International Union of Pure and Applied Physics

IUPAP Newsletter

JUNE 2018

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IUPAP NEW COMMISSIONS, COUNCIL AND PRESIDENTS — A NEW START!

Executive Council and Commission Chairs for the term 2018 - 2020

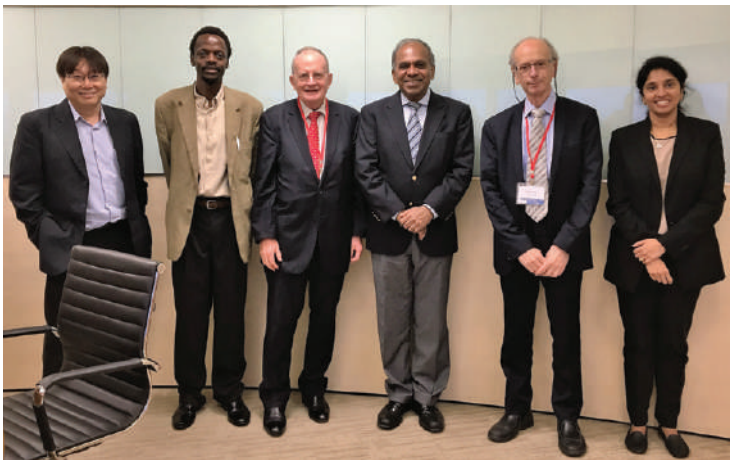
Our 29th General Assembly, held in Sao Paulo in October 2017 elected a new President and President-Designate, together with a new Council and Commissions. The new Council and Chairs of the Commissions (C&CC) met for the first time in Singapore on 3rd and 4th May 2018. This first meeting set out the path to be followed by IUPAP as it progresses toward its 30th General Assembly and second century in 2020 and 2022 respectively. In the previous newsletter, it was mentioned that President Kennedy Reed represented IUPAP at the funeral of Francis Allotey in Ghana. Unfortunately, he had an accident towards the end of his visit in Ghana, and developed complications which prevented him from attending this Council meeting to see through the initiatives he started.

The C&CC meeting was held at the Nanyang Technological University (NTU) in Singapore, home of our Office. The venue of the meeting was also a symbolic celebration of the agreement that Singapore will host our office until 2020, with positive prospects of extending the agreement beyond 2020 to allow us time and space to prepare for our centennial celebrations. Before the two-day C&CC meeting commenced, the Council officers had an opportunity to meet Professor Subra Suresh, the new President of NTU.

Review the Statutes; Revisit the Website and Procedures

We realised that, as would be expected of any organisation approaching its 100th anniversary, many of our documents are showing their age. Indeed, much of what we have written about us and shared with the world does not describe what we now do.

Our statues were written when “mail” meant “postal mail”, which was the primary mode of communication. Of course, our Council discusses Union matters over the internet, and has email votes to decide its position on particular matters. However, our statutes do not allow this to be an official position of the Union. The Council agreed to review the *Statutes and By Laws*, with the aim to submit the revised version to the 30th General Assembly for a decision. This may



Council Members with NTU President, Prof Subra Suresh (third from right)

lead to the possibility of an electronic General Assembly, as what the International Council for Science (ICSU) has done occasionally for the last decade.

New *Statutes and By Laws* will usher in new procedures; however, it may well be possible to make some of these changes in advance to the adoption of the new statutes. We will be reviewing those changes to improve our efficiency, transparency and communication with our members, who are communities of physicists engaged in independent scientific activity within each definite territory. We also seek to list each of the territories under a unique name to avoid any misunderstanding of the territorial boundaries, as defined in our Statutes. Our members may or may not come from the physical societies in the stipulated territories and as such, we are working to improve communication with individual physicists worldwide.

Concurrently, we will be updating the website to reflect the changes in the revised statutes. The process to redesign the website is likely to take some time to complete as it requires a significant allocation of financial and manpower resources.

Preparation for the Centenary Event

The Centenary of IUPAP is 2022. In 1922, physicists met at the Brussels General Assembly of the International Research Council and established IUPAP, with member countries and elected William Bragg as its first President. Interestingly, the first President of the International Union of Crystallography, our co-lead applicant for the ICSU project on Lightsources was William Bragg's son, Lawrence Bragg. At our 2017 General Assembly, a position of Vice President at Large with Responsibility for the Centenary, was created. Monica Pépe-Altarelli was appointed to that position. The General Assembly also formed a Working Group, chaired by Monica, for the centenary event. The Working Group has started to plan for the centenary event and explored ideas on theming the event to commemorate the past contributions of IUPAP; and demonstrate its relevance in the next century. A celebratory event will also be planned and satellite events pertaining to conferences supported by IUPAP are being considered.

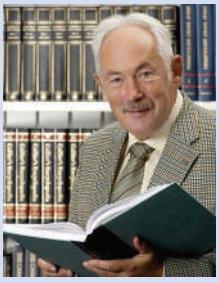
A New Vision for the Next Era

Physicists are well aware of the changing world. After all, many changes are the result of advances in physics, itself. The Centenary event provides an excellent opportunity to review our mission and aims. The Council will continue to overcome challenges in its effort to revise, adapt and re-formulate its approaches; and adopt new measures to fulfil its enshrined missions in the statutes, before IUPAP's 100th anniversary.

At the same time, we are boldly proposing to establish 2022 as the International Year of Basic Sciences for Development (IYBSD) as it coincides with the year of IUPAP's centenary and the 100th anniversary of the Nobel award to Niels Bohr. This unique opportunity will allow us to demonstrate Physics as a key pillar for both Basic Sciences as well as for Peace and Development; and share our new vision for the next era with the rest of the world.

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

IN MEMORIAM



Professor Peter Grünberg

The magnetism community mourned the passing of a dear colleague and Nobel Laureate **Peter Grünberg**. He passed away in the beginning of April in Jülich at the age of 78. He discovered the giant magnetoresistance (GMR) effect, in 1988, for which he was awarded the Nobel Prize in 2007 together with Albert Fert. Their discovery of the GMR effect, which the two scientists discovered independently of each other, led to a breakthrough in modern information technology: the storage capacity of hard drives was increased significantly, enabling the miniaturization of storage media, which significantly advanced the development of information technology worldwide. It marked the beginning of the research field spintronics and put the field of big-data and social media on the road.

In addition to the Nobel Prize, Peter Grünberg received a variety of prizes and honors. He had been honored for this discovery with the German Federal President's Future Prize in 1989 and the European Inventor Award in 2006. Additional awards partly together with Albert Fert include the Japan Prize of the Science and Technology Foundation of Japan (JSTF) and the Wolf Prize (both in 2007). To honor Peter Grünberg, the Institute for Festkörperforschung at the Forschungszentrum Jülich (Research Center Juelich), which he joined in 1972 and where he stayed beyond retirement in 2004, was renamed Peter Grünberg Institute in 2011.

Peter Grünberg was born on May 18, 1939, in Pilsen, Czech Republic. He entered Wolfgang Goethe University in Frankfurt in 1959. In 1963 he entered the Darmstadt University of Technology, emerging with a Ph.D. in physics in 1969. After a postdoctoral fellowship at Carleton University in Ottawa, Peter Grünberg joined in 1972 the Institut für Festkörper-forschung. In 1984, he changed his research field from the magnetism of rare-earth chalcogenides to the magnetism of thin metallic films and was very quickly successful. In 1986, he discovered with colleagues from the Argonne National Laboratory the antiferromagnetic interlayer exchange coupling between Fe layers across Cr interlayers.

He has made a significant impact to the field of magnetism. Our sincere condolences to his family. He will be remembered fondly by all of those whose life he impacted during his lifetime.

Professor Oscar Saavedra San Martin

Professor Oscar Saavedra San Martin was born in La Paz, Bolivia, in 1940 and passed away on 8 April 2018. As a young boy his dream was to be a medical researcher. But by the age of 15, he began to be fascinated by the skies and volunteered to help out at the Bolivian Mount Chacaltaya Observatory every day after school. Oscar left Bolivia for Italy to complete his studies in Physics and, after graduating, returned to his beloved country. At the age of 25, he was already the Director of the Cosmic Ray Physics Laboratory at Mount Chacaltaya. After three years he decided to go back to Italy and joined the Torino cosmic ray group, led by Professor Carlo Castagnoli, that was leading in high-altitude cosmic ray observations at the time. Afterwards he rose to become a professor at the University of Torino, where he spent the rest of his professional life.

He was member of the IUPAP commission C4 from 1996 to 2002. Professor Saavedra devoted his scientific career to the study of neutrinos and cosmic rays deep underground and in high altitude experiments. He was a co-leader of the Italian-Russian Mont Blanc Liquid Scintillator detector that was aiming to study the neutrinos from Supernova explosions. Following the detection of a signal from the Supernova SN1987a, he was awarded the prestigious 2007 Markov Prize by the Institute for Nuclear Research of the Russian Academy of Sciences. Besides his involvement in several other cosmic rays experiments, collaborating with scientists of many different countries, Oscar was the founder and the soul of the School on Cosmic Rays and Astrophysics, which aimed at giving budding South American youngsters an opportunity to attend an international school and increase their interest and future prospects in this field. He also led the International Emulsion Chamber Committee, which is responsible for the highly successful series of IUPAP sponsored conferences “International Symposium on Very High Energy Interactions (ISVHECRI)”, the 20th edition of which will be held in Nagoya, Japan during 21-25 May 2018. With his love and enthusiasm for science, for motivating and educating promising youngsters in Bolivia, and in Latin America, Oscar had become a source of joy and inspiration for everybody around him. His warm personality and infectious enthusiasm for science will be sorely missed by everyone who knew him.

ANNOUNCEMENT

THE GLOBAL SURVEY OF SCIENTISTS IS NOW OPEN!

We are very pleased to announce that the Global Survey of Scientists is open for responses from **1st May, 2018**. The survey is part of an interdisciplinary collaboration that led to the project entitled *“A Global Approach to the Gender Gap in Mathematical, Computing, and Natural Sciences: How to Measure It, How to Reduce It?”* which is being supported by the International Council for Science (ICSU) and various scientific unions, among them, IUPAP. The project aims to understand the problems faced by practitioners and researchers of the mathematics and computer and natural science communities around the world. The partners of the project are:

1. International Mathematical Union (IMU)
2. International Union of Pure and Applied Chemistry (IUPAC)
3. International Union for Pure and Applied Physics (IUPAP)
4. International Council for Industrial and Applied Mathematics (ICIAM)
5. International Astronomical Union (IAU)
6. United National Educational, Scientific and Cultural Organization (UNESCO)
7. International Union of Biological Sciences (IUBS)
8. Gender in Science, Innovation, Technology and Engineering (GenderInSITE)
9. International Union of History and Philosophy of Science and Technology (IUHPST)
10. Organization for Women in Science for the Developing World (OWSD)
11. Association for Computing Machinery (ACM)

The survey is available in seven languages (English, French, Russian, Spanish, Arabic, Chinese, and Japanese) here: https://statisticalresearchcenter.aip.org/cgi-bin/global18.pl.

The data is being collected by the non-profit Statistical Research Center of the American Institute of Physics. Responses to this survey are voluntary and the individual information is held in strict confidence. About 5,500 responses coming from all over the world were received during the first two weeks of May. The goal of the project partners is to obtain about 45,000 responses during the six months that the survey will remain open. We invite everybody to take the survey and invite his/her colleagues to do it as well. It is only by hearing from as many people as possible that we can better understand the worldwide situation of people in these fields.

Silvina Ponce Dawson
Vice-President at Large and Gender Champion

Updated Version of IUPAP Report 41

One of the mandates of the IUPAP Working Group 9: 'International Cooperation in Nuclear Physics', as confirmed by the OECD Global science Forum, is to update IUPAP Report 41 entitled 'Research Facilities in Nuclear Physics' on a regular scheduled time frame. IUPAP Report was first published as a hard copy and also in an electronic version in 2007. Since then individual nuclear physics laboratory descriptions have changed and entered accordingly.

Furthermore, following the fourth biennial Nuclear Science Symposium, which was held at the RIKEN Tokyo Office, August 29 – 30, 2017, the Introduction to IUPAP Report 41 has been updated with succinct synopses of the seven subfields of nuclear physics discussed at the Nuclear Science Symposium together with an Executive Summary. These synopses describe the current status of nuclear physics research with an emphasis on what is required to enhance the field of nuclear physics.

The eight sub-sections of this Introduction to IUPAP Report 41 are the following:

- 'Executive Summary', by Anthony W. Thomas, University of Adelaide
- 'Nuclear Structure, Nuclear Reactions, Nuclear Astrophysics', by Alexandra Gade, Michiga State University
- 'Hadronic Nuclear Physics', by Cedric Lorce, Ecole Polytechnique, Palaiseau
- 'QCD and Quark Matter', by Berndt Mueller, Brookhaven National Laboratory
- 'Fundamental Symmetries', by Jens Erler, National Autonomous University of Mexico
- 'Applied Nuclear Science', by Marco Durante, Trento Institute Fundamental Physics Applications – INFN
- 'Nuclear Power', by Nicolas Alamanos and Sylvie Leray, Division de Physique Nucleaire, CEA-Saclay
- 'Nuclear Physics Facilities', by Hideto En'yo, RIKEN, Nishina Center for Accelerator Based Science.

These eight synopses describe the more important science questions to be addressed in the coming five to ten years. The synopses have been posted and among other can be found by going to: www.triumf.info/hosted/iupap/icnp/index.html

Willem T.H. Van Oers
Secretary of IUPAP WG.9

NONLINEAR OPTICS AT NANOSCALE

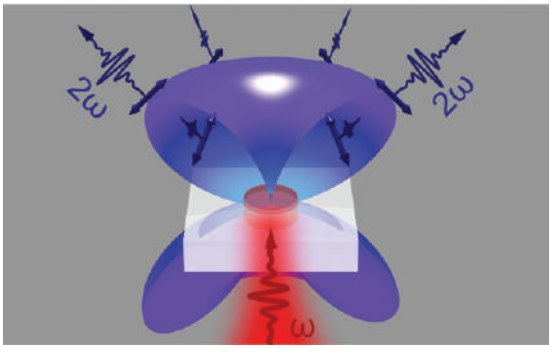
Dr. Mohsen Rahmani (2017 C17 YSP winner)

Dr. Mohsen Rahmani

Nonlinear optics describes the behaviour of light in nonlinear media, whereby light is directly controlled by light. It holds a great potential to eliminate the need for electronics altogether. This is the heart of modern photonic functionalities, including diversifying lasers and light, material interactions and more importantly information technology. The non-linear optical response of a material is generally very weak; therefore, non-linear optical interactions in end-user devices are generally based on large anisotropic crystals that gradually accumulate a strong effect.

Unfortunately, such crystals are not compatible with the size requirements of cutting-edge miniaturized systems. Together with advancements in nano-technology, the quest to realize nonlinear optics with enhanced optical nonlinear response at nanoscale has become very active in the last decade. My research is focused on developing efficient nonlinear optics from tailored nanostructures, whose thicknesses are typically a few hundred times less than a human hair, including metallic and high-index dielectric, semiconductors and hybrid nanostructures. Metallic (plasmonic) nanostructures are powerful tools due to their capabilities for light localization at the nanoscale. However, low damage threshold and Ohmic losses of metals have guided the attentions to high-index dielectric nanostructures. The negligible resistive losses of dielectric nanoantennas avoid heating problems and allow excitation at much-higher light intensities, which is of paramount importance for the efficiency. However, most of the dielectrics, e.g. silicon and germanium do not exhibit bulk quadratic optical nonlinearity because of their centro-symmetric crystal structure.

Currently, the group is focused on exploiting materials with non-centro-symmetric crystal structures, such as III-V semiconductors, e.g. GaAs and AlGaAs, with high nonlinear properties. Such nanostructures not only increase the conversion efficiency due to their lower-order nonlinearity, but also provide a unique opportunity to employ and/or control the polarization states of fundamental and/or nonlinear signal. This research opens new avenues for novel nonlinear imaging, bright fluorescent markers for bioimaging, as well as constituent elements for efficient nonlinear holograms.



Forward second harmonic generation by an AlGaAs nanocrystal

UNRAVELING KEY ION TRANSPORT MECHANISMS FOR THE SUSTAINMENT OF THE HIGH CONFINEMENT MODE IN THE ASDEX UPGRADE TOKAMAK

Dr. E. Viezzer (2018 C16 YSP winner), University of Seville, Spain

Dr. E. Viezzer

In magnetically confined fusion plasmas, one of the key issues is to get a high energy confinement within the core of the plasma. In this respect, the formation of transport barriers at the edge of the plasma during the transition from a turbulent state (low confinement regime, L-mode) to a high confinement regime (H-mode) with reduced turbulence and transport is a crucial point. The performance of an H-mode fusion plasma is highly dependent on the strength of the edge transport barrier which extends typically over a very thin layer in the outermost 5% of the confined plasma (Fig. 1(a) which shows the improvement in the ion pressure pi = ni kBTi in H-mode). The underlying reason for the formation of the H-mode transport barrier is believed to be the existence of a "sheared" plasma flow perpendicular to the magnetic field caused by the gradient of a local radial electric field, Er. The gradients in Er and the accompanying E×B velocity shear play a fundamental role for edge turbulence suppression, transport barrier formation and the transition from L- to H-mode. Thus, the interplay between macroscopic flows and transport at the plasma edge is of crucial importance to understanding plasma confinement and stability.

Recent advances in the diagnostic capabilities at the ASDEX Upgrade (AUG) tokamak enabled the measurement of several quantities that are believed to be key for the understanding of a tokamak H-mode: the edge Er profile, ion heat transport and poloidal impurity density and flow asymmetries. The measurements showed that Er exhibits a well (Fig. 1(c)), which is sustained by the pressure gradient of the main ion species. The radial location of the maximum E×B velocity shear coincides with that of the maximum ion pressure gradient (see Fig. 1). They both lie in the inner part of the Er well thus, indicating that this region is the important region for turbulence reduction observed in H-mode. The extension of the plasma rotation measurements to the high-field side of AUG revealed an asymmetry in the impurity density and flow structure at the plasma edge.

Unprecedented measurements of the ion temperature with a temporal resolution of 65 μs allowed us to study in detail the edge ion heat transport during edge localized mode cycles. The data shows that the ion heat diffusivity is close to the neoclassical level, at all times except for a short period when an edge phenomenon occurs that expels particles and energy.

Combining high-resolution measurements with state-of-the-art simulations enabled to shed light on the neoclassical nature of the ion edge transport barrier at AUG and its role in the sustainment of the H-mode. While these studies concern mainly the plasma of a specific device, it is an important contribution to the understanding of the physics of the H-mode, which is key to the realization of fusion in next-step fusion devices such as ITER and DEMO.

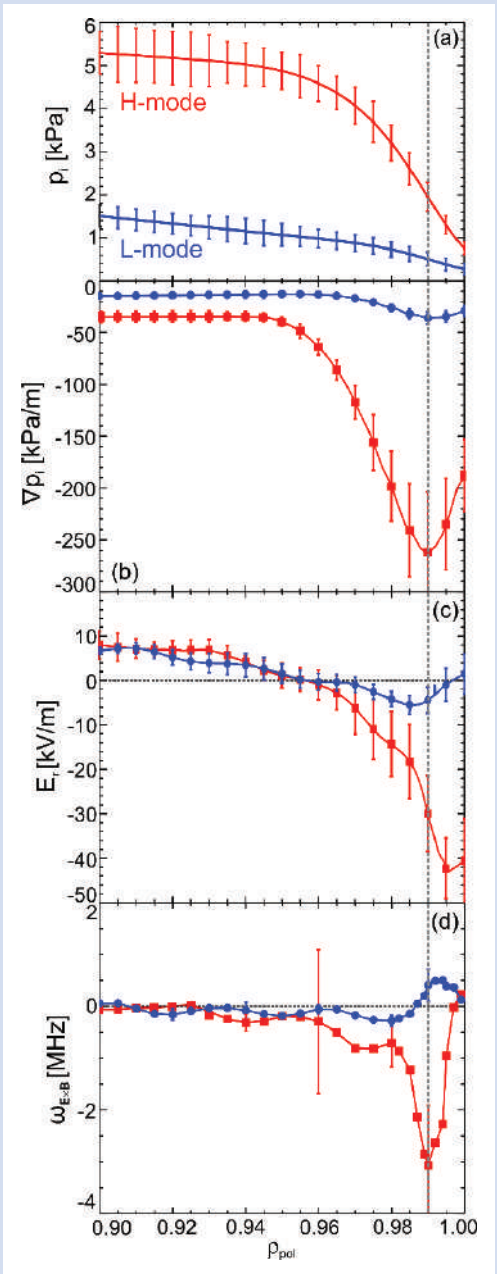


Fig. 1: (a) Main ion pressure and its gradient (b), (c) radial electric field and (d) **E×B** *velocity shear.*

REPORT ON THE TRAVELING LABORATORY IN SUB SAHARAN AFRICA, ZIGUINCHOR, SENEGAL (22 NOVEMBER - 02 DECEMBER, 2017)

Participants of the OpenLab Senegal 2017

The second Senegalese School of Crystallography entitled **Laboratory and Synchrotron Xray Crystallography: Applications to Emerging Countries**, was held in Assane SECK Ziguinchor University, Senegal under the auspices of IUCr, UNESCO, IUPAP and ICTP; it was predominantly intended for Masters, PhD students and postdocs in solid state physics, chemistry, material sciences and structural biology. Judging from the feedback of participants and lecturers, the school was a very large success.

The ICTP UNESCO-IUCr OpenLab Senegal 2017 ran from 22 November to 02 December on the Maison de l'Université Assane SECK de Ziguinchor (MUASZ). The intense courses were designed for Masters, PhD students and Postdocs interested in learning the background and techniques of modern X-ray crystallography. This second year edition featured a very strong list of lecturers from Africa and European Universities: M. Camara (U. Ziguinchor, Senegal), P. Kenfack (U. Dschang, Cameroon), C. Lecomte, B. El-Eulmi (both of U. Lorraine, France), F. Porcher (LLB,CNRS/ CEA, and University of Lorraine France), A. Bacchi (president of the ECA, U. Parma, Italy), M. Zema (IUCR officer, U. Pavia, Italy) B. Chérif (U. Constantine, Algeria), S. Onesti (Elettra - Sincrotrone Trieste, Italy), E. Martin (Bruker company) and M. Marchivie (U. Bordeaux, France). All these experts lectured and tutored the participants who mostly came from sub Saharan Africa. The courses were designed for anyone wanting to expand their general knowledge of Laboratory and Synchrotron X-ray crystallography.

The 30 participants came from 11 countries: Benin, Burkina Faso, Cameroun, Ivory Coast, Congo Brazzaville, Democratic republic of Congo (DRC), Gabon, Madagascar, Nigeria, Soudan and Senegal. The foreign students and most of Senegalese participants accommodation were supported by UNESCO, IUCr and the University of Ziguinchor.

The central goal of the School is to educate each participant with enough knowledge of the theory and practice of X-ray, neutron crystallography and synchrotron radiation. With this in mind, topics like X-ray and neutron diffraction physics, powder and single-crystal methods, physical properties of crystals, symmetry and group space, structure refinement, crystallographic databases, nano-crystallograhy, bio-crystallography and diffraction applications of the synchrotron light were covered during the lectures. While the practical sessions concerned on how to select a single-crystal on a microscope, discussing difficulties and problems and using Cambridge Structural Data base. Two real-case example data sets were given to the participants to cut their teeth on; they learn to use the WinGX software program and to recognize and resolve unexpected difficulties with structures. So, no matter whether you were already experienced or not, the course covered both basic and advanced skills and provided new and more in-depth insights into the subject. Therefore, everyone was able to profit and gain plenty of new knowledge about crystallography.

The young African crystallography school participant's claim that the discussions (or simply pleasant conversations) with lecturers and intensive peer to-peer contact during evening dinners provide for a unique experience, which they deem to be crucial to the scientific exchange and inspiration of junior crystallographers and/or chemical crystallographers. In addition to these scientific interactions and inspiration, this OpenLab and conferences, outreach programs offered a unique occasion to follow closely the development of crystallography and the advancement of knowledge in the emerging countries.

Cheikh Kanté, the Minister to the President of the Republic charged with the task follow-up on the plan for Emerging Senegal (PES) unexpectedly visited the school just like Professor Mary Teuw Niane Minister of Superior Education and Research of Senegal did in 2015 during the first crystallographic in Ziguinchor.

Cheikh Kanté, the Minister to the President of the Republic interacting with the participants

He extended his gratitude to the IUCr for renewing their truth in UASZ through the organization of the school.

After one week of intense course a two-day excursion was made to Cap-Skirring. The participants are always very impressed when they see the beautiful palm groves, forests mangroves and islands with rice fields. This year, we were able to visit the Crocodile breeding park Djibélor, Enampor CasaPluvium and artisanal clay pottery maker lady in Oussouye.

The effort to promote crystallography in Latin America, Africa and Southeast Asia, especially through promoting the communication and exchange between Masters, PhD students and Postdocs themselves and to leading Professors in the IUCr-OpenLabs is astonishing. Such actions are undoubtedly of vital importance for crystallography, physics, chemistry, earth sciences and biology, especially for an emerging country like Senegal, where young students have limited access to such top-level crystallographic courses and diffraction facilities. We are very grateful for the generosity of the sponsors and supporters: Thanks to the International Union of Crystallography (IUCr), IUPAP, International Center for Theoretical Physics (ICTP), United Nations Educational, Scientific and Cultural Organization (UNESCO), Brucker Company, Dectris Ltd, International Center for Diffraction Data (ICDD), Cambridge Crystallographic Data Centre (CCDC), French Crystallographic Association (AFC), AIC, British Crystallographic Association (BCA), European Crystallographic Association (ECA), Department of Chemistry of Assane SECK Ziguinchor University and the Rector of Assane SECK Ziguinchor University, several young African scientists have the opportunity to experience crystallography from a different perspective, to widen their horizons, meet new ideas and future collaborators, and finally get further motivation for the road ahead.

The questionnaire filled in by the participants provided positive feedback about the quality of the School, the friendliness and approachability of the lecturers, the organization and the venue. Participants often say they would like to have some free times to digest the content better and therefore be more active in the next lectures. Some say it would be better to delocalize the school at Cap-Skirring so that the excursion can be made done at the same place. But most students would have like the school to be held in French because they find the high level academic English not easy to grasp. A combination of lectures in French (the most difficult) and in English (for learning English language) would have been the best. One big regret for all, including lecturers, was that Bruker was notable to send in time the single crystal portable diffractometer which was supposed to be the main apparatus to hands on activities.

Each participant received a certificate and the young lady Julia Blandine BASSILIA from RDC received the ICCD travel grant. The personal impressions of three of the participants are given below.

The UNESCO-IUCr OpenLab Senegal 2017 – Report from participants

This 2nd Senegalese School of crystallography was really a life time experience for me. It completely changed the way I see science and research. Up to the UNESCO-IUCr OpenLab Senegal 2017 I had only seen research in Soudan, where I completed my undergraduate as well as graduate studies. By attending the lectures of Prof. Michele ZEMA, Prof. Alessia BACCHI, Prof. El-eulmi BENDEIF, Prof. Claude LECOMTE and so on, I learned more in detail about a wide area of research, which I had previously only read in publications. To be honest with you I didn't know what to do after the end of my PhD, whether I would stay in research or I would look for a job in my country. But after the conversations I had with many inspiring Professors my interest for research woke up again and I have already started looking for funding to start my postdoctoral research.

The UNESCO-IUCr OpenLabs are extremely important to pass the torch, and excite the next generation of scientists, and we should all help to be always first class and to keep the impact on our youth intact. I'll be happy to participate in such a process in the future and I am sure that Prof. Claude LECOMTE and Prof. Magatte CAMARA will gladly support the Sudanese participation in the future School of crystallography in Ziguinchor. Thank you for the warm Senegalese Teranga (i.e. hospitality) and stimulating atmosphere during the School, with my personal Best Wishes.

Jamal Eldine Muhammed, Soudan

The 2nd Senegalese School of crystallography exceeded my expectations and I feel deeply honored for having had the opportunity of being there.

Julia BASSILIA from Congo Brazzaville

The course was a well-organized mix of lectures and tutorials given by the tutors, all of whom were very helpful, friendly and always ready to answer any of the student's questions. Practical sessions involved learning on how to solve and refine crystal structures through prepared example structures.

Apart from the lectures, the social component of the school was just wonderful. Students and tutors socialized at every lunch break and dinner had in different restaurants in the town of Ziguinchor. There was also a gala diner which was a lot of fun and a great dinner party at the Hotel restaurant La Marsu in Cap Skirring at the very end of the first week. I thought it was wonderful to have so many different people from all around Africa and Europe getting along so well and enjoying their time together.

Bourayma Adam Gabon

THE COMMISSIONS ON MEDICAL PHYSICS (AC4) AND BIOLOGICAL PHYSICS (C6) – STRENGTHENING THE COOPERATION BETWEEN TWO NEIGHBOUR SCIENCES UNDER THE ROOF OF THE IUPAP

Fridtjof Nuesslin (Chair AC4 "Medical Physics"), Technical University Munich

(A short version of this article has been published in the C6 Newsletter December 2017)

Fridtjof Nuesslin

The International Organization for Medical Physics (IOMP) was founded in 1963 and represents over 25,000 medical physicists worldwide. It has 86 national member organizations. The mission of IOMP is to advance medical physics practice worldwide by disseminating scientific and technical information, fostering the educational and professional development of medical physicists, and promoting the highest quality medical services for patients. IOMP works together with international organizations such as IAEA, WHO and ILO to strengthen the role of Medical Physicists.

In the medical physics community, there are two major groups of individuals. The first group comprises those who are mainly working as health care professionals. These medical physicists are typically found in hospitals with departments for Radiology, Nuclear Medicine, Radiation Oncology, Radiation Protection, Medical Imaging, Physiology, furthermore in many other clinical branches like Neurology, Ophthalmology, Audiology, Anesthesiology etc.

The second group has a much broader scope with major focus on the application of physics principles and methods in biosciences such as biomedicine, biology, and bioinformatics. This field more generally termed Biomedical Physics covers investigations of physical and biological phenomena on molecular, cellular, tissue and organ level. Biomedical Physics interacts closely with Bioinformatics when describing these phenomena, analyzing data, designing models, and performing simulations. Of course, there are smooth transitions between both groups, mainly those persons who are working in academia with responsibilities both in patient care and in research.

In order to advance medical physics science and practice worldwide IOMP felt it essential to strengthen the interaction of medical physics with other branches of physics. Hence, in accordance with the mission of IUPAP (*"...to help in the application of physics toward solving problems of concern to humanity"*) the IOMP formed the International Committee on Medical Physics (IComMP) which has been recognized by the IUPAP as the Affiliate Commission on Medical Physics (AC4).

As stated in the rules of IUPAP (see Bylaws II Commissions) *each commission may propose to the Council up to four associate members*. In case of our commission AC4, it is a well-established tradition to invite the Chair of the C6 Biological Physics to join AC4 as one of such associate members. This tradition began in 2006 with U.Nienhaus (Germany) and continued with R.Grigeras (Argentine), J.Onuchic (USA), K. Yoshikawa (Japan) up to the present Chair C6 Ramin Golestanian (USA).

Why do I claim Medical Physics and Biological Physics are closely associated (neighboring) sciences? Where could the interaction happen across the borders of both disciplines? How could both Commissions contribute to vitalize scientific collaboration between medical/biomedical physics and biological physics? To provide the answers we may firstly ask what the essence of each discipline is. With all ambiguities in mind, one may state that

- **Biological Physics** as part of the biological sciences focuses on phenomena at interfaces of physical and life sciences. Biological Physicists investigate various aspects of vital structures and processes from biomolecules, cells, microorganisms, humans, animals to plants.

- Looking at its conventional priorities, **Medical Physics** is part of health care disciplines applying physical methods to optimize prevention, diagnostics, treatment of and rehabilitation from diseases. However, as mentioned above, the other face of Medical or better **Biomedical Physics** extends over biological sciences including molecular and cell biology, physiology, computational and systems biology, bioinformatics and biomedical computing.

Defining both disciplines in that way, there is obviously evidence for some overlap or better complement of Biomedical Physics and Biological Physics. However, instead of provoking turf battles, it is better to illustrate the mutual relation and the potential of interaction between both sciences with an example particularly relevant for Biomedical and Biological Physics, i.e. Cancer. From my own experience and involvement in cancer research, I want to address a few topics that challenge the physicists to look beyond the fences of their own playground.

Biological aspects of laser based radiotherapy:

Radiotherapy, together with surgery, is the most frequently used modality in cancer treatment. Medical electron linear accelerators deliver X-ray beams in the energy range up to about 20 MeV. To optimize the dose distribution increasing interest arises in the use of particle beams, primarily protons with energies up to 250 MeV. Particle beam generation however is a rather complicated and expensive technology. As an alternative, laser driven ion acceleration is considered a potentially more compact and in the long run cheaper method of delivering ion beams for radiotherapy. Among many problems not yet solved, the biological effectiveness of a laser generated particle beam may be different from the conventional X-ray beam due to the ultra-high intensity of a fms-short laser pulse. Questions arise on the biological response and molecular mechanism of such particle bunch dose rates of 10^{10} Gy/s compared to about 100 Gy/min in conventional medical linear accelerators.

Impact of hypoxia on cancer treatment

The impact of hypoxia on the outcome of cancer treatment is well established. This is true for bulky tumors with significant regions of necrosis as well as for smaller tumors, recurrences and micrometastases. As hypoxic tumor cells are resistant to radiotherapy and many anticancer drugs, it is essential for the

treatment planning to precisely localize the hypoxic subvolumes of the tumor-using radioisotope imaging (e.g. 18F-FMISO, 18F-FAZA, 64Cu-ATSM) and to modulate properly the dose distribution for the radiation treatment. For this purpose, the technology of intensity modulated radiotherapy turned out to be the most effective method. Hypoxia is just one of the reasons of the biological heterogeneity of a tumor requiring research for reliable and effective contrast agents, biomarkers and imaging methods.

Biomedical and Biological Imaging

Medical Physicists are increasingly involved in all imaging methods used in cancer diagnosis such as Magnetic Resonance (MR), Photon Emission Tomography (PET), Computertomography (CT), Ultrasound (US). The link to biochemistry, molecular biology and pharmaceutics is obvious. Beyond this health care aspect, Biomedical Physicists work in experimental cancer research to advance special adapted biological imaging techniques such as optical and opto-acoustic imaging, Nuclear Magnetic Resonance (NMR), MR-Spectroscopy, photoacoustic and molecular ultrasonography, elastography and others. The primary aim of these techniques in cancer research is to investigate the properties of tumors and tumor environment at cellular, subcellular and molecular level.

Radiomics, Radiogenomics

Radiation oncology has developed towards an imaging driven discipline. The diagnosis, treatment and follow-up phase are based on an ever-increasing number of images for each individual patient. However, currently descriptive and qualitative techniques dominate the clinical use of images whereas the complete digital content of images is typically not used in routine. Recently, a new approach has been introduced to develop standard operating procedures to convert these qualitative clinical images into minable data which are associated with patient demographic, outcome and gene expression databases. Based on properly selected imaging features methods of deep learning may be applied to personalize the selection of the treatment mode and to predict the treatment outcome.

Optimization of the treatment itself and cost effectiveness of health care by means of this approach of comprehensive individual data analysis including genomic data is envisaged.

The above examples are just a limited number of activities of Biomedical Physicists working in the large field of cancer research. I am sure that the colleagues from Biological Physics when for instance collating topics relevant for the rather new field in Biological Physics "Physics of Cancer" we would find quite a few areas that might complement those examples of Biomedical Physics in Cancer.

Finally, as good neighbors or complementary subjects, we should think about some joined activities. In the past, Biomedical Physicists and Biological Physicists exchanged ideas at conferences (ICBP, IOMP) and organized three joint symposia, beginning 2007 in Montevideo (*"Cellular & Tissue Imaging: challenges for modern radiotherapy"*). Commissions AC4 and C6 may consider this kind of mutual exchange and look out for opportunities.

IUPAP YOUNG SCIENTIST PRIZE 2017

International Commission on Optics (AC1)

Guilia Grancini

"For her deep knowledge on photophysical properties and ultrafast light-induced dynamical processes."

Giulia Grancini is Team Leader at the École Polytechnique Fédérale de Lausanne (EPFL) – Energypolis, currently based in Sion (Valais, Switzerland). She graduated from Politecnico of Milan in 2008 (MS in physical engineering). In 2012, she obtained her PhD in physics cum laude from the Politecnico of Milan with an experimental thesis focused on the realization of a new femtosecond-microscope for mapping the ultrafast phenomena at organic interfaces (see scheme below). During the PhD, she worked for one year as a visiting scientist at the physics department of Oxford University, where she pioneered new concepts within polymer/ oxide solar cell technology.

From 2012–2015, she has been a post-doctoral researcher at the Italian Institute of Technology (CNST@PoliMi) in Milan. In 2015 she joined the group of Prof. Nazeeruddin at EPFL, awarded with a Marie Skłodowska-Curie Fellowship. For her seminal contributions in the field of photophysics of hybrid perovskites, she received in October 2015 the prestigious National Award for Physics "EDISON, in memoria di Francesco Somaini" from the Edison Company & Alessandro Volta Foundation. Since 2016, she leads the PhysicsSolarLab at EPFL, aiming to address the fundamental physics behind advanced photovoltaic devices. In 2017, she was awarded with the Swiss Ambizione Energy Grant, which provides independent young researchers with up to 1 million CHF for leading innovative projects in the energy sector. Currently, she is also principal investigator of an European LaserLab project and co-manager of different Swiss projects with academic and industrial partners. She is author of more than 60 peer-reviewed scientific papers including a few in high-impact journals (more than 6000 overall citations) on the photophysical and optical properties of nano-structured semiconductors.

Giulia's work focuses on the current scientific challenge of exploring the fundamental photophysical processes underlying the operation of advanced materials for optoelectronic application, with special attention to photovoltaics. She contributed with pioneering work to the understanding of the ultrafast interface physics that governs the operation of organic and hybrid perovskite solar cells. Examples include the visualization of the charge transfer and exciton dissociation dynamics involved in the photovoltaic action by developing state-of-the-art sub 10-fs ultrafast spectroscopy systems and the determination of the nature of the photoexcited species in hybrid

perovskites and their dynamical evolution in the femtosecond/nanosecond timescale. Her works have been highly cited and recognized by the research community to be of utmost importance for guiding the development of efficient new generation solar technologies.

Giulia Grancini was awarded the IUPAP Young Scientist Prize in Optics 2017 for her "deep knowledge on photophysical properties and ultrafast light-induced dynamical processes".

For more information, visit https://people.epfl.ch/giulia.grancini?lang=en

IUPAP YOUNG SCIENTIST PRIZES 2018

Commission on Magnetism (C9)

Shinichiro Seki

"For discovery of multiferroic behavior and electrically controllable skyrmions in insulating chiral magnets."

Dr. Shinichiro Seki has been a Unit Leader in Center for Emergent Matter Science (CEMS) at RIKEN since 2013. He received his PhD degree in applied physics from the University of Tokyo in 2010. He was appointed Research Associate in 2010 and Lecturer in 2012 at Department of Applied Physics, the University of Tokyo. His area of interest is search of novel materials and phenomena associated with exotic spintronic functions. Dr. Seki is the recipient of the Young Scientists' Prize by the Minister of Education, Culture, Sports, Science and Technology in Japan, and the Young Scientist Award of the Physical Society of Japan.

Commission on Particles and Fields (C11)

Jaroslav Trnka (Theory)

"For the discovery and exploration of new physical and mathematical principles underlying the dynamics of particle scattering amplitudes in a wide range of theories."

Jaroslav Trnka is an Assistant Professor at the Department of Physics, University of California, Davis. He graduated from the Charles University in Prague in 2008, and received his PhD from Princeton University in 2013. He was a David Ellen Lee Postdoctoral Fellow at the California Institute of Technology before moving to UC Davis as a founding member of the Center for Quantum Mathematics and Physics (QMAP). His research has been focused on the development of new methods for calculating scattering amplitudes of elementary particles.

Heather Gray (Experimental)

"For her broad and creative contributions as well as leadership in performance and physics analysis in the ATLAS experiment and beyond, culminating in her strong role in the searches and initial measurements of Higgs boson interactions with quarks."

Heather Gray received her undergraduate education at the University of Cape Town in South Africa. She then obtained her PhD from the California Institute of Technology in Pasadena in the USA in 2011. She worked as a fellow and a research staff scientist at CERN in Switzerland until 2017. She is currently a Divisional Fellow in the physics division at Lawrence Berkeley Laboratory in the USA. She has been a member of the ATLAS collaboration since 2006. Her research program includes studying the coupling of the Higgs to fermions, track reconstruction algorithms and performance, detector simulation and silicon pixel detectors.

Commission on Atomic, Molecular and Optical Physics (C15)

Alexey Gorshkov

"For his outstanding contributions on quantum properties of interacting cold atoms, cold dipolar matter, quantum optics, quantum transduction, and quantum simulations."

Alexey Gorshkov received his A.B. and PhD degrees from Harvard in 2004 and 2010, respectively. In 2013, after three years as a Lee A. DuBridge Postdoctoral Scholar at Caltech, he became a staff physicist at NIST. At the same time, he started his own research group at the University of Maryland, where he is a fellow of the Joint

Quantum Institute and of the Joint Center for Quantum Information and Computer Science. His theoretical research is at the interface of quantum optics, atomic physics, condensed matter physics, and quantum information science. One of the main long-term goals of his theoretical research group is to understand and control large interacting quantum systems, as well as to design and create new ones. Applications of his research include quantum computing, quantum communication, and quantum sensing.

Commission on Plasma Physics (C16)

Eleonora Viezzer

"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."

Eleonora Viezzer studied physics and mathematics at the Leopold-Franzens University of Innsbruck and at the Ludwig-Maximilian University of Munich. She did her PhD thesis "Radial electric field studies in the plasma edge of ASDEX Upgrade" at the Max Planck Institute for Plasma Physics in Garching, Germany and received her doctorate from the Ludwig-Maximilian University of Munich in 2013. During her PhD thesis she built a high-resolution edge charge exchange recombination spectroscopy diagnostic suite which allowed her to unravel the nature of the radial electric field and the existence of poloidal impurity asymmetries. Following her thesis work, she did a Postdoc at the Max Planck Institute for Plasma Physics with a EUROfusion Researcher fellowship. In 2016, she started her academic career with a tenure track position and a Marie Sklodowska Curie grant at the University of Seville where she is currently leading a research group on tokamak plasma edge physics.

International Commission on General Relativity & Gravitation (ISGRG – AC2)

Samuel E Gralla

"For his exceptional and broadly varied contributions to general relativity and relativistic astrophysics."

Sam Gralla received his PhD from the University of Chicago in 2011 and held postdoctoral appointments at Maryland (2011-2014) and Harvard (2014-2015) before joining the faculty of the University of Arizona in Fall 2015. His early work focused on the motion of small bodies in general relativity and other classical field theories, including foundational work on self-force effects relevant for gravitational-wave astronomy. He has since branched into two main directions: the use of spacetime techniques to model strong-field plasma dynamics near neutron stars and black holes, and theoretical studies of extremal black holes and their observational signatures. Recent highlights include the discovery of unique gravitational-wave and electromagnetic signatures of rapidly rotating black holes.

Gralla was the recipient of an Einstein fellowship in 2011 and has been awarded an NSF CAREER grant to begin in 2018. Gralla is also known as a superb communicator, having received three speaking awards as a student, including the Hartle prize awarded by this commission. A video recording of his 2017 lecture "Rethinking Reality: Space, Time, and Gravity" [link: https://www.youtube.com/watch?v=Dn33_ySzB-w&t=1795s] has been viewed more than 100,000 times in its first year on YouTube.

Commission on Computational Physics (C20)

Noa Marom

"For advancing the prediction of the structure and properties of molecular crystals from 6irst principles by developing algorithms for con6iguration space exploration, combined with many-body perturbation theory methods for electronic excitations."

Noa Marom received a B.A. in Physics and a B.S. in Materials Engineering, both Cum Laude, from the Technion-Israel Institute of Technology in 2003. From 2002 to 2004 she worked as an Application Engineer in the Process Development and Control Division of Applied Materials. In 2010 she received a PhD in Chemistry from the Weizmann Institute of Science. She was awarded the Shimon Reich Memorial Prize of Excellence for her thesis. She then pursued postdoctoral research at the Institute for Computational Engineering and Sciences (ICES) at the University of Texas at Austin. From 2013 to 2016 she was an Assistant Professor in the Physics and Engineering Physics (PEP) Department at Tulane University. In 2016 she joined the Materials Science and Engineering Department at Carnegie Mellon University as an Assistant Professor. She holds courtesy appointments in the Department of Chemistry and the Department of Physics. She is a member of the Pittsburgh Quantum Institute (PQI) and an affiliate of the Scott Institute for Energy Innovation. She has recently received the Sanibel Symposium Young Investigator Award, the NSF CAREER Award, the DOE INCITE Award (2017,2018), and the Charles E. Kaufman New Investigator Award. For more information: www.noamarom.com

UPCOMING SUPPORTED CONFERENCES (JUNE–SEPTEMBER 2018)

24 June–14 July 2018 Namibia
The African School of Fundamental Physics and Applications (ASFPA 2018)

25 June–31 July 2018 Tokyo, Japan
International Symposium on Quantum Fluids and Solids (QFS2018)

1–7 July 2018 Rome, Italy
Fifteenth Marcel Grossman Meeting on General Relativity (MG 15)

2–6 July 2018 Dodoma, Tanzania
Entrepreneurship Workshop for Scientists and Engineers (IWSE 2018)

4–11 July 2018 Seoul, Korea
International Conference on High Energy Physics (ICHEP 2018)

8–13 July 2018 Paris, France
Conference on Precision Electromagnetic Measurements (CPEM 2018)

9–13 July 2018 Caen, France
22nd International Conference on Few-Body Problems in Physics (FB 22)

16–20 July 2018 Providence, RI, USA
12th International Conference "Identification of Dark Matter 2018" (IDM 2018)

22–27 July 2018 Santa Cruz California, USA
International Colloquium on Magnetic Films and Surfaces (ICMFS 2018)

22–27 July 2018 Barcelona
ICAP 2018 International Conference on Atomic Physics (ICAP 2018)

23–27 July 2018 Madrid, Spain
International Conference of Superlattices, Nanostructures and Nanodevices (ICSNN 2018)

23–28 July 2018 Montreal, Canada
XIX International Congress on Mathematical Physics (ICMP 2018)

29 July–2 August 2018 California, USA
Conference on Computational Physics 2018 (CCP2018)

19–24 August 2018 Beijing, China
12th International Conference on Materials and Mechanisms of Superconductivity(M2S-2018)

19–24 August 2018 Saskatchewan, Canada
14th International Conference on X-ray Microscopy (ICXRM2018)

26–31 August 2018 Aarhus, Denmark
34th European Conference of Surface Science (ECSS 2018)

3–7 September 2018 Lisbon
19th International Conference on the Physics of Highly Charged Ions (HCI 2018)

17–28 September 2018 Cracow/Krakow, Poland
International Conference on Magnetism (ICM 2018)

25–28 September 2018 Dubna, Russia
8th International Symposium on Very Large Volume Neutrino Telescopes (VLVNT 2018)

UPCOMING ENDORSED COMMISSION CONFERENCES (JUNE–SEPTEMBER 2018)

7–12 July 2018 Valencia, Spain
22nd International Conference on Relativity and Gravitation & the 13th Eduardo Amaldi Conference on Gravitational Waves

14–22 July 2018 California, USA
42nd COSPAR Scientific Assembly and Associated Events (COSPAR)

25–31 July 2018 Sicily
New Trends in Nonequilibrium Statistical Mechanics: Classical and Quantum Systems (NTNSMCQ 2018)

30 July–3 August 2018 Moscow, Russia
10th International Workshop on Ring Imaging Cherenkov Counters (IWRICC 2018)

27 August–21 September 2018 Les Houches, France
Active Matter and Non-Equilibrium Statistical Physics (AMNSP 2018)

2–7 September 2018 Cassis, France
International Quantum Cascade Lasers School and Workshop (IQCLSW) 2018

5–7 September 2018 Paris, France
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16–21 September 2018 Geneva, Switzerland
28th International Conference on Electromagnetic Isotope Separators and Related Topics (EMIS 2018)

17–22 September 2018 Dubna, Russia
The XXIV International Baldin Seminar on High Energy Physics Problems "Relativistic Nuclear Physics and Quantum Chromodynamics" (BALDIN 24)