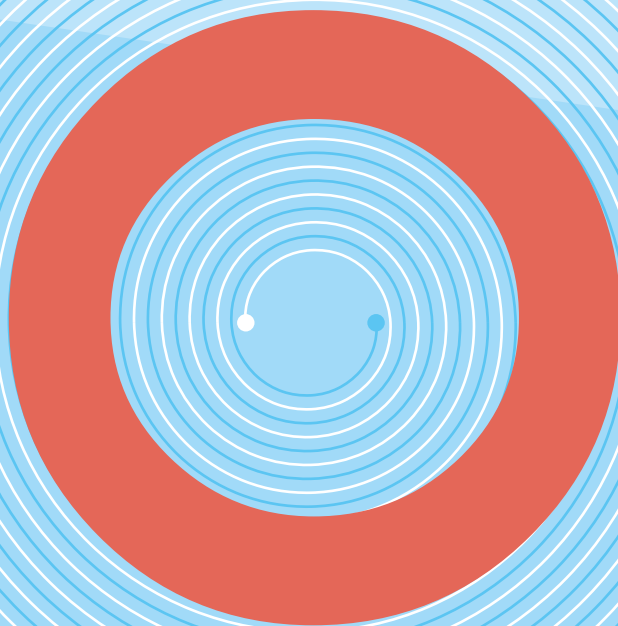


# ICTP: A Year in Review

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The Abdus Salam  
International Centre  
for Theoretical Physics



The Abdus Salam

**International Centre  
for Theoretical Physics**

2021: A Year in Review





# Contents

Foreword	4
ICTP Research	6
ICTP Impact	10
2021 Timeline	14
Governance	28
Donors	29
Scientific and Administrative Staff 2021	30
In Memoriam	35



# Foreword

Coming after a year of international lockdowns and much uncertainty, 2021 began with some trepidation here at ICTP. How would the pandemic play out over the coming year? When could we expect to allow visitors to our campus again? Could ICTP continue to live up to its reputation as a first-rate research centre and an international hub of scientific networking under continued COVID restrictions?

The Centre learned some important lessons in 2020 about maintaining connections where face-to-face meetings were impossible. Our quick shift to online meetings and education meant that no scientist anywhere would be left behind. By the end of 2021, the number of scientists participating in ICTP activities rebounded to (and indeed slightly exceeded) pre-COVID levels. Offering all of our activities online seems to be especially advantageous to female scientists: in 2021, 30% of ICTP participants were women, the highest percentage ever reached at the Centre.

As vaccines rolled out and COVID case numbers decreased, ICTP took small steps to re-open. Under strict health protocols, Diploma and other students were allowed back to campus and eventually to in-person classes. We were cautiously pleased to be able to hold our first major hybrid events in 2021, including the 30th Anniversary of the Postgraduate Diploma Programme and the graduation ceremony for the Diploma

Class of 2021, as well as the delayed Dirac Medal and Prize ceremony for our 2020 winners André Neveu, Pierre Ramond and Miguel Virasoro (posthumously).

We all, including ICTP, have adjusted to the new reality of living with COVID. As the world slowly re-opens, we are looking ahead to new horizons and new possibilities. The Centre will soon celebrate its 60th anniversary, and we hope to use that milestone to seek new resources to improve our facilities and enrich our programmes. In 2021 we hired an Advancement Officer to help us reach our financial goals, while our newly hired head of the Marie Curie Library is consulting with the ICTP community to transform the library into a modern space. We are rebuilding our website, transforming it into a global science portal that can more effectively meet the needs of ICTP's international community.

As we look toward the future, ICTP remains committed to what it has always excelled at: performing cutting-edge research in science and offering unique, enriching training and education opportunities for scientists coming from disadvantaged parts of the world. We remain firm believers in the notion that an investment in basic sciences is an investment in a sustainable, peaceful future.

**Atish Dabholkar**  
*Director, ICTP*



ICTP Director Atish Dabholkar and Diploma students celebrate the visit of Giorgio Parisi weeks after he received the 2021 Nobel Prize in Physics. Parisi was at ICTP to deliver his first public lecture as a Nobel laureate.

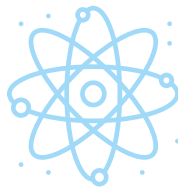
# ICTP Research

ICTP is widely regarded as an extraordinary environment for advancing knowledge in the physical and mathematical sciences, with a permanent faculty of 45 distinguished scientists who conduct rigorous world-class, curiosity-driven research in frontier and interdisciplinary science ranging from string theory, cosmology, and black holes to quantum computing, climate science, and quantitative life sciences. They teach and mentor hundreds of students and young researchers every year, equipping them to go on to study, teach, and conduct research in the world's finest universities, and to contribute to the development of science in their home countries. Research at ICTP has been linked, directly or indirectly, to five Nobel prizes.

ICTP's unique strength lies in its ability to bring together large numbers of gifted scientists from developing and developed countries to participate in joint research. From its early focus on theoretical high energy physics, the Centre's research areas have evolved in response to the needs of physicists and mathematicians from the developing world, and now include the areas below.

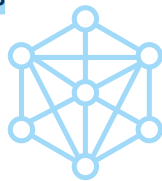
## High Energy, Cosmology and Astroparticle Physics

The High Energy, Cosmology and Astroparticle Physics (HECAP) section at ICTP is studying some of the most exciting areas in physics today, from string theory to physics at large energy colliders, from neutrino phenomenology to alternative cosmologies.



## Condensed Matter and Statistical Physics

Strange and unexpected behaviours may emerge when large numbers of particles collect together. Researchers in the Condensed Matter and Statistical Physics (CMSP) section at ICTP are tackling this challenging realm with a variety of analytical and numerical techniques, with a particular focus on the development of new methods of numerical simulation.



## Mathematics

ICTP's Mathematics section emphasizes two core functions: the creation of new mathematical knowledge and its global dissemination, in particular to developing countries. Research by ICTP's mathematicians reflects the important synergy between mathematics and physics, as well as the role of mathematics in driving the rapid development of technological advances.



## Science, Technology and Innovation Unit

ICTP's diverse Science, Technology and Innovation Unit (STI) encompasses areas of research that respond to the most critical needs of the ICTP scientific community, such as fast and reliable connectivity and support in the development of advanced instrumentation. These areas are at the boundary between the core research fields of ICTP and more applied fields of research. They encompass activities for which the demand in developing countries is enormous and growing.



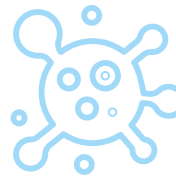
## Earth System Physics

Understanding the various components of the Earth system, including their interactions and processes, forms the basis of research by ICTP's Earth System Physics section (ESP). From building and using models of climate change and its impacts to deciphering the mechanics of earthquakes and volcanoes, ESP research covers a wide spectrum.



## Quantitative Life Sciences

Scientists in ICTP's Quantitative Life Sciences section are uncovering the underlying physics in the broad domain of life sciences that encompasses disciplines ranging from molecular and cell biology to terrestrial and oceanic ecology, and economics and quantitative finance.



# ICTP Research in Numbers 2021

## Number of researchers

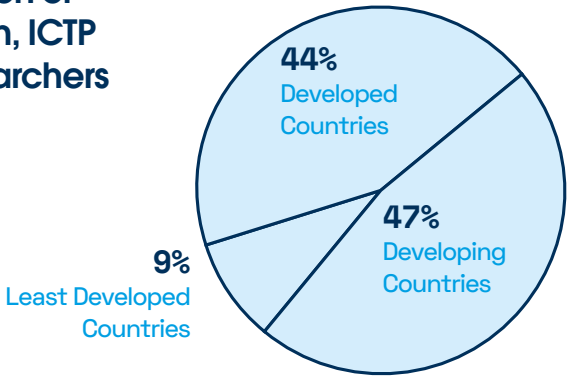
Staff, consultants, longterm visiting scientists, postdoctoral fellows

192

## Number of countries represented by ICTP researchers

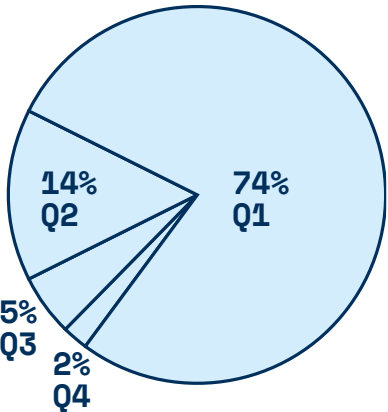
43

## Region of origin, ICTP researchers

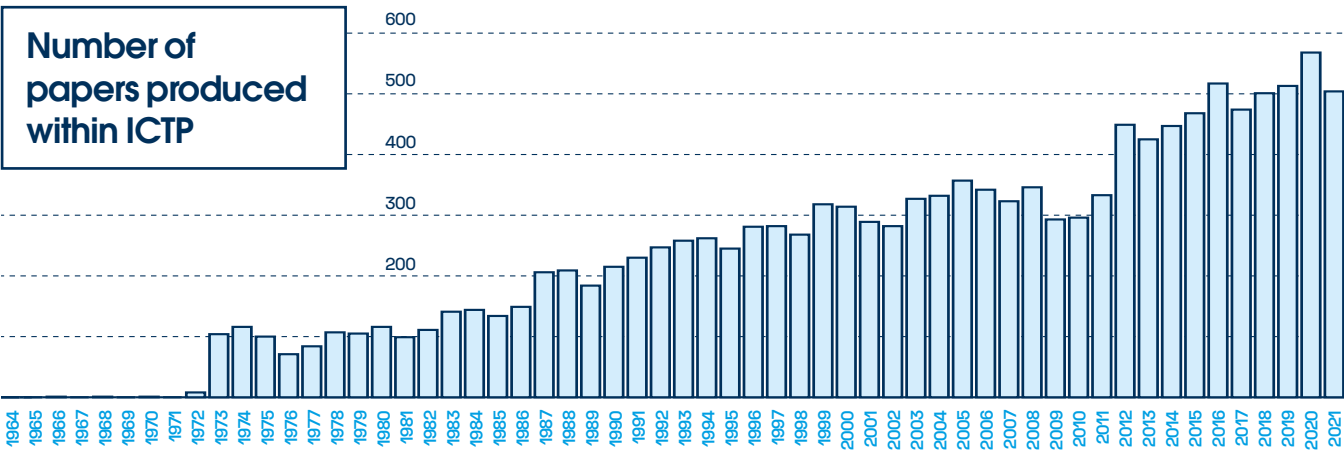


## ICTP's quality research

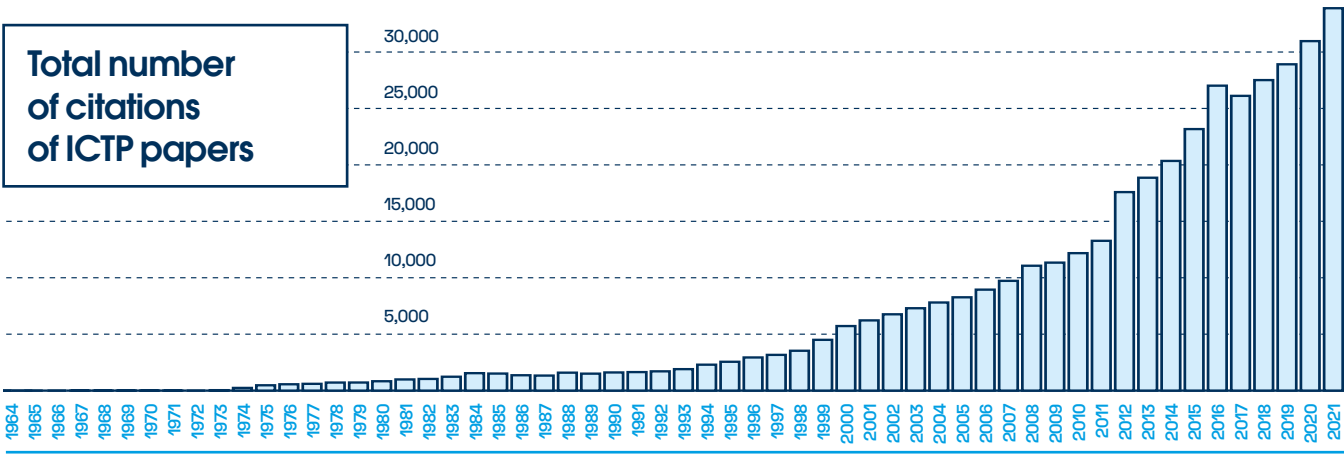
Around three-fourths of ICTP research is published in the most-cited journals, an indication of the quality of ICTP research: pie chart shows ESI Total Citations quartiles' frequencies for ICTP papers produced in from 2016-2021.



## Number of papers produced within ICTP



## Total number of citations of ICTP papers





# Publication Highlights

## High Energy, Cosmology and Astroparticle Physics

Acharya, B. S., Kinsella, A., & Morrison, D. R. (2021). Non-perturbative heterotic duals of M-theory on G2 orbifolds. *Journal of High Energy Physics*, 2021(11). [https://doi.org/10.1007/jhep11\(2021\)065](https://doi.org/10.1007/jhep11(2021)065)

Celoria, M., Creminelli, P., Tambalo, G., & Yingcharoenrat, V. (2021). Beyond perturbation theory in inflation. *Journal of Cosmology and Astroparticle Physics*, 2021(06), 051. <https://doi.org/10.1088/1475-7516/2021/06/051>

Janssen, O., & Mirbabayi, M. (2021). Low-temperature entropy in JT gravity. *Journal of High Energy Physics*, 2021(6). [https://doi.org/10.1007/jhep06\(2021\)074](https://doi.org/10.1007/jhep06(2021)074)

Miró, J. E., & Guerrieri, A. (2021). Dual EFT Bootstrap: QCD Flux tubes. *Journal of High Energy Physics*, 2021(10). [https://doi.org/10.1007/jhep10\(2021\)126](https://doi.org/10.1007/jhep10(2021)126)

## Condensed Matter and Statistical Physics

Manzano, G., Subero, D., Maillet, O., Fazio, R., Pekola, J. P., & Roldán, É. (2021). Thermodynamics of gambling demons. *Physical Review Letters*, 126(8). <https://doi.org/10.1103/physrevlett.126.080603>

Mendes-Santos, T., Turkeshi, X., Dalmonete, M., & Rodriguez, A. (2021). Unsupervised learning universal critical behavior via the intrinsic dimension. *Physical Review X*, 11(1). <https://doi.org/10.1103/physrevx.11.011040>

Pullanchery, S., Kulik, S., Rehl, B., Hassanali, A., & Roke, S. (2021). Charge transfer across C-h...o hydrogen bonds stabilizes oil droplets in water. *Science*, 374(6573), 1366–1370. <https://doi.org/10.1126/science.abj3007>

Stephens, A. D., Qaisrani, M. N., Ruggiero, M. T., Díaz Mirón, G., Morzan, U. N., González Lebrero, M. C., Jones, S. T., Poli, E., Bond, A. D., Woodhams, P. J., Kleist, E. M., Grisanti, L., Gebauer, R., Zeidler, J. A., Credgington, D., Hassanali, A., & Kaminski Schierle, G. S. (2021). Short hydrogen bonds enhance nonaromatic protein-related fluorescence. *Proceedings of the National Academy of Sciences*, 118(21). <https://doi.org/10.1073/pnas.2020389118>

Zong, H., Robinson, V. N., Hermann, A., Zhao, L., Scandolo, S., Ding, X., & Ackland, G. J. (2021). Free electron to electride transition in dense liquid potassium. *Nature Physics*, 17(8), 955–960. <https://doi.org/10.1038/s41567-021-01244-w>

## Mathematics

Arezzo, C., Balducci, F., Piergallini, R., Scardicchio, A., & Vanoni, C. (2021, October 1). Localization in the discrete non-linear Schrödinger equation and geometric properties of the microcanonical surface. *arXiv.org*. <https://doi.org/10.48550/arXiv.2102.10298>

Carneiro, E., Das, M. K., Florea, A., Kumchev, A. V., Malik, A., Milinovich, M. B., Turnage-Butterbaugh, C., & Wang, J. (2021). Hilbert transforms and the equidistribution of zeros of polynomials. *Journal of Functional Analysis*, 281(9), 109199. <https://doi.org/10.1016/j.jfa.2021.109199>

Climenhaga, V., Luzzatto, S., & Pesin, Y. (2021). SRB measures and young towers for surface diffeomorphisms. *Annales Henri Poincaré*. <https://doi.org/10.1007/s00023-021-01113-5>

Göttsche, L., & Kool, M. (2021, December 6). Sheaves on surfaces and virtual invariants. *arXiv.org*. <https://doi.org/10.48550/arXiv.2007.12730>

## Earth System Physics

Chemison, A., Ramstein, G., Tompkins, A. M. et al. Impact of an accelerated melting of Greenland on malaria distribution over Africa. *Nat Commun* 12, 3971 (2021). <https://doi.org/10.1038/s41467-021-24134-4>

Giorgi, F., Coppola, E., Jacob, D., Teichmann, C. et al. (2022). The CORDEX-core EXP-I initiative: Description and highlight results from the initial analysis. *Bulletin of the American Meteorological Society*, 103(2). <https://doi.org/10.1175/bams-d-21-0119.1>

Ranasinghe R, Ruane AC, Vautard R, Arnell N, Coppola E, Cruz FA, et al., 2021. "Climate Change Information for Regional Impact and for Risk Assessment," in *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, et al. (Cambridge University Press). Available at: <https://www.ipcc.ch/>.

Sadeghi-Bagherabadi, A., Vuan, A., Aoudia, A., Parolai, S., The AlpArray and AlpArray-Swath-D Working Group, Heit, B., Weber, M., Haberland, C., & Tilmann, F. (1AD, January 1). High-resolution crustal S-wave velocity model and Moho geometry beneath the southeastern alps: New Insights from the swath-D experiment. *Frontiers*. <https://doi.org/10.3389/feart.2021.641113>

## Quantitative Life Sciences

Baker, A., Biazzo, I., Braunstein, A., Catania, G., Dall'Asta, L., Ingrosso, A., Krzakala, F., Mazza, F., Mézard, M., Muntoni, A. P., Refinetti, M., Sarao Mannelli, S., & Zdeborová, L. (2021). Epidemic mitigation by statistical inference from Contact Tracing Data. *Proceedings of the National Academy of Sciences*, 118(32). <https://doi.org/10.1073/pnas.2106548118>

Manzano, G., Subero, D., Maillet, O., Fazio, R., Pekola, J. P., & Roldán, É. (2021). Thermodynamics of gambling demons. *Physical Review Letters*, 126(8). <https://doi.org/10.1103/physrevlett.126.080603>

Touzo, L., Marsili, M., & Zagier, D. (2021). Information thermodynamics of financial markets: The glosen–milgrom model. *Journal of Statistical Mechanics: Theory and Experiment*, 2021(3), 033407. <https://doi.org/10.1088/1742-5468/abe59b>

Zaoli, S., & Grilli, J. (2021). A macroecological description of alternative stable states reproduces intra- and inter-host variability of gut microbiome. *Science Advances*, 7(43). <https://doi.org/10.1126/sciadv.abj2882>

## Science, Technology and Innovation Unit

Canessa, E., & Tenze, L. (2021). Ideals and virtual realities. *International Journal of Emerging Technologies in Learning (IJET)*, 16(21), 201. <https://doi.org/10.3991/ijet.v16i21.25493>

Crespo, M. L., Foulon, F., Cicuttin, A., Bogovac, M., Onime, C., Sisterna, C., Melo, R., Florian Samayoa, W., García Ordóñez, L. G., Molina, R., & Valinoti, B. (2021). Remote Laboratory for e-learning of systems on chip and their applications to nuclear and scientific instrumentation. *Electronics*, 10(18), 2191. <https://doi.org/10.3390/electronics10182191>

Migoya-Orué, Y., Alazo-Cuartas, K., Kashcheyev, A., Amory-Mazaudier, C., Radicella, S., Nava, B., Fleury, R., & Ezquer, R. (2021). B2 thickness parameter response to equinoctial geomagnetic storms. *Sensors*, 21(21), 7369. <https://doi.org/10.3390/s21217369>

Zennaro, M., Rainone, M., & Pietrosevoli, E. (2021). TAT.py: Tropospheric Analysis Tools in python. 2021 17th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob). <https://doi.org/10.1109/wimob52687.2021.9606437>

# ICTP Impact

Science is a powerful driving force in the success of any nation, contributing to its economic well-being and the individual fulfilment of its people. Many countries, however, do not have the infrastructure or educational provision to support the growth of science and technology and to keep pace with the developed world. Technology unsupported by science simply does not take hold or flourish. It is not enough to have the know-how; countries also need the know-why. ICTP is committed to addressing and eliminating those inequalities.

ICTP’s reach and impact is global. The Centre’s four regional centres of excellence in Brazil, China, Mexico and Rwanda bring ICTP’s unique blend of high-quality physics and mathematics education and high-level science meetings closer to scientists everywhere. Our Physics Without Frontiers programme spreads the joy and wonder of physics to students in science and technology lagging countries, helping to build the next generation of scientists.

ICTP also builds scientific capacity through programmes coordinated by its External Activities Unit. These include support for scientific meetings, research networks, visiting scholars, and collaborative agreements with universities in developing countries. The latter, which ICTP considers ‘affiliated centres’, receive ICTP support for their postgraduate programmes in physics or mathematics, and are encouraged to enrol staff and students in ICTP programmes.



# ICTP: A Hub for Global Scientific Excellence

ICTP’s work at the very frontiers of research makes us a destination of choice for leading physicists and mathematicians from all over the world. Each year, ICTP brings together thousands of world-leading and early career scientists from more than 150 countries to participate in advanced workshops and conferences that explore topics at the cutting edge of physics and mathematics. This rich intellectual atmosphere is enhanced by resources such as our Marie Curie Library – one of Europe’s finest research libraries – our high-performance computing facilities, and residential and community facilities that promote informal social and intellectual interactions where ideas are discussed over meals or coffee.

Over the years, some 106 Nobel Laureates, 20 Fields Medallists, and members of our distinguished Scientific Council have spent time at ICTP, offering unparalleled opportunities for the brightest minds in the world, whether established or early-career scientists, to learn from each other.

ICTP also reaches directly into the developing world. Our four partner institutes in Brazil, China, Rwanda, and Mexico give scientists in those countries access to our networks, expertise, and convening power and have flourishing research and training programs of their own and in collaboration with ICTP.

ICTP has been the anchor of the “Trieste Science System” – a network of institutes including the International School for Advanced Studies (SISSA), Elettra Synchrotron Facility, and the University of Trieste – which offers even broader opportunities for collaboration within a short distance of our campus.

## ICTP Activities in Numbers, 2021

6525

scientific visitors, including those who participated remotely

152

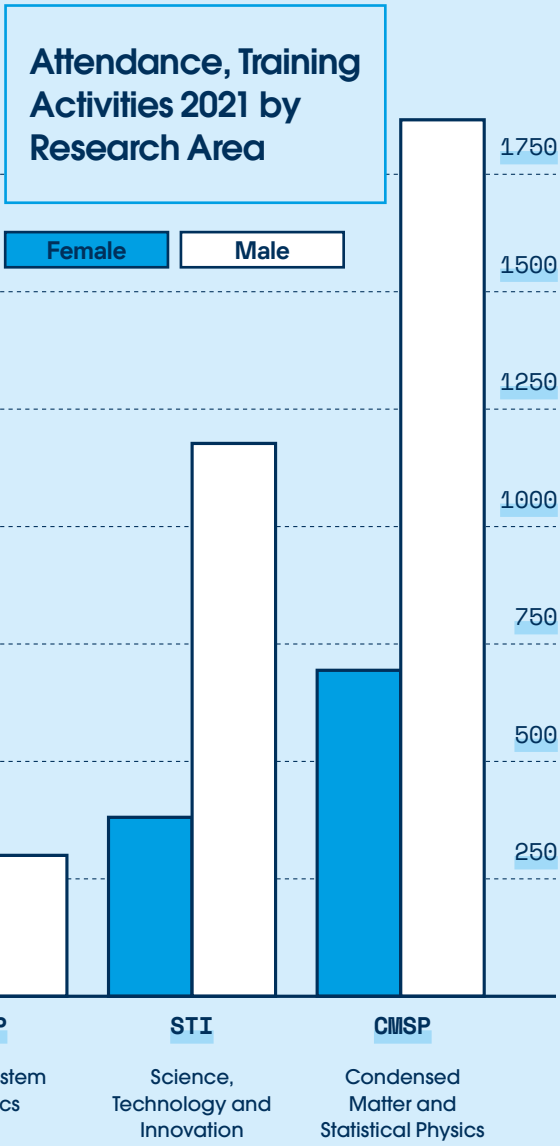
nations represented

30%

of visitors were women

53

conferences, schools and workshops



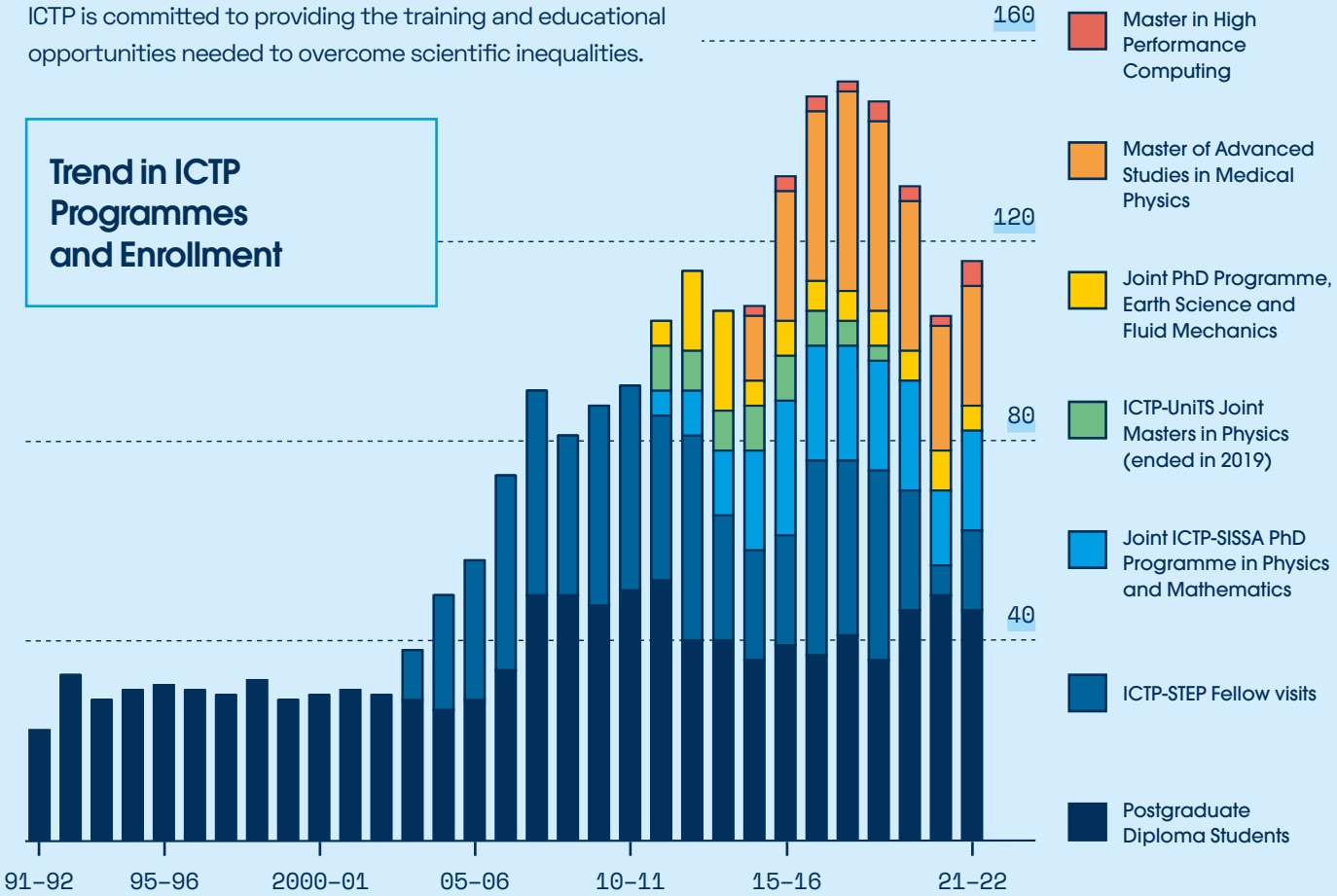
# Education & Training

ICTP believes that talent is found everywhere; we all gain from the diversity of perspectives created by ensuring that scientists are empowered and can contribute to scientific discourse independently of possibly constraining factors such as geography, gender, class, or ethnicity. The Centre works to transcend such barriers both to individual achievement and to building the science base in developing countries, through our training and education programmes.

Developing scientific talent contributes to the economic well-being and the individual fulfilment of nations. Many countries, however, do not have the infrastructure or educational provision to support the growth of science and technology and to keep pace with the developed world. This is where ICTP can help.

ICTP offers a unique environment for scientists at all stages of their careers to advance their knowledge in physics and mathematics. From our intense, one-year Postgraduate Diploma Programme that prepares young scientists for doctoral studies, to the Associates Scheme, which supports sabbatical visits of established scientists, ICTP is committed to providing the training and educational opportunities needed to overcome scientific inequalities.

## Trend in ICTP Programmes and Enrollment



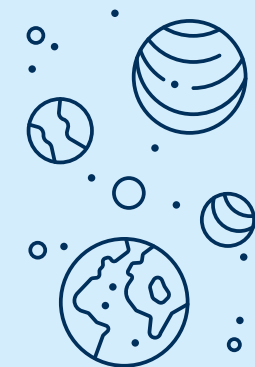
## ICTP Education in 2021

116

students enrolled in masters, PhD, Diploma, and STEP programmes

39

countries represented (including 8 least-developed countries)



93

scientists from 29 countries engaged in career development programmes (Associates, TRIL, and Elettra)



# 2021 Timeline

## January



Masters in Medical Physics students at their hybrid graduation ceremony

### Master of Medical Physics Graduation

Eight students from eight developing countries became the latest to receive a Master of Advanced Studies in Medical Physics (MMP) at a hybrid ceremony. The students had completed ICTP’s two-year study and clinical training programme, in spite of the hardships brought on by the pandemic, which struck just as the students were set to begin their hands-on experience in hospitals.



### ICO/ICTP Gallieno Award

ICTP and the International Commission for Optics (ICO) awarded their 2021 ICO/ICTP Gallieno Denardo Award to David Hayrapetyan of the Russian-Armenian University in Yerevan, Armenia, for “his breakthrough contributions to the theory of semiconductor nanosystems, as well as his promotion of optics and photonics in Armenia under difficult circumstances.”

### Spirit of Abdus Salam Award

Three members of the extended ICTP community shared the 2021 Spirit of Abdus Salam Award: Mohamed Hassan, former executive director of The World Academy of Sciences; Gregorio Medrano Asensio, a Spanish physicist with a long history of collaboration with Abdus Salam and a frequent ICTP visitor; and Hilda Cerdeira, a scientist in ICTP’s Condensed Matter section who developed ICTP’s eJournals Delivery Service for scientists at institutions in least developed or low-income countries.



Hilda Cerdeira   Mohamed Hassan   Gregorio Medrano Asensio

## February



ICTP’s new STI unit addresses critical technical needs of the ICTP scientific community (photo: Marco Zennaro)

### Science, Technology and Innovation Unit

ICTP launched its Science, Technology and Innovation unit to address critical needs of the ICTP scientific community such as fast and reliable connectivity and support in the development of advanced instrumentation. The new unit consolidates activities and areas of research that had been under the umbrella of ICTP’s Applied Physics section. This includes wireless ICT, Internet of Things, advanced scientific instrumentation, ionospheric modelling, space weather, additive manufacturing, science dissemination, cultural heritage, and optics.



### Dirac Medal and Prize Ceremony, 2019 Winners

The 2019 Dirac Medal and Prize Ceremony, postponed from 2020 due to COVID, took place virtually to honour the three recipients whose research has made a profound impact on modern cosmology. Viatcheslav Mukhanov (Ludwig Maximilian University of Munich), Alexei Starobinsky (Landau Institute for Theoretical Physics) and Rashid Sunyaev (Max Planck Institute for Astrophysics, and Space Research Institute, Moscow) shared the prize “for their outstanding contributions to the physics of the Cosmic Microwave Background (CMB) with experimentally tested implications that have helped to transform cosmology into a precision scientific discipline by combining microscopic physics with the large-scale structure of the Universe.”

# 2021 Timeline

## February

### From Dirac Medal to Wolf Prize

Giorgio Parisi, an ICTP Dirac Medallist (1999), was awarded the prestigious Wolf Prize “for ground-breaking discoveries in disordered systems, particle physics and statistical physics.” He is a professor of theoretical physics at the University of Rome “La Sapienza”, where his research has focused on quantum field theory, statistical mechanics, and complex systems.



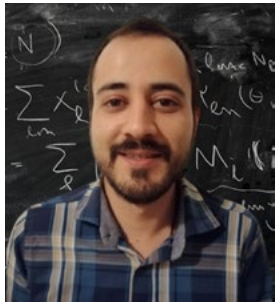
Alicia Dickenstein

### Awarding Excellence by Women in Science

Alicia Dickenstein, a former ICTP Senior Simons Research Associate, was awarded the 2021 L’Oreal-UNESCO International Award for Women in Science. An Argentinian mathematician with extensive connections to ICTP, she was awarded the prize for her “outstanding contributions at the forefront of mathematical innovation by leveraging algebraic geometry in the field of molecular biology.”



Nesrine Yousfi



Saeid Aliei



Krister Jazz Urog

### High-tech Graduates

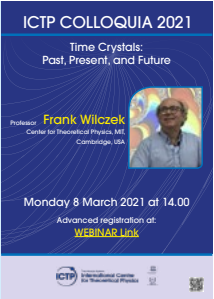
Three students from Algeria, Iran and the Philippines—all supported by ICTP—graduated from the Centre’s Master’s in High Performance Computing programme, run jointly with the International School for Advanced Studies (SISSA). The ICTP students—Saeid Aliei from Iran, Krister Jazz Urog from the Philippines and Nesrine Yousfi from Algeria—successfully completed the two-year programme that combines lectures with hands-on and applied projects to prepare future HPC specialists for academia and industry.

## March

### Joint ICTP Colloquium

#### “Time Crystals: Past, Present and Future”

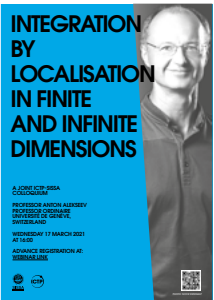
Nobel Laureate Frank Wilczek  
Center for Theoretical Physics, MIT, USA



### Joint ICTP- SISSA Colloquium

#### “Integration by Localisation in Finite and Infinite Dimensions”

Anton Alekseev  
University of Geneva, Switzerland



## April



Representatives from Trieste science institutes, including ICTP Director Atish Dabholkar (third from right) at the signing of a research agreement with Generali

### Data Science & Artificial Intelligence Institute

ICTP—along with the Scuola Internazionale Superiore di Studi Avanzati (SISSA), University of Trieste, University of Udine, MIB Trieste School of Management, and the global insurance company Generali—signed a memorandum of understanding that lays the foundation for a Trieste institute for data science and artificial intelligence.

The Data Science & Artificial Intelligence Institute will nurture new talent and foster new collaborations through joint activities such as seminars and workshops, PhD and master programmes, dissemination activities, as well as upskilling and reskilling opportunities for the employees of industrial partners.



# 2021 Timeline

May

## A New Home for Global Science

ICTP's host city - Trieste - was selected as the new home for the International Union of Pure and Applied Physics (IUPAP), adding to the already significant presence of international research institutes in Italy's so-called "City of Science". ICTP scientist Sandro Scandolo was named as IUPAP's Deputy Secretary General for Administrative Affairs.



Joint ICTP Colloquium

**"Towards Genome Scale Drug Design"**

**Riccardo Sabatini**  
Orion Biosciences, USA

**TOWARDS GENOME SCALE DRUG DESIGN**

A JOINT ICTP-ORION COLLOQUIUM  
PROFESSOR RICCARDO SABATINI  
ORION BIOSCIENCES, USA  
WEDNESDAY 13 MAY 2021  
9:00 AM  
ADVANCE REGISTRATION AT TRIESTE

June



EAFIR physics masters students at their graduation ceremony

## Africa's Rising Stars of Physics

ICTP's partner institute in Rwanda, the ICTP-East African Institute for Fundamental Research (EAFIR), celebrated a milestone in its three years of existence: its first batch of master students successfully completed the requirements for a master's degree. The nine students, coming from Rwanda,

Uganda and Sudan, were enrolled in the MSc physics programme that EAFIR conducts with the University of Rwanda. Many of the students were accepted to PhD studies at universities in the US and Europe, while others were hired to teach at the University of Rwanda and at secondary schools.

July

## Climate Research Honoured

ICTP Staff Associate In-Sik Kang was awarded the World Meteorological Organization's (WMO) top award, the IMO Prize, for his outstanding contributions to climate science.



In-Sik Kang

August



ICTP Director Atish Dabholkar (centre) with members of the Brazil G20 delegation

## ICTP and the G20

ICTP hosted two high-level meetings of delegates from Brazil and Turkey as side events to the G20 Ministerial Meeting that took place in Trieste, and met with South Africa's Minister of Higher Education, Science and Technology. The delegates discussed ongoing and future initiatives between ICTP and their countries.



# 2021 Timeline



## August

### ICTP Postgraduate Diploma Graduation Ceremony 2021

Forty-three Diploma students completed the 2020-2021 Postgraduate Diploma Programme and received diplomas at a ceremony on 25 August. Many have been accepted to masters and PhD studies at universities around the world, thanks to the knowledge and experience they have gained at ICTP.

The 43 graduates from 27 countries who completed ICTP's Postgraduate Diploma Programme in 2021 after a year of intensive study reflected the cultural diversity ICTP is known for. The diplomas they received acknowledged their achievements

in mastering theses in ICTP's many research areas. With their newly gained knowledge, and a boost of confidence from having completed the Postgraduate Diploma Programme, the scholars are ready to begin the next stages of their science career journeys. Several of them shared their hopes and dreams:



**Younes Benyahia**  
Algeria  
*Diploma in Mathematics; admitted to ICTP/SISSA Joint PhD Programme*

"There is a very good environment here at ICTP for science. Everyone is discussing math and physics. The professors are so friendly, you can have coffee with them while you casually talk about math. It's surprisingly very diverse, a lot of fields of mathematics are covered here, even if there are just a few faculty members. Whatever you like, you can find it here."



**Rolando Ramirez Camasca**  
Peru  
*Diploma in Condensed Matter Physics; admitted to PhD, University of California San Diego, USA*

"My dream job has always been to have a joint appointment between a university either in the US or Europe and a university in Peru. I think that way I will be able to connect those two communities and exchange knowledge but also give opportunities to Peruvian or Latin American students to get to know the research that is done outside the universities outside the country."



**Kyrell Verano**  
Philippines  
*Diploma in Quantitative Life Sciences; admitted to PhD, University of Trieste*

"My long-term plan is to do work in academe near my home town in the Philippines. There is a growing research community there doing really interesting, impactful work. Joining this community, I wish to build a research team, hopefully to do significant research that can help the community, provide jobs for young scientists, and introduce them to a lot of learning opportunities in the world."



**Arpon Paul**  
Bangladesh  
*Diploma in High Energy, Cosmology and Astroparticle Physics; admitted to PhD, University of Minnesota, USA*

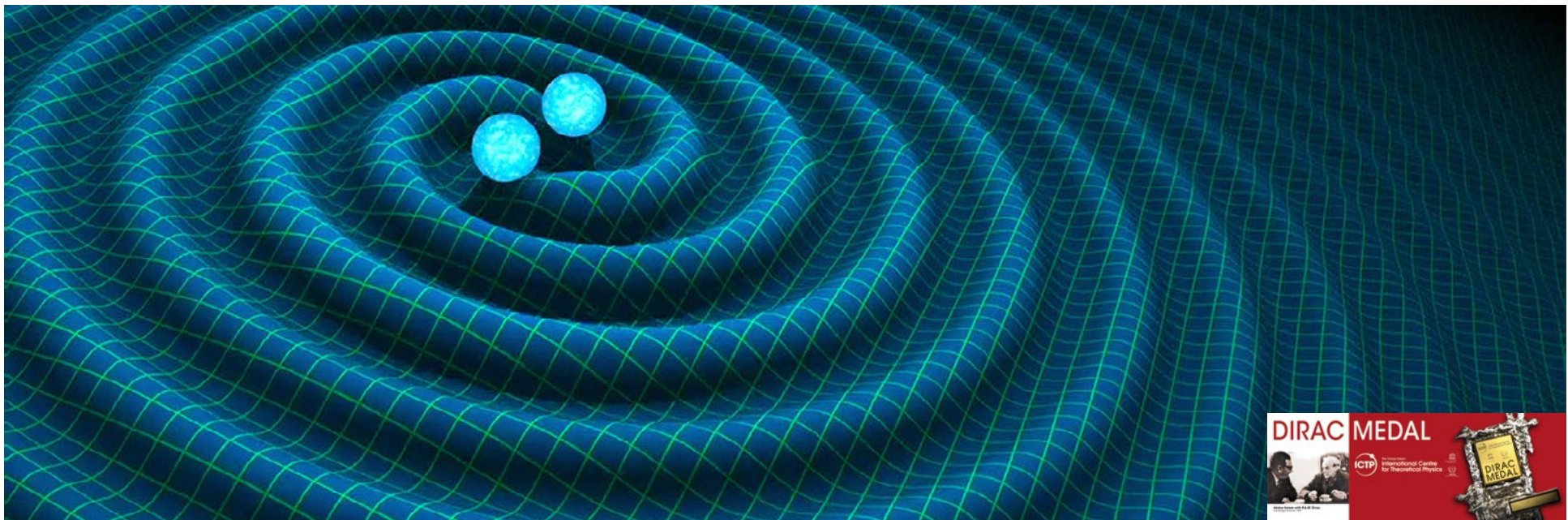
"When I was in high school I attended physics olympiads and there I met a lot of physics professors and students who were working in physics. There I got an idea of the path I could go to be a physicist. Later I did my undergraduate in physics, and, here I am!"



**Amelia Sanchez Perez**  
Cuba  
*Diploma in Earth System Physics; admitted to MSc at National Polytechnic Institute, La Paz, Mexico*

"The Diploma Programme exceeded my expectations. Here I learned a lot. I had excellent professors. And something important for me, in my field, is that I learned two programming languages, Fortran and Python. I think this knowledge will translate into a bright perspective for my future career."





### ICTP Announces 2021 Dirac Medallists

ICTP awarded its 2021 Dirac Medal and Prize to four physicists whose theoretical work underpinned the 2015 detection of gravitational waves generated by black holes. The 2021 Dirac Medallists are:

- + Alessandra Buonanno, Max Planck Institute for Gravitational Physics, Germany
- + Thibault Damour, Institut des Hautes Études Scientifiques (IHÉS), France
- + Frans Pretorius, Princeton University, USA
- + Saul Teukolsky, Caltech and Cornell University, USA

The four physicists have received the medal for establishing the predicted properties of gravitational waves in the curvature of spacetime produced when stars or black holes spiral together and merge. Their work was essential for the detection

of gravitational waves from these energetic astronomical events by gravitational-wave observatories. Alessandra Buonanno is the second woman to receive the Dirac Medal in its nearly 40-year history.

Albert Einstein’s General Theory of Relativity from more than 100 years ago predicted gravitational waves and black holes. According to the theory, two masses that are circling each other lose energy by producing gravitational waves. It causes the masses to spiral together and eventually merge to a single object, a black hole, if the masses are large enough. The energy released in gravitational waves can be impressively large but the gravitational interaction is so weak that detection and interpretation required very sensitive measurements and reliable knowledge of what to look for. The



Alessandra Buonanno, Max Planck Institute for Gravitational Physics, Germany



Thibault Damour, Institut des Hautes Études Scientifiques (IHÉS), France



Frans Pretorius, Princeton University, USA



Saul Teukolsky, Caltech and Cornell University, USA

four Dirac medallists were responsible for resolving the great challenges of performing accurate computations of the predicted waveforms.

Gravitational waves carry information on the motions of objects in the Universe. Their detection opens new avenues of exploration into the history and structure of our Universe. “One thing you can do with the LIGO signals is

study possible modifications of gravity, to check whether the signal is compatible with the predictions of general relativity or not,” said ICTP cosmologist Paolo Creminelli, adding that the waves could also be used as tools to explore how black holes are formed or to study the features of neutron stars, opening a whole new view of the Universe much as Galileo’s telescopes did.



### Diploma 30th Anniversary

Thirty years of high-level physics and mathematics instruction, and more than 1000 graduates from 80 countries: the success of ICTP’s Postgraduate Diploma Programme was front and centre at a three-day online event to mark its 30th anniversary.

The event, which took place from 23 to 25 August 2021, celebrated one of ICTP’s most cherished programmes, and offered a chance for Diploma alumni to share their memories and make new connections. Highlights of the event included:

- + a keynote speech by 2020 Nobel Laureate in Physics Andrea Ghez
- + a talk on diversity in science by Sylvester James Gates, Jr, president of the American Physical Society
- + talks by prominent Diploma alumni, including Mabouba Diagne, a Diploma mathematics graduate who is now vice-president of finance and corporate services at the ECOWAS Bank for Investment and Development
- + parallel sessions in various regions of the world to foster the creation of networks
- + social activities to encourage Diploma alumni to connect, reconnect and celebrate.



# 2021 Timeline

## September

ICTP Colloquium

**“Some Current Issues in the Later Stages of Human Evolution”**

**Chris Stringer**  
Natural History Museum, London

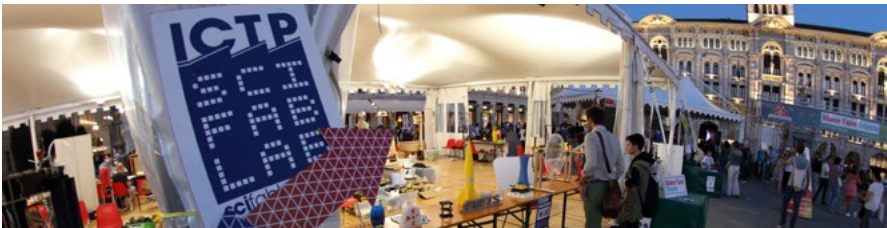
ICTP COLLOQUIA 2021

Some Current Issues in the Later Stages of Human Evolution

Professor **Chris Stringer**  
University College London  
Bristol University, U.K.

Wednesday 8 September at 16:00

Advanced registration at:  
[WEBINAR LINK TRA](#)



The ICTP SciFabLab space at the 2021 Trieste Maker Faire

### A Meeting of Makers

Maker Faire Trieste, the annual gathering of creative, curious people who enjoy learning, doing and sharing, took place in Piazza Unità in Trieste. It was organized by ICTP and Comune di Trieste, in collaboration with Trieste’s science center Immaginario Scientifico and with the support of Regione Autonoma Friuli Venezia Giulia.



## October

Joint ICTP-SISSA Colloquium

**“The Value of Science”**

2021 Nobel Laureate **Giorgio Parisi** gave a lecture at ICTP on “The Value of Science”. It was the first public talk by Parisi since the announcement of his Nobel Prize on 5 October.

**THE VALUE OF SCIENCE**

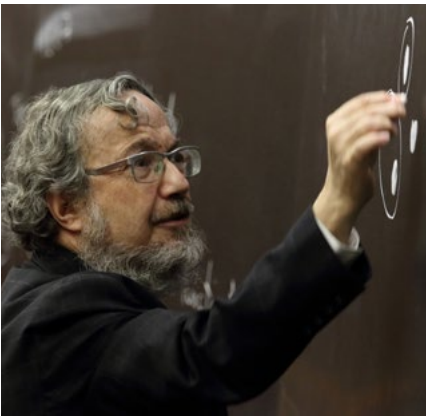
A JOINT ICTP-SISSA COLLOQUIUM

PROFESSOR **GIORGIO PARISI**  
2021 NOBEL PRIZE LAUREATE  
UNIVERSITY OF ROMA LA SAPIENZA

WEDNESDAY 20 OCTOBER at 11:00

ALLA MAGLIERA - FORMER SISSA BUILDING

FOLLOW ONLINE VIA ZOOM WEBINAR WEBINAR LINK



Don Zagier

### Mathematics Excellence

Mathematician Don Zagier, Emeritus Scientific Member and Director, Max Planck Institute for Mathematics, and holder of ICTP’s Ramanujan International Chair, was awarded the Fudan-Zhongzhi Science Award 2021 with Benedict Gross, for their formulation and proof of the Gross-Zagier formula.



### ICTP Collaboration in the Middle East

ICTP signed a Memorandum of Understanding to collaborate with the Royal Scientific Society of Jordan (RSS) and the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME). The collaboration will promote scientific research, education, training, and communication in Jordan and the Middle East and North Africa (MENA) region.

### Celebrating Science

ICTP was well represented at Trieste’s annual science festival for the general public, TriesteNext, as well as the yearly European-wide science outreach event, Researchers’ Night; both events took place on the same weekend in September. ICTP scientists participated by giving talks, joining in informal learning activities, or just sharing their passion for science with people stopping by the ICTP booth.

ICTP scientist Antonello Scardicchio giving a public talk at TriesteNext

**DIRAC MEDAL**

International Centre for Theoretical Physics

**2020 DIRAC MEDAL CEREMONY**  
22 October 2021 at 14:00

With introductory remarks about the scientific contributions of the Medalists by  
**Jeff Harvey**  
(University of Chicago)

**André Neveu**  
(University of Montpellier)  
Perfektively Connected Higher Dimensional Charges of Free Surface Dimple-Water Gravity Waves

**Pierre Ramond**  
(University of Florida)  
Following Dirac's footsteps

**Miguel Virasoro**  
(Universidad Nacional de General Sarmiento)  
Awarded posthumously  
A special 40th anniversary celebration will follow at 16:00

### 2020 Dirac Medal and Prize Ceremony

ICTP celebrated the 2020 Dirac Medal and Prize winners with a hybrid ceremony, honouring André Neveu of University of Montpellier, Pierre Ramond of University of Florida, and Miguel Virasoro (posthumously) of Universidad Nacional de General Sarmiento – “for their pioneering contributions to the inception and formulation of string theory which introduced new Bosonic and Fermionic symmetries into physics.”



# 2021 Timeline

## November

ICTP Colloquium

**“The Phase Behaviour of Supercooled Water: Recent Computational Results”**

**Pablo Debenedetti**  
Princeton University

ICTP COLLOQUIA 2021

The Phase Behavior of Supercooled Water: Recent Computational Results

by **Pablo Debenedetti**  
Princeton University, USA

Wednesday 17 November 2021 at 16.00

Advanced registration at: [WEBINAR Link](#)

### Mathematics Prize Announced

Neena Gupta, a mathematician at the Indian Statistical Institute in Kolkata, was awarded the 2021 DST-ICTP-IMU Ramanujan Prize for Young Mathematicians from Developing Countries. Gupta received the Prize for her outstanding work in affine algebraic geometry and commutative algebra, in particular for her solution of the Zariski cancellation problem for affine spaces.



Neena Gupta



### Supporting Women in Science

ICTP held its fifth Career Development Workshop for Women in Physics, bringing together (online) women physicists from all over the world to learn from one another's experiences and form a sense of community.

Some 164 participants from 57 countries listened to talks and panel discussions, and participated in training sessions on crucial non-technical skills that women physicists may otherwise have less opportunity to acquire than their male peers.

## December



Rondrotiana Barimalala



Narendra Ojha

### ICTP Prize

ICTP awarded its 2021 ICTP Prize to two researchers who have made notable contributions to climate research. Rondrotiana Barimalala of the University of Cape Town, South Africa, and Narendra Ojha of the Physical Research Laboratory, Ahmedabad, India, shared the prize for their important work on diverse aspects of climate change in Africa and Asia.

### Graduation Ceremony for Medical Physicists

Twenty four medical physicists hailing from twenty one countries received Master of Advanced Studies in Medical Physics (MMP) degrees at an ICTP ceremony capping their studies. A two-year advanced training programme in the field of medical physics, the MMP is jointly organised by ICTP and the Trieste University and co-sponsored by the International Atomic Energy Agency (IAEA).



ICTP Director Atish Dabholkar presenting the Centre at a World Expo session

### ICTP at World Expo

ICTP's mission and research took centre stage on 14 December at a World Expo session dedicated to international research institutions in Italy. The event, titled "Italian Research Institutions Facing Global Challenges", featured opening remarks by Maria Cristina Messa, Italy's Minister of University and Research, followed by presentations by top research institutes in Italy, including ICTP.

# Governance

ICTP operates under a tripartite agreement between the Italian Government, the International Atomic Energy Agency (IAEA), and the United Nations Educational, Scientific and Cultural Organization (UNESCO). Each party has a representative on the Centre’s Steering Committee, which sets general guidelines for the Centre’s activities, determines budgeting levels, and considers proposals from the Director for the programme, work plans, financial plans, and budget.

ICTP also has a Scientific Council that comprises distinguished specialists in disciplines relevant to the Centre’s activities who represent a broad geographical range. The Council advises ICTP on its programmes of activities, taking into consideration major academic, scientific, educational and cultural trends relevant to the Centre’s objectives. ICTP is a UNESCO Category 1 Institute.

## ICTP Steering Committee

<b>Italian Government:</b> Fabio Zwirner Department of Physics and Astronomy, University of Padua	<b>UNESCO:</b> Shamila Nair-Bedouelle Assistant Director-General Natural Sciences Sector	<b>IAEA:</b> Najat Mokhtar Deputy Director General, Department of Nuclear Sciences and Applications
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## ICTP Scientific Council

<b>William Bialek</b> Department of Physics Princeton University, USA	<b>Michele Parrinello</b> Department of Chemistry and Applied Biosciences, ETH Zurich, Switzerland
<b>Edouard Brézin</b> Laboratoire de Physique Théorique de l’ENS, France	<b>Mercedes Pascual</b> Department of Ecology and Evolution, University of Chicago, USA
<b>Ngô Bảo Châu</b> Department of Mathematics University of Chicago, USA	<b>Lisa Randall</b> Department of Physics, Harvard University, USA
<b>Elfatih A.B. Eltahir</b> Department of Civil and Environmental Engineering Massachusetts Institute of Technology, USA	<b>Valery A. Rubakov</b> Russian Academy of Sciences Institute For Nuclear Research, Russian Federation
<b>David Gross</b> Kavli Institute for Theoretical Physics, UC Santa Barbara, USA	<b>Gang Tian</b> Department of Mathematics Princeton University, USA
<b>Jeffrey A. Harvey</b> Department of Physics, Enrico Fermi Institute, USA	<b>Cumrun Vafa</b> Department of Physics Harvard University, USA
<b>Luciano Maiani (Chair)</b> Dipartimento di Fisica Università di Roma La Sapienza, Italy	<b>Peter Zoller</b> University of Innsbruck Institute for Theoretical Physics and IQOQI, Austrian Academy of Sciences, Austria
<b>Marc Mézard</b> École Normale Supérieure, France	

# Donors

ICTP would like to express its deep gratitude to all the donors and partners who supported us in 2021.

- + AIKO S.r.l., Torino, Italy

+ Code for Science and Society, Inc., Portland - USA

+ Comune di Trieste, Italy

+ Consiglio Nazionale delle Ricerche -Istituto Nazionale di Ottica, Italy

+ Consiglio Nazionale delle Ricerche -Istituto Officina dei Materiali, Italy

+ Consiglio Nazionale delle Ricerche -Istituto per lo Studio dei Materiali Nanostrutturati, Italy

+ ENEL Italia S.r.l., Italy

+ European Commission (EC)

+ European Space Agency, The Netherlands

+ Fondazione Bruno Kessler, Italy

+ Friends of ICTP Association, Italy

+ German Aerospace Center, Germany

+ IIE Scholar Rescue Fund, New York, USA

+ Indian Institute of Science, India

+ Institute for Anthropological Research, Croatia

+ International Atomic Energy Agency

+ International Commission on Illumination (CIE), Austria

+ International Telecommunication Union, Switzerland

+ Istituto Nazionale di Alta Matematica, Italy

+ Istituto Nazionale di Fisica Nucleare (INFN), Italy

+ Istituto Nazionale di Oceanografia e Geofisica Sperimentale, Italy

+ King Abdulaziz University, Saudi Arabia

+ Kuwait Foundation for the Advancement of Sciences (KFAS)

+ Lupieri Fabrizio, Enemonzo (UD), Italy

+ Middle East Federation of Organizations of Medical Physics, Qatar

+ Ministero dell’Istruzione, dell’Università e della Ricerca (MIUR), Italy
- + Regione Autonoma Friuli Venezia Giulia, Italy

+ Salam Ahmed, London, UK

+ Shenzhen UBM Herong Exhibition Co., Ltd, China

+ Simons Foundation, USA

+ Sincrotrone Trieste Società Consortile per Azioni, Italy

+ SISSA, Italy

+ Società Alpina Delle Giulie, Italy

+ The International Society for Optical Engineering (SPIE), USA

+ The International Union of Geodesy and Geophysics (IUGG), Germany

+ The World Academy of Sciences (TWAS), Italy

+ UNESCO

+ Università degli Studi di Trieste (DCPS), Italy

+ Università degli Studi Milano Bicocca, Italy

+ Université Paris Saclay, France



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**Atish Dabholkar**

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Tahir Shah

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Corinne Degoutte

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Svetlana Gorodetskaya

### System and Network Analyst

Clement Onime

### Head, ICTS

Ulrich Singe

### IT Engineer, ICTS

Snezana Stantic

### Public Information Officer

Mary Ann Williams

In addition, ICTP employed 116 General Service staff in 2021

## High Energy, Cosmology and Astroparticle Physics

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Kyriakos Papadodimas  
Pavel Putrov  
George Thompson  
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Seifallah Randjbar-Daemi  
Goran Senjanovic  
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Nayara Fonseca  
James Ingoldby  
Diksha Jain  
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Ida Zadeh

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Alfredo Gonzalez Lezcano  
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Marco Matteini  
Ali Murad  
Marcello Musso  
Giancarlo Panizzo  
Riccardo Penco  
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Mubarak Suliman  
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Ralph Gebauer  
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Titas Chanda  
Giuliano Chiriacco  
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Ricardo Franklin Mergarejo  
Pierre Martin Fromholz  
Sukanya Ghosh  
Ana Laura Gramajo  
Karen Hovhannisyan  
Zhi Li

Ugo Marzolino  
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Andrei Pavlov  
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Rutong Si  
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Nandhakumar Velankanni  
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Yingdan Wang

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Asja Jelic  
Alessandro Laio  
Giuseppe Santoro  
Erio Tosatti

### Scientific Collaborator:

Mauro Sellitto

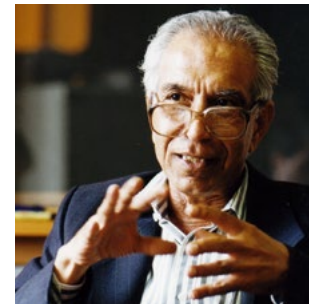
# Scientific and Administrative Staff 2021

Mathematics	Quantitative Life Sciences	Earth System Physics	Science, Technology and Innovation
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## In Memoriam

The ICTP community was saddened by the passing of the following members in 2021; they will be missed.



**M.S. Narasimhan**

M.S. Narasimhan was the head of ICTP's Mathematics section from 1993 to 1999, mentoring many mathematicians from the developing world. After retiring from ICTP, he continued to be a friend and advisor of ICTP and served as a member of the Scientific Council. His work earned him prestigious awards, including the 1989 Chevalier de l'Ordre National du Mérite awarded by the President of France, the Padma Bhushan Award by the President of India (1990), the C.V. Raman Birth Centenary Award of the Indian Science Congress (1994), and the 2006 King Faisal Prize.



**Miguel Virasoro**

Miguel Virasoro, born in Buenos Aires, Argentina, was director of ICTP from 1995 to 2002. He was well-known for the discovery of the Virasoro Model and for his great contributions to the development of infinite-dimensional Lie algebras. Together with Giorgio Parisi and Marc Mézard, Virasoro gave great contributions to the field of statistical mechanics, and in particular to the study of spin glass states in infinite dimensions. In 2020, Virasoro was awarded ICTP's Dirac Medal, sharing the prize with André Neveu of University of Montpellier, and Pierre Ramond of University of Florida, "for their pioneering contributions to the inception and formulation of string theory which introduced new Bosonic and Fermionic symmetries into physics".



**Charles Chidume**

Charles Chidume was an ICTP staff member from 1992 to 2009 in the Mathematics section, and coordinated the section's Diploma courses from 1992 to 2007. He was a founding member of the African University of Science and Technology (AUST) and, at the time of his death, had been AUST's acting president. He was the recipient of the 2019 AMMSI-Phillip Griffiths Prize and a Fellow of The World Academy of Sciences.







The Abdus Salam  
**International Centre  
for Theoretical Physics**

