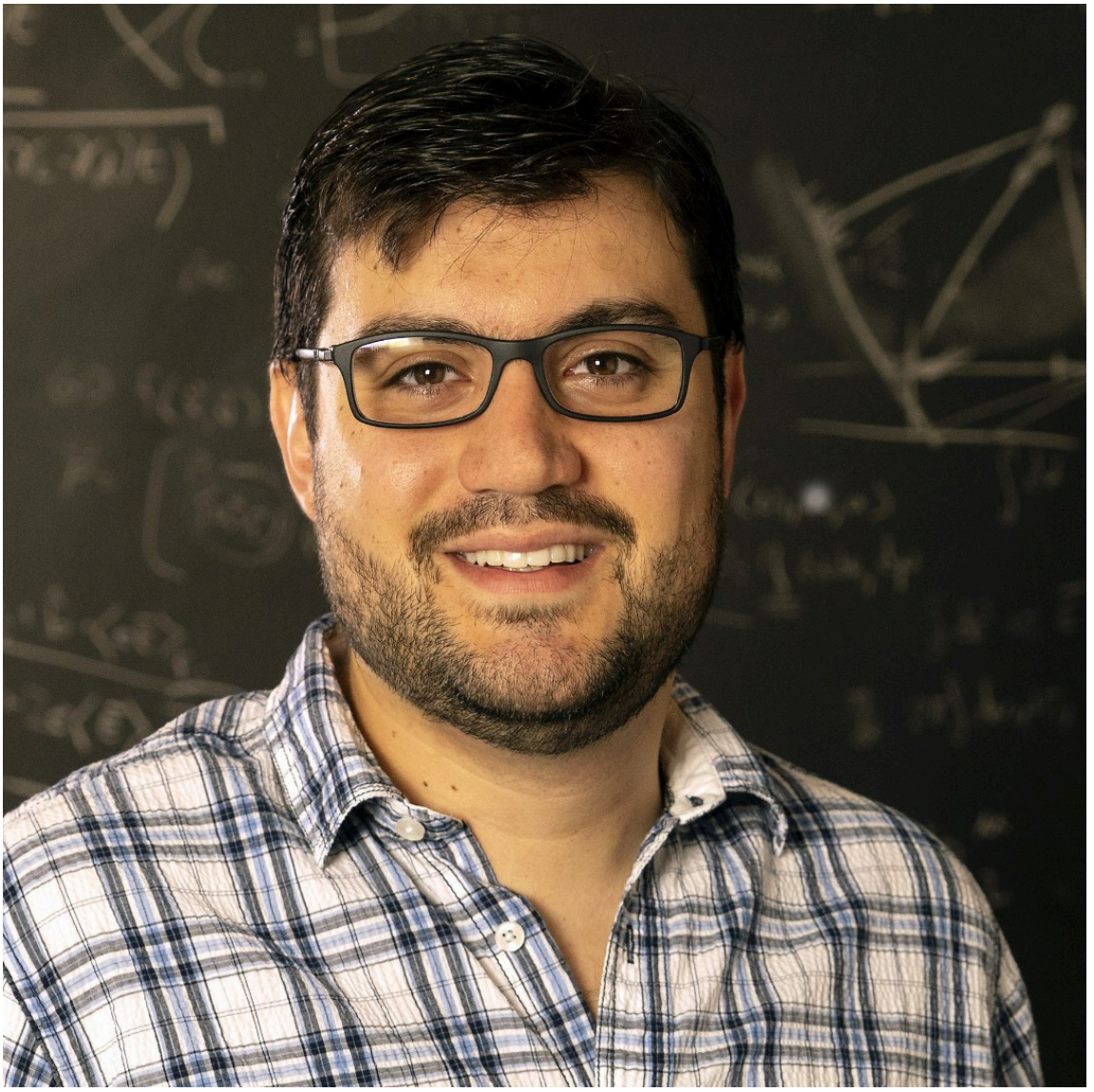
Matthew Norcia

"For his seminal contributions to cavity-QED, optical tweezers, and dipolar quantum gases, specifically, the realization of an optical tweezer clock and of two dimensional supersolids in dipolar quantum gases"

C20 - Commisison on Computational Physics - 2024

Dr. Yang Zhang

"For his significant and innovative achievements in computational study of topological bands and quantum anomalous Hall states in two-dimensional semiconductors."



C16 - Commission on Plasma Physics - 2024

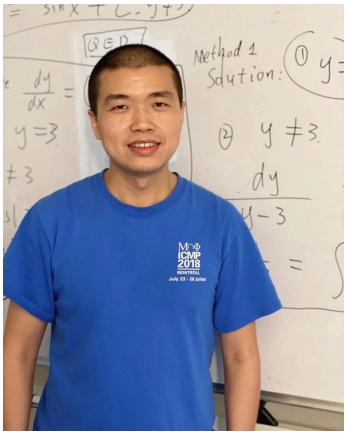
Dr. Vinícius Njaim Duarte

“For elucidating the mechanism behind the nature of the nonlinear response of Alfvénic waves in fusion experiments, and for the advancement of collisional plasma kinetic theory that led to a self-consistent transport theory, established from first principles and successfully applied to the dynamics of fusion plasmas and self-gravitating systems.”

C18 - Commission on Mathematical Physics - 2024

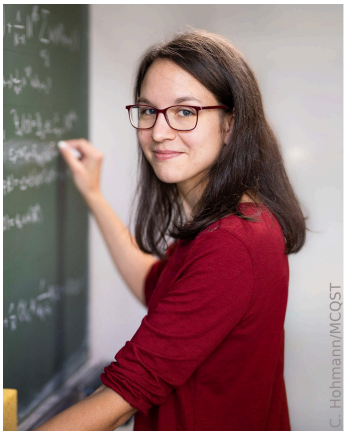
Amanda Young

"Lea's research focuses on quantum many-body systems, in particular on a



Wencai Liu

"His research has resolved numerous challenging problems, including the



Lea Bossmann

"Amanda’s research lies in the classification of quantum phases of matter and focuses

mathematical description of the spectrum and dynamics of interacting Bose gases."

irreducibility of Fermi and Bloch varieties, and the proof of geometric Borg's theorem in arbitrary dimensions."

on using analytical methods to investigate spectral and dynamical properties of ground states of quantum lattice models."

C11 - Commission on Particles and Fields - 2024

Jennifer Ngadiuba

"For co-design, development and deployment of novel machine learning techniques to address complex elementary particle physics challenges with focus on ultra-fast real-time data analysis on hardware triggers and for model agnostic searches for beyond the Standard Model physics signals at the Large Hadron Collider".

Ian Moult

"For the invention of novel jet substructure observables which have had a direct impact on the collider physics program, and for developing new effective field theory techniques to enable high precision calculations, including in multi-prong kinematics and in subleading soft and collinear limits."

IUPAP

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