International Union of Pure and Applied Physics

SEPTEMBER 2018

Newsletter

President: **Kennedy Reed** • Editor-in-Chief: **Kok Khoo Phua** • Editors: **Maitri Bobba; Sun Han**

IUPAP Office hosted & supported by: **NANYANG TECHNOLOGICAL UNIVERSITY, SINGAPORE**

NEW MEMBERS, NEW INITIATIVES, NEW INTERNATIONAL SCIENCE COUNCIL!

New Members

Since our last Council and Chairs of the Commissions (C&CC) meeting in Singapore on 3rd and 4th May 2018, we have received an application from Jordan for IUPAP membership. The Council enthusiastically approved this application. Jordan is now a new IUPAP member. This is very important for both parties since IUPAP has strongly supported the SESAME project (Synchrotron-light for Experimental Science and Applications in the Middle East) located in Jordan, from its very beginning as a project for physics, peace and development. We believe that Jordan's adherence to IUPAP will allow us to further support Jordanian physicists working in the spirit of SESAME, and contributing to peace and development in their country and in the region.

We also have interesting prospects for applications for IUPAP membership from Uruguay and Vietnam. We are counting on IUPAP Vice-President at large Nithaya Chetty and IUPAP Secretary General K.K. Phua to help expand IUPAP membership.

Michel Spiro (President-Designate), Kennedy Reed (President) and Bruce McKellar (Past-President)

We also welcome other interested individuals to lend their support in this endeavor. We believe that it is a high priority for IUPAP to fulfill its missions to assist in the worldwide development of physics, to foster international cooperation in physics and to help in the application of physics toward solving problems of concern to humanity.

New initiatives connected to International Years

After the May 2018 IUPAP sponsored conference on Science and Development in Vietnam, one of us (IUPAP President Designate Michel Spiro) addressed the President of the Socialist Republic of Vietnam, Trần Đại Quang, and many high-level dignitaries from the government, the parliament and the communist party. One of our messages was that Vietnam should increase its participation in international scientific unions or organizations such as IUPAP and take the lead in pushing for a proposal for an International Year of Basic Sciences for Development, in the context of the UN 2030 Agenda for Sustainable Development. This message was very well received, and just recently, we learnt that Vietnam is ready to take the lead in pushing for the proposal of an International Year of Basic Sciences for Development (IYBSD) in 2022. The IUPAP celebrates its Centenary in 2022, and this celebration would hopefully connect to this International Year. As we have mentioned already in the June Newsletter, the IYBSD will allow us to show that Physics is a pillar for Basic Sciences and a pillar for Peace and Development and the celebration of this International Year will be an unique opportunity to advertise our new vision matching our era. A celebratory event, in Geneva, is now planned, including several satellite events attached to conferences supported by IUPAP and its members, There will also be some publications in various forms in the media.

Meanwhile, we are also organizing in the forthcoming year, the International Year of the Periodic Table of Chemical Elements. One of us (the IUPAP Past President Bruce McKellar) is part of the steering committee. IUPAP Commission 12 on Nuclear Physics, and other Commissions are also working on ways to participate and celebrate the event.

The report of the IUPAP-IUPAC Joint Working Group on criteria for discovery of new elements has been received by the Unions and the Presidents - Zhou Qifeng (qfzhou@iupac.org), President of IUPAC and Kennedy Reed (reed5@llnl.gov), President of IUPAP, have approved its publication in the Journal of Pure and Applied Chemistry. The report is provisional and the Presidents welcome comments and suggestions.

The IUPAC and IUPAP Procedures for Validating Claims for the Discovery of New Elements and Naming those Elements, approved by both Unions last year and available on the IUPAP website as an appendix to the minutes of the 2017 Council meeting, http://iupap.org/wp-content/uploads/2013/07/CCC-Minutes_2017_v6.pdf.

American Physical Society

IUPAP Vice President at Large with responsibility for Finance, Enge Wang, has been elected to be the International Councilor of the American Physical Society (https://www.aps.org/publications/apsnews/updates/election-18.cfm). He will take up this position on 1 January 2019. We look forward to even closer relations with the American Physical Society.

International Science Council

The first General Assembly of the newly constituted International Science Council (ISC) was held in Paris from July 5th to July 7th. This new Council results from a merger of ICSU (Natural Sciences) and ISSC (Social Sciences). The ambition of this new body is to become the "Global Voice for Science", in regards of Global Challenges. For this, they will be promoting values; launching programs, producing brochures, approaching International Organizations such as UNESCO and the UN and organizing prestigious GA's every 3 years. Almost all International Scientific Unions and almost all countries are members of the General Assembly. In Paris we voted for the Officers (the President, one President Elect, two Vice Presidents, the Secretary, the Treasurer) and for the ten Ordinary Members of the Governing Board. The vote resulted in a certain imbalance, probably due to the voting procedure, which was somewhat blind to the occurrence of possible imbalances. As a result, unfortunately, there will be no physicist, neither among the Officers nor among the ordinary members of the governing board. Let us hope that next time, in three years from now, this will not be the case. Nevertheless, we count very much on this new International Science Council to help us in promoting projects of global interest, including physics, such as for instance, an International Year of Basic Sciences for Development in 2022!

IN MEMORIAM

Burton Richter (1931 - 2018)

(Image credit: Courtesy SLAC National Accelerator Laboratory)

Burton Richter, Professor Emeritus at the Physical Sciences at Stanford University, and, former director of the SLAC National Accelerator Laboratory, died on July 18 in Palo Alto. He was 87.

Richter moved from MIT to the current Stanford's High-Energy Physics Laboratory in 1956. In 1963, Richter joined SLAC to design a 3.2 km high-energy electron-positron collider (SPEAR). The collider was built in just 27 months, and went into operation in 1973. In November 1974, Richter and his team discovered a new particle with a mass around 3.1 GeV that they called "psi". This particle was independently observed at Brookhaven by Samuel Ting (he called it "J"). Richter and Ting received the Nobel Prize in 1987 for the discovery of the "J/psi" particle that confirmed the existence of the charm quark. In 1984, Richter became the director of SLAC, a position that he held until 1999. Under his directorship, the world's first linear collider – the 3km SLAC Linear Collider was designed, and built in 1987.

In addition to the Nobel Prize, Richter received many honors and awards: the DOE's Ernest Orlando Lawrence Award in 1976, the U.S. Department of Energy's Enrico Fermi Award in 2012 and the National Medal of Science, in 2014. He was a member of the National Academy of Sciences, a fellow of the American Academy of Arts and Sciences and the American Association for the Advancement of Science. He also held the position of the President of the International Union of Pure and Applied Physics and the American Physical Society.

I met Burt for the first time in 1997, at an international conference covering various topics including synchrotron radiation. He asked me many questions about the science done with synchrotron radiation and the importance of the coherence of the photon beam. He had a very strong personality and a vision for SLAC in the future. Burt was not only a particle physicist but also an accelerator physicist and this is very unusual. Contrarily to many high energy physicists, he was looking beyond particle physics to the possible development of linear accelerators to produce hard X-rays. He asked me to join the SLAC Science Advisory Committee and sometime later to accept the position of IUPAP President Designate for the period 1999-2002. At first I refused but Burt finally convinced me to accept the position. Burt was President Designate 1996-1999 and President from 1999-2002.

During his term, he introduced several very important changes. Some scientists were remaining in commissions for 20 years and some chairmen had held many terms. To inject new blood, he decided to revise the statutes and by-laws: all elections should be for a term of three years, Chairs and Vice-Chairs may not be re-elected to the same positions, ordinary members may be re-elected once, continuous service in all capacities shall not exceed three terms. Burt was very interested by the energy problems. He pushed the creation of a working group on Energy (2002) because the ICSU report, to avoid political problems, was only focusing on renewable energy, which is not a very good scientific approach. In 2010, Richter published Beyond Smoke and Mirrors: Climate Change and Energy in the 21st Century, a very interesting and iconoclastic book.

He created the working group on "Women in Physics" (1999) at a time when physicists were not paying too much attention to this subject. The first IUPAP International Conference on Women in Physics was held in Paris in March 2002.

IUPAP is a member of ICSU (International Council for Science). At that time, ICSU was made up of 73 national members and 27 scientific unions. Some of the unions were large, having budgets much larger than that of IUPAP. Each union was deciding what they should pay, so some unions were paying very little. It had a constitution under which each country had one vote. The priority item for ICSU was the environment. While this might have been satisfactory in the short term, it was not a good long-term policy. Basic science had been ignored. Under pressure from Burt and others, it was decided to have a Working Group on Basic Science. Burt was thinking that ICSU should not give the impression that in developing countries the only thing of interest was applied science. The finances of ICSU became problematic in 2002 when they lost on the value of stock and were obtaining little interest on investments. Burt Richter asked to have somebody from IUPAP in the ICSU Financial Committee. The budget ran a deficit. It had been decided to change the fee currency to euros, which had resulted in about a 20% increase in subscription. We decided that IUPAP would not accept the increase in fees asked by ICSU until a more realistic scenario was adopted for the contributions of the countries and the unions.

It has been a real privilege to work with Burt. We have lost a great physicist and also somebody who has played an important role for changes at IUPAP and ICSU. We wish to express our condolences to his family.

Yves Petroff-IUPAP President (2002-2005)

Burt Richter and the Working Group on Women in Physics.

The creation of the Working Group on Women in Physics as Working Group 5 (WG5) was decided at the 1999 General Assembly when Burt Richter was incoming president of the union. Judy Franz, a person that was also key for the formation of the group and the advancement of the women in physics agenda, was there at the General Assembly. Here is her recollection of the Assembly and of the very important role of Burt Richter's for the existence of WG5: "At the 1999 General Assembly a delegate from Sweden made a motion to form a Working Group on Women in Physics. I think that everyone, other than the Swedish delegation, was quite surprised. There were very few women delegates present (maybe 3 or 4), and several of us spoke strongly in favor. Several men spoke rather strongly against the motion. Burt was very even-handed. He and the outgoing president allowed the debate and vote. The motion passed but not unanimously. Soon after that Burt asked me to set up the Working Group and made sure that we had the funding and resources that we needed to carry out our task. After much consultation, I put together an international group with the Brazilian physicist, Marcia Barbosa, as chair. With Burt's support within APS (Burt was past president of the society), I was able to use APS staff to help with the logistics. We had several meetings - the first was in Washington, DC. The big decision that we made was to hold a Conference on Women in Physics, which took place in Paris in 2002. Jackie Beamon-Kiene and my administrative assistant did a huge amount of work on this. Burt, who had always treated women fairly but hadn't realized the barriers faced by most women, attended the full conference. He was really impressed by what he saw and heard, and I think he left a changed person. He continued to be very supportive of the Working Group as past president. Burt was one of my heroes and I miss him greatly!"

Silvina Dawson, Associate Member of WG5

WOMEN IN PHYSICS THANKS RETIRING MEMBER

Jackie Beamon-Kiene

Congratulations and good wishes to Jackie Beamon-Kiene who officially retired from working at the American Physical Society as their Executive Office Administrator at the end of July. Jackie has also been the administrator for the Working Group 5 on Women in Physics since its inception, so we say a huge thank you to her and to the APS for supporting her in this vital work.

Jackie has been at the heart of WG5 in more ways than one. She has helped keep each successive group functioning, living and breathing – the heartbeat. But more than that she manages to combine efficiency and practicality with sensitivity and compassion – the heart.

While Jackie does indeed deserve her retirement we are loathe to let go of her and so we are extremely pleased that she has agreed to continue to work with us while a successor is appointed.

So on behalf of WG5, current and previous members, all travel grant recipients and ICWIP attendees, thank you Jackie and we wish you all the best in this new phase of your life.

Gillian Butcher (chair WG5)

ANNOUNCEMENT

IUPAP Vice President at Large with responsibility for Finance, **Prof Enge Wang**, has been elected to be the International Councillor of the American Physical Society (APS) (https://www.aps.org/publications/apsnews/updates/election-18.cfm].

He takes up this position on 1 January 2019. We look forward to even closer relations with the American Physical Society.

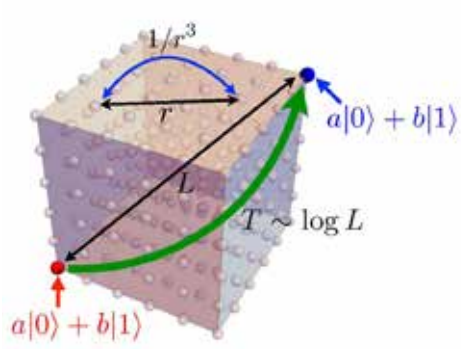
INFORMATION PROPAGATION AND ENTANGLEMENT GENERATION WITH LONG-RANGE INTERACTIONS

Alexey V. Gorshkov (C15 - 2018 Young Scientist Prize Winner)

I lead a group that does theoretical research at the interface of quantum optics, atomic physics, condensed matter physics, and quantum information science. One of the main long-term goals of my group's research is to understand and control large interacting quantum systems, as well as to design and create new ones. Applications of this research include quantum computing, quantum communication, and quantum sensing.

One example of the research direction that led to the IUPAP Young Scientist Prize in Atomic, Molecular and Optical Physics is my group's work on understanding and harnessing quantum systems with long-range interactions. Atomic, molecular, and optical systems with long-range interactions, such as polar molecules and Rydberg atoms, are arguably the most controllable, tunable, and strongly interacting quantum systems. Precise control over them has recently opened a new paradigm for quantum computing and communication, entanglement generation, and engineering of new phases of matter.

The goal of this research direction in my group is to advance the frontier of this new paradigm by exploring the - still largely unknown - potential of these systems, which are often evolving in time far out of equilibrium. Examples of the work include new bounds on how quickly quantum information can propagate [1, 2], entanglement can be generated [3], and correlations can build up [4] in quantum systems with long-range interactions. Another example is the experimental demonstration, in collaboration with the group of Chris Monroe at the University of Maryland, of fast propagation of correlations in a trapped-ion chain in the regime where the chain can be described as a spin chain with long-range interactions [5]. The final example is a protocol that uses unitary evolution under controlled dipolar interactions in



three dimensions to send quantum information over distance L in a really short time T ~ log L, as illustrated in the figure. In contrast, for short-range interactions, this time is much longer, scaling as T ~ L. This protocol may allow for faster quantum computing algorithms and for faster generation of metrologically relevant entanglement in three-dimensional arrays of dipoles such as polar molecules, Rydberg atoms, magnetic atoms, and NV centers.

[1] Z.-X. Gong, M. Foss-Feig, S. Michalakis, and A. V. Gorshkov, Phys. Rev. Lett. 113, 030602 (2014).

[2] M. Foss-Feig, Z.-X. Gong, C. W. Clark, and A. V. Gorshkov, Phys. Rev. Lett. 114, 157201 (2015).

[3] Z.-X. Gong, M. Foss-Feig, F. G. S. L. Brandao, and A. V. Gorshkov, Phys. Rev. Lett. 119, 050501 (2017).

[4] M. C. Tran, J. R. Garrison, Z.-X. Gong, and A. V. Gorshkov, Phys. Rev. A 96, 052334 (2017).

[5] P. Richerme, Z.-X. Gong, A. Lee, C. Senko, J. Smith, M. Foss-Feig, S. Michalakis, A. V. Gorshkov, and C. Monroe, Nature 511, 198 (2014).

THE GENDER GAP IN SCIENCE PROJECT IN THE INTERNATIONAL CONGRESS OF MATHEMATICIANS

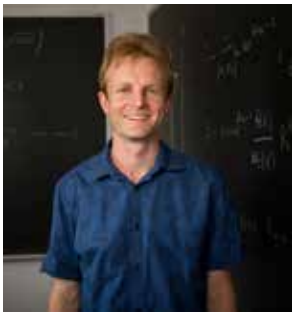
Silvina Ponce Dawson, IUPAP Vice-President at Large (Gender Champion); Member of the Executive Committee of the Gender Gap in Science Project, **Marie-Francoise Roy**, Chair of the IMU Committee for Women in Mathematics; Coordinator of the Gender Gap in Science Project

Silvina Ponce Dawson, Marie-Francoise Roy and June Barrow-Green (the three panel speakers)

The International Mathematical Union (IMU) has a comprehensive International Congress of Mathematicians (ICM) once every four years. The congress covers all areas of mathematics and, as such, attracts a large variety of mathematicians from all over the world. The first ICM took place 121 years ago in Zurich, Switzerland. This year the event took place for the first time in the southern hemisphere. It was held on August 1-9 in Rio de Janeiro, Brazil. A total of 3018 mathematicians from 114 countries attended the meeting in person while the website of the congress received over 400,000 views and 2.36 million people connected on social media during the days of the congress. IMU is the scientific union that leads the "Gender Gap in Science" Project that is currently carried on with the participation of IUPAP and many other unions and with the financial support of the International Council of Science and the union partners. The aims of the Project are, on one hand, to analyze the gender gap in mathematical, computing and natural sciences, paying particular attention to regional differences. On the other hand, based on the collected evidence, it seeks to induce change through the elaboration of recommended policies that could be implemented at various levels. The ICM hosted a special event entitled '*The Gender Gap in Mathematical and Natural Sciences from a Historical Perspective*', where we presented an outline of the project and described the activities that are carried out by the IUPAP Working Group on Women in Physics to evaluate and improve the situation of female physicists. The panel was moderated by Caroline Series, president of the London Mathematical Society and Vice-Chair of the IMU Committee for Women in Mathematics, and included a contribution by June Barrow-Green from the Open University, UK, who described the historical context of the gender gap in mathematics. Activities as this one that involve the participation of representatives of different unions are very fruitful. They let us learn from the experience of others and potentiate our efforts by joining forces. Crossing the borders between disciplines was most valued by Maryam Mirzakhani, the only woman ever to win the prestigious Fields Medal who sadly died at a very early age last year. Maryam was celebrated at ICM through an exhibition that lasted for the whole duration of the congress. The tribute was launched at the first World Meeting of Women in Mathematics, $(WM)^2$, that took place as a satellite event on the eve of the ICM. It is very auspicious that the contributions of women scientists are celebrated at the largest events of our disciplines. Hopefully, in the future, all members of the scientific community will recognize these contributions on a regular basis.

EXTREMAL BLACK HOLES

Samuel Gralla (AC2 - 2018 Young Scientist Prize winner)



Black holes are ubiquitous in our universe and give rise to spectacular astrophysical phenomena such as jets from active galaxies. Black holes are also important in string theory and other attempts to formulate a consistent theory of quantum gravity, as they represent a universal low-energy limit with certain properties that any consistent theory must account for, together with certain puzzles each theory aims to explain. Many of the relevant calculations, questions, and processes are connected with the so-called extremal limit, which for astrophysical black holes corresponds to rapid rotation. My recent research has focused on understanding the physics and astrophysics of extremal black holes, both for astrophysical application and fundamental understanding.

On the astrophysics side, we have found unique "smoking gun" signatures of rapidly rotating black holes. We revealed a distinctive gravitational-wave signature of a high-spin black hole that is orbited by a smaller black hole or neutron star. The radiation from this system finishes with a slow decay on a single frequency, in contrast to the "chirp" (rapid rise in frequency and amplitude at merger) of ordinary binaries. Observing such a signal with present or future gravitational-wave detectors would demonstrate the existence of very rapidly rotating black holes and provide a precise measurement of the spin rate. We have also uncovered a unique electromagnetic signature potentially observable with upcoming submillimetre observations: time variation originating from near the horizon will display a distinctive "vertical" oscillation pattern.

Our fundamental investigations have focused on a peculiar instability of extremal black holes recently discovered by the mathematician Aretakis. We have revealed the instability to be associated with an emergent near-horizon symmetry long studied by string theorists in the context of the holography (the idea that gravitational systems are actually described by non-gravitational theories in one lower dimension—colloquially, "living on the boundary"). We thereby give a universal formulation of the instability, independent of the details of the particular black hole or theory being studied. However, we have also shown that the instability is of the "weak null" type visible only to in-falling observers, which raises a puzzle for holography, since it is not clear how the boundary theory can encode this information.

LIGHT AND LIFE: A STUDENT PHOTO CONTEST

International Day of Light Celebration at IIT Bombay

Parinda Vasa (C17 Member, Indian Institute Of Technology Bombay, India)

Remya K P (First Prize)

Srinivasulu Grandhi (First Prize)

Shashi Ranjan (Second Prize)

Sujit Udupa (Second Prize)

Starting this year, the International Day of Light (IDL) will be held on May 16th every year, to mark the anniversary of the first successful operation of the laser in 1960 by physicist and engineer, Theodore Maiman. Invention of laser is an ideal example of how light and light related technologies can revolutionize several fields like communications and healthcare and bring benefits to society. Every year, IDL activities will be celebrated worldwide with the help of UNESCO and several other partner institutions and sponsors. This year, over 600 events were held in 87 countries, in which hundreds of thousands of people celebrated the vital role of light and associated technologies in various aspects of life like science, culture, art, and education.

At the Department of Physics, Indian Institute of Technology Bombay, Mumbai, India we organized a student photo contest, “Light and Life” to celebrate IDL. The theme of this contest was the importance of light and light based technologies in life on earth. Along with IDL, we also celebrated Diamond Jubilee of IIT Bombay. This event was also supported by, the International Union of Pure and Applied Physics’ (IUPAP) Commission on Laser Physics and Photonics (C17). The contest “Light and Life” was available nationwide to students of all ages and all backgrounds. It promoted equality among different student sectors of society. Students from various departments and institutes enthusiastically participated in the contest. Winning as well as some selected photographs were displayed in Physics Department, and the winners were awarded with book vouchers. Some of the winning photos are shown below. We look forward to celebrate IDL again in coming years.

INTERNATIONAL DAY OF LIGHT, OPENING CEREMONIES IN PARIS

Cather Simpson, Member, Commission on Laser Physics (C17)

The Eifel Tower lights up the sky. Headquarters Paris Ouverture de la journée mondiale de la Lumière; Copyright:UNESCO/Nora Houguenade

Over 600 people from around the world congregated in Paris to celebrate; Photo Credit: Prof Cather Simpson

On May 16, 1960 Theodore Maiman successfully demonstrated the operation of the ruby laser for the first time. Fifty-eight years later, on May 16, 2018, over 600 artists, scientists, industry leaders, politicians and others gathered at UNESCO Headquarters in Paris, France to celebrate the first International Day of Light. New Zealand played a central role in establishing the International Day of Light in a joint proposal to UNESCO with Ghana, Mexico, and the Russian Federation. I attended as a representative of New Zealand's science community, and it was a brilliant event.

Like the International Year of Light and Light Based Technologies in 2015, the International Day of Light marks and celebrates the importance of light in all facets of our lives today, and inspires us to improve our future through light. It's not just about high-tech physics – lighting in our houses seems commonplace now, but this seemingly mundane advance transformed our society every bit as much as has the light-driven internet. Access to lighting is changing people's lives for the better today in remote, poor parts of our planet – remedying light poverty is a key initiative of many who celebrate the International Day of Light.

The opening ceremonies featured talks by Nobel Prize winners Claude Cohen-Tannoudji (Physics, 1997) and Kip Thorne (Physics, 2017). A "science show" by a group of young Belgian students entertained us all. New Zealand's Sir Peter Gluckman participated in a panel focused upon how science should inform and influence policy and policy makers. I was fascinated by the international viewpoints – every continent except Antarctica provided some illumination.

It wasn't just science though. Khaled Toukan spoke about SESAME, the Synchrotron-light for Experimental Science and Applications in the Middle East project that he directs. This facility based in al-Balqa Jordan is inspirational and it provides a powerful example of how light can unify across a very troubled region. Other presentations informed us about light and culture and toured us through the universe and our exploration of it. Sometimes the absence of light is every bit as important as its presence.

The cultural events and artistic displays were amazing. A heart-stopping highlight was the soprano soloist, Katerina Mina, whose performances at the beginning and the end immersed and uplifted us. The day ended with a stunning light show by Kari Kola, a video of which can be seen here: http://karikola.com/productions/international-day-of-light-flagship-event-2018

Woven through the event were the United Nations Sustainable Development Goals and how light and light-based technologies will help achieve them. The Director-General of UNESCO, Audrey Azoulay, opened the topic with her address at the start

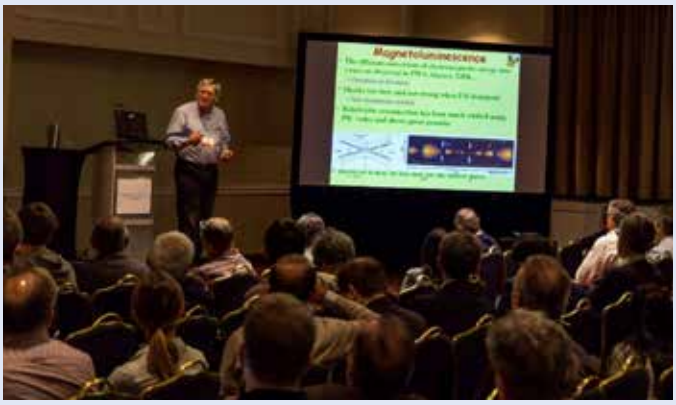
Prof. John Dudley, Chair of the IDL Steering Group. Photo Credit: Prof Cather Simpson

of the ceremony. Professor John Dudley, who led the massively successful 2015 International Year of Light and Chair of the IDL Steering Committee, touched upon them as well.

The International Year of Light saw thousands of events across the globe, run by students and teachers, artists and musicians, politicians and museums, Nobel Prize winners and PhD candidates. The International Day of Light is shaping up to have even more impact. For the first IDL in 2018, over 600 events were run in 87 countries – New Zealand led the way with the first event to mark the day with a light show on the Auckland Harbour Bridge (https://www.vector.co.nz/about-us/sponsorship/lights/light-events/unesco-international-day-of-light). The inspirational success of IDL 2018 means we're all looking forward to what we can achieve for IDL in 2019.

INTERNATIONAL CONGRESS ON PLASMA PHYSICS (ICPP 2018)

International Congress on Plasma Physics (ICPP 2018) held in Vancouver, Canada from 4th to 6th June 2018. It highlighted the advances in theory and experiments for a wide range of topics in plasma physics. They ranged from astrophysical and near space environments to laboratory-produced plasmas for fusion energy, particle acceleration and X-ray sources, nano-materials, etching, etc., as well as the study of basic phenomena such as wave-particle and laser-plasma interaction, turbulence, transport, heating, magnetic reconnection physics and high energy density plasmas. The keynote speaker (Roger Blandford) opened the Congress with an outstanding presentation on "The limits of plasma physics" and used several examples from observations in extreme astrophysical environments to demonstrate some of the inadequacies of current plasma theory and where new ideas are needed. A plenary talk on quantum plasmas (Fernando Haas) suggested a possible theoretical formalism that could be developed and eventually tested in these extreme conditions. The plenary presentation (Lilia Ferrario) on plasma astrophysics in less extreme regimes, such as accretion flows in magnetic compact stars, showed current theory could successfully model many of the observations. Current sheets play a central role in space and laboratory plasmas and are sites of magnetic reconnection where explosive release of magnetic energy into kinetic energy of charged particles can occur. Lev Zelenyi presented recent satellite observations and theoretical results from current sheets in planetary magnetospheres which linked to C.Z. (Frank) Cheng's talk on the physical processes and theory of driven magnetic reconnection. Other plenary talks focussed on the advances in the fundamental nature of kinetic plasma turbulence (Frank Jenko) guided by high performance computation, and experiments and modeling of Advanced Tokamaks (Richard Buttery) with the aim of achieving high-beta and steady state fusion energy scenarios in magnetic confinement (Yeong Kook Oh). Other key highlights of the Congress included a special plenary and panel discussion on "Pathways to Fusion", chaired by Blair Bromley and a basic plasma physics special session on "Pattern Dynamics in Plasmas", organized by Patrick Diamond and chaired by Raul Sanchez. In the former session, the progress and future plans of four contemporary approaches to fusion were reviewed; magnetic confinement and the ITER project (Alain Becoulet), direct drive inertial fusion (Ricardo Betti),



ICPP 2018 Keynote Speaker, Prof. Roger Blandford on "The Limits of Plasma Physics"

fusion from magnetized target compression (Michel Laberge), and advanced beam-driven field reverse configuration fusion concept (Sergei Putvinski). The latter two alternative concepts are privately funded (General Fusion, TAE Technologies) and during the panel discussion some of the issues with private versus public funding of fusion research were debated. In the special session on plasma pattern dynamics, examples from fluid and plasma turbulence were used to demonstrate the ideas of scale selection and natural competition between secondary structures, thus leading to a new theoretical framework to understand and interpret experiments and simulations.

During the banquet ceremony, Dr. Eleonora Viezzer was awarded the 2018 IUPAP Young Scientist Prize in Plasma Physics for her exceptional contribution in the field of confined fusion plasma physics combining theoretical models and experiment. Her citation reads: 'For outstanding contributions on the interplay between radial electric fields, plasma flows and transport in magnetically confined fusion plasmas combining cutting-edge diagnostic techniques and state-of-the-art theoretical models.'

The ICPP 2018 was supported by IUPAP, and its funds allowed the organizers to provide travel support for delegates from Developing/Disadvantaged countries and support for student attendees.

YOUNG SCIENTIST PRIZES

Commission on Semiconductors (C8)

Heejun Yang

"*For seminal contributions to the mathematical theory of many-body quantum systems, in particular the proof of the ionization conjecture in Thomas-Fermi-Dirac-von Weizsäcker theory and the justification of the Bogoliubov approximation for a class of interacting Bose systems.*"

Heejun Yang received his PhD in physics with a subject on graphene by scanning tunneling microscopy and spectroscopy (STM/STS) from Seoul National University (Korea) and University Paris-Sud XI (France, a joint degree) in 2010, and experienced industrial device studies in Samsung Electronics from 2010 to 2012. Then, he conducted his research on graphene spintronics in CNRS/Thales as a postdoc from 2012 to 2014. With his research background on molecular and nanometer-scale studies (in Seoul and Paris) and electric and spintronic device physics (in Samsung and CNRS/Thales), he moved to Sungkyunkwan University as an assistant professor on March 2014 and started original device studies with phase engineering of low-dimensional materials. He has proposed novel and conceptual interface devices such as 'Graphene Barristor' and 'Ohmic homojunction contact between semiconductor channel and metal electrodes'.

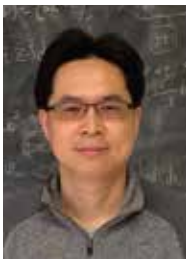
Jean Christophe Blancon

"For his outstanding contributions to elucidating mechanisms of formation and dissociation of exciton states in solution processed perovskite quantum well semiconductors for efficient optoelectronics."

Jean Christophe Blancon is a senior research Scientist in the George R. Brown School of Engineering at Rice University (Houston, TX, USA). He graduated from the University of Lyon (France), and completed in 2010 his M.Sc. in physics from the Ecole Normale Superieure de Lyon, and his M.Sc. in optics and photonics from the Karlsruhe Institute of Technology (Germany). He was a postdoctoral fellow who joined Los Alamos National Laboratory (USA) in 2014 after obtaining his Ph.D. in physics from the University of Lyon in 2013, where he worked on measuring the absolute absorption cross-section of individual single- and double-wall carbon nanotubes. During his four-year postdoctoral appointment at Los Alamos, Jean-Christophe's main contribution was to elucidate mechanisms of formation and dissociation of exciton states in solution-processed, organic-inorganic, perovskite quantum well semiconductors, which has led to the core design of perovskite-based optoelectronic devices. His work has opened a new direction for tuning the materials chemistry of hybrid perovskite based low dimensional materials and for achieving desired and new emergent functionalities. This work has led to more than 20 publications among which in Nature, Science, Nature communications, and Advanced materials, cited more than 2000 times.

Jean-Christophe's work focused on understanding multi-scale phenomena in low dimensional hybrid materials and directly correlate nanoscale physical mechanisms, including charge-energy conversion and transfer, to understand macroscopic figures-of-merit and performances of optoelectronics devices such as solar cells, light emitters, detectors, and transistors. His recent focus has been on investigating the interplay between the mechanical, optical, and electronic properties of hybrid perovskites.

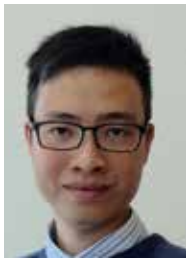
Commission on Mathematical Physics (C18)



Wei Kuo Chen

"*For fundamental mathematical results about spin glasses, including the proof that the Parisi formula has a unique minimizer and the Sherrington-Kirkpatrick model exhibits full-step replica symmetry breaking.*"

Chen earned his B.Sc. and M.Sc. in Math from Taiwan. In 2009, he received his Ph.D. degree in math at the University of California, Irvine. From 2012 to 2015, he was a L.E. Dickson instructor in the department of mathematics at the University of Chicago. Since then, he has been serving as an assistant professor in the school of mathematics at the University of Minnesota.



Phan Thanh Nam

"*For seminal contributions to the mathematical theory of many-body quantum systems, in particular the proof of the ionization conjecture in Thomas-Fermi-Dirac-von Weizsäcker theory and the justification of the Bogoliubov approximation for a class of interacting Bose systems.*"

Phan Thanh Nam was born in 1985 in Phu Yen, Vietnam. He graduated from Vietnam National University at Ho Chi Minh City in 2007 and obtained his PhD in Mathematics from University of Copenhagen in 2011. Afterwards, he was a Post-doc at CNRS and University of Cergy-Pontoise until 2013, a Post-doc at IST Austria until 2016, and an Assistant Professor at Masaryk University until 2017. Currently, he is a Professor of Mathematics at LMU Munich.

Nam's work concerns the mathematical treatment of large quantum systems from first principles. His PhD thesis contains an original result on the maximum negative ionization of atoms. Further important contributions include a full solution to the ionization problem in Thomas-Fermi-Dirac-von Weizsäcker theory (joint with Rupert Frank and Hanne Van Den Bosch), a novel approach to the mean-field approximation of Bose gases (joint with Mathieu Lewin and Nicolas Rougerie), and a rigorous justification of Bogoliubov excitation spectrum (joint with Mathieu Lewin, Sylvia Serfaty and Jan Philip Solovej). He also works on many-body quantum dynamics, semiclassical approximation, and Lieb-Thirring type inequalities.

Vadim Gorin

"For his groundbreaking work on the universality of local correlations in random tilings and nonintersecting random walks, and the discovery of locally interacting particle systems linked to random matrix ensembles."

Vadim Gorin was born in Moscow, Russia. He became a candidate of sciences in mathematics at Moscow State University in 2011, and at the same year, he earned his PhD in mathematics from the Utrecht University. Vadim spent the spring of 2012 at Mathematical Sciences Research Institute at Berkeley and then joined the mathematics department of the Massachusetts Institute of Technology. He has been working at MIT since that time: first as a CLE Moore Instructor and currently as an assistant professor.

Vadim Gorin works on asymptotic representation theory, studying various properties of representations of groups linked into series (such as unitary groups, orthogonal groups, or symmetric groups) as the rank tends to infinity. In a related work on mathematical statistical mechanics, Gorin focuses on 2-D lattice models, random matrices, and interacting particle systems.

The central tool of his research is the use of symmetric functions of representation-theoretic origin for the delicate asymptotic analysis of large stochastic systems of particles. Among the main results is the analysis of the macroscopic fluctuations for a class of discrete random stepped surface models leading to the Gaussian Free Field. In another direction, Vadim (with several collaborators) discovered a surprising appearance of random matrix distributions in the local limits of statistical mechanics systems such as the six-vertex model and random sorting networks.

CONFERENCE REPORTS:

20th International Symposium on Very High Energy Cosmic Ray Interactions (ISVHECRI) held at the Nagoya University, Japan from 21/05/2018 - 25/05/2018 discussed not only air shower physics but also various aspects of very high energy cosmic ray interactions concerning multi-messenger astrophysics with cosmic neutrinos, gamma-rays and positrons. It was a platform for many interaction model builders to gather at once and communicate with each other. Future LHC measurement for proton-oxygen collisions was also intensively discussed.

30th International Conference on Photonic, Electronic and Atomic Collisions (ICPEAC XXX) held in Cairns, Queensland, Australia from 26/07/2017 - 01/08/2017 focussed on 6 main topics. The topics were - Harnessing ultra-intense X-rays for dynamic 3D imaging, New Physics with Advanced Positron Traps and Beams, Heavy particle collisions: from single atomic targets to complex molecular clusters, Dipolar quantum gases and liquids, Attosecond electron dynamics on surfaces and layered systems and Novel high harmonic generation schemes.

26th International Conference on Atomic Physics (ICAP 2018) was held in Barcelona from 22/07/2018 - 27/07/2018. The conference covered several hot topics, such as, Topology in atomic systems, Quantum gases, Quantum computation and communication, Quantum simulation and quantum annealing, Fundamental tests and precision measurements, Quantum optics and quantum nanophotonics, Intense fields and ultrafast science, Rydberg and artificial atoms and molecules, Atomic Clocks and quantum metrology and Cold molecules.

ULT2017: Frontiers in Low Temperature Physics, held in Heidelberg, Germany from 17/08/2017 - 21/08/2017 presented new and important work over a wide range of topics. They included quantum fluids and solids, quantum matter under extreme conditions, quantum phase transitions and quantum criticality, quantum transport and quantum turbulence, non-equilibrium quantum systems, nuclear magnetism, nano-electronics and nano-mechanical systems, new cooling technologies, sensors, amplifiers and detectors at the quantum limit. Three poster awards were given to, Harriet van der Vliet from Royal Holloway, University of London, UK, Toshiaki Kanai, from Osaka City University, Japan and Lingzhen Guo, from KIT, Karlsruhe, Germany, for the topics "Thermal boundary resistance", "Turbulence in 4He", and "Phase Space Crystals" respectively.

XIV Hadron Physics 2018 held in Florianopolis, Brazil, from 18/03/2018 - 23/03/2018 discussed the many results related to neutron stars, heavy ion collisions, magnetized quark matter and lattice nuclear physics at a pedagogical level.