IUPAP International Union of Pure and Applied Physics

Newsletter

DECEMBER 2021

President: **Michel Spiro** • Editor-in-Chief: **Kok Khoo Phua** • Editors: **Silvina Ponce-Dawson; L.C.Kwek; Paola Rodari; Cecilia Cressi; Sandro Scandolo; Judy Yeo; Lionel Seow**

PRESIDENTS' NOTE

Dear readers and friends of IUPAP,

We are starting a year full of celebrations: 2022 marks the 100th anniversary of the creation of our Union and it has also been declared International Year of Basic Sciences for Sustainable Development by the UN General Assembly.

We will have a Centennial Symposium at the ICTP in Trieste, Italy, on 11-13 July 2022. This will be an opportunity to discuss our new vision and advance with our Action Plan. The Symposium will include plenary talks by keynote speakers and other activities, with an emphasis on aspects of the IUPAP history, on developing countries, collaborations among countries, physics education, and many other items consistent with the IUPAP mission. Everybody is invited to celebrate the centenary of IUPAP in their own countries and regions. In particular, there has been a regional e-conference organized by the Pakistan Physical Society that was very successful. Michel Spiro gave some opening remarks at the conference where he introduced a brief portrait of the IUPAP. Another regional initiative, “100 years of Physics in Africa – ‘Past, present and Future’”, was organized by the African Physics Community in celebration of the IUPAP Centenary. The project plans to share stories that celebrate and communicate the immense contributions that physics education and research have made to Africa’s development. A regional conference is also expected to be organized in Latin America to celebrate both the IUPAP centenary and the 60 years of existence of the Latin American Center for Physics (CLAF).

We will have a photo contest to portray the beauty of physical processes, the impact of physics on our everyday lives and the ways in which physics research and education is carried out all over the world. The contest will be divided in two categories: “Beyond Our Eyes” (for images that have been obtained through special scientific equipment or are the result of numerical simulations) and “At A Glance” (for all other images that have been obtained with a professional, amateur or cellular camera). Submissions for the contest will be open on February 14th. A specially selected jury will choose 12 finalists, six of which will receive a monetary award (three in each category). Two more photos in each category will be voted through social networks. The winners will be announced by the beginning of July and will receive their awards during the Centennial Symposium. We expect to have an exhibition in Trieste with the 12 finalists selected by the jury and the 4 additional photos voted over social networks. These 16 photos/images will be made available for printing and to be used as screensavers on various formats, both on the IUPAP’s website and over its social networks. They will also be used on IUPAP posters and other material related to the Centenary celebrations. More details on the contest can be found on the IUPAP’s website.

The celebrations for the centennial will be combined with those of the International Year of Basic Sciences for Sustainable Development (IYBSSD) which will be launched with a special event at UNESCO headquarters in Paris on July 1st, 2022. We expect to close both the celebrations for IYBSSD and for the IUPAP centennial with a ceremony at CERN’s Science Gateway.

In 2022 we will have two meetings of the Executive Council and Commission Chairs: one in late January and the other immediately before the Centennial Symposium. The week after the symposium we will have a General Assembly, without elections and in virtual form on July 14th 2022. In 2023 we expect to have our GA in hybrid mode, with the in-person part at CERN in Geneva, Switzerland.

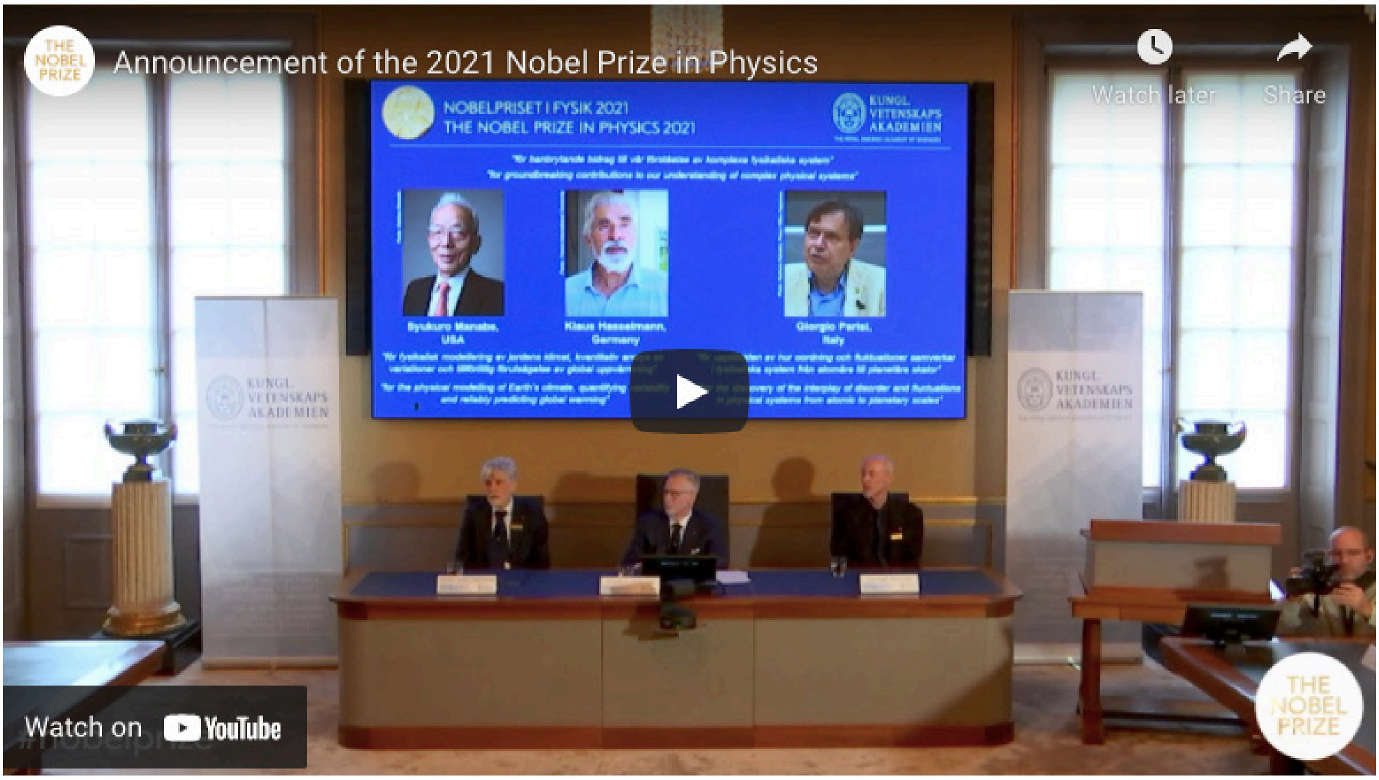
Keep the dates and stay tuned for new announcements on the very exciting activities that will surround the IUPAP’s centenary and IYBSSD!

Michel Spiro
President of IUPAP
Chair, Steering Committee for the proclamation of IYBSSD 2022

Bruce McKellar
Past President

Silvina Ponce Dawson
Acting President Designate

The Nobel Prize in Physics 2021



Announcement of the 2021 Nobel Prize in Physics by Professor Göran K. Hansson, Secretary General of the Royal Swedish Academy of Sciences, on 5 October 2021.

The Nobel Prize in Physics 2021 was awarded "for groundbreaking contributions to our understanding of complex systems". One half of the Prize was awarded jointly to Syukuro Manabe and Klaus Hasselmann "for the physical modelling of Earth's climate, quantifying variability and reliably predicting global warming". The other half was awarded to Giorgio Parisi "for the discovery of the interplay of disorder and fluctuations in physical systems from atomic to planetary scales."
Giorgio Parisi has a long standing relationship with the IUPAP. He was head of the Italian delegation for a certain period of time and in 1992 he and Joel Lebowitz received the prestigious Boltzmann Medal. Parisi was awarded the medal for his fundamental contributions to statistical physics, particularly, for his solution of the mean field theory of spin glasses. The Boltzmann Medal is awarded triennially by the IUPAP's Commission on Statistical Physics (C3). It is the second time that a Boltzmann medalist then receives the Nobel Prize in Physics.

Separate articles by Jorge Kurchan on the contributions of Giorgio Parisi and by Isidoro Orlanski on the contributions of Syukuro Manabe and Klaus Hasselmann are included in what follows.

J. Lebowitz and G. Parisi celebrating their Boltzmann medal (photo from the November 1992 issue of Physics Today, AIP).

The gold in an alloy
On the work of Giorgio Parisi, 2021 Nobel Prize Laureate

Text written by Jorge Kurchan, ENS Paris, France

Giorgio Parisi, Ill Niklas Elmehed

Almost exactly half a century ago, Canella and Mydosh reported that AuFe alloys showed indications 'that a mag- netic ordering exist which exhibits some characteristics of antiferromagnetism' but 'whose interactions and properties are by no means understood'. A few years later, S Edwards and PW Anderson published a paper which, despite its orotund title – Theory of Spin Glasses – would be the beginning, rather than the conclusion, of a long scientific story. They introduced there a model of randomly interacting spins. In order to compute the average over random disorder of the free-energy – rather than that of the partition function Z – they proposed that one should treat n copies of the system n = 1,2,..., and then somehow prolong the result to $n \rightarrow 0$, to obtain lnZ. This is the Replica Trick, as we know it in physics. Soon afterwards, D Sherrington and S Kirkpatrick had the natural idea of making a version of Edwards and Anderson's where each spin interacts with all others. In less bizarre fields of physics, this 'mean-field' approach yields a simplified, yet easily solvable first approach. Indeed this was almost the case: they were able to obtain the transition into a 'spin glass' phase relatively easily. However, they found something was amiss, the entropy was negative at low temperature – an impossibility for a system of discrete variables.

As legend has it, Giorgio Parisi was looking at that time for ways to attack a problem in QCD, and thought that this intriguing situation in the Sherrington-Kirkpatrick's problem would provide a 'warming-up' exercise. It had already been noted that what could wrong with the SK solution was that the transition to low temperature was accompanied by a symmetry-breaking, but the only symmetry to break was the one between the replicas that had been introduced to solve the system! And, worst of all, no such scheme was successful in making the SK entropy work. In a first paper, Parisi found a consistent way to do this: you had to break the replicas in n/m groups of m replicas, but then when you made $n \rightarrow 0$ you kept m finite: the subsets were larger than the set. That brought the entropy closer to zero, but it was not enough. He later proposed a more general 'telescoped' scheme, where you broke groups into smaller groups, and again into smaller groups, and so on. Iterating this excentric scheme ad infinitum, with each subset larger than its parent, the result obtained in the end was healthy (positive entropy), and was a good candidate to be the correct solution.

Generations of students and postdocs have shared the same feeling of unease when first encountering this piece of alien clockwork. Was it the correct one? Here comes what is perhaps the most astounding feat of Parisi: he spent a long time 'shaking the tree' of his ansatz, finding 'better' ones that in the end always fell back to the old one. He also checked it numerically as far as it was possible. But, more importantly, he and his collaborators (notably M Mézard and MA Virasoro) spent years working to tease out of his solution all the consequences it implied. What could be the meaning of the breaking of a symmetry that is not given by Nature but is a device of mathematical strategy? In the end, what started as a solution of a model, yielded a whole world of rugged landscapes, with valleys, valleys within valleys, barriers separating other barriers and trees of probability.

It took over three decades to confirm rigorously that the result for SK is the correct one, in a rigorous mathematical way. But what about AuFe, and other real, three-dimensional glasses? We still do not know if Parisi's solution applies to them, but the passion for this point has cooled over the years, and for a simple reason: the theoretical scheme began bearing abundant fruit in other fields. Let us see an incomplete list:

- Attractor Neural Networks and the Perceptron, the embryo of Deep Learning
- Ecology and Game Theory models with many actors
- Problems in computer science such as coloring the vertices of graphs avoiding same color in connected sites, or the optimal journey of a travelling salesman
- Discovering the space of solutions of complex boolean equations
- The analysis of error-correcting codes
- Liquids and glasses made of spherical particles

Related to the latter, consider the packing of spheres in d-dimensional space, when d → ∞ These may be regular 'lattice' packings – a mathematical problem with a long history that already interested Minkowski – or completely disorganised 'amorphous' packings. For the latter, applying Parisi construction one obtains a packing density that is not only better than any the mathematicians have got (and that, physicists believe, is optimal), but also a sharp value for the more modest level of packing that may be actually constructed in finite time. We know a lot of new things about the actual organization of the space of all possible packings.

Symptomatic of this list of subjects is the fact that they are by nature interdisciplinary, and physicists have something to offer, to a substantial extent based on Parisi's work. There is a very strong effort these days to adapt what we know to the language and the rigour requirements of other fields. The Parisi construction used, and also highlighted, the universality behind these complex problems, teaching us not only how to answer questions, but which questions we may ask. It is a very good example of how the peculiar way of reasoning that physicists have, with its leaps of intuition – and sometimes of faith – may be useful for all science.

How Suki Manabe Revolutionized Climate Science

Text written by Isidoro Orlanski, Emeritus AOS, Princeton University

Syukuro Manabe, Ill Niklas Elmehed © Nobel Prize Outreach

When I first heard that Syukuro (Suki) Manabe had won the Nobel Prize in Physics, I switched radio stations to confirm the great news. I was beyond happy for Suki, who has been my esteemed colleague and good family friend for almost 55 years. On a professional level, I was also delighted that the Swedish Academy of Sciences was honoring the field of climate topics and climate change with this prestigious award. My excitement brought back a wealth of memories of my workings alongside Suki.

In 1967, as I was completing my Ph.D. at the Massachusetts Institute of Technology, I went to Washington DC to interview for a postdoc position at a new, small governmental lab, the Geophysical Fluid Dynamics Laboratory (GFDL). I was expecting to visit an established, polished facility but was taken aback to see that GFDL was housed in an indescribable, single-story building that looked like a small-box retail store. It did feature a large room, with a window facing the street, that housed its state-of-the-art computer. Given that supercomputers were a novelty at the time, afternoon passersby would often stop on the sidewalk to marvel as the machine cranked through its calculations. Notwithstanding its modest exterior trappings, I soon came to appreciate the pioneering work that was taking place there.

It all started when Joe Smagorinsky created GFDL a few years earlier at the suggestion of John Von Neumann, renowned Princeton mathematician, and Jules Charney, groundbreaking MIT meteorologist (and my doctorate advisor). The goal was to develop computer models to capture geophysical systems. The lab was composed of scientists hand-selected to focus on weather and climate modeling. Suki Manabe (climate dynamics), Kirk Bryan (oceanography), and Kikuro Miyakoda (weather prediction) comprised the core. The team was surrounded by a complement of scientists, research assistants, highly qualified programmers, and four new postdocs, which eventually included me. My arrival at the lab coincided with the publishing one of the most profound scientific articles related to climate change, "Thermal Equilibrium of the Atmosphere with a Given Distribution of Relative Humidity (1967)," authored by GFDL's Suki Manabe and Richard Wetherald.

Manabe and Wetherald (1967) considered changes in water vapor, carbon dioxide, ozone and modeled clouds as very radiative, active elements. Keeling's carbon dioxide measurements on Mount Loa, Hawaii, suggested increasing levels of CO_2 in the early sixties. Several scientists tried to understand the effects of an increase in CO_2 on the Earth's surface temperature, but their results were confusing; some showed heating, others cooling. Suki showed that the inconsistencies of previous studies resulted from estimating surface temperature independently from the response to the troposphere, which was affected by the radiative effects of carbon dioxide.

Manabe and Wetherald showed that a purely radiative thermodynamic model gave a superadiabatic vertical temperature gradient with temperatures that were too cold in the upper troposphere and too warm in the lower troposphere relative to actual observations. Under these model conditions, the simulated atmosphere is in an unstable equilibrium which generates convective instability, moist or dry, to release the super adiabatic lapse rates. Because of this, the energy balance needs to include the effect of sensible and latent heating due to dry and moist convection for a correct estimate of the impact of CO_2 in the atmosphere, which was lacking in the models of the time.

Knowing the limitations of the simple radiative models, Manabe designed a parameterization to capture the effects of moist convection in their simple 1-D(z) model. His *Convective Adjustment* scheme assumes that buoyant convection prevails at the cloud-scale in a humid, convectively unstable atmosphere. Manabe's technique used an iterative method on temperature with a condition: when a layer has an unstable lapse rate, the temperature changes until the unstable levels are eliminated from the vertical column, removing large-scale super moist adiabatic instabilities.

When the effects of moist convective adjustment were included in the radiative calculations, a consistent balance between surface and the deep atmosphere energetics was achieved. Manabe and Wetherald successfully estimated the sensitivity of surface temperature to a doubling of CO_2 to be 2.3 ^{0}C, when the realistic distribution of relative humidity was assumed. They concluded that these calculations did not exhibit extreme sensitivity as previous studies.

The year after my arrival, GFDL moved from Washington DC to the Forrestal Campus of Princeton University. GFDL's move would allow it to collaborate with Princeton faculty in a new academic joint venture, "The Atmospheric and Oceanic Science Program."
Suki's three-dimensional atmospheric models were very complicated. They started with arbitrary initial conditions and ran for very long periods until equilibria were found. This allowed him to detect significant climate signals distinct from the very high frequency of the daily weather patterns. In a sense, he was "seeing the forest from the trees."

In 1969 Suki, with his good friend and GFDL colleague Kirk Bryan, collaborated to couple their atmospheric and oceanic models. This represented a significant development in modeling and was essential to improve climate simulations capabilities. The atmospheric model depended on a prescribed ocean surface, but the more sophisticated, coupled model allowed the ocean to evolve in parallel with the atmospheric climate.

Manabe and collaborators wrote more than 150 papers on climate sensitivity to greenhouse gases, hydrological cycle, soil wetness, and water vapor. Then, recognizing the powerful tool he had developed, he studied ancient and present climates. This next step opened an area of research on modeling climate dynamics. As Manabe recently said: "I was doing it just because of my curiosity. I enjoyed studying climate change. Curiosity is the thing, which drives all my research activities. So it is great fun to use a model to study how climate change over the last 400 million years has evolved." Manabe's revolutionary idea was a breakthrough, giving researchers a powerful new tool to investigate the Earth's complex climate system.

Reflecting on the 1967 seminal paper, AOS Senior Meteorologist Professor Isaac Held, a graduate student under Manabe, said it provided the first "robust, physically-based estimate" of how much the Earth would warm given the increased CO_2 in the atmosphere. "Suki's enthusiasm for his work just rubbed off on the people around him; I think that combined with his humility. He never had much of an ego. People often underestimated him when they first talked to him because he had that humility and humor. It's clear to everyone that the IPCC [Intergovernmental Panel on Climate Change] wouldn't have the solid scientific foundation for its projections of future climate change and the need for mitigation that it has now in the absence of Suki's work", Held said.

In 2021, carbon dioxide in the atmosphere has reached 420 ppm, from 300 ppm in preindustrial times, accompanied by an increase in global surface temperature of 0.9^{0}C. This is half the increase assumed of CO_2 by Manabae's 1967 paper, and it is approximately half the temperature change predicted. Still, we are already experiencing more frequent extreme global weather events, including heatwaves, severe hurricanes, wildfires, and the disappearance of several glaciers. Manabe predicted that tropospheric temperatures would increase, and the stratosphere would cool. This year NASA published results of temperatures in the upper layers of the atmosphere over the past thirty years. The data are showing considerable cooling. The empirical evidence aligns with Manabe's climate projections.

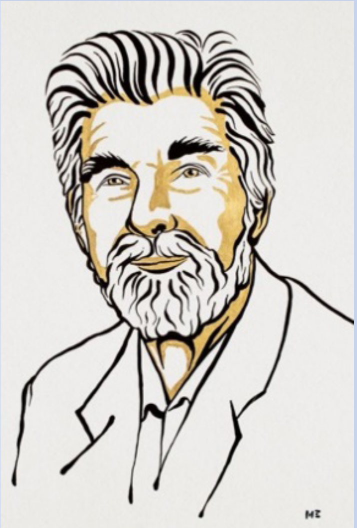
The combination of Suki's persistence, humility, and scientific curiosity flourished in the environment created at GFDL and Princeton University and allowed for the creation of pathbreaking work in our understanding of climate.

THE GEOPHYSICAL FLUID DYNAMICS PROGRAM STAFF
Front row: *Stephen Fels, Dawn Eldridge, Esther Olsen, Isaac Held, Kikuro Miyakoda, Syukuro Manabe*
Middle row: *Sheldon Judson, Gareth Williams, Kirk Bryan, Jorge Sarmiento, Abraham Oort, Yoshio Kurihara, Isidoro Orlanski*
Back row: *George Philander, George Mellor, Jerry Mahlman, Joseph Smagorinsky*

The picture was taken for the first ten years of the Atmospheric and Oceanic Science Program. The photograph shows most of the faculty in the program, a couple of university faculty members and university staff, and the rest of the GFDL scientists who participated in the program (remarkably, most of the GFDL scientists in the picture are retired now with more than forty years in the Laboratory).

Klaus Hasselmann. Between Feynman diagrams and ocean dynamics.

Text written by Isidoro Orlanski, Emeritus AOS, Princeton University



Klaus Hasselmann, Ill Niklas Elmehed © Nobel Prize Outreach

I think we met with Hasselman once, in the early seventies, at the Geophysical Fluid Dynamics Laboratory (GFDL), while he was visiting the oceanographic institute at Woods Hole. He was visiting Kirk Bryan to discuss Kirk's new ocean model. I then met with some of his collaborators from the Max Planck institut, in particular, with Dirks Olbers (due to my early work on internal gravity waves in the ocean) and Jürgen Willibrand, who spent a few sabbaticals at GFDL.

I learned much of what I know about Hasselmann's from an interesting interview that he did with Hans von Starch and Dirk Olbers for the American Institute of Physics in 2006. I found Hasselmann's answers very interesting, particularly when asked why he had chosen to focus on oceanography, when atomic theory and nuclear research were much more fashionable at the time.

Hasselmann explained, "I wanted to work on problems which I thought I would be able to solve. I did not want to work on abstract, theoretical problems. I was working in turbulence and wind surface waves and liked my field of work, and I only gradually drifted into oceanography, meteorology and climate research. Later, I did then become interested in quantum field theory, elementary particle physics and general relativity, through my work on nonlinear interactions in geophysical wave fields, starting from ocean waves."

One of Hasselmann's most important early works was solving the evolution and spectrum of oceanic wind waves, which he was able to do using methods he learned when shuffling with turbulence theory. In Hasselman's own words, "Although the relevant closure methods were inadequate when it came to solving the strongly nonlinear turbulence problem, they were directly applicable to the problem of weak interactions between ocean wave components. So I was able to derive a closed expression for the nonlinear energy transfer between ocean waves. It was represented by a relatively complicated so-called Boltzmann integral. Basically, I solved this problem to relieve my frustration at not being able to solve the turbulence problem."

Hasselman's work on wind waves spanned over the sixties and finished in the early seventies. It culminated in the successful field experiment in which his team published "Measurements of Wind Waves Growth and Swell Decay" during the Joint North Sea Wave Project (JONSWAP). -These results allowed them to show that the nonlinear energy transfer was the dominant process governing the form and rate of growth of the ocean wave spectrum. Hasselman's early formation in theoretical physics was reflected in many of his papers related to the interaction of surface gravity waves and the ocean bottom. In most of his papers he applied a slight modification of the interaction-diagram formalism of Feynman diagram rules.

After the creation of the World Climate Research Program in 1979, Germany committed funds to the Max Planck Institute for the development of climate models. Hasselman realized early on that making a distinction between anthropogenic climate change and natural climate variability would be very important. After the creation of the institute, Hasselman explained, "I had two goals; one was to understanding the origin of the natural variability of climate. It was an important issue if we wished to distinguish between natural climate variability and human made climate changes." He also understood the need to develop a good ocean model in order to have suitable climate models.

I remember in the early days of GFDL that "weather" and "climate defined weather" referred to phenomena that required initial conditions to define their evolution, while "climate" only required boundary conditions: orography, surface temperature (land and ocean), sea ice extent, sun constant and radiative forcing form atmospheric absorbents (greenhouse gases, ozone, etc.). One of Hasselmann's major contributions was to introduce the idea that long-term climate variability could be explained very simply by adding the short term fluctuations of the daily atmospheric weather as noise, in analogy with the diffusion process of Brownian motion. His previous experience in stochastic processes on surface gravity wave dynamics and turbulence allowed him to develop a stochastic climate model.

Furthermore, he was instrumental in developing methods that allowed for solving the central practical problem: the ability to distinguish between anthropogenic climate change and natural climate variability. In the period between1979-1995 he published many articles that were central to identify anthropogenic climate changes (Detection of Climate Change and Attribution of Causes, IPCC 1996).

The Nobel committee cites Manabe and Hasselmann for their contributions to our understanding of climate. The scientific training of both scientists and the approaches they followed are markedly different. Whereas Dr. Manabes's approach relied on deterministic climate models, Dr. Hasselman took a more probabilistic approach that leveraged his theoretical physics and quantum mechanics background. By recognizing the contributions of the two scientists, the Academy has underscored the importance of the problem at hand and the value in approaching it from a variety of perspectives.

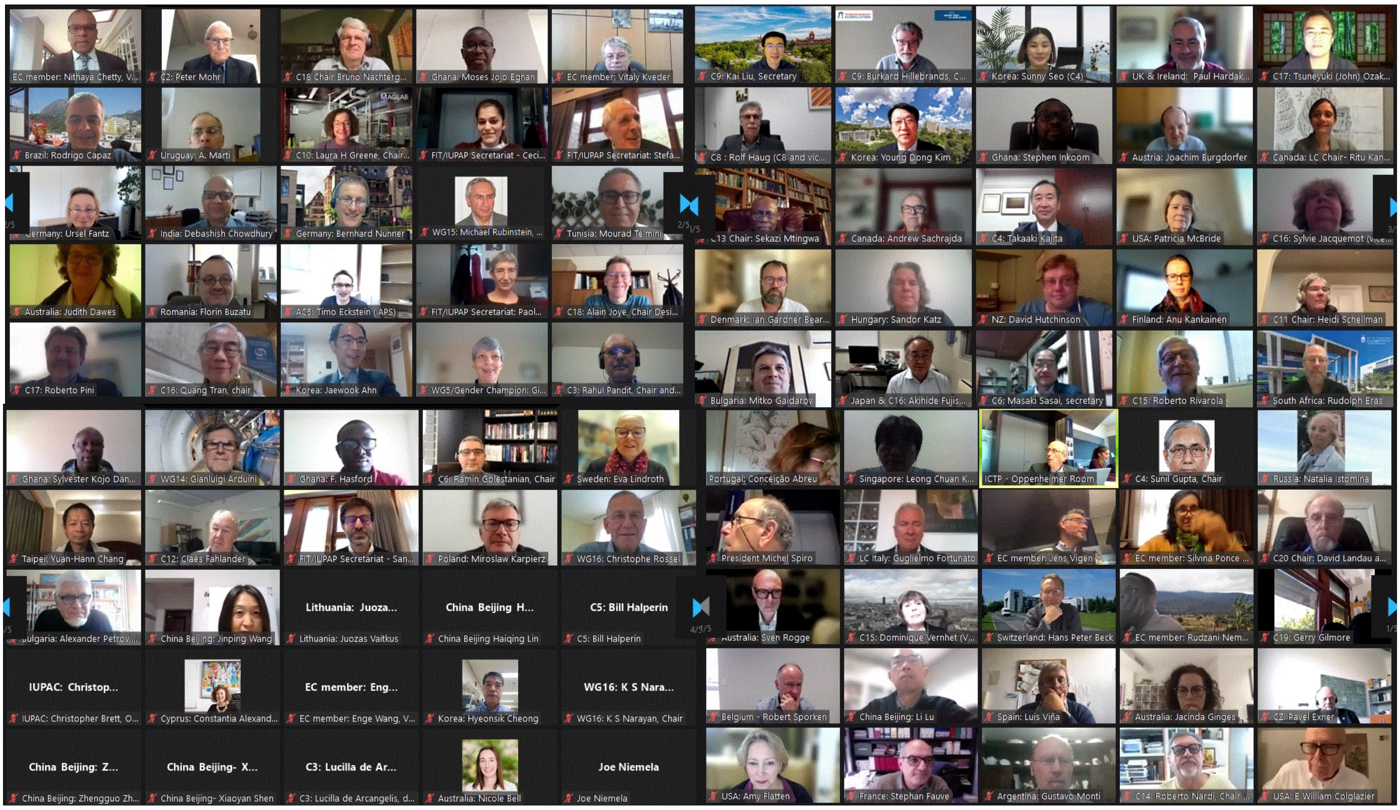
A call to action: the role of physics in delivering the global green economy

On the occasion of the 2021 United Nations Climate Change Conference (COP26), which took place in Glasgow, UK, on October 31-November 12, 2021, the IUPAP was invited to sign a statement on the role of physics in the green economy. The invitation was unanimously accepted by the EC and the IUPAP is now one of the signers, together with national physics societies from around the globe, of the statement entitled "A call to action: the role of physics in delivering the global green economy". Among other aspects, this declaration points to the important role of physics in our understanding of the climate and in the variety of projects that seek to reduce energy consumption and diminish pollution. The document also highlights the need of multidisciplinary approaches **to address these issues; of strongly supporting international collaborations, for which** the free movement of scientists is fundamental and of having a diverse and inclusive workforce as a way to enrich teams and enhance innovation. All these aspects are at the heart of IUPAP's expanded aims as stated in our recently approved Strategic Plan. In signing this statement, we expect to encourage the active participation of the physics communities worldwide to find solutions to the very urgent problems that humanity is facing.

IUPAP Young Scientist Prize (2021)

Commission on Astroparticle Physics (C4): Carlos Alberto Argüelles Delgado and Francesca Calore
Commission on Biological Physics (C6): Amin Doostmohammadi
Commission on Magnetism (C9): Can Onur Avci
Commission on Atomic, Molecular and Optical Physics (C15): Carlos Hernández García
Commission on Plasma Physics (C16): Tatasuya Kobayashi
Commission on Mathematical Physics (C18): Stefanos Aretakis, Chiara Saffirio, and Vincent Tassion
Commission on Computational Physics (C20): Prineha Narang
Affiliated Commission on Gravitation and General relativity, ISGRG (AC2): Christopher Berry

Collage of the 30th General Assembly (Online) on October, 20, 2021



The International Year of Basic Sciences for Sustainable Development proclaimed by the United Nations General Assembly for 2022

IYBSSD2022
International Year
of Basic Sciences
for Sustainable Development

The United Nations General Assembly approved by consensus the resolution 76/A/L.12 promulgating the year 2022 as the International Year of Basic Sciences for Sustainable Development (IYBSSD2022). Proposed by Honduras with the co-sponsorship of 36 other countries, the decision was adopted on 2 December 2021. This is the result of the mobilization of the international scientific community, led since 2017 by IUPAP. The direct involvement of CERN and of 26 other international scientific unions and research organizations was fundamental for the achievement and confirms the resolution 40/C 76 adopted unanimously by the UNESCO General Conference of 25 November 2019. IYBSSD will focus on the links between basic sciences and the Sustainable Development Goals that define the United Nations Agenda 2030. This will be a unique opportunity to convince all stakeholders that through a basic understanding of nature, the actions that might be taken will be more effective for the common good.

The opening ceremony of IYBSSD will take place at UNESCO headquarters on July 1st, 2022. The closing ceremony is expected to take place at CERN's Science Gateway in 2023. Several other activities will be held in connection with the year's celebration. Anybody willing to organize an event, an initiative or a program during IYBSSD 2022 that would like an official endorsement by the Steering Committee of IYBSSD is invited to fill out the form available here.

For more details, please visit the IYBSSD website or contact: Michel Spiro, president of the Steering Committee for IYBSSD2022 – michel.spiro@iybssd2022.org or Luc Allemand, secretary general of IYBSSD2022 - luc.allemand@iybssd2022.org

IUPAP Approved Conferences

Commission	Conference Name	Date Scheduled	Location
C2	2022 Conference on Precision Electromagnetic Measurements (CPEM 2022)	12 – 16 December 2022	Wellington New Zealand
C3	The 28th IUPAP International Conference on Statistical Physics”	08 – 12 August 2022	Tokyo, Japan
C4	27th European Cosmic Ray Symposium	24 – 29 July 2022	Jijmegen, The Netherlands
C5	The 29th International Conference on Low Temperature Physics (LT29)	18 – 24 August 2022	Hokkaido, Japan
C5	ULT2022 - Frontiers of Low Temperature Physics - (International Conference on Ultralow Temperature Physics 2022)	25 – 28 August 2022	Otaru, Japan
C8	International Conference Conference on the Physics of Semiconductors (ICPS)	26 June - 01 July 2022	Sydney, Australia
C9	Trends in Magnetism	12 – 16 September 2022	Venezia
C9**	The 24th International Colloquium on Magnetic Films and Surfaces (ICMFS-2022)	03 - 08 July 2022	Okinawa, Japan
C10	International Conference on Materials and Mechanisms of Superconductivity & High Temperature Superconductors	17 – 22 July 2022	Vancouver, Canada
C10	12th International Conference on Magnetic and Superconducting Materials (MSM22)	18 – 22 September 202	University of Duisburg-Essen (Germany)
C10	International Conference “NANOMATERIALS: APPLICATIONS & PROPERTIES”	04 – 09 September 2022	Krakow, Poland
C11	International Conference on High Energy Physics (ICHEP)	06 – 13 July 2022	Bologna, Italy
C11	The 30th International Conference on Neutrino Physics and Astrophysics (Neutrino 2022)	30 May – 04 June 2022	Coex, Seoul
C11	30th International Symposium on Lepton Photon Interactions at High Energies	10 – 14 January 2022	Manchester, UK
C11	26th International Conference on Computing in High Energy and Nuclear Physics	16 – 20 May 2022	Norfolk, VA, USA
C11	LHC Physics (LHCP) Conference	16 – 21 May 2022	Taipei, Taiwan
C12	International Nuclear Physics Conference (INPC)	11 - 16 September 2022	Cape Town, South Africa

C12	QNP 2022 - 9th International Conference on Quarks and Nuclear Physics	05 – 09 September 2022	Gustav-Stresemann-Institut Bonn, Germany
C12	DREB2020 - Direct Reactions with Exotic Beams	27 June – 01 July 2022	Jijmegen, The Netherlands
C12	International Conference on Strangeness in Quark Matter (SQM2022)	13 – 19 June 2022	Busan, Republic of Korea
C13	Quantum Africa Conference 6th Series	12 - 16 September 2022	Kigali, Rwanda
C13	4th CFPLP-Physics for a Sustainable Development Location: Praia, Cape Verde	11 - 16 September 2022	Praia, Cape Verde
C13	Quantum Materials in the Post Covid-19 era	10 - 16 July 2022	Quy Nhon, Vietnam
C13	Development Workshop with Gender Perspective for Early Career Scientists and Students	26 - 29 July 2022	Honduras, Tegucigalpa
C14	International Conference on Physics Education (ICPE)	18 – 23 July 2022	Sydney/Australia/Thailand/Indonesia
C14	International Conference of Physics Students	09 – 16 August 2022	Universidad Iberoamericana Puebla, Mexico
C15	The 27th International Conference on Atomic Physics, to be held in Toronto, Canada, 17-22 July 2022.	17 – 22 July 2022	Toronto, Canada
C15	20th International Conference on the Physics of Highly Charged Ions	29 August – 02 September 2022	Matsue, Japan
C15	ATTO VIII: 8th International Conference on Attosecond Science and Technology		Orlando, Florida, USA
C16	ESCAMPIG 2022 - EurophysicS Conference on Atomic and Molecular Physics of Ionized Gases	11 – 15 July 202	Paris, France
C17	12th CIRP Conference on Photonic Technologies [LANE 2022]	04 – 08 September 2022	Fuerth, Germany
C17	9th International Conference on Optical Terahertz Science and Technology (OTST 2022)	24 – 29 April 2022	Budapest, Hungary
C18	Mathematical Results in Quantum Theory (QMATH) 15	12 – 16 September 2022	Davis, California, USA
C18	The 34th International Colloquium on Group Theoretical Methods in Physics	18 – 22 July 2022	Strassbourg, France
C19	Monitoring the Non-Thermal Universe	05 – 09 September 2022	Cochem Germany
C20	IUPAP Conference in Computational Physics	31 July – 04 August 2022	Austin, Texas, USA

Affiliated Commissions			
AC1	The 25th Congress of the International Commission for Optics (ICO-25) and the 16th Conference of International Society on Optics Within Life Sciences (OWLS-16)	05 – 09 September 2022	Dresden, Germany
AC2	23rd International Conference on General Relativity and Gravitation	03 – 08 July 2022	Beijing, China
AC3	24th International Congress on Acoustics	24 – 28 October 2022	Hwabaek International Convention Center (HICO) in Gyeongju, Korea
AC4	World Congress on Medical Physics and Biomedical Engineering, IOMP School	12 – 17 June 2022	Singapore