International Union of Pure and Applied Physics

MARCH 2019

Newsletter

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THE PRESIDENTS' MESSAGE

2019 is the 150th anniversary of Mendeleev's paper on the Periodic Table, and the IUPAP is one of the supporters of the International Year of the Periodic Table (IYPT), celebrating this important scientific milestone. The IYPT was launched at UNESCO in Paris on 29th January 2019, and the three of us had a part in the launch. It was emphasised that all of the elements are made in nuclear reactions, and that all of those which have been discovered since 1939, have been made in contemporaneous nuclear reactions. Highlights included, an account of the recent discoveries up to element 118 - Oganesson by Yuri Organessian (Mr Element 118); an account of the Origin of the Elements in Outer Space by the 118 Kavali Prize Laureate and President of the International Astronomical Union, Ewine van Dishoeck; and a description of the production of radioisotopes and their uses in medical diagnosis and therapy by Alinka Lépine-Szily, the past Chair of the IUPAP Commission C12 for Nuclear Physics.

The opening ceremony was run at the time the program,"Journeys from Alchemy to Chemistry" was being attended by thousands of French elementary school children. This featured a short animated film narrated by Professor Jim Al-Khalili, who also will deliver a public lecture on Nuclear Physics and the Making of the Modern Periodic Table at the 27th IUPAP International Conference on Nuclear Physics in Glasgow on 30th July 2019. This public lecture will be a highlight of the IUPAP activities to celebrate the IYPT.

The leading sponsor of the IYPT is, as you would expect, the International Union of Pure and Applied Chemistry (IUPAC) and another, like IUPAP, is the International Astronomical Union (IAU). Both of these Unions, IUPAC and IAU, are celebrating their centenaries this year, and we warmly congratulate them on this important occasion, as we did during the opening celebrations of the IYPT. We are working to develop closer relations with these and other kindred Unions. The operations of the newly formed International Science Council, of which we are all members, will benefit if we can strengthen these links. We are also looking forward to the participation of all of them in the International Year of Basic Sciences for Development in 2022 or 2023.

Our organization and its activities depend on our members who provide the finances and the man-power. As we approach our centenary in 2023, we thank them for their support, and we are working to ensure that they are getting what they hope for when they make these contributions to us, and to find out how they feel we should develop in our second century.

Remember that the mission of IUPAP is, *'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'.* We can do this fully, only when all of the nations and regions which are contributing to the development of physics, and which can benefit from the physics in their society, become members of the IUPAP. Our Vice President at Large with the responsibility for New Members is leading our efforts to bring new members into our Union, and to reinstate past members who now have Observer Status. Watch these pages for exciting announcements.

Kennedy Reed, *President*
Michel Spiro, *President Designate*
Bruce McKellar, *Past President*

IOMP-IUPAP Workshop "Medical Physics Partnering with the Developing World", 2018

Slavik Tabakov (Past-President, IOMP)

The cooperation between IUPAP and the International Organization for Medical Physics (IOMP) continues for more than 10 years. The fifth jointly sponsored IOMP-IUPAP Workshop, dedicated to medical physics development in the Low and Middle Income countries (LMIC) – aka developing countries, took place at the World Congress on Medical Physics and Biomedical Engineering WC2018, Prague, Czech Republic. The Congress is under the aegis of the International Union for Physical and Engineering Sciences in Medicine (IUPESM), the Union between IOMP and its sister organization IFMBE.

The Workshop was co-organised by the then members of IOMP ExCom: S Tabakov (IOMP President), Y Pipman (Chair PRC of IOMP), L Judas (WC2018 Co-President), F Nuesslin (IUPAP AC4 Chair). The Workshop also included speakers from the International Atomic Energy Agency (IAEA) and the World Health Organisation (WHO).

The IOMP/IUPAP Workshop "Medical Physics Partnering with the Developing World" attracted around 90 participants from 23 countries. About 3/4 of the participants were from LMIC, including the most senior medical physicist representatives from Africa, Latin America and Asia.

The Workshop discussed the current situation and professional development in all continents (submitted by the IOMP Regional Organisations). The programme included an overview of the current global situation and needs of medical physicists. This

Some of the lecturers and participants at the IOMP-IUPAP Workshop "Medical Physics Partnering with the Developing World", Prague, 2018

was followed by presentations from the regions, delivered by the senior colleagues from LMI countries, supported by IOMP/IUPAP grant.

Special emphasis was made to the future inclusion of medical physicists in the healthcare provision in the LMIC, resulting to a need of almost tripling the number of medical physicists globally by 2035. The need of further partnering with the colleagues from LMIC was underlined and the Workshop was praised as an important step in this direction.

The presented papers from the IOMP Regional Organisations in Asia (AFOMP); South-East Asia (SEAFOMP); Middle-East (MEFOMP); Europe (EFOMP); Africa (FAMPO); Latin America and Caribbean (ALFIM) were published at the IOMP Journal Medical Physics International (issue December 2018) and are available free from: www.mpijournal.org

At the end of the Workshop the IUPAP Chair AC4, the IOMP Officers and all speakers and participants expressed their sincere gratitude for the support from IUPAP and IOMP, as well as for these regular IOMP-IUPAP activities dedicated to professional development in the LMIC. The next joint Workshop is planned for the International Conference on Medical Physics in Chile, September 2019.

LAAAMP Enters Year Three

Sekazi K. Mtingwa (SKM), Sandro Scandolo (SS), Michele Zema (MZ)
LAAAMP Executive Committee

Lightsources for Africa, the Americas, Asia and Middle East Project (LAAAMP), led by IUPAP and the International Union of Crystallography (IUCr) just closed out its second year of operations and is off to a fast start in Year 3. LAAAMP's targeted regions are Africa, Mexico, the Caribbean, Southeast Asia, and Middle East. At conception, LAAAMP identified five tasks to pursue, namely:

(1) conduct a survey of crystallography and advanced light source (AdLS) users in the targeted regions and develop a **Strategic Plan** for each;

(2) send seasoned AdLS users to the targeted regions under the **Colloquium Programme** to enhance researchers' knowledge of crystallography and AdLSs and how they can be of benefit in their research and training of students, and become a partner in the launch of IUCr-UNESCO-LAAAMP OpenLabs, which is a network of operational crystallography laboratories in developing countries;

(3) develop and disseminate an informational, nontechnical brochure that explains the tremendous dividends derived from crystallography and AdLS research and training;

(4) send **FAculty-STudent (FAST)** Teams to any of the sixteen AdLS partners around the world for two months of training, mainly on the beamlines, and when possible, allow them to continue the training for another two months the following year; and finally

(5) convene a meeting at UNESCO Headquarters in Paris at the end of the year 2019 to present the Strategic Plans and launch more detailed Business Plans that include feasibility studies of constructing AdLSs in regions where they do not currently exist.

Year 3 began with a major push on concluding the survey, which is posted on the LAAAMP Website at https://laaamp.iucr.org/. To assist in this effort, Dorian Bohler, a staff physicist at the SLAC National Accelerator Laboratory, joined the LAAAMP team to identify those researchers in the targeted regions who should submit responses to the survey and assist with the development of the Strategic Plans in the regions.

X-TechLab

A huge success of the Colloquium Programme stems from Thierry d'Almeida's visit to his home country of Benin. A member

of the LAAAMP Steering Committee and currently employed as a senior research engineer at France's Commissariat à l'Energie Atomique, d'Almeida traveled to Benin from 30 April to 7 May 2018 to deliver a series of lectures on AdLSs, related techniques and their relevance to specific issues of interest in Africa, and his own synchrotron-based research. Jean-Pierre Ezin, a member of LAAAMP's Regional Committee for Africa and former African Union Commissioner for Human Resources, Science and Technology, arranged for the venues of the lectures to be at the Institut de Mathématiques et Sciences Physiques (IMSP) in Porto-Novo and at the Université de Abomey-Calavi (UAC) in Cotonou.

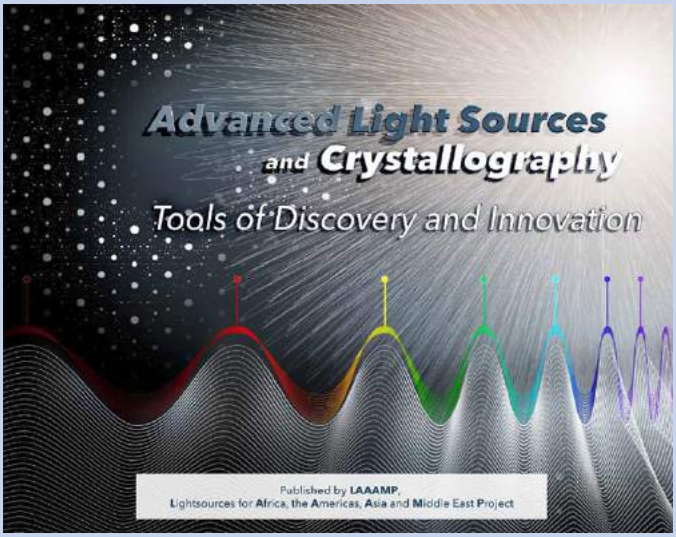
While in Benin, d'Almeida met Claude Borna, who is the Scientific Advisor to Benin's President Patrice Talon. She arranged for d'Almeida to return to Benin for a one-hour meeting on 12 September 2018 with President Talon and his Cabinet. She also arranged for d'Almeida to meet with President Talon two days prior to that meeting, during which time he acquainted President Talon with various initiatives, including LAAAMP, the African Light Source, and his own idea to establish a crystallography training program in Benin to benefit students from Benin and neighboring countries. The latter idea, which d'Almeida dubbed X-TechLab, highly impressed President Talon, who indicated that that is precisely the kind of initiative that he has been seeking, and hence pledged his government's support for the project. Subsequently, X-TechLab was allocated space in Sèmè City, which is between Cotonou and Porto-Novo and is being established as a high-tech hub for Benin.

According to d'Almeida, the mission of X-TechLab is to create a center of training for a new generation of crystallographers. Students participating in X-TechLab will train for 2 weeks, twice per year. The first 2 weeks will focus on theoretical material and introductory demonstrations, while the second 2 weeks will be more detailed and specific. Approximately 50 IMSP students will train, with an additional 60 students from UAC and other institutions, both from inside Benin and neighboring countries, such as Nigeria, Togo, Niger and Burkina Faso, i.e., a total of approximately, 110 Masters and Ph.D. students per year. With support from LAAAMP, the government of Benin, and the World Bank's Africa Higher Education Centres of Excellence (ACE) program, d'Almeida; Marielle Agbahoungbata X-TechLab Co-Leader, who is presently at the University of Zurich; Ezin; and one of the authors (MZ) are working with colleagues in Benin to acquire discounted single crystal and powder diffractometers from Bruker AXS and a dry-air cryostat from Oxford Cryosystems. While Cambridge Crystallographic Data Centre will provide free access to the Cambridge Structural Database for a period of three years, IUCr will provide free access to all IUCr Journals and the International Tables for Crystallography for a period of three years. The first X-TechLab training session is set to begin on 13 May 2019, with d'Almeida, Agbahoungbata, MZ and Claude Lecomte, who chairs IUCr's Crystallography in Africa Initiative, as the lead instructors.

Thierry d'Almeida Addresses Benin President Patrice Talon's Cabinet (Photo Courtesy of Government of Benin)

LAAAMP Brochure

The brochure, entitled Advanced Light Sources and Crystallography: Tools of Discovery and Innovation, recently underwent a second printing. It is available on the LAAAMP Website in English, Spanish and French, with the International Atomic Energy Agency (IAEA) donating the latter two translations. Ernie Malamud, the brochure editor, currently is in discussions with IAEA about them donating the next translation into Arabic. Hardcopies of the brochure have been in great demand at conferences. Indeed the brochure has been extremely helpful in educating the public and governmental officials about the tremendous benefits derived from crystallography and AdLSs.



Cover of LAAAMP Brochure

FAST Teams

Perhaps the most high-profile LAAAMP initiative is its (FAculty-STudent) FAST Team program. For this, LAAAMP disseminates a solicitation each year calling for faculty with less than a year's experience with AdLSs to apply with a Ph.D. student to spend two months at one of the 16 LAAAMP AdLS partners. LAAAMP provides airline tickets and partial meal expenses, while the AdLSs provide housing and additional partial meal expenses. One of the authors (SS) oversees the travel arrangements through the Travel Office of the Abdus Salam International Centre for Theoretical Physics. During 2018, LAAAMP and the AdLSs awarded grants to 16 FAST Teams, and they anticipate supporting 15 FAST Teams in 2019, for a total of 30 individuals receiving awards. Where possible, LAAAMP allows previous awardees to participate for another two months during the year following the first award.

Kirsi Lorentz and her research team (from left to right: Yuko Miyauchi, Grigoria Ioannou, Kirsi Lorentz and Iosif Hafez) at the XAFS/XRF beamline control hutch (© Kirsi Lorentz, The Cyprus Institute)

It is important to note that LAAAMP does not compete with regional AdLS initiatives. On the contrary, it helps to facilitate them, especially via its FAST Team training program and assists in developing Strategic Plans. For example, Kirsi Lorentz and her graduate student, Grigoria Ioannou, from the Cyprus Institute were LAAAMP FAST Team awardees in 2017 and 2018 at the European Synchrotron Radiation Facility (ESRF), where Jean Susini and colleagues hosted them. Their team became the first users at SESAME in Jordan, where they obtained paleontology data on the XAFS/XRF beamline.

2nd African Light Source Conference and Workshop (AfLS2)

Another important example of LAAAMP's assistance to local efforts, is the African Light Source initiative, which has been incorporated as a nonprofit foundation under the laws of South Africa with Simon Connell of the University of Johannesburg as Chair and one of the authors (SKM) as Deputy Chair.

From 28 January-2 February, the foundation convened a conference and workshop at the University of Ghana-Legon, located just outside the capital city of Accra. Leading the Organizing Committee were Connell as Chair and Prosper Ngabonziza, originally from Rwanda and currently employed at the Max Planck Institute for Solid State Research, as Vice-Chair. AfLS2 convened jointly with the 2nd Pan-African Conference on Crystallography (PCCr2) with the University of Ghana's Robert Kingsford-Adaboh, Benjamin Agyei-Tuffour and David Dodoo-Arhin leading the local organisation. There were approximately 250 attendees, with Francesco Sette, Director General of the ESRF being among them. Kwabena Frimpong Boateng, Ghana's Minister of Environment, Science, Technology and Innovation, delivered a message from Ghana's President Nana Addo Dankwa Akufo-Addo, in which the President announced that he will champion the African Light Source to make it an official project of both the African Union and the Economic Community of West African States. According to President Akufo-Addo's statement, 'A light source is a seed and magnet for high tech industry and all kinds of associated research institutions in all fields. It would be the most important, common, shared, very-large scale, scientific infrastructure for Africa'.

Also in attendance were Richard Catlow, Foreign Secretary of the Royal Society UK, and Felix Dapare Dakora, President of the African Academy of Sciences (AAS). One of the outcomes of the Workshop part of the meeting is that the AAS with support from the Royal Society will take a leading role in advocating for an African Light Source among top African and European governments and funders, with special attention paid to the African Union.

Three important recommendations from the Workshop and emphasized by Connell are that African countries should form three kinds of consortia:

- the first consortium to become a collaborative member of an existing AdLS,
- the second to construct a collaborative multinational beamline at an existing AdLS, and
- the third to establish four regional research centres for research and training in crystallography and AdLSs in Northern, Eastern, Western and Southern Africa.

Finally, a decision was made, to collaborate with partners across Africa to develop local researchers' sample preparation and screening feeder facilities prior to taking those samples to AdLSs for data acquisition. It was noted, that the African Laser Centre (https://www.africanlasercentre.net/) is already an extensive network of laser laboratories across the African continent and could serve as the foundation for enhancing local feeder infrastructures.

A special treat during one of the joint plenaries was a lecture by Sir Thomas Blundell, entitled Structure-guided Fragment-based Drug Discovery for Cancer and Tuberculosis: Fighting the Emergence of Resistance. He gave an interesting historical account of his experiences with drug discovery, dating from his early days working in the laboratory of chemistry Nobelist Dorothy Hodgkin.

On the Pan-African Crystallography side of the conference, a major feature was the installation of another IUCr-UNESCO-LAAAMP OpenLab, led by one of the authors (MZ) and Claude Lecomte. Many students participated in the lectures and demonstrations using diffractometer equipment provided by the three organisations and the Bruker AXS.

AfLS2/PCCr2 Group Photo

Mexican Light Source

Another regional initiative to which LAAAMP is providing assistance is the Mexican Light Source. To realize that goal, on 25 November 2018, the Governor of the Mexican State of Hidalgo, Omar Fayad, announced plans to construct an AdLS in his state. He appointed Herman Winick of Stanford University and originator of the idea for SESAME, President of the Strategic and International Scientific Advisory Council to lead the effort. Moreover, he named Lamán Carranza, Hidalgo's Secretary of Planning and Prospective, to lead the local effort within Mexico. The hope is that Mexico's newly elected President, Andres Manuel Lopez Obrador, will embrace the goal of bringing an AdLS to Mexico. To seed the effort, Governor Fayad approved 25 million US dollars to begin planning. Matías Moreno of the Universidad Nacional Autónoma de México and Chair of LAAAMP's Regional Committee for Mexico has worked diligently over the past decade to lay much of the foundation for this effort.

The LAAAMP Executive Committee continues to reach out to the international community to spread the word of its activities. During 27-30 November 2018, author SKM traveled to the University of the West Indies-Mona Campus outside Kingston, Jamaica to attend the 21st General Meeting and Conference of the Caribbean Academy of Sciences (CAS) in celebration of the 30th Anniversary of CAS and 70th

L to R: Robert Lancashire, CAS Foreign Secretary, Professor of Chemistry Emeritus (University of the West Indies, Mona Campus, Jamaica), Tara Dasgupta, CAS Jamaica Chapter President, Professor of Chemistry Emeritus (University of the West Indies, Mona Campus, Jamaica), Winston Mellowes, CAS President, Professor Emeritus of Chemical Engineering (University of the West Indies, St. Augustine, Trinidad and Tobago), Sekazi Mtingwa, LAAAMP Chair of Executive Committee, TriSEED Consultants, USA

Anniversary of the University of the West Indies. There was tremendous interest in the LAAAMP FAST Team program, and thus LAAAMP was able to communicate its activities to more nations throughout the Caribbean.

In another outreach effort, on 29 January 2019, author SS attended the Periodic Table and Sustainable Development Goals Session at the Opening Ceremony of the International Year of the Periodic Table 2019 at UNESCO's Headquarters in Paris. During his address, he described LAAAMP as an example of international collaboration.

The future is bright for LAAAMP. In anticipation, it has launched its 2019 fundraising campaign so that it can continue its activities beyond the December 2019 conclusion of the International Science Council grant that has provided the bulk of the funds for its activities to this time.

There is more to come! So, stay tuned for the LAAAMP wrap up of Year 3 at its December 2019 meeting at UNESCO Headquarters in Paris.

Sandro Scandolo at UNESCO's Opening Ceremony of the International Year of the Periodic Table 2019

Atomic Engineering of Advanced Gallium Nitride Ultraviolet-to-Terahertz Photonics

Can Bayram (2018 AC1 YSP winner), *Innovation COmpound semiconductoR LABoratory (ICORLAB), University of Illinois at Urbana-Champaign*

Prof. Can Bayram from University of Illinois at Urbana-Champaign, IL, USA was awarded the 2018 IUPAP Young Scientist Prize in Optics "for revolutionizing the way graphene has been employed and making major contributions to III-V photonic devices."

At University of Illinois, Prof. Bayram explores novel materials, devices, and their 3D hetero-integration on unconventional platforms such as graphene and silicon and investigates heat transport across/through semiconductors; efficiency droop mechanisms and remedies in AlInGaN emitters; and ultra-fast THz photonics/electronics.

In the visible spectrum, Prof. Bayram **explores a novel approach that can address the "green gap" and "droop" problems**, which are major bottlenecks to the worldwide adoption of conventional and advanced solid-state lighting (SSL). Thus far, research on blue and green LEDs has been focusing on hexagonal (six-fold symmetry) (h-) LEDs because of natural crystallization of III-nitrides (e.g. (In)GaN) in that form. Prof. Bayram, recently, **invented a new method to synthesize cubic (four-fold symmetry) (c-) phase GaN materials for the use of cubic III-nitrides in photonic devices.** Based on the fact that h-crystal <0001> direction and c-crystal <111> directions are equivalent, his team demonstrated that if two h-phase growth fronts merge within a degree of ~110° (i.e. the angle between the two Ga-N bonds in the hexagonal tetrahedral bonding), a c-phase will form. Most recently, this novel approach enabled cubic GaN with high internal quantum efficiency of 29% on a CMOS-compatible Si(100) substrate via nano-patterning [ACS Photonics 5 (3), 955–963 (2018)]. In theory, c-phase LEDs have other advantages over h-phase LEDs, including smaller effective masses, smaller Auger losses, higher drift velocity, higher carrier mobility, higher doping efficiency, and higher optical gain, promising to solve the **droop and green gap problems in conventional and advanced SSL.**

Prof. Bayram worked as a Postdoctoral Research Scientist in the Silicon Technologies Division at the IBM Thomas J. Watson Research Center, Yorktown Heights, NY, USA from 2011 till 2014. His postdoctoral work at IBM on a novel means of thin film technology achieved record-breaking specific power solar cells and was featured on the cover of Advanced Energy Materials. He has – for the first time – integrated GaN-based devices on CMOS-compatible silicon substrates. This work was highlighted as the frontispiece in the Advanced Functional Materials issue. Most notable, Prof. Bayram demonstrated direct epitaxy of GaN on Graphene for the first time, as published in Nature Communications, and revolutionized the way graphene has been employed. Despite having many superior electrical properties, graphene has not had a significant impact in electronics yet due to the absence of a band gap. Instead of focusing on electrical properties, Prof. Bayram exploited another unique property of graphene; graphene is crystalline and it does not form strong bonds with other materials. This thought process led him to develop the technique for growing high cost semiconductors on graphene. In this aspect, in Nat. Comm. 5: 4836 (2014) four major breakthroughs are reported as (1) Large scale epitaxial growth of "single crystalline" GaN on graphene (one [0001] orientation), (2) Exfoliation of entire single crystalline GaN film from the graphene template and dry-transfer onto a Si substrate, (3) Multiple growth/transfer of GaN by the reuse of a single graphene template, and (4) Fully-functional single crystalline and flexible III-nitride blue LEDs on plastic. This work is of wide interest for the scientific community and even in the general public sector because the results show a new paradigm for graphene-based technology. Also, immediate impact on the scientific society is expected

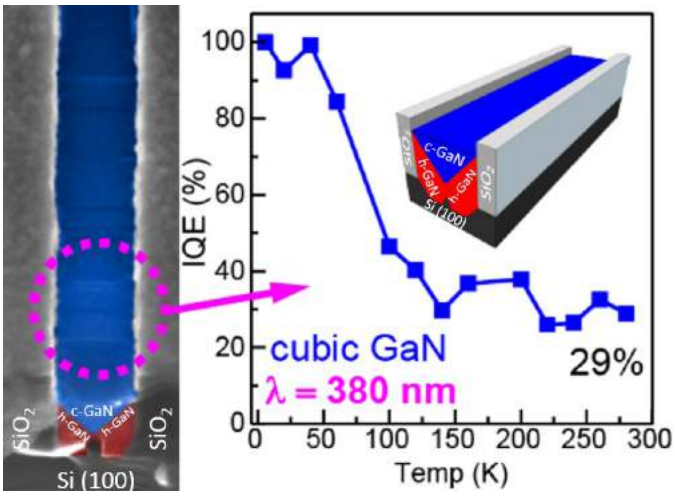


Figure 1. Cubic GaN demonstrates an internal quantum efficiency (IQE) of ~29% at an ultraviolet (UV) wavelength of 384 nm at room temperature. This graphic demonstrates the process of phase transition of hexagonal (h-)GaN (red) to cubic (c-) GaN (blue) through the composite SEM image of these U-shaped grooves. The temperature-dependent IQE of the UV emission (λ ~ 384 nm) from the U-shaped groove (magenta circle), which has pure cubic GaN on the surface, is shown on the right with a 3D drawing of the U-groove as the inset. The room-temperature IQE of 29%, which is a major finding, is labeled. [adopted from ACS Photonics 5(3), 955 – 963 (2018)]

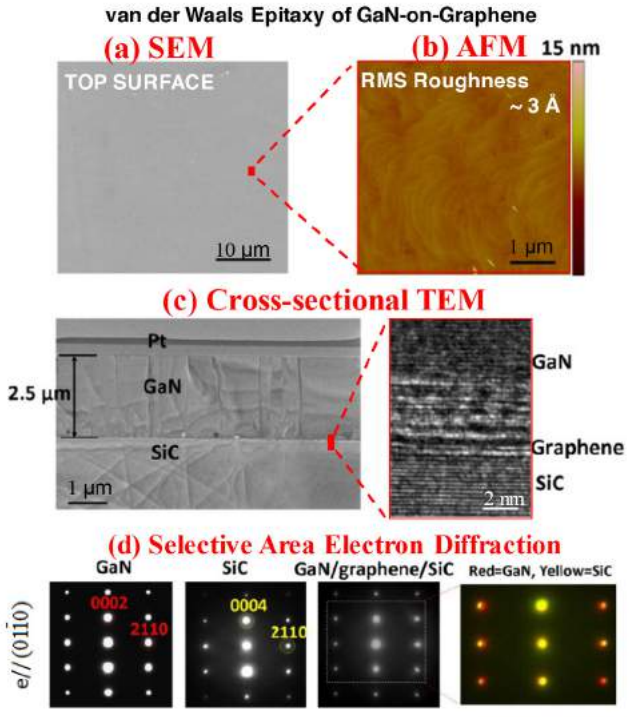


Figure 2. 3D-on-2D technology as exemplified by GaN-on-Graphene. High quality GaN layers are grown on epitaxial graphene. (a) Scanning electron and (b) atomic force microscopy images reveal atomically smooth surfaces. (c) Cross-sectional transmission electron microscopy and (d) selective area electron diffraction reveal crystallographic arrangement between the layers. [adopted from Nat. Comm. 5: 4836 (2014)]

since the concept of semiconductor growth and transfer by using a graphene template could be generally applied for many other 3D and 2D materials. This work in Nat. Comm. already received 120+ citations (within four years).

Prof. Bayram also invented novel ZnO-InGaN hybrid green LED [Appl. Phys. Lett. 93, 081111 (2008)], held the world record output power for ultraviolet LEDs on silicon platform [Appl. Phys. Lett 102, 011106 (2013)], and contributed to the development of thin-film inorganic vertical LEDs suitable for bioimaging, biomanupulation, and biophotonics [Appl. Phys. Express 6 (11), 112301 (2013)]. However, no one has imagined that the III-nitride spectrum could be expanded into infrared and even terahertz as conventional band-to-band energy gap did NOT allow. In his early career, Prof. Bayram pushed the wavelengths of GaN technology to longer and longer wavelengths above visible by engineering INTERSUBBAND energy levels, to reach terahertz spectrum. In this area, he has demonstrated a couple of breakthroughs (1) First GaN devices (by MOCVD) at the optical telecommunications wavelengths (~1.5 μm) [Appl. Phys. Lett. 95, 201906 (2009)], (2) Longest optical transitions in GaN materials (up-to 5.5 μm) [J. Appl. Phys. 111, 013514 (2012)], and (3) First reliable resonant tunneling in GaN devices [Appl. Phys. Lett. 97, 181109 (2010)].

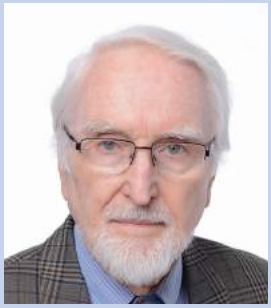
2017 American Physical Society's Robert R. Wilson Prize, 'The Triumph Over Intrabeam Scattering in Particle Accelerators: Key to Empowering Many Major Discoveries'

Sekazi K. Mtingwa
Chair, C13 Commission on Physics for Development
Chair, LAAAMP Executive Committee

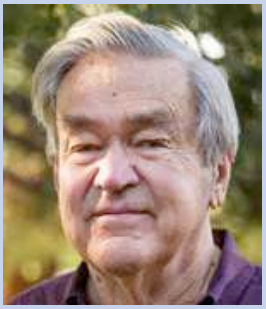
One of the biggest headaches physicists encounter when operating high intensity particle accelerators is controlling the natural tendency of particles within a beam to spread out as they propagate together, due to the Coulomb repulsion between particles of the same electric charge. This fundamental problem plagues both proton (antiproton) and electron (positron) beams, since they each are composed of particles carrying the same electric charge. Beams are characterized by their horizontal and vertical emittances (phase space), which are the product of horizontal or vertical beam size and the corresponding angular divergence. The more that one packs particles into ultra-small emittances to drive up the rate of collisions (luminosity) between counter-rotating beams, thereby increasing the chance of discovering new and revolutionary physics, the more the Coulomb repulsions between particles within each beam increase their emittances and thus degrade the performance of the accelerator.

There are two categories of Coulomb interactions that physicists must understand. The first, considers only large-angle scatterings and is called 'the Touschek effect', named for Bruno Touschek, the first physicist to provide an approximate understanding of the phenomenon. There is no change in the particle phase-space distribution due to this effect; however, there is the loss of both scattered particles. The second kind of Coulomb interaction, dubbed intrabeam scattering (IBS), involves only small-angle scatterings. The particles in the beam are not lost, but the phase space volume slowly increases. One gets the visual image of the beam slowly blowing up in size, degrading the performance of the accelerator. Thus, this has a negative impact on accelerators for both high energy/nuclear physics and synchrotron light sources.

Understanding IBS for high energy physics is what drew Anton Piwinski of DESY, and James D. Bjorken and the author, previously of Fermilab, to the subject. All three chronicle their experiences with developing the theory of IBS in a recent invited review article (Physical Review: Accelerators and Beams, 21, 114801, 2018) in celebration of receiving the American Physical Society's 2017 Robert R. Wilson Prize for Outstanding Achievement in the Physics of Particle Accelerators. The citation for that award reads as follows:



Anton Piwinski



James D. Bjorken

For the detailed, theoretical description of intrabeam scattering, which has empowered major discoveries in a broad range of disciplines by a wide variety of accelerators, including hadron colliders, damping rings/linear colliders, and low emittance synchrotron light sources.

As discussed in the article, the theoretical understanding of IBS played a crucial role in the discovery of the intermediate vector bosons W^+, W^-, Z^0, and Higgs particle at CERN; the top quark at Fermilab; and the perfect liquid quark-gluon plasma at Brookhaven's Relativistic Heavy Ion Collider.

Since Piwinski had developed the first comprehensive theory of IBS in 1974 (Proc. 9th Int'l. Conf. High Energy Accel., Stanford, p. 405, 1974), Simon van der Meer approached him in 1977 when he was pursuing his work on stochastic beam cooling that led to the discovery of the intermediate vector bosons. Physicists designed CERN's Super Proton-Antiproton Synchrotron to collide counter-rotating protons and antiprotons at several hundred GeV of energy per beam. The difficulty was that antiprotons do not naturally exist in any significant quantities in the world around us. Hence, they had to be produced by scattering protons onto a target, collecting the antiprotons from the collision debris in CERN's accelerator called the Antiproton Accumulator, and greatly reducing their phase space volume via van der Meer's beam cooling system before sending the antiprotons out to the Super Proton-Antiproton Synchrotron for collisions with counter-rotating protons. Thus, the purpose of the stochastic cooling system was to pack as many antiprotons as possible into a small phase space to increase the luminosity of the collisions of counter-rotating proton and antiproton beams and hence create sufficient vector bosons to allow detection. In Piwinski's words, He asked for the most precise calculation of the rise times due to IBS, because stochastic cooling would have to compete with IBS. Piwinski and colleagues, Frank Sacherer, K. Hübner, and Dieter Möhl, immediately went to work adapting Piwinski's theory to the task and developing computer codes used to understand the interplay of IBS and stochastic cooling. The rest

is history. Van der Meer and Rubbia shared the 1984 Nobel Prize for the 1983 discovery of the W^+, W^-, and Z^0 vector bosons. Subsequently, Bjorken and the author had to confront a similar situation at Fermilab during the 1980s. Fermilab's Tevatron was designed to collide protons and antiprotons at roughly 1 TeV per beam in an effort to discover the long sought top quark. There, the antiprotons were cooled in the laboratory's Antiproton Source in sufficient numbers and high enough density in phase space to send out to the Tevatron for collisions with counter-rotating protons. Here as at CERN, there was a battle between the stochastic cooling systems trying to jam huge numbers of antiprotons into a small phase space and the blowup of the beam due to IBS. The author was on the team that designed and constructed Fermilab's stochastic beam cooling system, modeled after van der Meer's at CERN. In particular, the author and John Marriner shared the responsibility of finalizing the design of Glen Lambertson and colleagues' design of the stochastic cooling electrode prototypes produced at Lawrence Berkeley National Laboratory. After finalizing the design, the author was responsible for the final electrodes' assembly, quality control testing, and installation into the accelerators called the Debuncher and Accumulator, two major components of the Antiproton Source. Bjorken and the author working together used the tools of their field, quantum field theory, to derive the theory of IBS in an entirely new way (Part. Accel. 13, p. 115, 1983). After considerable work, they were able to show conclusively that IBS was under control. Moreover, Fermilab's David Finley, Alvin Tollestrup and the author used both Piwinski's and Bjorken and the author's formulations of IBS to analyze successfully the luminosity lifetimes of both the Tevatron and proposed Tevatron upgrade. All of this IBS work at Fermilab played a major role in the discovery of the top quark and other exciting physics at that laboratory.

One challenge in performing numerical analyses from IBS theory is that the integrals are quite complicated and must be evaluated at hundreds of locations around the accelerator and interpolated between those locations. Thus, the computer times needed to evaluate the integrals tend to be long, which makes it difficult for accelerator magnet layout (lattice) designers to make changes in the lattice and obtain quick feedback on IBS effects. The good news is that many of the applications are to beams wherein the energies are large compared to the rest mass of the beam particles. This is certainly the case for the huge high-energy accelerators such as CERN's Large Hadron Collider and Fermilab's Tevatron. Moreover, it is the case for the much lower energy synchrotron light sources. Even though the energies in the latter are a few GeV, the rest mass of the electron is only about half an MeV. Thus, many have derived IBS formulae for asymptotically large energies that are applicable to both large and small accelerators. One of the most highly used is the one derived by Tollestrup and the author at Fermilab (Fermilab-Pub-89/224, 1987), where they obtained a closed analytic expression for the complicated Piwinski integral. Karl Bane at SLAC has generated considerable activity with his work (Proc. 8th Eur. Part. Accel. Conf., Paris, p. 1443, 2002). Also, Kiyoshi Kubo, Andrzej Wolski and the author in their work (Phys. Rev. ST Accel. Beams 8, 081001, 2005) and the author in another work (African Physical Review, 2:0001, 2008) combined the formalisms of Bane and Tollestrup and the author to obtain completely integrated expressions and used them to analyze plans for the proposed electron-positron International Linear Collider.

On the lower energy side of the accelerator energy scale, a precise understanding of IBS at synchrotron light sources is empowering many transformational discoveries in a myriad of disciplines. An example of the latter is the need to overcome IBS at Sweden's new MAX IV synchrotron light source, which has introduced a revolutionary new technology called the Multi-Bend Achromat (MBA) for the layout of the magnets. There is a race to implement this new technology, which has ushered in so-called 4th generation synchrotron light sources, at a number of leading synchrotron light sources around the world. In addition to MAX IV, these include the entirely new Sirius light source in Brazil and upgrades to a number of operating light sources, including the European Synchrotron Radiation Facility in France, the Advanced Photon Source in the USA, Spring-8 in Japan, and Elettra in Italy. Vertical electron beam emittance is naturally quite small. In comparison, horizontal emittances tend to be many times larger. Hence, the smaller the horizontal electron emittance in synchrotron light sources, the brighter the photon beams tend to be that they generate. The new MBA technology shrinks the horizontal emittance significantly compared to the 3rd generation synchrotron light sources, and hence boosts their photon brightness by several orders of magnitude, leading to the anticipation of major scientific and technological discoveries in the years ahead. However, this shrinkage of beam emittance leads to significant IBS growth in beam dimensions. Fortunately, the mechanism of IBS is sufficiently understood, so that accelerator physicists now know how to design the necessary technologies needed to mitigate it. For MAX IV, thanks to the detailed understanding of IBS and the employment of Landau cavities, accelerator physicists are able to reduce the IBS horizontal emittance blowup from 45% down to 13% and below, leading to a major enhancement in photon brightness. Thus, the future is BRIGHT for the 4th generation synchrotron light sources and the discoveries that will ensue.

To conclude, IBS has been a major difficulty in the operation of modern particle accelerators. However, thanks to the detailed theoretical understanding of IBS, accelerator physicists are able to mitigate its effects and yield revolutionary discoveries.

Skyrmions in Multiferroic Materials

Shinichiro Seki (2018 C9 YSP winner), *RIKEN Center for Emergent Matter Science (CEMS)*, Japan*

In conventional materials, the magnetic properties are affected by magnetic field and the dielectric properties are by electric field. In contrast, the control of magnetism by electric field (or inversely the control of dielectric nature by magnetic field) is called magneto electric (ME) effect. Recently, the electric control of magnetism has been intensively studied as one of the key issues in the field of spintronics. For example, the electric current in conductive materials has widely been employed for the control of magnetism in the latest MRAM device, while this approach is always accompanied with severe Joule heating and the suppression of associated energy loss is highly demanded. On the other hand, the electric field in the insulator causes only negligible Joule heat loss, and therefore the realization of gigantic ME response will dramatically reduce the energy consumption in the magnetic information storage or processing devices.

To enable the large and versatile ME effects, we focused on the study of multiferroics, i.e. insulating materials endowed with both magnetic and dielectric orders. By developing the original material design strategy based on the symmetry analysis, we discovered many new multiferroic materials with unique ME functions. In particular, we extended the idea of ME coupling to the novel spin object, called magnetic skyrmion. Skyrmion is a concept originally proposed to describe the excitation in particle physics, and recently discovered in magnetic materials as a nanometric

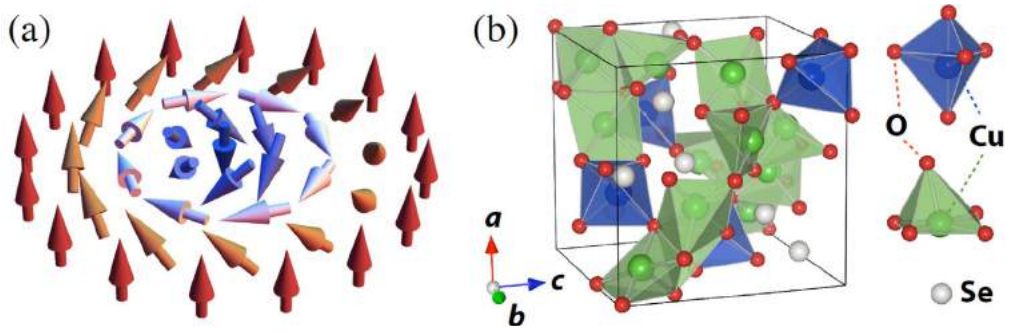


Fig. 1: (a) Schematic illustration of magnetic skyrmion. (2) Crystal structure of chiral-lattice multiferroic insulator Cu_2OSeO_3.

vortex-like swirling spin texture with topologically-protected particle nature (Fig. 1a). In metallic system, the skyrmion exhibits nontrivial manner of interaction with conduction electrons due to its topological character, which enables the current-induced control of skyrmion dynamics. Because of such electric controllability, small size, and particle-like nature, skyrmion is now rapidly attracting attention as a promising building block for novel spintronic device like high-density magnetic storage. However, such current-driven approach inevitably involves joule heat loss, and the previous observation of skyrmions has been limited to specific metallic alloys with B20 structure.

Here, we newly discovered the appearance of skyrmions in a multiferroic insulator [1]. We expected that the chiral symmetry of underlying crystal lattice and associated Dzyaloshinskii-Moriya interaction plays a crucial role for the stabilization of skyrmion spin texture, and successfully discovered the emergence of skyrmions in a chiral-lattice insulator Cu2OSeO3 (Fig. 1b) by performing the Lorentz transmission electron microscopy and neutron scattering experiments. Moreover, through the detailed dielectric and magnetic measurements, we proved that the skyrmion spin texture in insulator can magnetically induce electric polarization via the relativistic spin-orbit interaction. Such a coupling between skyrmion spin texture and electric polarization strongly suggests that the stability and dynamics of skyrmions in insulators can be manipulated by external electric field, which has later experimentally been confirmed. This approach utilizing electric field in insulators is free from the Joule heat loss in contrast to the current-driven method in the metallic system, and therefore provides energetically more efficient way to realize the electric control of skyrmions. The above finding may contribute to the development of next generation of ultra-high-density magnetic storage device with extremely low energy consumption.

**Current affiliation: Department of Applied Physics, University of Tokyo [1] S. Seki, X. Z. Yu, S. Ishiwata, and Y. Tokura, "Observation of Skyrmions in a Multiferroic Material", Science 336, 198 (2012).*

The American Physical Society (APS) launches the inaugural African Physics Newsletter

Nithaya Chetty, Vice President (New Members)

The APS has published the inaugural issue of the African Physics Newsletter in February 2019. Subscriptions to the newsletter are free and open to both Africans and non-Africans. To subscribe go to https://go.aps.org/africanphysics

In her opening address, the CEO of the APS, Kate Kirby, stated that “While this newsletter is an undertaking by physicists in Africa, APS is happy to serve as the initial publisher. This electronically distributed, quarterly publication is free and open to anyone in and outside of Africa. I invite the international physics community to sign-up to receive this newsletter and learn more about the exciting physics research, physics meetings, and other physics related news from across Africa.”

The newsletter is a means for African physicists to communicate with physicists outside of Africa, for African physicists to communicate among themselves, and for physicists and organizations outside of Africa to communicate with those in Africa. No such means has existed for each of these three needs. The need for better means of communication with and among African physicists is one the areas of need identified by the survey of African physics conducted by the Physics in Africa Project sponsored by the American Physical Society, the European Physical Society, South African Institute of Physics, and the International Center for Theoretical Physics. Relying on African volunteers, the newsletter is a low cost, historic step forward to addressing the communication void. The newsletter will publish quarterly.

The overseeing board comprises: • Prof. N. Chetty (University of Pretoria, Pretoria, South Africa) Vice President, IUPAP • Dr. J. E. Gubernatis (Los Alamos National Laboratory, Los Alamos, New Mexico) Chair of the Physics in Africa Project; Member, Committee on International Scientific Affairs, American Physical Society • Prof. A. Wagué (Dakar Cheikh Anta Diop University, Dakar, Sénégal) President African Physical Society, International Councilor, American Physical Society

The editorial board comprises: • North: Prof. M. Zghal (University of Carthage, Tunis, Tunisia) • South: Prof. I. Gledhill (University of Witwatersrand, Johannesburg, South Africa) • East: Prof. G. Amolo (Technical University of Kenya, Nairobi, Kenya) • West: Prof. S. K. Danuor (Kwame Nkrumah University of Science and Technology, Kumasi, Ghana).

Besides representing North, South, East, and West Africa, these editors represent both the Francophone and Anglophone communities distinctive of different African nations.

We encourage you to forward the newsletter to colleagues you think may be interested in hearing about the latest developments in physics in Africa, and to encourage them to subscribe.

Do you have a meeting or conference you'd like posted? Do you have news or articles you'd like to share with your colleagues? This is the initial launch of a newsletter by and for the African physics community. Look for more information in the next African Physics Newsletter on how to submit information to the newsletter and share your news with colleagues across the African continent.

34th International Conference of Physics Students 2019

Initiated in 1986, the International Conference of Physics Students (ICPS) brings together each year approx. 500 students from around 50 countries - organised for physics students by physics students. Thus, the focus at ICPS lies both on scientific exchange and international networking of the upcoming physicist generation.

Regarding the first part there will be student talks and poster sessions as well as outstanding guest lecturers including Nobel Prize Laureate of 1985 Klaus von Klitzing talking about the SI redefinition or Director General of the European Space Agency Johann-Dietrich Wörner. For the networking part excursions, a city tour and socials in the evenings will be organised to meet old friends and make new ones.

Group Photo ICPS 2018 in Helsinki

To enable as many students as possible to attend ICPS 2019 different support schemes such as visa-friendly reimbursement rules, invitation letters with the conference confirmation, limited conference fee grants (jIAPS contest) and travel grants (ICPS Worldwide grant) are in place. Vice versa ICPS 2019 gets supported besides social foundations by the International Union of Pure and Applied Physics, the European Physical Society as well as the German Physical Society.

Place: Cologne, Germany

Time: 10th August – 17th August 2019

2nd application phase: 1st April – 15th April 2019 via https://icps.cologne/registration/

Contact & further information: info@icps.cologne, icps.cologne

Social Media: www.facebook.com/icps2019

Please feel free to share the provided information with anyone interested/to suitable mailing lists. Similarly, please never hesitate to get in touch with us.

Conference Reports:

23rd Latin American Symposium on Solid State Physics (SLAFES XXIII), held in San Carlos de Bariloche, Argentina from 10/04/2018 - 13/04/2018, was a resounding success. The participants found the talks by the 61 speakers to be of high calibre and based on new scientific work shown on the 9 conference topics. The IUPAP grant was used in full to cover the accommodation expenses of the 18 foreign invited plenary and semi-plenary speakers from 11 countries (two other invited speakers are residents in Argentina).

International Conference on Science for Development (ICSD), held in Quy Nhon, Vietnam from 09/05/2018 - 10/05/2018 focussed on 2 main messages. One, that Vietnam should increase its participation to international scientific unions or organizations (such as CERN and IUPAP) and take a lead in pushing for an International Year of Basic Sciences for Development (IYBSD) in 2022, in keeping with the UN 2030 Agenda for Sustainable Development. The second message was that Vietnam and other countries should promote basic, applied and social sciences for their development.The conference participants were addressed by the President of the Socialist Republic of Vietnam, Trần Đại Quang, and by many high-level dignitaries from the government, the parliament and the communist party, each emphasising the messages for the conference. The 2020 worskhop on Science, Ethics and Human Development, hopes to increase women participation from Vietnam.

International Conference on Precision Physics of Simple Atomic Systems (PSAS) held in Vienna from 13/05/2018 - 18/05/2018 highlighted the important and highly topical contributions that treated the transition to the new SI system, where artifact-based units are replaced by fundamental constants and atomic properties. Very recent precision measurements on fundamental transitions in hydrogen disagree with each other and put additional emphasis on the importance and difficulty to scrutinize the proton size puzzle. Furthermore, precision measurements and calculations on simple molecules and molecular ions have been presented as well as the latest results from antihydrogen and other exotic atoms. The four-loop QED calculation for g-2 is a particularly noteworthy theory achievement, where the final results from a 20y-long effort have been presented.

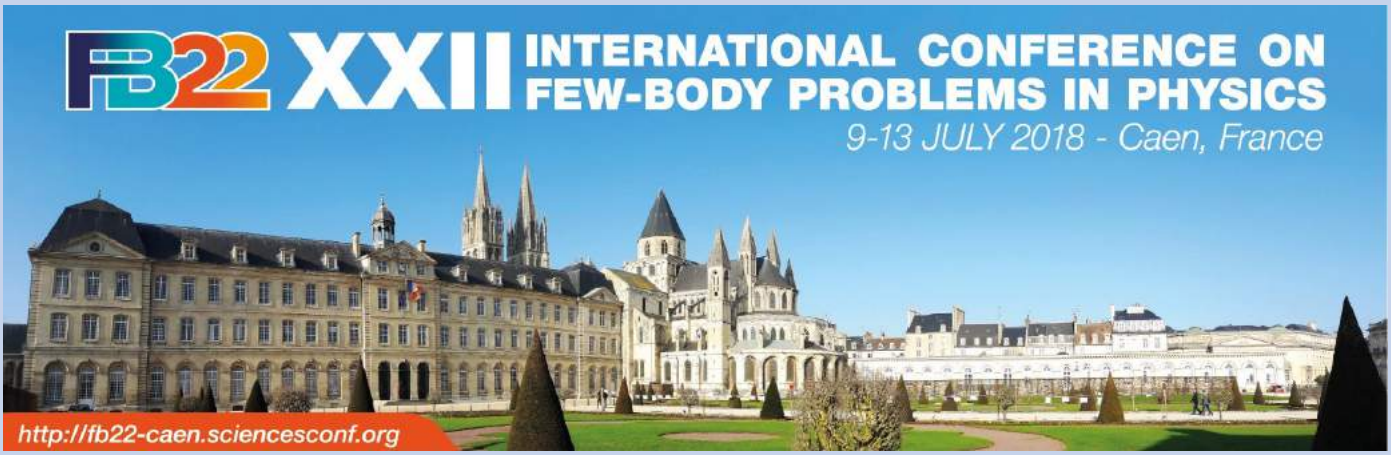
World Congress on Medical Physics and Biomedical Engineering (WC2018), held in Prague, Czech Republic from 03/06/2018 - 08/06/2018 had more than 60 invited and educational lectures. 650 scientific contributions were presented during the congress, covering all relevant topics in medical physics, dosimetry, and radiobiology. Seven special sessions and a number of workshops were organised in parallel.

NEUTRINO 2018, held in Heidelberg, Germany from 04/06/2018 - 09/06/2018 used ZENODO online proceedings, where every talk and poster got a DOI number and can be cited. This allowed for the organisers to finish the complete proceedings including all talks within days, thereby also saving natural resources.

The 5th Biennial African School of Fundamental Physics and Applications (ASP2018), held in Windhoek, Namibia from 24/06/2018 - 14/07/2018 was extended to include: (1) one-week general Physics Conference with the aim to attract African students, post-docs, and research faculties to present their work and network with international participants; (2) one-week outreach for secondary schools in the host country. In Namibia, ASP covered 39 high schools, with upwards 1200 10-12th grade high school students in one week. The objective was to motivate learners to develop and maintain interests in physics; (3) one-week training workshop for high school teachers in the host country. We had 62 high school teachers from all over Namibia. The objective to train teachers to improve their preparation and delivery. The next edition of the ASP will take place in Morocco in 2020."

Nuclei in the Cosmos XV, (NICXV) held at the Laboratori Nazionali del Gran Sasso from 24/06/2018 - 29/06/2018 focussed on the Last works about Gravitational Waves, Features and characterisation of International Underground laboratories with their scientific programmes and the reviews on last works about Double Beta decay and Dark Matter experiments.

2018 Conference on Precision Electromagnetic Measurements (CPEM), held in Paris, France from 08/07/2018 - 13/07/2018 was very successful. The technical programme featured three plenary sessions with seven keynote speakers, addressing the revised International system of units and its foundations, quantum technologies based on optical and solid state devices, interferometric measurements on gravitational waves and new optoelectronic and electronic devices using semiconductor nanowires. Moreover special oral sessions were organized around the SI and important works on new topics such as the electrical measurements for small mass and force metrology , metrology and quantum technology, electrical measurements for micro-nanoelectronic devices and nanomagnetism and spintronics.



22nd International Conference on Few-Body Problems in Physics (FB22), held at the Centre de Congrès, Caen, France from 09/07/2018 - 13/07/2018 had a dedicated session to the inaugural "Faddeev Prize" in few-body physics created by the North American and European few-body physics working groups. The laureates were Profs Vitaly Efimov (University of Washington, Seattle) and Rudolf Grimm (Innsbruck) were recognised, respectively, for the discovery of the Efimov Effect and the first experimental observations. Special topical sessions were held on: 1) the physics of multi-neutron clusters and 2) lattice QCD with a focus on its application to very light nuclei. Of the invited talks, 31 were plenary, including 8 presented by females. FB22 comprised of 42 sessions (plenary + parallel) of which 10 had a female chair. The IUPAP support grant was used to reduce the registration fees for the greatest number of participants, with a particular emphasis on students.

International Colloquium on Magnetic Films and Surfaces (ICMFS2018), held in UC Santa Cruz, CA from 22/07/2018 - 27/07/2018 highlighted traditional topics of ICMFS - magnetic thin films and surfaces. Recent developments addressed were, spin dynamics, particularly ultrafast processes (~fs time scale), topological spin textures, e.g. skyrmions, and in particular 3d nanomagnetic spin systems, such as skyrmion tubes, hopfions or chiral magnetic boppers. The ICMFS2018 featured a broad mix of traditional as well as those new directions. Notable presentations were by P. Sutcliffe (hopfions), J. Zhang (3d chiral spin textures), A. Fernandez-Pacheco and C. Donnelly (3d nanostructures and their characterization), S.Mangin (AOS), A. Chumak (magnonic computation approaches), M. Mueller (oxide films), S Fukami (NVM). This meeting went very smoothly and was a great scientific success. Particularly the younger colleagues (students), some of them being the first time at a major international conference enjoyed the highly interactive setting and the excellent talks. One major event was the best student presentation award, which was partially sponsored from the available IUPAP funds.

20th International conference on Superlattices, Nanostructures and Nanodevices (ICSNN), held in Madrid from 23/07/2018 - 27/07/2018 presented the recent new discoveries by high quality speakers, like, P. Jarillo-Herrero on bilayer graphene, A. Patane on novel van der Waals crystals, A. Sachrajda on spin hole qubits in quantum dots and by J. Petta on spin-photon coherent coupling. Also very exciting review on quantum computing in Silicon was presented by M. Simmons. Excellent talks were devoted to new results on Majorana Fermions by L. Kouwenhoven and D. Loss. New results on excitons in 2D semiconductors were provided by Prof. T. Heinz. An exciting talk was also given by S. Louie on topology and interaction effects in 1D and 2D Materials.

International Symposium on Quantum Fluids and Solids (QFS2018), held at the Ito International Research Center, Tokyo, Japan from 25/07/2018 - 31/07/2018 was a great success. QFS focussed on (1) Common interests in Majorana fermions, topological quantum states and their possible applications to quantum computation have been deepened and widely shared by researchers working on different systems, such as superfluid 3He, spin-triplet superconductors, cold atoms and semiconducting nanowires. (2) New features of quantum turbulence in cylindrical tubes and confined geometries have been reported, which stimulated interdisciplinary discussions across superfluid helium and atomic BEC gases. (3) Novel quantum phases where superfluidity and spatial orders are intertwined or the gapless spin liquid state is emerged by large quantum fluctuations have been proposed in helium monolayers adsorbed on graphite.

14th International Conference on X-ray Microscopy (XRM2018), held in Saskatoon, Saskatchewan Canada from 19/08/2018 - 24/08/2018 featured applications of pychography to materials science and biology studies, making the transformation of this from technique development to application. Both winners of the Werner Meyer-Ilse award were women; this is an award given to young scientists for exceptional contributions to the advancement of x-ray microscopy through either outstanding technical developments or applications.

12th International Conference on Materials and Mechanisms of Superconductivity (M2S), held in Beijing, China from 19/08/2018 - 24/08/2018, addressed many research topics such as copper oxide superconductors, iron-based superconductors, heavy fermion superconductors, organic superconductors, and topological superconductors, and reported the latest developments in superconductivity theory and applied research. The conference set 60 sessions in the research field of superconductivity, and arranged 13 plenary talks, 235 invited talks, 102 oral talks and 429 poster presentations for the more than 1200 participates from 31 countries and regions.

34th European Conference on Surface Science (ECOSS), held in Aarhus, Denmark from 26/08/2018 - 31/08/2018, covered all of surface science with 5 parallel sessions supplemented by morning plenary sessions. The newest results within 2D materials, catalysis, oxides, ultrafast surface dynamics, electronic structure, molecular self-assembly and reactions on surfaces were presented. Highlights span the reported discovery of new ice nucleation seeds and routes, graphene synthesis on metal nanoparticles, novel method developments within ultrafast LEED, novel 2D materials properties measured with ultrafast resolution and new insights and approaches within heterogeneous catalysis, oxides and molecular architectures on surfaces.

XXIV International Baldin Seminar on High Energy Physics Problems "Relativistic Nuclear Physics and Quantum Chromodynamics"(BALDIN) held in Dubna, Russia from 17/09/2018 - 22/09/2018 had many interesting talks. E.Santopinto(Genoa,Italy) on Pentaquark and hybrid states, G.Pakhlova (Moscow,Russia) on Exotic quarkonium at e+e- colliders, I.Boyko (JINR) on Recent results from the BESIII experiment, G.Cabras (Bologna,Italy) on Probing QCD with the ATLAS detector, H.Stoecker (Frankfurt, Germany) on MAGIC - how Matter's extreme phases can be revealed in gravitational wave observations and in relativistic heavy ion collision experiments and A.Karpov (JINR) on Superheavy elements research at Dubna: achievements and perspectives.