

# europ physics news

THE MAGAZINE OF THE EUROPEAN PHYSICAL SOCIETY

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**European Mathematical Society**  
**How the WWW came about**  
**Surprises in the Hard X-ray Sky**  
**EPS directory 2013**

**44/4**  
**2013**

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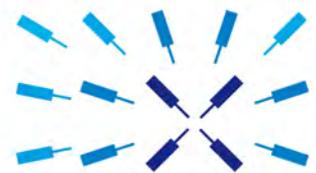
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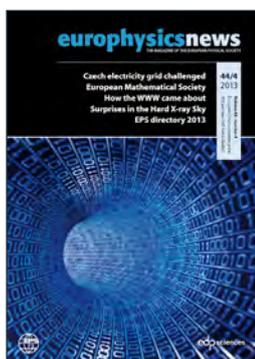
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**Cover picture:** information tunnel in binary signs, see article "an eye-witness report on how the WWW came about" see p.22. ©iStockPhoto



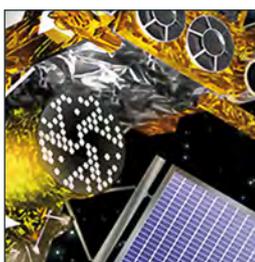
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[EDITORIAL]

## Surviving in Science

**Like most scientists, I have greatly benefited from interactions with colleagues from many different countries. I have also been lucky to participate in several travelling lecturer programmes set up to support seminars for students and early-career researchers. This has allowed me to meet many young researchers working in very different environments: from small groups operating on a shoestring in developing countries, to students working with Nobel Prize Winners in major national labs.**

Irrespective of geography or environment, however, it is immediately apparent that the same two questions preoccupy the vast majority of young physicists. Firstly, how do I obtain a permanent job? Secondly, having got one, how do I survive as a scientist in the long term?

Of course, it has never been easy to obtain a permanent position in physics, and research and teaching are extremely demanding. But everything does seem to be harder for the current generation of young scientists: there is a real scarcity of openings relative to the number of applicants, and there is increasing pressure for young scientists to take on administrative responsibilities early in their careers. Students are keen observers, and as they watch their supervisors work in the modern research environment, it is clear that they will naturally ask serious questions about the best way to navigate their own future careers.

These concerns are extremely important, but it is not often that they are addressed head on. However, as scientists we are also educators, and so we should not hesitate to actively provide advice on careers as well as on physics! Obtaining a PhD is of course an important and significant achievement, but it is really only the start! A successful career in research requires many other skills: from an appreciation of the politics of science, to writing and communication, to management and leadership.

When starting out, the breadth of this required expertise can seem daunting, but it is very easy to identify topics where simple and practical advice can help young researchers to build and enjoy a long-term career in physics. There is no shortage of helpful resources available, and assembling this material into a half day format of seminars and talks and exchanges is not only straightforward but is in fact a great deal of fun! I have been organizer, speaker and a member of the audience at many events of this kind, and I have seen at first hand the tremendous benefit that they provide.

There are many important points to make during such an event, but my own favourite is the importance

**Learning how to manage long-term collaborations is in my view one of the most important skills**

▼ A successful career in science involves maintaining long term collaborations

of developing a collaborative spirit. Physicists work in an environment where we constantly challenge and test each other's ideas, and this places great demands on collaborations. I like to stress the need to successfully maintain working relationships with colleagues who are at times co-workers, at times competitors, and at times employers! Learning how to manage long-term collaborations is in my view one of the most important skills that we can discuss with young scientists. Learning how to effectively share ideas is essential to stimulate new discoveries. And this, after all, is what we are all aiming at. ■

■ **John Dudley**  
*President of the EPS*



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## EPS HISTORIC SITES

# The Hill of Arcetri, near Florence (IT)

**The hill of Arcetri, one of the most evocative places in the environs of Florence, was designated a historic site by the EPS, the European Physical Society, in the course of a ceremony held on 17 May 2013 in the Garbasso building at Arcetri. It is the second historic site in Italy to have received this distinction, after the Fermi Fountain in Via Panisperna in Rome, which was made famous by the experiments on the slowing down of neutrons performed there by Enrico Fermi in 1934. In this way, the EPS has acknowledged the important role played by the renowned scientists and institutions that have worked and operated on the site of the Florentine hill.**

The scientific history of the hill began in 1631 when Galileo Galilei decided to move to Villa Il Gioiello in order to be closer to his two daughters Livia and Virginia, who were nuns in the convent of San Matteo in Arcetri. From the window of his study he could see the daughter convent. It was here that Galilei lived the last 11 years of his life, wrote his *Discourses relating to Two New Sciences* and discussed with his students Vincenzo Viviani and Evangelista Torricelli.

In 1872 the Astronomical Observatory was set up on the same hill by the astronomer Giovan Battista Donati, who was a student of Giovan Battista Amici, whose name is associated to famous reflecting and refracting telescopes and other scientific optic instruments. A decisive contribution to the development of the observatory was later on made by the astronomer Giorgio Abetti.

In 1921 the Institute of Physics was opened here through the initiative of the physicist Antonio Garbasso, who succeeded in setting up a school – which later became known as the school of Arcetri – together with Gilberto Bernardini, Enrico Fermi, Giuseppe Occhialini, Giulio Racah, Franco Rasetti and Bruno Rossi. It was here in 1926 that Fermi wrote his fundamental article on the statistics of half-integer spin particles, which are now known as *fermions*. In 1930, Rossi produced high quality Geiger Muller counters and invented the coincidence circuit known as *Circuito alla Rossi*. The coincidence circuit was, in 1932, applied by Occhialini to the Wilson chamber of Patrick M.S. Blackett in the Cavendish laboratory.

In 1927 the Institute of Optics was founded by Vasco Ronchi, who was the prime mover behind the revival of optical studies in Italy.

The ceremony took place in the morning of 17 May in the former Institute of Physics: after the greetings of Alberto Tesi, Chancellor of the University of Florence, of Antonio Masiero, Vice Chairman of the Italian National Institute of Nuclear Physics (INFN), of Massimo Inguscio, representing the National Research Council (CNR), and Filippo Mannucci, Director of the Astronomical Observatory of Arcetri, Luisa Cifarelli, Vice President of the EPS, presented the general motivations for establishing “the scientific world heritage sites” and the particular motivations leading to the designation of the Hill of Arcetri as EPS historic site for Physics.

During the EPS ceremony, the agreement between the University of Florence, the INFN, CNR and the Italian National Institute of Astrophysics (INAF) research institutes entitled *Il Colle di Galileo – Galileo’s Hill*, was presented, together with the first issue of the journal of the same name.

Giacomo Poggi, Acting Vice-Chancellor of the University of Florence and Chairman of the *Il Colle di Galileo* Scientific Committee illustrated the agreement, which envisions a shared commitment on the part of the bodies



▲ The ceremony for the unveiling of the plaque (from left to right: A. Tesi, L. Cifarelli, D. Dominici, M. Inguscio and G. Poggi)

that are now operating on the hill, or that have done so in the past, to promote the organisation in Arcetri – and in particular in Villa Il Gioiello, which has belonged to the University of Florence since 1942 – meetings, workshops and specialised training initiatives for young researchers and postgraduates. Roberto Casalbuoni then presented the journal, which is named after the project and of which he is the Scientific Editor, illustrating the reasons leading to its foundation and the contents of the first issue.

After the unveiling of a plaque set up at the entrance to the Arcetri

**The ceremony took place in the morning of 17 May in the former Institute of Physics**

university district, detailing the motivations behind the EPS designation, the participants ended the meeting with a walk up the hill, passing in front of the sites of the historic institutes, after which the itinerary was rounded off by a guided tour of Villa Il Gioiello, the evocative premises of Galilei’s last dwelling. ■

■ **Daniele Dominici**

*Department of Physics and Astronomy, University of Florence, Sesto F, Firenze  
Galileo Galilei Institute for Theoretical Physics, Arcetri, Firenze*

▼ The Astronomical Observatory on the hill of Arcetri



**NOTE COMPLEMENT, EPN 44/3, P.10**

In the article on the change of EPL Editor in Chief, the author wishes to have the PACS list completed. Here is the end of the list:

- 60 Condensed Matter: Structure, Mechanical and Thermal Properties
- 70 Condensed Matter: Electronic Structure, Electrical, Magnetic, and Optical Properties
- 80 Interdisciplinary Physics and Related Areas of Science and Technology
- 90 Geophysics, Astronomy, and Astrophysics ■

# 2013 Prize winners of the High Energy Physics Division of the EPS

The EPS High Energy Physics Division announces the winners of its 2013 prizes, which have been awarded at the Europhysics Conference on High-Energy Physics (EPS-HEP 2013), Stockholm (Sweden) 18-24 July 2013 (<http://eps-hep2013.eu/>)

## The main prize

The 2013 High Energy and Particle Physics Prize, for an outstanding contribution to High Energy Physics, is awarded to the **ATLAS and CMS collaborations** (CERN, CH), “for the discovery of a Higgs boson, as predicted by the Brout-Englert-Higgs mechanism”,

▼ (Top)  
the ATLAS team,  
(bottom)  
the CMS team



and to **Michel Della Negra** (CERN, now at Imperial College London, UK), **Peter Jenni** (CERN, now at Freiburg University, DE) and **Tejinder Virdee** (Imperial College London, UK),

▼ (Left to right)  
P. Jenni,  
M. Della Negra,  
T. Virdee



“for their pioneering and outstanding leadership roles in the making of the ATLAS and CMS experiments”.

In July 2012, the ATLAS and CMS collaborations announced the discovery of a new heavy particle at a mass around 125 GeV. Its properties were strikingly similar to those of a Higgs boson, a long-sought particle expected from the mechanism for electroweak symmetry breaking that was introduced almost 50 years ago by Robert Brout, François Englert and Peter Higgs. Experimental confirmation of the Higgs boson presented monumental challenges because of its relatively large mass and small production rates in cleanly detectable modes. The observation has required the creation of experiments of unprecedented capability and complexity, designed to discern the signatures that correspond to the Higgs boson. Their creation has required the use, and in many cases the development, of cutting-edge technologies. In addition, the gigantesque structures were supplemented with appropriate software and computing systems that enabled the analysis of the vast amounts of data that had to be collected. This work has required the collective efforts of over three thousand physicists and engineers from each experiment. These teams collected the data and analyzed it to establish that a Higgs boson, very much like the one in the Standard Model, exists. The prize recognizes the collective efforts of the ATLAS and CMS collaborations, as well as those of three physicists, P. Jenni for the ATLAS experiment and M. Della Negra and

T. Virdee for the CMS experiment, who provided pioneering ideas and led the teams that designed, constructed and commissioned the detectors over the course of nearly twenty years.

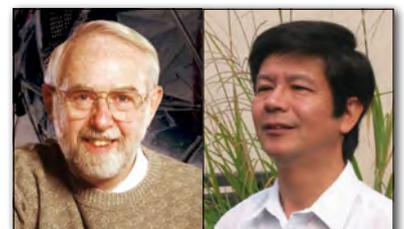
The discovery of a Higgs boson signifies the existence of a fundamentally new type of particle. As a particle of spin zero, the Higgs boson is fundamentally different from all other elementary particles that have spin one-half or spin one. With its mass now measured by the two experiments, all properties of the Higgs boson are predicted by the Standard Model, and can thus be confronted with experimental data in the hunt for new physics and the search for a deeper theory of nature.

For further reading: <http://eps-hepp.web.cern.ch/eps-hepp/index.php>

## Other prizes

The **2013 Giuseppe and Vanna Cocconi Prize**, for an outstanding contribution to Particle Astrophysics and Cosmology in the past 15 years, is awarded to **Arthur B. McDonald** and **Yoichiro Suzuki** “for their outstanding contributions to the solution of the solar neutrino puzzle by measuring the flux of all neutrino flavors from the Sun with the SNO and Super-Kamiokande experiments”.

▼ (Left to right) A.B. McDonald, Y. Suzuki



The **2013 Gribov Medal**, for outstanding work by a young physicist in Theoretical Particle Physics and/



or Field Theory, is awarded to **Zohar Komargodski** “for his deep insights into the structure of the renormalization group in four-dimensional field theories and, in particular, his proof (with Adam Schwimmer) of the *a*-theorem”.

The **2013 Young Experimental Physicist Prize**, for outstanding work by one or more young physicists in the field



of Particle Physics and/or Particle Astrophysics, is awarded to **Diego Martinez Santos** “for his outstanding contributions

to the trigger and commissioning of the LHCb experiment, and the analyses leading to first evidence for the rare decay  $B_s^0 \rightarrow \mu^+ \mu^-$ ”.

The **2013 Outreach Prize**, for outstanding outreach achievement connected with High Energy Physics and/



or Particle Astrophysics, is awarded to **Don Lincoln**, “for communicating in multiple media the excitement of High Energy

Physics to high-school students and teachers, and the public at large”.

6<sup>th</sup> EPS-QEOD Europhoton Conference

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## ABOUT THE JUNE EXECUTIVE COMMITTEE MEETING OF THE EPS

The Executive Committee met at the EPS Secretariat in Mulhouse on 8 June 2013. The President J. Dudley gave an update on the on-going process of endorsement of the International Year of Light by the UN General Assembly. The Executive Committee also approved the terms of reference for honorary members. The new EPL Editor in Chief, Giorgio Benedek, briefly presented a draft of a 10-point Action Plan to increase visibility of the journal. The planning for the Energy conference (E2C, 27-30 October 2013, Budapest, Hungary) is ongoing, the

EPS General Meeting will be jointly organised, scheduled on 28<sup>th</sup> October. The next ExCom meeting will be held in conjunction with the Energy Conference, and the ceremony of the Debrecen historic site, 26-27 October in Budapest, Hungary. A complete report is available for EPS Individual Members at [www.eps.org](http://www.eps.org) ■

David Lee,  
Secretary General of the EPS

# The Odysseus contest reveals the next generation of scientists

**Students from all over Europe demonstrated their interest in science during the Odysseus contest. They met the 17<sup>th</sup> and 18<sup>th</sup> April 2013 in SpaceExpo (Noordwijk, the Netherlands) during the final award ceremony.**



Over 430 high school students from 19 European countries participated in the Odysseus Contest, organised from July 2011 through April 2013. After one national and one international evaluation round, 5 teams were selected as laureates of the contest. The students enjoyed participating in the contest and became ambassadors to inspire other students to take part in science education projects and initiatives.

The Odysseus contest challenged students between the ages of 14 and 18 from all EU countries, and beyond, to develop a project on the theme of space exploration, using their knowledge, creativity and critical thinking. Students formed teams of 2 to 5 members, with a teacher as a coach, and prepared a project in one of the contest's categories: Solar System, Spaceship – global cooperation, and Co-evolution of life.

All entries were assessed and scored on scientific knowledge, practical implementation and creativity by highly experienced evaluators. The final winners (one in each category, one public favourite and one from non-EU country) were selected and won a once-in-a-lifetime experience in the astronauts training centre in Cologne and attended the award ceremony at Space Expo in the Netherlands, where they received their prizes.

*“Our research gave us much experience, knowledge and fun”,* said the ILost team from Slovakia, laureate in the Solar system category. The ILost team's project determined the distribution of helium and heavy elements C, S, O, Ar and Ne known to be present in the atmosphere of Jupiter.

The Exoplants team from Greece won in the Co-evolution of life category. The students studied the growth of plants under radiation of different wavelengths, as well as in conditions of limited or poor lighting. For a few months they worked hard, collecting all experimental data, searching published material, writing, correcting and repeating the measurements.

The Bay School team from United Kingdom took the prize in the category Spaceship-Global cooperation. The aim of their project was to visit a comet and, using a probe analyse it for any evidence that comets could have brought the key building blocks of life to earth. The team worked on the

construction of the spacecraft, probe and its control.

*“It has been our most exciting and rewarding project”,* declared the Strado Sphere team from Norway. They explored the effects of extreme altitude on the harmonics of vibrating metal wires from a miniature violin. They won the contest amongst the non-EU participants.

The contestants had the possibility to vote for their favourite project. Orion Innovative Modular Settlement project by a Romanian team was declared winner. The project outlined a way to engage in space exploration, which will lead humans to new discoveries and to a new way of living.

The contest was co-organised by Ellinogermaniki Agogi, the European Physical Society, Signosis and Space Expo, financed by a grant from the European Commission under the 7<sup>th</sup> Framework Programme. ■

■ **Bénédicte Huchet**

*Communication officer of the EPS*

▼ A set of competitors and mentors at the Odysseus contest



# The EPS Edison Volta Prize

**The European Physical Society, the *Centro di Cultura Scientifica* "Alessandro Volta" – Centro Volta, Como, Italy (birth town of A. Volta) and EDISON S.p.A., Milan, Italy (Europe's oldest energy company, founded in 1884) established in 2011 the EPS Edison Volta Prize to promote excellent research and achievement in physics. The first award of the EPS Edison Volta Prize was announced on November 2012 (see: <http://www.epsnews.eu/2012/11/eps-edison-volta-prize-2012/>).**

## THE EPS EDISON VOLTA PRIZE 2012: A REWARD TO CERN LHC

**"Building on decades of dedicated work by their predecessors, the 2012 EPS Edison Volta Prize has been awarded to: Rolf Dieter Heuer, CERN Director General, Sergio Bertolucci, CERN Director for Research and Computing, and Stephen Myers, CERN Director for Accelerators and Technology, for leading the culminating efforts in the direction, research and operation of the CERN Large Hadron Collider (LHC), which resulted in many significant advances in high energy particle physics, in particular, the first evidence of a Higgs-like boson in July 2012."**

The European Physical Society (EPS), the *Centro di Cultura Scientifica* "Alessandro Volta" (Centro Volta) and EDISON S.p.A. have established the prize to promote excellent research and achievement in physics, its terms of reference and the process leading to the final decision. The Prize Selection Committee was composed of: L. Cifarelli (then EPS President), C. Hidalgo (then EPS Plasma Physics Division Chair), M. Huber (EPS Honorary Member), V. Matveev (JINR Director), and G. Casati (Centro Volta Scientific Coordinator). The EPS Edison Volta Prize was awarded in 2012 for the first time. The prize consists in €10,000 and is accompanied by a silver medal and a diploma.

The Large Hadron Collider (LHC) has already delivered a billion millions of proton-proton collisions at an unprecedented energy level of

8 TeV in the centre-of-mass frame, and at an unprecedented luminosity; moreover collisions between accelerated Pb nuclei in the same energy/nucleon pair scale have been achieved. The particles emerging from the collisions are detected, filtered and analysed by two gigantic general-purpose experiments, ATLAS and CMS, and, focussed on specific scopes, by ALICE, LHCb, TOTEM and LHCf. Already many important physics results have been published.

These achievements are the result of the efforts over more than 20 years by thousands of scientists, engineers and technicians operating at the European Organization for Nuclear Research (CERN), in Universities and in Laboratories all over the world, and of the Agencies supporting, coordinating and guiding the activities.

Initially, the LHC was the vision of a few farsighted scientists. Already at the end of the 1970s, a working group chaired by Antonino Zichichi, and

charged by the European Committee for Future Accelerators (ECFA) to define the design of the Large Electron Positron collider (LEP), underlined in its "White Book" (the ECFA-LEP 1979 Progress Report) the importance of building the LEP in a 27 km long tunnel, with a wide enough cross section to be able in a future, after the completion of LEP operations, to host a ring of superconducting magnets for a proton-proton collider.

LEP Note 440, published in April 1983 by Stephen Myers and Wolfgang Schnell gave birth to the LHC concept. The "official" kick-off of the LHC project is generally considered to be a workshop held in 1984 in Lausanne, led by Giorgio Brianti, where the community of physicists and machine experts reached the agreement on a collider for protons and nuclei. The following phases were difficult, due, in particular, to the approval in the USA of the Superconductive Super Collider (SSC), with a centre-of-mass energy of 40 TeV, much

▼ Rolf Dieter Heuer, Sergio Bertolucci, Stephen Myers (courtesy of CERN)



greater than anything that could be built at CERN. The vision and the conviction of Carlo Rubbia, the then CERN Director General, kept the project alive up to its approval, without increasing the CERN budget, by the CERN Council in 1993 and further in 1994. In the following years, the Director General Christopher Llewellyn Smith led the effort of enlarging the participation in CERN of non-Western European Countries. Japan, India, Russia, Canada and the USA entered with the status of CERN observer States in the 1990s.

The design physics performance of the LHC could compete with that of the much larger SSC (which was finally cancelled by the USA Congress in 1993) as a result of the superior applied superconductivity skills present in Europe. These in turn had been developed and transferred to European industry by the HERA project at DESY in Hamburg and by other projects. The efforts to develop the superconductive magnet technology at CERN, under the leadership of Romeo Perin, and in the collaborating States led to the delivery of the first INFN-CERN dipole, which reached 8.73 T in 1994.

The LHC Project Leader was Lyn Evans. After Christopher Llewellyn Smith, the construction effort was sustained by the General Directorates of Luciano

**In July 2012, ATLAS and CMS announced the first solid evidence for a new particle and the determination of its first features**

Maiani, who started the installation of the LHC elements, and Robert Aymar, who led the installation to completion. The last dipole magnet, of the necessary 1232, was installed in 2007.

A long commissioning phase followed, under the direction, since 2009, of the three Prize Laureates – Rolf Heuer, Sergio Bertolucci and Stephen Myers – with the first physics data taking runs at LHC in 2010. Even if the maximum design energy (14 TeV) is foreseen to be reached only in 2014-2015, after two years of technical works, the current CERN Directorate succeeded in smoothly providing to the experiments the data needed for a wealth of physics results and for a major breakthrough.

In July 2012, ATLAS and CMS announced the first solid evidence for a new particle and the determination of its first features. The latter likely correspond to those of the only element still missing of the Standard Model, the scalar boson responsible of the mass of all the other particles, called "the Higgs". Additional work has been and will be going on in the future to further check the predictions of the theory. The discovery was made possible by the very advanced technology of both detector systems, developed in the past two decades. This regards

the basic detector elements, the read-out electronics, the software to analyse the data and to simulate the background sources and, in addition, the distributed computing infrastructure, the GRID, developed to provide the required huge computing power to process the data. As a matter of fact the Higgs particle production, immediately followed by a decay into a final state that can be reliably detected, happens once in around  $10^{14}$  (one hundred million millions) collisions. Concerning the LHC experiments, their various detector components were not all built at CERN, where they were finally assembled and tested, but rather in a large number of Laboratories and Universities on all the Continents.

The construction of CMS and ATLAS experiments were led by Michel Della Negra and Peter Jenni respectively. In the next phases the Spokespersons were changed by the Collaborations on a rotation basis: Jim Virdee, Guido Tonelli and Joe Incandela for the former, Fabiola Gianotti and Dave Charlton for the latter. Many other scientists and technicians made vital contributions to the experiments, in addition to all those who contributed to the collider. There are far too many to be mentioned here, but this prize is meant to encompass them all. ■

## THE EPS EDISON VOLTA PRIZE 2012: CEREMONY

At EPS Council in Strasbourg, on 5 April 2013, the award ceremony of the EPS Edison Volta Prize 2012 took place in the presence of two of the three winners: Rolf Dieter Heuer and Stephen (Steve) Myers. Since then the "Higgs-like boson" mentioned in the original citation of the Prize has indeed become a "Higgs boson" and its properties have been better determined. Further studies are needed, as pointed out by Rolf Heuer in his lively speech to EPS Council, after Steve Myers' brilliant illustration of the fantastic performance of the LHC collider which allowed such an epochal discovery.

► L. Cifarelli awarding S. Myers (left) and R. Heuer (middle) at EPS Council 2013 in Strasbourg



The winners also received the Prize Medal, a faithful reproduction in bur-nished silver of the “Medaglia Premio dell’Associazione per l’Incremento del Commercio in Como”, Tempio Voltiano Catalogue N. 2, 1877. The first edition was struck in 1838. The medal shows a neo classical realistic portrait of Alessandro Volta, work by Francesco Putinati, a renowned engraver who had been his contemporary. The contour of the medal bears the saying (in Latin): ALEXANDRO VOLTAE NOVOCOMENSI, *i.e.* (dedicated) to Alessandro Volta from Novum Comum, which was the old name given to the city of Como by Julius Caesar. The Prize Medal was

conferred to each of the winners by then EPS President Luisa Cifarelli. Representatives of EDISON R&D Division and Centro Volta Scientific Council, Sergio Zannella and Giulio Casati, also attended the ceremony.



◀ The original medal kept at Tempio Voltiano in Como used as model for the EPS Edison Volta Prize (courtesy of N. Canobbio)

One week later, a wonderful final award ceremony took place in the magnificent Villa Erba Antica, at Cernobbio, Lake Como, in the presence of the Mayor of Como, Mario Lucini, the President of Centro Volta, Giuseppe Castelli, the Chief Executive of EDISON, Bruno Lescoeur, and the then EPS immediate past President, Luisa Cifarelli. The relevance of the prize was duly highlighted. The event, organized by EDISON and Centro Volta, had a strong media resonance. All the winners were there and the concluding talk by Sergio Bertolucci on “Small particles, big questions and the optimism of curiosity” ravished the audience. ■

## CENTRO VOLTA

Centro Volta is a non-profit organization, created in 1983 by local Public Administrations, Regione Lombardia and ten Universities in Lombardy Region, with the aim of providing scientists all over the world with a distinctive environment for fostering scientific communication, interaction and debate. Headquartered on Lake Como’s shores — one of the most beautiful areas in northern Italy, easily accessible from four international airports and characterized by a perfect blend of natural beauty,

history, art and culture — the Center represents the ideal location to hold scientific conferences, seminars, workshops, summer schools and other scientific

initiatives that require the availability of a charming and peaceful atmosphere, where creativity and exchange of ideas are to be favored and encouraged.

▼ Villa Grumello, Como, the site of Centro Volta.



The Center organizes on average 30 events per year, attracting several thousands of scientists and researchers, working on a wide range of fields and disciplines. The scientific program is approved by a scientific committee whose members are designated by the rectors of the Universities. This *melting-pot* effect also leads to the birth of new challenging endeavors and collaborations, as witnessed by the wealth of initiatives, activities, and projects currently undertaken by the Center. ■

## THE EDISON COMPANY

Founded in 1884, Edison is Europe’s oldest energy company. Today Edison, which is part of EDF Group [Electricité de France], is one of the most important Italian operators in the procurement, production and marketing of electric power, natural gas and crude oil. Edison employs about 3,200 people in Europe, Africa and Middle East. In the electric power business, Edison has a fleet of

highly efficient facilities with a diversified production mix ranging from combined cycle gas turbine (CCGT) plants to hydroelectric, wind, solar and biomass. In the hydrocarbons business, Edison has extensive Exploration & Production of hydrocarbons activities in the Middle East and Africa and is committed to develop European gas import infrastructures. In 2008, Edison entered the

Italian residential market with a sales package to supply electric power to families. A year later, Edison broadened its sales offers for families with the addition of natural gas. In 2010 Edison achieved the milestone of one million customers served in Italy and it’s strengthening its positioning as main private operator in the energy market. Edison and its subsidiaries operate across Europe (Italy,

Greece, UK, Norway, Croatia, Bulgaria, Romania, Hungary, Belgium and Turkey), Africa (Algeria), Middle East (Egypt). Edison considers research, development and innovation activities as essential tools to win the global challenges and to promote sustainable development. Edison believes R&D represents a competitive opportunity in which companies can bring to bear their competencies in terms of innovation. ■

# Interview to Sergio Bertolucci

by L. Cifarelli

## How do you feel as first winner, together with R.D. Heuer and S. Myers, of this newly established EPS Edison Volta Prize?

It was very good that the European Physical Society has decided to award this prestigious Prize, which is the first one as I understand, recognizing the importance of CERN and of what CERN has achieved in the last year. As its Research Director, I am of course incredibly proud and pleased by this.

It is also a very important message that this Prize is presented in a way, which nicely connects fundamental research and societal application, and it is also significant that EDISON is a co-sponsor of the Prize.

I think that all in all 2012 has been an exceptional year for particle physics and for science. I always recall the title of THE ECONOMIST announcing in its cover page the Higgs discovery, and the comment was: "A giant leap

for science", not for physics. The understanding of the Higgs discovery triggers very important reflections on the physical world that we are just starting to explore.

The EPS in this same year has been very active in promoting the image of science as main driver to crisis overcome. The clear message which emerges from the present situation is that "from this crisis we'll never go back to where we were before, we can only go forward". And science is the best means that Europe has to keep playing a fundamental role in a sustainable future. We have to remind that while Europe is not representing 1/3 of the world population, it still produces 1/3 of the world knowledge. This is as it is now and needs just to be defended.

**Science is the best means that Europe has to keep playing a fundamental role in a sustainable future**

## What is in your view the best way to proceed to preserve science potential?

It is a complex problem, difficult to summarize in few sentences. In my opinion, Europe strategy should rest on three pillars: education, research infrastructures, networking: we have to become the European Union of Knowledge, not only the union of the banks! To this end, we need visionary and long-term policies, aimed on one side to the optimization of our present potentialities, while reflecting on the future strategic choices to enable our leadership in the globalized knowledge race.

In this respect, Europe has just completed updating its Strategy for Particle Physics, (<http://council.web.cern.ch/council/en/European-Strategy/esc-e-106.pdf>), in order to define the community's direction for the coming years and to prepare for the long-term future of the field.

This is the first update of the Strategy document approved in 2006 and, at the light of the success of the LHC, confirms the effectiveness of the European organizational model for particle physics, founded on the sustained long-term commitment of the CERN Member States and of the national institutes, laboratories and universities closely collaborating with CERN. Europe should preserve this model in order to keep its leading role, sustaining the success of particle physics and the benefits it brings to the wider society. Moreover, the updated Strategy takes into account the worldwide particle physics landscape, and, recognizing the fact that the scale of the next planned facilities requires a worldwide effort, promotes a positive attitude toward globalized forms of participation, which could strike a balance among competition and collaboration. ■

## EPS EDISON VOLTA PRIZE 2014 – CALL FOR NOMINATIONS

**N**ominations are now open for the Edison Volta Prize of the European Physical Society [EPS, <http://www.eps.org/>]. The award – intended to promote excellence in research – will be given in recognition of outstanding research and achievements in physics.

The EPS Edison Volta Prize is given biennially to individuals or groups of up to three people. The award consists of a diploma, a medal, and 10,000 € in prize money.

The Prize has been established in 2011 by the **Centro di Cultura Scientifica "Alessandro Volta"** [Centro Volta,

<http://www.centrovolta.it/volta-en/>], **EDISON S.p.A.** [<http://www.edison.it/en/index.shtml>] and the **European Physical Society**. It has been awarded for the first time in 2012.

The Prize Selection Committee is composed of:

- the EPS President
- an EPS Division or Group Chair
- an EPS Honorary Member
- a Representative of an EPS Associate Member institution
- a Representative of Centro Volta.

Nominations for the EPS Edison Volta Prize 2014 should include:

**The EPS Edison Volta Prize is given biennially to individuals or groups of up to three people**

- personal details about the nominee(s), including biographical statements
- citations highlighting the work of the nominee(s)
- up to three statements of support from individuals who are familiar with such.

**The deadline for nominations is 21 October 2013.**

For more information, in particular to read the Prize Charter, and for the detailed procedure for nominations, please visit the European Physical Society webpage: [http://www.eps.org/?page=distinction\\_prize\\_ed](http://www.eps.org/?page=distinction_prize_ed) ■

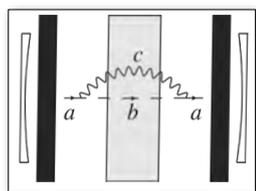
# Highlights from European journals

## QUANTUM PHYSICS

### Tunnelling of the 3<sup>rd</sup> kind

It is a fundamental property of quantum field theory that averaging over quantum fluctuations results in an effective theory that is non-local. Furthermore, it is possible that this effect can be demonstrated using a cavity quantum electrodynamics setup.

In the proposed configuration (sketched in figure) the effective non-locality becomes evident in that an atom has a finite probability to traverse an arbitrarily high potential barrier. The atom,  $a$ , can "split" into a virtual excited state,  $b$ , and a virtual photon,  $c$ ,



▲ The incoming atom  $a$  emits a virtual photon  $c$  and enters an excited state  $b$ . After traversing the barrier they recombine and return to the original state. The mirrors on either side represent an optical cavity used to enhance the coupling of photons to the atom. The black walls denote potential barriers blocking both  $a$  and  $b$ , confining the atom and preventing contact with the mirrors.

which do not interact with the barrier, and can consequently cross it and recombine into the original atomic internal state. This so-called "tunnelling of the third kind" is distinct from regular quantum tunnelling (the "first kind") in that it relies upon the many-body interactions inherent to quantum field theory but absent from non-relativistic quantum mechanics; it is a purely quantum field theoretic effect.

Aside from its novelty as a gedankenexperiment, the process has the potential to stimulate some very interesting experiments in quantum optics and cold atom physics.

Moreover, it may serve as a demonstration for "light-shining-through-walls" experiments that use comparable effects (real particle conversion - "tunnelling of the second kind") to search for particles beyond the Standard Model. ■

■ **S. A. Gardiner, H. Gies, J. Jaeckel and C. J. Wallace**, 'Tunnelling of the 3<sup>rd</sup> kind: A test of the effective non-locality of quantum field theory', *EPL* **101**, 61001 (2013)

## APPLIED PHYSICS

### Spotting the invisible cracks in wind turbines

A new approach is available for real-time monitoring of the structural health of wind turbine components during exposure to turbulences. The method is developed for analysing the elastic characteristics of mechanical structures subjected to



▲ Wind turbines can be weakened by unsuspected damages. (Credit: kovik)

disturbances, akin to the turbulences affecting wind turbines. A significant percentage of the costs of wind energy is due to wind turbine failures, as components are weakened under turbulent air flow conditions and need to be replaced. The challenge for the team was to find a method for detecting fatigue in the wind turbines' parts without having to remove each of the components and while the turbine is in operation.

Until now, standard methods have relied on so-called spectral analysis, which looks at the different frequency response. But these measurements are distorted by the turbulent working conditions and often only detect really major damages.

The analytical method developed by the authors enables a distinction between dynamics attributed to mechanical properties, such as stiffness of the blade, and those attributed to interfering noise, such as turbulences. The authors demonstrated that they were able to precisely detect the changing mechanical properties of the beam material based on an analysis of the mechanical vibrations. ■

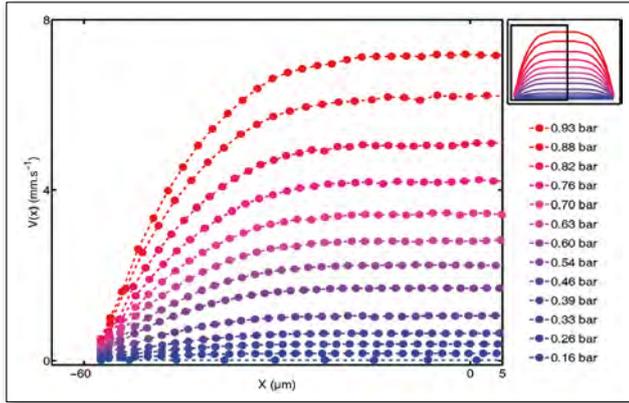
■ **P. Rinn, H. Heißelmann, M. Wächter and J. Peinke**, 'Stochastic method for in-situ damage analysis', *Eur. Phys. J. B* **86**, 3 (2013)

## CONDENSED MATTER

### Microgels behaviour under scrutiny

A new study explores the counter-intuitive behaviour of a microgel composed of soft polymer blobs with the capability of behaving like dense emulsions or granular materials.

The authors have studied the flow of a microgel known for its intermediate behaviour between fluid and solid, confined in microchannels. They have shown, in the present study, that its behaviour under confinement differs from predictions based on standard theories. Indeed, its molecules are not only subjected to local forces, but also to neighbouring forces that affect its flow. The authors chose to study the influence of confinement on



▲ Set of measured velocity profiles with Carbopol microgel

the flow of a polymer microgel named Carbopol. It is made of jammed acrylic acid polymer blobs, typically a few microns in size, dispersed in water. They confirmed, for the first time in a microgel, that the flow properties at a local point do not depend only on the local force, but also on the dynamics of its vicinity. This has previously been shown in concentrated emulsions, granular materials and foams under confinement. ■

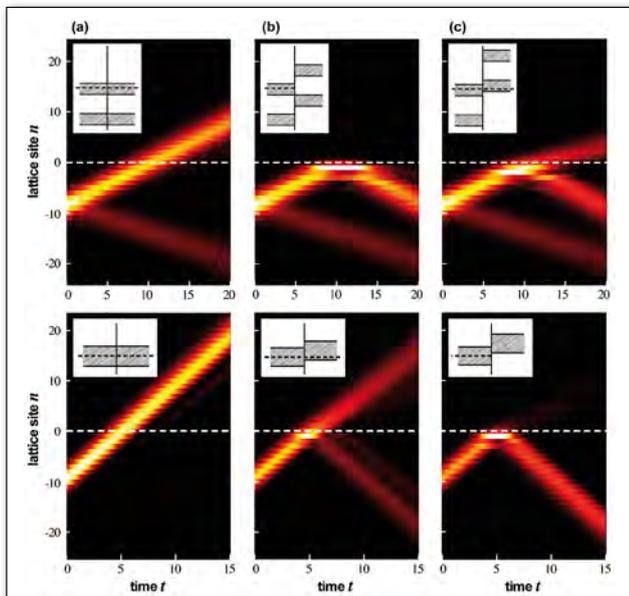
■ **B. Geraud, L. Bocquet and C. Barentin,**  
 'Confined flows of a polymer microgel', *Eur. Phys. J. E* **36**, 30 (2013)

QUANTUM PHYSICS

## Coupled particles cross energy wall

The first model demonstrating that it is possible for two particles to cross an energy barrier together, where a single particle could not, is shown here.

▼ Numerically-computed evolution of the coupled particle density function across the potential wall



A new kind of so-called Klein tunnelling - representing the quantum equivalent of crossing an energy wall - is presented in a model of two interacting particles. The authors relied on an analytical and numerical study of a landmark model of interacting particles, called the Hubbard model. They predict a new type of Klein tunnelling for a couple of interacting particles confronted by an energy barrier. Even though the barrier is impenetrable for single particles, it becomes transparent when the two particles cross the energy barrier together.

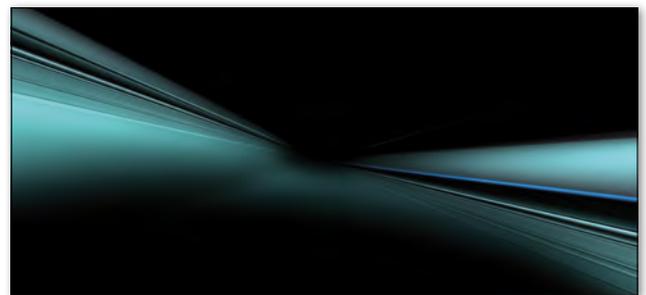
They expect these predictions to be confirmed experimentally in ultra-cold atoms trapped in optical lattices. If this is the case, similar quantum simulation could be a tool for emulating multiple-particle systems. ■

■ **S. Longhi and G. Della Valle,**  
 'Klein tunneling of two correlated bosons',  
*Eur. Phys. J. B* **86**, 231 (2013)

PARTICLE PHYSICS

## Ephemeral vacuum particles induce speed-of-light fluctuations

New research shows that the speed of light may not be fixed after all, but rather fluctuates, while its value could be set by the total number of elementary particles in nature. Two *EPJD* neighbour papers challenge established wisdom about the nature of vacuum. Vacuum is one of the most intriguing concepts in physics. When observed at the quantum level, vacuum is not empty. It is filled with continuously appearing and disappearing particle pairs such as electron-positron or quark-antiquark pairs.



▲ Light propagating in a vacuum travels at a speed that fluctuates due to ephemeral particle pairs. (Credit: Ilco)

In the work presented in reference 1, the authors established, for the first time, a detailed quantum mechanism that would explain the magnetisation and polarisation of the vacuum, referred to as vacuum permeability and permittivity, and the finite speed of light. This finding is relevant because it suggests the existence of a limited number of ephemeral particles per unit volume in a vacuum. As a result, there is a theoretical possibility that the speed of light is not fixed, as conventional physics has assumed. Instead, this speed would be dependent on variations in the vacuum properties of space or time.

In the work of reference 2, the other authors found that a specific property of vacuum called the impedance, which is crucial in determining the speed of light, depends only on the sum of the squares of the electric charges of particles' pair but not on their masses. If their idea is correct, the value of the speed of light combined with the value of vacuum impedance gives an indication of the total number of charged elementary particles existing in nature. ■

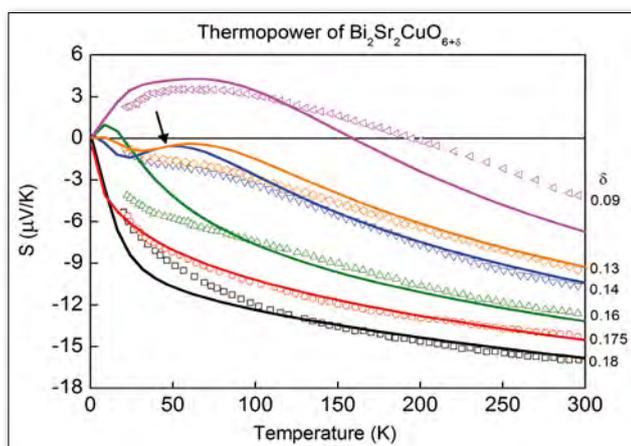
■ **1 - M. Urban, F. Couchot, X. Sarazin and A. Djannati-Atai,** 'The quantum vacuum as the origin of the speed of light', *Eur. Phys. J. D* **67**, 58 (2013)

■ **2 - G. Leuchs and L. L. Sánchez-Soto,** 'A sum rule for charged elementary particles', *Eur. Phys. J. D* **67**, 57 (2013)

## CONDENSED MATTER

# In the thermopower of underdoped cuprates

In recent years the possibility of electron-like Fermi-surface pockets in the high- $T_c$  cuprates has become an area of intense experimental and theoretical interest. What is the origin of these pockets? Are they connected to the mysterious pseudogap, a depletion in the density of states that dominates thermodynamic and transport properties over a wide range of temperature and doping? Until now, experimental support for these pockets has been confined to samples which, in addition to pseudogap effects, exhibit a separate spin/charge stripe correlation, making their connection to the pseudogap unclear.



▲ Comparison of calculated (line) and measured (symbols) thermopower of  $\text{Bi}_2\text{Sr}_2\text{CuO}_{6+\delta}$ . The undulations (arrowed) arise from electron-like Fermi-surface pockets.

In the present paper we calculate the thermopower of high- $T_c$  cuprates from the resonating-valence-bond spin-liquid model developed by Yang, Rice and Zhang, achieving an excellent match with experimental data. A key result of this work is the identification of features in the observed thermopower corresponding to electron pockets in the Fermi-surface appearing

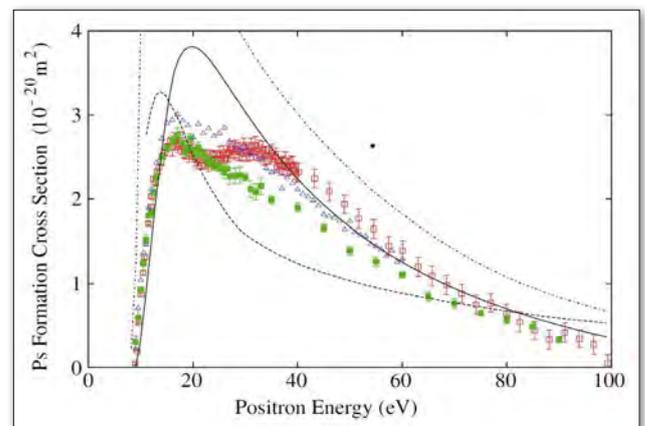
with the opening of the pseudogap. These results link the pseudogap with Fermi-surface reconstruction and will be of considerable interest to researchers using photoemission, quantum oscillations and other techniques presently engaged in efforts to detect these pockets directly. ■

■ **J.G. Storey, J.L. Tallon and G.V.M. Williams,** 'Electron pockets and pseudogap asymmetry observed in the thermopower of underdoped cuprates', *EPL* **102**, 37006 (2013)

## PARTICLE PHYSICS

# Positronium formation in the noble gases

Positronium (Ps) is a neutral atom composed of an electron and its anti-particle, the positron. Since its reduced mass is essentially half that of atomic hydrogen, its binding energy is 6.8 eV. Being anti-particles, this electron-positron pair will annihilate producing gamma rays in about a tenth of a microsecond, long enough for experiments to be carried out. Ps can be formed in positron scattering from atoms and its cross section measured.



▲ Positronium formation cross-section for argon: solid curve, present results; dashed curves, previous calculations. Experimental measurements: hollow squares, UCL; solid squares, UCSD; triangles, ANU.

For most atoms, Ps formation has the lowest inelastic threshold. Theoretically, this is a two-centre problem (atomic nucleus and the center-of-mass of Ps) and thus difficult to calculate directly. We have simplified this problem by treating it as direct ionization with a threshold 6.8 eV below the true ionization threshold. Our method also ensures the rapid decrease in the Ps formation cross section at high energies. Even with this simple model our results for the noble gases are in much better agreement with experimental measurements than calculations based on more elaborate theories. ■

■ **R.P. McEachran and A.D. Stauffer,** 'Positronium formation in the noble gases', *J. Phys. B: At. Mol. Opt. Phys.* **46**, 075203 (2013)



# CZECH ELECTRICITY GRID CHALLENGED BY GERMAN WIND

■ Zbyněk Boldiš – ČEPS, a.s. – Czech Republic – DOI: 10.1051/epr/2013401

**Transmission systems in continental Europe are synchronously interconnected and represent one physical network over a very large area - from Portugal to Poland and from Denmark to Turkey. This interconnection allows electricity trading and mutual assistance among transmission system operators (TSOs). On the other hand, it may cause problems like system failures or instability spreading from one system to another. This interconnected system is now subject to the integration of large amounts of intermittent electric power and has to be technically upgraded and economically re-positioned [1].**

**I**t is important to realise that commercially agreed electricity trading between two countries create physical power flows, which do not fully follow scheduled ways of commercial flows, especially in the meshed network of Central and Eastern Europe (CEE). Power flows follow a path of least electrical resistance. When there is a lack of infrastructure for direct transmission of flows (as it is now the case in Germany, with insufficient north-south interconnections) [2], they flow in a parallel way to the areas of electricity load. If the wind blows in the northern part of Germany, power surplus generated in wind farms there seeks its way to consumption centres in southern Germany and further southward and south-eastward. This spontaneous effect is due to the so-called rule of horizontal balancing of wind generation in Germany, causing the electricity produced by renewable energy sources (RES) to be distributed and

consumed uniformly within the entire territory of Germany. Thus, the power flows from north to south through lines of least resistance, causing parallel flows in the Benelux countries in the West and in Poland and the Czech Republic in the East. The situation is further aggravated by electricity exports from Germany to Austria, which are limitless due to the common German-Austrian market area. These unplanned flows cause an extra load on transmission lines in the neighbouring systems and may even cause extreme overloading [3] and [4].

**The geographical position of the Czech Republic in the centre of continental Europe has a significant impact on the operation of the Czech transmission grid (ČEPS). Five interdependent cross-border interconnections together with a strong internal national network determine the ČEPS grid as a natural transit system that is strongly influenced by external impacts such as transit flows [5].**

### Extreme transit flows in winter 2011/12

In the period from mid-November until mid-December 2011 and in January and February 2012, ČEPS and other CEE TSOs faced exceptionally high transit flows over their grids. The main cause was increased wind feed-in from the northern part of Germany and the subsequent transit of this electricity to the centres of consumption located in Austria and areas further south and southeast. From ČEPS's perspective the situation was extreme both in its duration (almost three weeks in November/December) and in volume (historical maxima of unplanned flows over 3500 MW).

The situation was aggravated by a shortage of hydro power from Austria and the Balkan countries due to a long dry weather period. During this period the import balance of Austrian TSO APG reached 4000 MW, overproduction in Germany resulted in export levels up to 8500 MW, while the scheduled exchange between Germany and Austria increased up to 6000 MW. Also, due to the commissioning of new generation capacities in Poland (Belchatow power plant), a significant increase in cross-border export from Poland (by approx. 1000 MW) took place in this period as well. Such scenarios surpassed worst cases investigated in the EWIS study (2010) [1], with levels which were projected for the target year 2015 being reached already in 2011.

Regarding the cross border interface between ČEPS and the German TSO 50HzT during this period, the maximum secure operational limit of 1700 MW was exceeded several times (see Fig. 2), by up to 260 MW. The commercial and physical flows had different directions and the difference between them was up to 2000 MW.

The most critical day in that period was December 3<sup>rd</sup>, 2011. Cross-border capacities (trading limits) were deliberately reduced (both from the ČEPS and 50HzT side) to lower market transactions during disturbed operation, but it had very limited impact on the physical cross border flows. Furthermore, intraday trading sessions had to be stopped both in the export and import directions.

All remedial actions available (both costly and non-costly) were exhausted and there was a risk of a cascading collapse if one line accidentally tripped. The situation would have ended up in a local blackout.



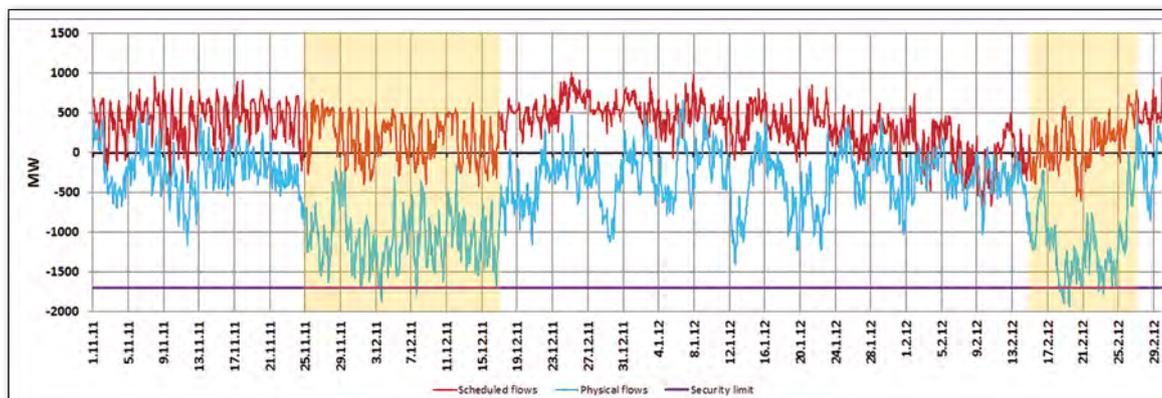
### Challenges of the operational situation on August 22<sup>nd</sup>, 2012 in the CEE region

A similar situation may also occur in the summer period, when photovoltaic power comes into play. Some TSOs from the CEE region again faced difficulties in connection with transit flows.

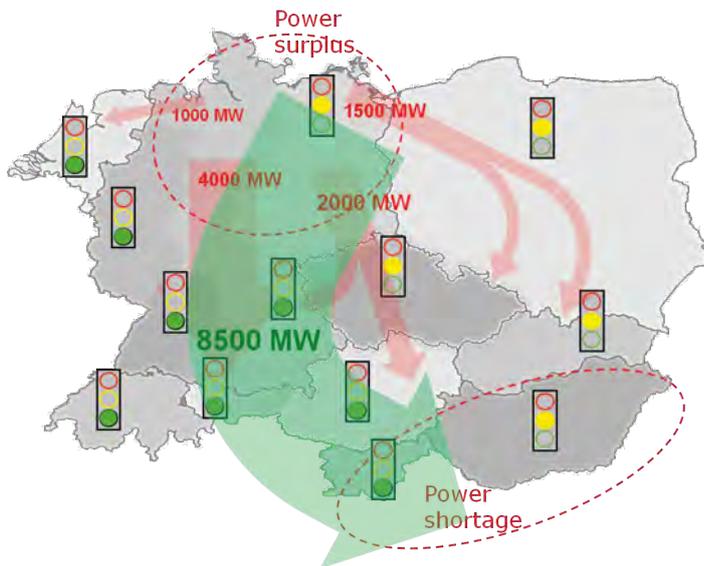
Although high wind and solar productions were predicted (and recorded, see Figure 4) for August 22<sup>nd</sup>, 2012, no major problems were anticipated as simulated power flows on D-1 (one day before) were lower than the ones observed during operation. On that specific day, scheduled maintenance took place (outages of several cross-border lines and the whole cross-border profile between Poland and Slovakia). High transiting flows worsened operational conditions and simultaneously affected some CEE grids (PSE, ČEPS, SEPS) on this day. This led finally to the activation of Multilateral Remedial Actions in which four TSOs were involved, in the framework of which APG was requested to make a production volume of 800 MW available. In parallel, production was reduced in the 50HzT control area by up to 900 MW to compensate for the aforementioned power increase.

During the critical hours on August 22<sup>nd</sup>, the export balance of Germany exceeded 9 000 MW, while import balance of Austria was more than 3 000 MW. Regarding the German-Austrian profile of ca. 5 300 MW of scheduled commercial transactions, only half of this flowed physically through this

▲ FIG. 1: Power flow in the Central and Eastern Europe (CEE) region with the national transmission system operators of the Czech Republic (ČEPS), the Slovak Republic (SEPS), Poland (PSE), Austria (APG), Hungary (MAVIR), Slovenia (ELES) and the two German regional operators (50HzT and TTT). The symbols schematically indicate the dominant locations of wind and photovoltaic power and that of the consumers in the south.



◀ FIG. 2: Scheduled and physical flows on the ČEPS-50HzT profile. Plotted is the power for the period from 1.11.2011 to 29.2.2012. The red line represents the scheduled flows, the blue line represents physical (measured) flows and the violet straight line represents the physical limit of the interconnector between 50HzT and ČEPS



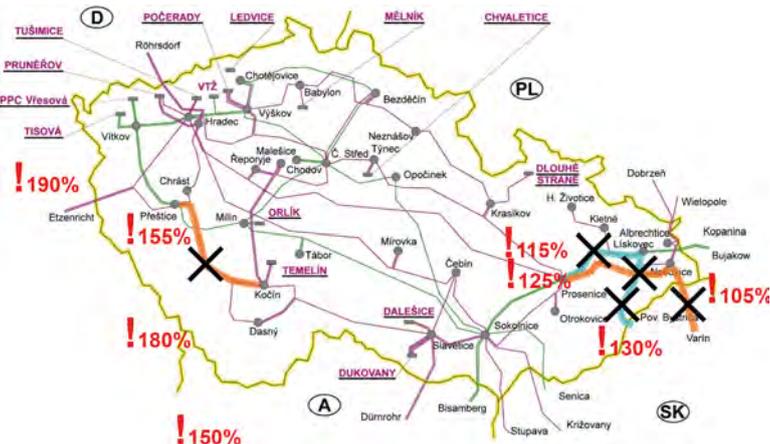
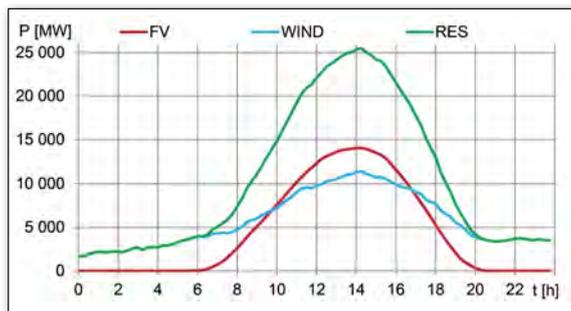
▲ FIG. 3: General power flows on December 3<sup>rd</sup>, 2011 and activation of the Real-time Awareness and Alarm System (yellow lights)

border. The other half transited through neighbouring states on both the western and eastern neighbouring systems. Subsequently, the physical flow across the Polish-Czech border was at the level of 2 400 MW, although almost no commercial exchange was scheduled from ČEPS to PSE.

After the event, the effect of a possible tripping of the overloaded tie line between the Czech Republic and Slovakia Nošovice-Varín was also simulated (see Figure 5). The neighbouring lines in the region would have taken the extra load; however, due to their overloading, cascading trips could also have occurred in the western part of the Czech Republic as a consequence. A potential result would have been a fatal overloading of lines also across the border in neighbouring Germany and Austria.

▼ FIG. 5: Overloading of lines and their possible cascading tripping can end up in unmanageable congestions and cause a blackout. Black crosses indicate tripping of lines, exclamation marks indicate congested lines / regions with values of flows in % of physical line limits.

▼ FIG. 4: Production from German renewable energy sources (RES) on August 22<sup>nd</sup>, 2012. Red denotes the photovoltaic, blue the wind power; the green curve is the sum.



### Conclusions

A mix of

- steady increase in intermittent sources, especially wind installations not backed by sufficient transmission infrastructure development in Germany, and
- a single market zone Germany–Austria enabling unlimited market transactions within these countries results in physical power flows that bypass Germany through the Polish and Czech systems. These eastern German neighbours experience overloading of their transmission systems especially during periods of high-wind production in Germany.

Substantial improvements, both modernisation of the transmission grid and construction of new lines are under preparation. However, these measures, due to time-consuming permitting procedures, are rather long-term. Due to current and especially future operational challenges related to RES and market arrangements in Germany/Austria, ČEPS decided in favour of a costly, but indispensable medium-term measure – the installation of phase shifting transformers on the ČEPS-50 Hertz profile to be put into operation in 2016. By controlling the power flows and seeking their optimisation, transformers will contribute to the secure operation of the systems and also enhance transmission capacities in this region. Finally, optimisation of the amount and proportion of intermittent renewable energy sources would also help to tackle grid and electricity system-related challenges in a long-term perspective, as shown in [6].

### About the author



Since 2006 **Zbyněk Boldiš** has been working for ČEPS as Member of the Board responsible for Energy Trade & International Relations. Before that he worked for E.ON and ČEZ as Trader. Zbyněk studied at the University of Economics in Prague. e-mail: [boldis@ceps.cz](mailto:boldis@ceps.cz)

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# THE EUROPEAN MATHEMATICAL SOCIETY

## THE HOME FOR MATHEMATICS IN EUROPE

■ Marta Sanz-Solé – Professor at the University of Barcelona – President of the European Mathematical Society – DOI: 10.1051/epn/2013402

**The European Physical Society has invited me to write an article on the European Mathematical Society (EMS) in its magazine, Europhysics News. This gives me a great opportunity to provide the community of European physicists with an overview of a learned society whose objectives are very similar to those of the European Physical Society. The longstanding connections between our scientific communities make it natural that we should strengthen the links between us.**

**M**athematics and physics have a common history and an intertwined development. The scientific analysis of nature, the primary goal of physics, is intimately related to mathematics. Physical challenges have been the most important source of inspiration for mathematical theories. In turn, mathematics provides the language and logical structure for the rigorous description of physical theories. It is also a rich source for open questions. For example, it is via the language of mathematics that striking but not yet observed physical phenomena have been predicted.

Historical scientific celebrities, such as Archimedes, Averroes, Galileo, Newton, Gauss, Euler and Poincaré, just to mention a few, made revolutionary discoveries in both mathematics and physics. This ability to speak both languages so fluently and productively has become more rare. The terrific progress in both disciplines, has resulted in a differentiation. Nevertheless, cross-fertilization between the two fields continues to this day, and has spawned a hybrid field: mathematical physics.

The creation of national learned societies has developed in parallel with the differentiation between disciplines. Subsequently, with the establishment of the European Union and the strengthening of European identity, instruments to improve co-operation across Europe have become of the utmost importance.

It is in this context that the EMS was founded in 1990, and it is not surprising that the EPS, with an earlier creation,

acted as a source of inspiration during the process of drafting its statutes. With a history of 22 years, the EMS has set up solid roots, reached its maturity and achieved a significant level of influence.

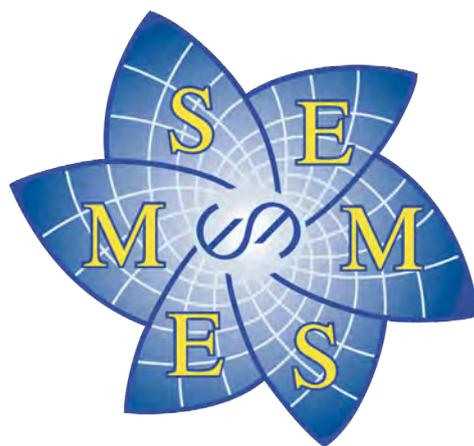
### Membership

The EMS is much more than a federation of national mathematical societies. Its statutes provide for two types of membership: corporate and individual members. The former consists of mathematical societies, and research and academic organizations primarily devoted to promoting research in mathematics. Currently, EMS membership encompasses about 60 mathematical societies,

20 research centres and 10 academic institutions in European countries, along with about 3000 individual members. Looking closely at the organizations gathered behind these figures, it is fair to say that EMS is representing mathematics and is the voice of mathematicians in Europe.

The EMS website is the instrument for communication with our membership, and at the same time the showcase of the Society. However, there are also other ways to keep contact with

our members. For example, through the EMS Newsletter, a quarterly open access journal sent out to all EMS members in printed copies. All issues are available online on <http://www.ems-ph.org/journals/journal.php?jrn=news>. Between two consecutive editions of the EMS Newsletter, an electronic leaflet - the EMS e-News - with headlines, announcements, relevant news from committees, publications, *etc.*, is sent out to all EMS members.





▲ EMS meeting at the Guggenheim Museum in Bilbao

Since 2008, we hold an annual meeting of Presidents of EMS member societies. This is an occasion to follow closely their developments, to learn about their projects and concerns, and to get their feedback on important issues of common interest. It is also a place where synergies between different national societies are generated.

### Committees

To a large extent, the main aims of the Society are developed within its committees. The Executive Committee (EC) has the special role of piloting, developing and monitoring actions resulting from discussions held and agreements taken in the Council – the General Assembly of the Society. Besides the EC, which is the governing board of the Society, there are ten EMS Committees: applied mathematics, developing countries, education, ethics, electronic publishing, meetings, publications, raising public awareness of mathematics, European solidarity, and women in mathematics. Their names clearly express their field of interest and action. Committees operate under considerable autonomy. However, they are requested to deliver a written report at each EC meeting. A member of the EC acts as liaison person between a given committee and the EC. This is to assure a permanent monitoring, and a smooth communication. The European Research Centres of Mathematics (ERCOM) is formally also an EMS committee. However, in practice it is a network of research mathematical centres in Europe under the umbrella of the Society. Most of the committees meet at least once every year. All have a webpage on the EMS website and most of them, their own website. The committee Raising Public Awareness of Mathematics is responsible for the website [mathematics-in-europe.eu](http://mathematics-in-europe.eu), a showcase for activities aimed to increase attraction of young students to mathematics and the interest of society in this discipline.

▼ The author, Marta Sanz-Solé



### Publications

In 2001, the EMS launched its Publishing House (EMS PH) dedicated to the publication of high-quality peer-reviewed journals and books in all areas of mathematics. The plan arose as a necessity to provide a good service to mathematicians in the dissemination of mathematical knowledge, with the commitment of keeping the prices as low as is economically sustainable and maintaining a high standard in the editorial and publishing processes. Currently, the EMS PH is publishing fifteen journals, and books in nine specific series. They are distributed by the traditional subscription model and are among the least expensive mathematical journals. We are closely following and discussing the new trends in publishing, analyzing its impact in the current business model and possible ways to necessary changes in the future.

Together with FIZ Karlsruhe and the Heidelberg Academy of Sciences, the EMS is responsible for Zentralblatt MATH (ZBMATH). This is the world's most complete and longest running abstracting and reviewing service in pure and applied mathematics covering the period from 1868 to present.

### Scientific activities

The most visible and largest scientific activities of the EMS are the quadrennial *European Congresses of Mathematics* (ECMs). The average number of participants is about 1000. At ECMs, the most recent and challenging trends in mathematics are exposed, while maintaining the unity of the discipline. Six years before the year of the Congress, the EC publishes a call for bids of organizers, considers the proposals and appoints a site committee, which makes a report to the EC. The final selection is left to Council. The first ECM was held in Paris, in 1992. It was followed by Budapest (1996), Barcelona (2000),

Stockholm (2004), Amsterdam (2008) and Kraków (2012). The 7<sup>th</sup> ECM will be in Berlin, on July 18-22, 2016. The scientific committee of an ECM is appointed by the EC. It is responsible for the selection of plenary and invited speakers, and special sessions. The local organisers contribute to shaping the programme with the organization of poster sessions, panel discussions and outreach activities, like public lectures and exhibitions. With the co-operation of member societies, the EMS runs *Joint Mathematical Weekends*, and other special activities. In the framework of collaborative agreements, it also organizes Summer Schools, one of them with the International Association of Mathematical Physics. The EMS nominates distinguished speakers at prestigious mathematical conferences and an EMS lecturer every year.

### Prizes

The EMS Prize was established at the very early times of the Society. At most ten laureates are chosen and presented at each ECM. The Prize consists of an award to a young researcher not older than 35 years, in recognition of excellent contributions in Mathematics. As for today, about 20% of laureates won later the prestigious Fields Medal.

In co-operation with the European Consortium for Industrial Mathematics (ECMI) and the Fraunhofer Institute for Industrial Mathematics (ITWM), the EMS awards the Felix Klein Prize to a young scientist (or a group) in recognition of excellent contribution in Industrial Mathematics. Recently, a new prize funded by Springer Verlag was established: the Otto Neugebauer Prize in the History of Mathematics. It was firstly awarded in 2012.

### Closing

This is a schematic description of basic facts on the EMS. In the global world, international learned societies are more that ever of strategic importance to support the advances of disciplines and to promote indispensable interactions. The current political structures in Europe and its strong historical identity, provide full meaning to and show the strong necessity for the existence of solid scientific umbrellas, platforms and networks within Europe. We can proudly state that EMS is playing this role for mathematics in Europe.

### Websites references

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## [ Letter to the Editor ]

by Herman C.W. Beijerinck

Eindhoven University of Technology, Eindhoven - The Netherlands

DOI: 10.1051/epn/2013403

## 'Crossing borders'

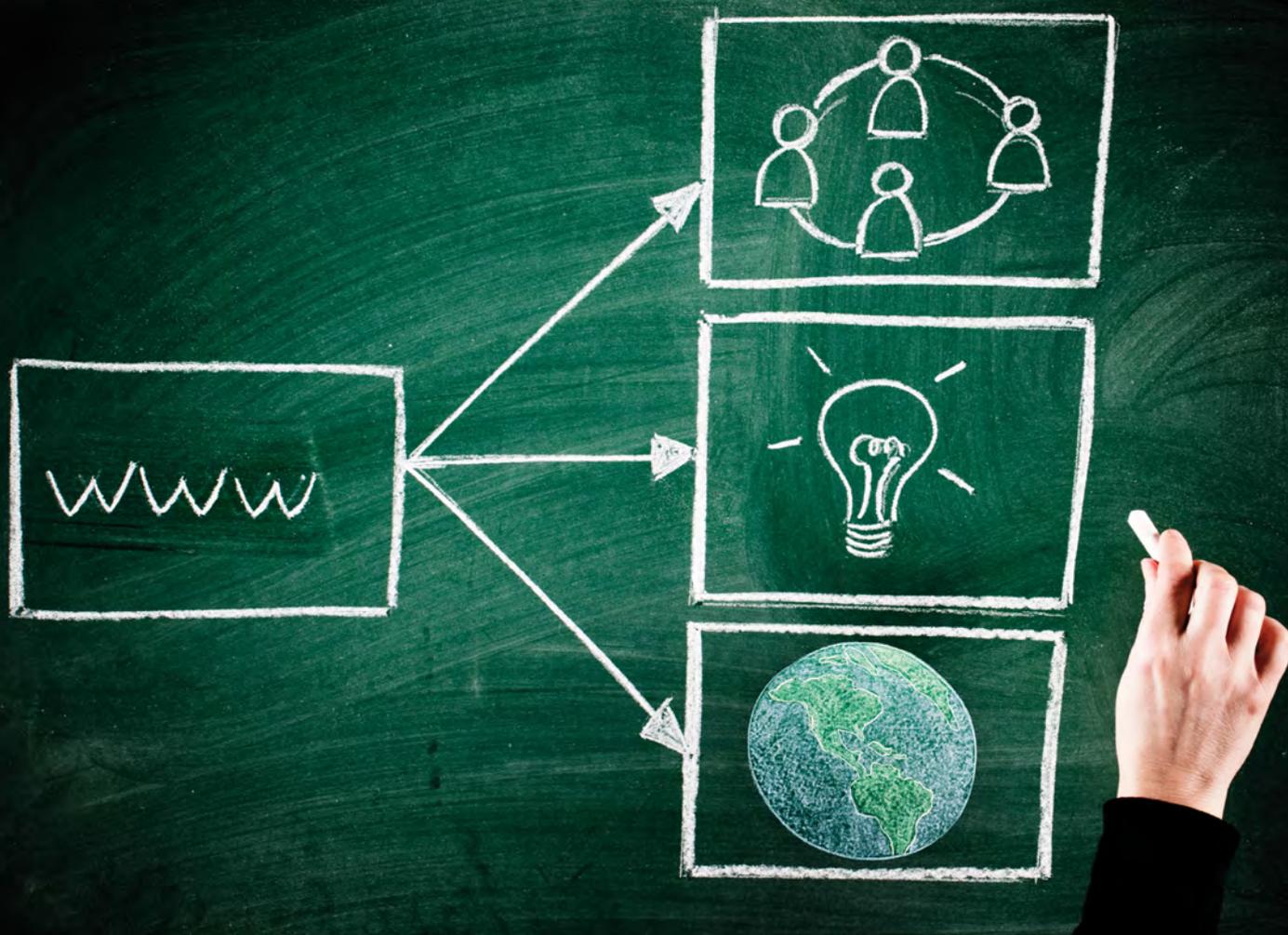
Scientists are overwhelmed by publications in their field. We do our very best to keep up with literature and barely achieve this goal. Meetings with a wide scope are an excellent means of picking up new ideas. Even a 10-minute talk can be enough for an *'Aha Erlebnis'* that inspires for further thought. It is not the time invested that is important; it is the open mind that sets the stage for this moment of inspiration.

General physics journals like Europhysics News should fill their niche in providing information to physicists. Keep in mind that EPS members are busy people, with little time for additional reading. Papers should be very well phrased, concise and have excellent illustrations.

Columns are a special class in such a journal. Their predictable appearance in every issue, their consistency in style and format, and their challenging content are ingredients that are highly addictive in a positive sense. Look at the successful column 'Physics in daily life', and at the new column 'Opinion'. Both tease the reader into thinking about issues that are somewhat off the beaten track. At a general interest level, columns serve the same purpose as meetings. The next step for EPN is to stimulate the discussion on crossing borders to fields like theater, art, and music. Where do they meet, how do they interact? Think of the play on the Heisenberg/Bohr discussions in the middle of WW II. Did we discuss it in EPN? I can't remember we did. Think of the recent book and play 'In free fall' by Juli Zeh, which has two physicists in the lead role. Who has read this wonderful book? Has it been discussed by physicists? These examples are very important for our profession, because they convey an image of physics to society. Like our Forum on Physics and Society, it represents an outreach into the public domain that we cannot neglect.

I propose a new column in EPN, tentatively called 'Crossing borders'. It could be a broad link to society, by informing our readership on these interesting and important new developments. Culture is surely not the only neighboring field we can link to physics. What about psychology, philosophy, history and even religion? Would it not be interesting to see where we meet, what we agree on and how we disagree? Just think of the important role that paradigms have in our peer review system for new projects. 'Crossing borders' can have a major impact, both within EPS and in society at large.

EPN, I dare you to cross this line! ■



# AN EYE-WITNESS REPORT ON HOW THE WWW CAME ABOUT

■ Horst Wenninger\* – CERN, Geneva – DOI: 10.1051/epn/2013404

**During the 1990s basic web technologies were developed at CERN. Seeking approval for the Large Hadron Collider (LHC) and being short of resources, CERN decided very soon to provide free access to the web technologies. This would ultimately lead to a revolution in communication.**

**O**n the occasion of the 20<sup>th</sup> birthday of the World Wide Web celebration at CERN in 2009, the Editor of the CERN Courier, Christine Sutton, wrote: *Twenty years ago something happened at CERN that changed the world forever* [1]. Indeed, in the year 1989, Tim Berners-Lee presented a document, entitled: **Information Management: A Proposal** [2] to his group leader at CERN (see Fig. 1). This proposal outlined the basic idea evolving into the Web, the key technology popularizing the Internet around the world. A detailed description of what was happening during the years 1989 and later can be found in the literature

[3], including an authentic recording of all the technical and political ups and downs. This led finally in 1995 to the establishment of the World Wide Web Consortium (W3C) and already by 1999 to almost ten million Web-Servers operating around the world, creating more economic wealth and income than the cost of any government investment in basic research.

## Eye witness

My eye-witness report on how the WWW came about concerns the crucial years 1993 to 1995, when CERN management had to concentrate most efforts on the approval of the LHC project. Before 1993 Information on

\* I am grateful to Robert Cailliau for his advise and for cross-reading the report

web-related activities at CERN came to me from Carlo Rubbia, the then CERN Director General. He presented a transparency to the Finance Committee of CERN showing a spider network and explaining that “some CERN guys are working on an information management tool based on hypertext technology – whatever this means – which they want to call *World Wide Web* or WWW”.

**There are only very few crucial properties of WWW: it sits on top of the internet-naming scheme, it is such simple hypertext that it does scale up indefinitely, it uses a simple text-based format and it is guided by open, free standards that anyone may contribute to. And it was put in the public domain very early on.**

*Definition by Robert Cailliau*

The web community grew fast because (i) in 1992 the portable browser developed by Tim Berners-Lee and collaborators was released by CERN as freeware and (ii) in April 1993 CERN declared the web technology and program code to be open software [4].

Two CERN divisions – Computing and Networking (CN) and Electronics and Computing for Physics (ECP) – were involved in web topics. The key players were Tim Berners-Lee (CN), his group leader Mike Sendall (ECP), and Robert Cailliau (ECP).

Both Tim and Robert (Fig. 2) were fighting for a decision at CERN to allocate resources and take the lead in developing and promoting the web. They evaluated that CERN would need to open some 35 positions for software developers and they tried hard to convince the CERN management to follow their vision.

CERN management had to disappoint them, forced by increasing pressure from Member States to reduce staff costs at CERN in order to free resources to build the LHC. Delegates argued that specialized institutes in CERN Member States would be able to step in.

Robert Cailliau managed to attract the interest of the Direction of the French Institut National de Recherche en Informatique et en Automatique (INRIA) for the web topic during the WWW conference at CERN in 1994. More recently, INRIA announced in a press release [5]:

**"INRIA has supported W3C's mission since the inception of the Consortium in 1994, notably by hosting W3C's European branch".**  
**"INRIA now Hosts the First W3C Office in France"**

In spite of the rapid success of the web, CERN as a physics lab could not continue to invest effort in an informatics project without support. Already in 1992/93 Robert Cailliau started to enquire at the EU about possible support and funding.

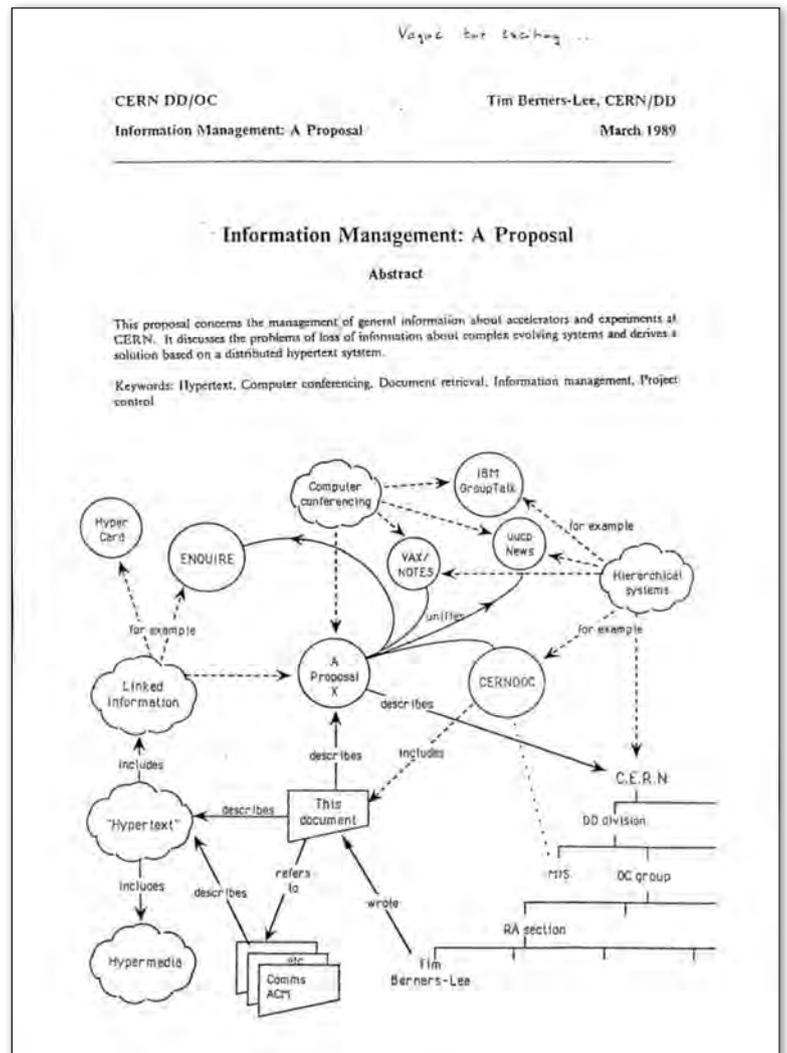
My personal efforts to establish contacts and to raise interest for the web technology with EU commissioner Martin Bangemann (*Europe and the Global Information Society (1994)*) and meetings with representatives of the Deutsche Post did not help. Similar efforts from colleagues in other CERN Member States showed that national monopolies in Europe were not yet allowing serious discussions on broader visions as expressed by Vice-President Al Gore in the US (*Information Superhighway*). So, while information networks in Europe were dominated by national monopolies, the US picked up the challenges rapidly, developed web tools such as Mosaic world wide web browser and triggered the Internet boom.

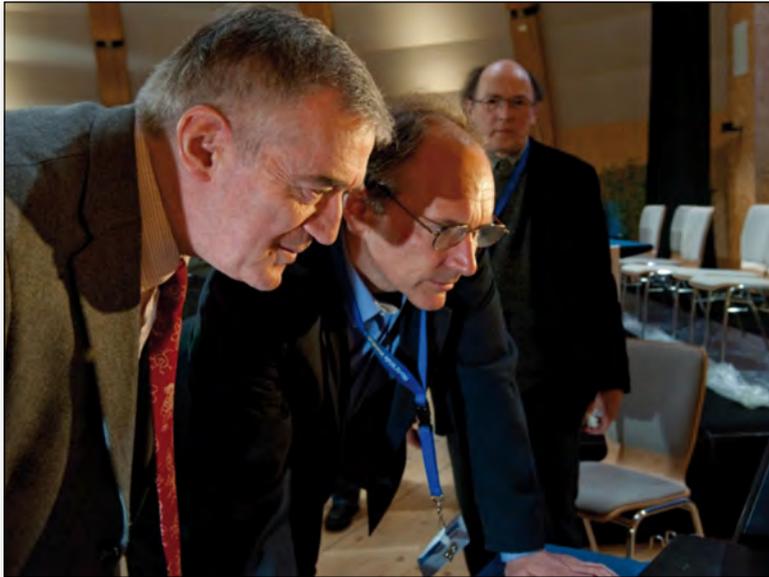
Most of the tedious negotiations with the EU, and with the pushy US colleagues from MIT, were left to Tim and Robert, supported by their Group and Division Leaders.

**Events that I remember very well**

- i. When Robert Cailliau wanted to organise a first International WWW Conference, we agreed that CERN could host this conference in its Council Chamber, since less than a hundred people were expected to participate. Instead, 600 web developers turned up and overfilled the main auditorium.

▼ **Fig. 1:** The document that changed the world. Note the hand-written comment 'Vague but exciting' by Tim Berners-Lee's group leader.





▲ Fig. 2: Tim Berners-Lee (middle) and Robert Cailliau (left) in front of the NeXT computer, used in 1990 to run the first WWW server, multimedia browser and web editor (copyright CERN)

- ii. My intervention at a meeting in Geneva where I defended the WWW against the French Minitel people. As a result, I was invited by the representative of the Hewlett-Packard company in Geneva after the meeting.
- iii. My lunch in the CERN Glass-Box restaurant with James Clark, who announced his intention to develop a “user-friendly” web browser. This became the basis for the NETSCAPE company [6].
- iv. My meeting with people from Brussels and MIT, and finally the question put to me by Tim Berners-Lee, whether CERN could offer him the position of a Director, as was done by MIT.

I encouraged Tim to look after his career and to accept the MIT offer, since CERN would not be in a position to top this offer. We agreed, however, that CERN should stay in close contact. Robert Cailliau, Mike Sendall and P.G. Innocenti were of great help to finally get support from Brussels to set up the W3C, with INRIA taking the place of CERN as European partner of MIT. In 1994, Tim Berners-Lee left CERN and joined the Laboratory for Computer Science at the Massachusetts Institute of Technology.



► Fig. 3: Web logo by Robert Cailliau (copyright CERN)

In December 1994, the CERN Council finally approved the construction of the Large Hadron Collider. LHC had to be built in the existing LEP tunnel with a tight budget. In January 1995, CERN and the European Commission invited INRIA to continue the European involvement. INRIA is heavily involved in European projects and collaborations with similar institutes in Europe and the world.

Robert Cailliau promoted the Web around the world (see Fig. 3). I very well remember the transparency he used to illustrate the many different connectors for electrical plugs one needs when traveling. The web technology allows ignoring all such hardware differences in communication via the internet.

The Tsunami of data from LHC experiments could not have been handled without the LHC-GRID, a natural extension of web-based Internet technology regrouping computer center hardware. Let me conclude my recollections by quoting Bob Jones, the CEO of the CERN Openlab, in his talk at the 2012 EPS-TIG workshop at Erice [7]:

**The World Wide Web provides seamless access to information that is stored in many millions of different geographical locations. The Grid is an infrastructure that provides seamless access to computing power and data storage capacity distributed over the globe. The grid now extends into the Cloud, and today a European Cloud Computing Partnership starts with big science teaming up with big business.**

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- [5] INRIA Press Release [www.inria.fr/en/news/mediacentre/w3c-france-office](http://www.inria.fr/en/news/mediacentre/w3c-france-office)
- [6] James Clark biography: [www.biography.com/people/james-clark-9542204](http://www.biography.com/people/james-clark-9542204)  
"In 1994 James Clark sent an email to Marc Andreessen, a recent graduate of the University of Illinois who had developed a Web browser called Mosaic at a time when most people did not know the Web existed. Clark and Andreessen agreed to launch a new company devoted to Web software, and Netscape was born. The company had a phenomenal impact, quickly dominating the fledgling browser market and scaring industry giant Microsoft into changing its corporate focus."
- [7] EPS Technology and Innovation workshop, ERICE October 2012 <https://indico.cern.ch/conferenceDisplay.py?oww=True&confid=215087>



# SURPRISES IN THE HARD X-RAY SKY

■ **Thierry J.-L. Courvoisier** – Data Centre for Astrophysics, University of Geneva – DOI: 10.1051/epn/2013405

Cosmic objects emit throughout the electro-magnetic spectrum, from radio waves to very high-energy gamma rays. Some spectral regions can be observed from the ground, but space instrumentation is needed for most of them. Some spectral regions are particularly difficult, for example hard X-rays and MeV gamma rays. For one thing, in this spectral region photons interact least with matter. Moreover, no focussing optics was available until very recently. INTEGRAL, the gamma ray observatory mission led by ESA, was designed to observe the sky in this very domain.

**A**strophysics space missions are long-term endeavours. INTEGRAL, the gamma ray satellite launched by the European Space Agency (ESA) in 2002 is no exception. The mission was proposed by a group of European and US scientists to ESA in 1989. Following a number of studies and successful competitions it was selected in 1993. The years between 1995 and 2002 were a long succession of strenuous efforts. The first hurdle was the replacement of US and UK funds, which, although formally committed at the time of selection, did not materialise. Then came a series of technical difficulties, most rather unexpected, like major difficulties to glue radiation-hardened components in such a way that they could endure temperature excursions of some 200K. Not trivial either were the discussions with the Soviet-Union, which transformed into Russia during the process, to obtain a launch on a Proton rocket free of financial charge, but for a reasonable share of the data.

All these hurdles were overcome, not least thanks to the competence of all the teams involved and the strong will of all the actors: scientists, engineers and staff from ESA and national funding bodies. The success is demonstrated by the fact that INTEGRAL was originally funded for two years of operations, designed for five years in orbit, was launched on October 17 2002 and is still functioning flawlessly in Summer 2013.

The mission [6] was designed to provide observations with high-energy resolution through a spectrometer, SPI [5], and high angular resolution through an imager, IBIS [4]. "High" is to be understood here in terms of hard X-ray and gamma ray astronomy, and means that the spectral resolution  $\lambda/\Delta\lambda$  is of the order of 400 at 1MeV and the angular resolution about 12'. These two core instruments are complemented with an X-ray monitor, JEM-X [2], and an optical camera, OMC [3]. Together these instruments provide a hard X-ray and gamma ray coverage from a few keV to several MeV, a very wide spectral band. The data are collected at the ISDC [1], where they are processed, archived and distributed to the world astronomical community.

### Five outstanding results

Ten years into the mission, a number of results have been collected. As often when the sensitivity of a set of instruments in a spectral domain increases by a large

factor, surprising results are obtained. INTEGRAL is no exception to this in the hard X-rays and soft gamma rays. The first surprise was to discover sources that are bright above 10 keV and were unknown as X-ray sources before the INTEGRAL measurement. This is insofar surprising because the INTEGRAL instruments use a coded mask optics (the shadow of a mask is measured and the "shadowgramme" is deconvolved to obtain a sky image) that is considerably less efficient than the focusing optics that can be used below 10 keV. The expectation was thus that INTEGRAL sources would have been known from lower energy X-ray sky surveys. A large collection of results is presented in [7], where extensive bibliographical references can be found. We highlight here five domains in which INTEGRAL observations have made important contributions. The choice reflects the prejudice of the author; others would most probably have highlighted a somewhat different set of domains.

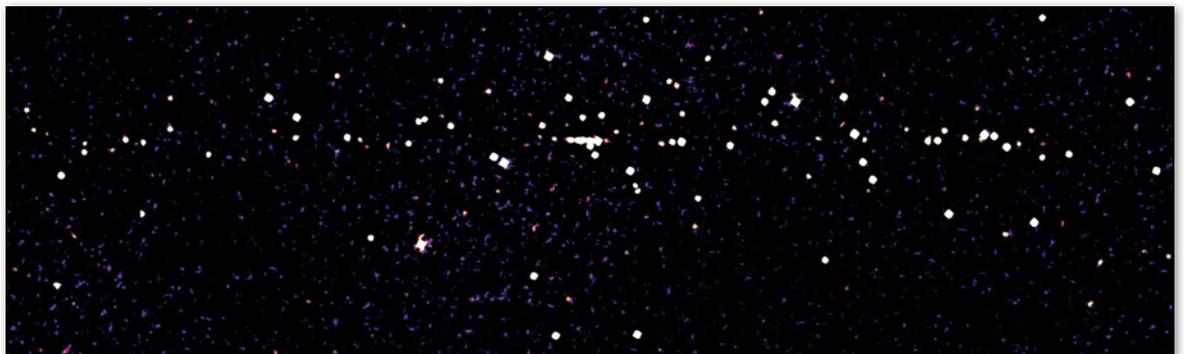
### Populations of galactic compact objects

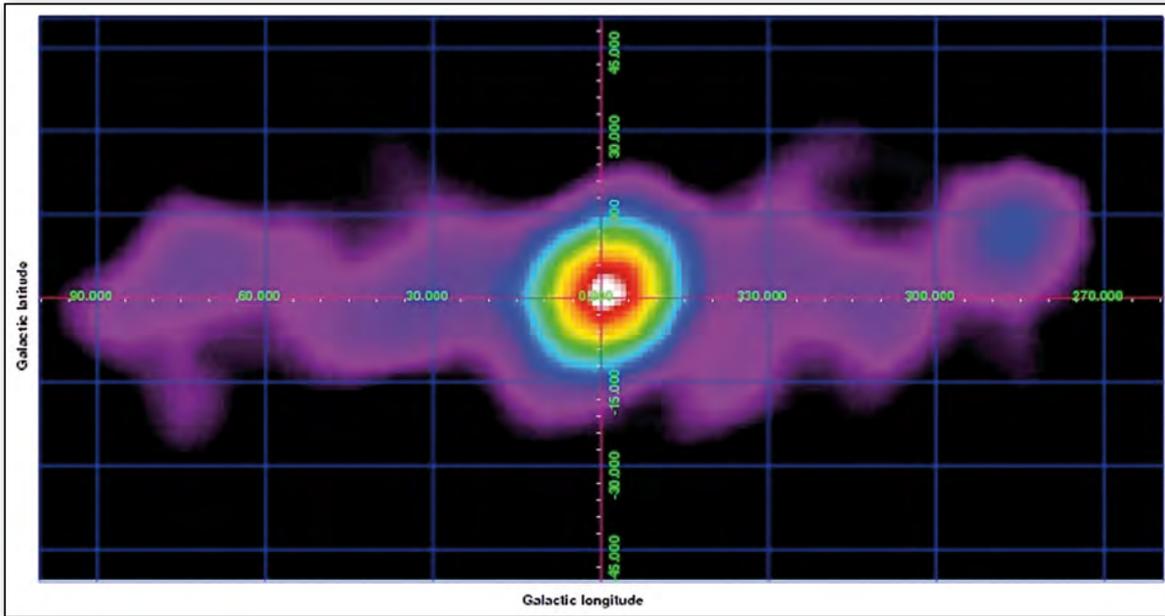
X-rays are absorbed by dust and gas in interstellar space. The absorption cross-section increases towards lower energies, roughly with the third power of inverse photon energy. Sources embedded in relatively dense environments therefore shine only above 10 keV or so. Since surveys using X-ray focusing telescopes had been sensitive only at energies less than 10 keV, such sources could not be discovered prior to INTEGRAL observations.

INTEGRAL/IBIS has a very large field of view of about 30 degrees and a much improved sensitivity compared with its predecessor instruments. It discovered serendipitously hundreds of hitherto unknown highly absorbed bright X-ray binary sources in our Galaxy (fig. 1). A large fraction of these sources are binary systems in which a neutron star orbits close to a giant star in regions that are dense from the wind emitted by the giant. This dense matter is in part accreted by the neutron star, causing it to radiate the gravitational binding energy of the accreted material as X-rays, and also absorbs the X-rays at the lower energies, letting only the higher energy X-rays shine outwards. The compact neutron star thus serves in a certain way as a probe of the stellar wind conditions in its surrounding, giving a way to study not only the accretion process, but also the wind conditions.

► FIG. 1:

The central regions of the Galaxy as seen by INTEGRAL (Credit ISDC/R. Walter).





◀ **FIG. 2:** Electron positron annihilation in the central region of the Galaxy (Credit ESA/Bouchet).

### Electron–positron annihilation in the central regions of the Galaxy

It has been known for a number of years that “cold” electrons and positrons annihilate in the central region of the Galaxy. This annihilation gives rise to a narrow emission line at 511 keV, the rest energy of the electron. INTEGRAL/SPI has imaged the line emission in the central region of the galaxy and resolved the line in energy. The temperature of the electrons and positrons can be deduced from the line profile; it is some 5000 K. The SPI image shows that the emission has two components: one spherical centred around the centre of the Galaxy and the other associated with the disk of the Galaxy (fig. 2). While the origin of the electrons poses no difficulty, that of the positrons still eludes our understanding. The disk emission can be due to positrons originating in radio-active decays of elements synthesised in stars. However, no convincing origin has been found for the positrons giving rise to the spherical component. Many explanations have been brought forward in the literature. They range from positrons created in binary systems in the bulge of the Galaxy, to positrons that would be created by radioactive processes in the disk of the Galaxy and transported, possibly along magnetic field lines, to its central regions, to positrons associated with the decay of as yet unidentified dark matter particles. None of these possibilities is free of significant difficulties. The discussion is ongoing.

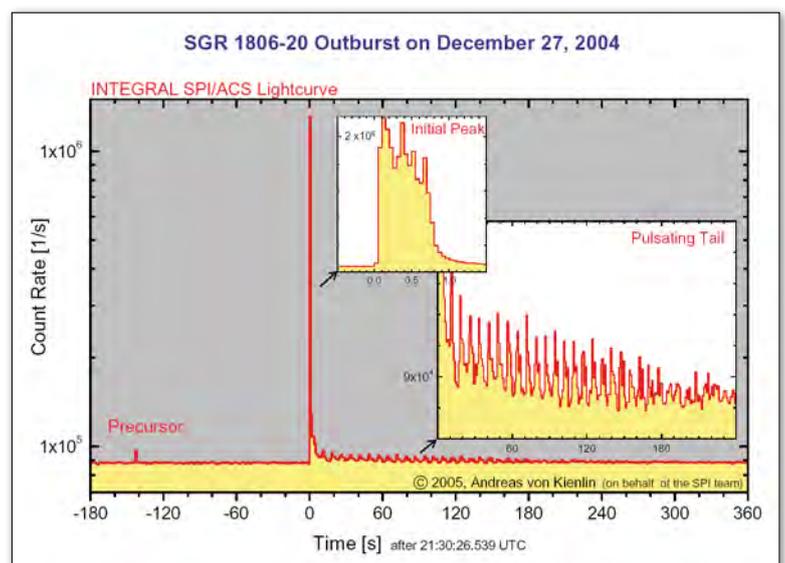
### Variability in the X-ray sky

One of the most important findings of X-ray astronomy over the last decades is the extreme variability that many sources exhibit. While observations of the sky in visible light has led us to think that stability is the rule, except within the orbit of the Moon, high energy astrophysics has taught us otherwise: violent physical phenomena take place on timescales as short as milliseconds (gamma ray

bursts), seconds to hours and days (binary stars and even quasars). The wide field of view of INTEGRAL has allowed observers to catch many unexpected phenomena and to discover a new class of objects, the Supergiant Fast X-ray Transients (SFXT). The outbursts of these sources may last for as little as some hours and take place very rarely, hence the difficulty to catch them in the act. These sources, like the absorbed sources discussed above, are binary systems in which a compact object orbits close to a massive star. Other types of variable sources detected by INTEGRAL include pulsars in binary systems that accrete matter and angular momentum. The latter accretion could be measured through precise timing observations by an X-ray instrument of a new INTEGRAL source. The phase of the pulsed emission shifted during the few weeks in which the source was active, thus convincingly showing the neutron star spin acceleration.

Very recently the nucleus of a Galaxy brightened considerably for a fraction of a year. This isolated event is due to

▼ **FIG. 3:** Giant flare from the soft gamma repeater 1806-20. The source of the flare was not in the field of view of the INTEGRAL instrument. The flare is, however, so bright that it is recorded in the detector’s active shield (credit MPE).



the disruption of a lone massive planet that cruised too close to the massive black hole hosted at the centre of the Galaxy. The planet was tidally disrupted and subsequently accreted onto the black hole releasing gravitational energy as X-ray radiation in the process.

### Magnetars

The energy source in X-ray sources is most often – but not always – due to the matter falling in the deep potential well of a compact object. Some sources in our Galaxy are isolated so that the nature of the energy radiated cannot be due to accretion from a companion. These objects, magnetars, are powered by their magnetic field. They come in two sorts, the anomalous X-ray pulsars and the soft gamma repeaters. Magnetic fields of up to  $10^{15}$  Gauss (or  $10^{11}$  T) are found in these objects, flares are caused by the reorganisation of field lines as the solitary objects slow down in their rotation (fig. 3). A surprise is that the energy output from these objects is maximum in the hard X-rays, and that this is not a result of local absorption, nor of interstellar absorption but really seems to be caused by the as yet poorly understood emission mechanisms.

### Active galaxies and the X-ray background

In 1962, the first rocket that measured X-rays from space beyond the Sun discovered a bright source, Sco X-1, and a ubiquitous radiation. This was later called the diffuse extra-galactic X-ray background. At low X-ray energies, this background could be resolved in individual weak sources. The origin of this background at higher energies is more difficult to assess. On one side the spectral shape of the background does not match that expected from the superposition of weak extra-galactic sources in our

surroundings, and on the other side hard X-ray instruments could not image weak sources. INTEGRAL has been able to resolve some 2.5% of the diffuse X-ray extra-galactic background, and has also shown that the hard X-ray spectral shape of local active galaxies differs from previous expectations. This leads one to think that, with the advent of focusing optics between 10 and 100 keV, this component will indeed also be resolved in individual sources.

### Conclusion

INTEGRAL had been funded for two years of observations and designed for five years of orbital life. It is now more than ten years that INTEGRAL functions flawlessly and provides a continuous string of new and often unexpected results. We can only hope that reasonable funding authorities will continue the support to the mission as long as the instruments and satellite function as well as they do now, and new results keep hitting the press.

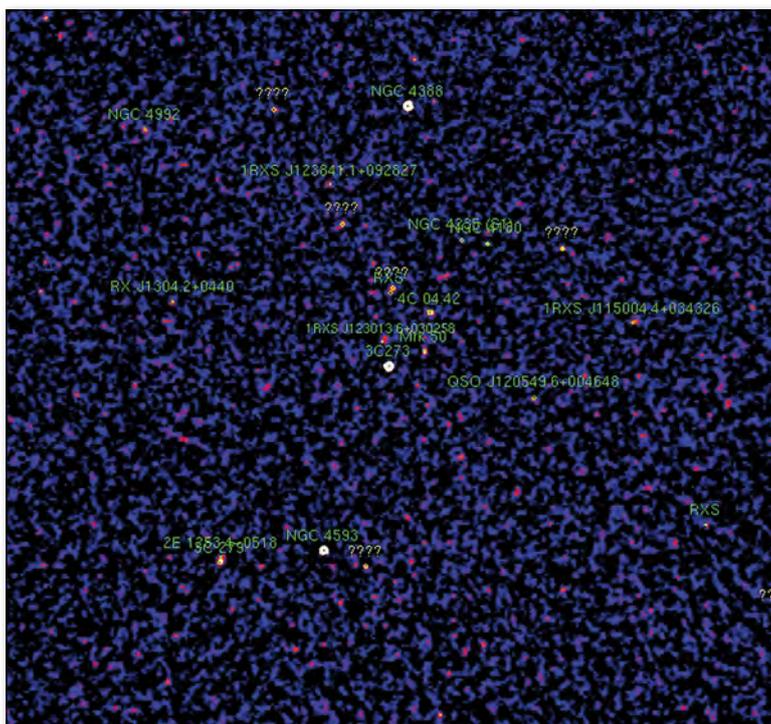
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Thierry J.-L. Courvoisier is president of the Swiss Academy of natural Sciences and of the Swiss Academies of Arts and Sciences. He is also president of the European Astronomical Society (EAS).

▼ FIG. 4:  
The deepest INTEGRAL extra-galactic image. Individual sources represent some 2.5% of the diffuse X-ray background.



### Acknowledgements

It has been a rare privilege to be associated with the INTEGRAL mission for some 25 years. The results presented here stem from the astronomical community at large that makes an extensive use of the satellite. Their work rests on the efforts of the teams behind the instruments and the ISDC. My deep gratitude goes to all who shared their knowledge and results with me in the course of the years.

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## Opinion: Open Access: Accept the challenge!

Alex Bradshaw is a former President of the German Physical Society (DPG) and an EPS Fellow

According to the EPS website, a multi-society statement on Open Access is in preparation in order “to express the point of view of the European learned societies, which in most of the cases, are also publishers of scientific journals and therefore deeply concerned”. Open Access means that scientific information, primarily in the form of peer-reviewed scholarly publications, is made freely available on internet servers, where it can be read, downloaded, copied, printed, searched, without financial, legal or technical barriers. The only restriction on its use is an obligation to attribute the work to the author. The concept has recently been extended to cover access to original research data. The new organisation “Science Europe” summarises the benefits: “Open Access improves the pace, efficiency and efficacy of research, and heightens the authors’ visibility, and thus the potential impact of their work. It removes structural and geographical barriers that hinder the free circulation of knowledge and therefore contributes to increased collaboration, ultimately strengthening scientific excellence and capacity building”. Creative commons or similar attribution licences are of course an important component. Central to the concept of Open Access are free-to read internet journals which are financed by article charges (the so-called “gold” route), rather than by conventional subscriptions. (Unfortunately, the misnomer “author pays” is widely used to describe this system. In practice, it is the author’s institution or funding agency which pays.) A variant is the “hybrid” model, whereby the journal operates on a traditional

subscription basis, but there is the possibility of paying an article charge for free access. *New Journal of Physics (NJP)* is widely regarded as the most successful Open Access physics journal. It was founded by two European physical societies, DPG and IoP, in 1998 and now has an impact factor of 4.2, with yearly 850 published papers and 1.7 million full-text downloads. The second possibility is the “green” route, in which authors deposit copies of their articles published in traditional journals in a free-to-read document server, or “repository”, normally of their own institution. Access can be immediate upon publication or after an embargo period, depending on the policy of the publisher.

Initially, Open Access was bitterly opposed by commercial publishers, but even they have begun to set up their own Open Access journals. What then has led to the sudden nervousness of some learned societies? The concept has long enjoyed considerable support in the wider scientific community. At the political level, however, there has been almost a revolution in official thinking in the last few months. Whereas for many years governments and funding agencies have been mildly supportive, little pressure has been exerted on authors. Now the message has become very clear: “the results of publicly financed research must be made publicly available”. The US administration, the European Union and the Research Councils UK are making Open Access obligatory for the publication of the results of contract research they finance. The UK clearly favours the “gold” route and is putting up money to facilitate the transition. The German parliament has

**Learned societies should accept the challenge and participate actively in shaping the transition into the new Open access era**

recently passed a resolution calling on the Government to provide extra funds for gold Open Access.

There are some problems. The transition period will be expensive and may require additional funding, but there is no evidence that gold Open Access – once the system has been transformed – will be any more expensive than the existing, subscription-based one. The costs for peer-review, copy-editing and the necessary servers are the same. Research-intensive institutions may find themselves paying more because they publish more papers, but on the other hand their budgets and their contract funding will also be higher. High-impact journals may have to charge more, because their rejection rates are higher. The activities of “dubious” publishers may also cause confusion. Another, admittedly serious problem, will be financing article charges for colleagues without institutional funding, e.g. in some third world countries or retirees who are still scientifically active. Here, the journals must be accommodating. But, on the positive side, establishing a new system will enable us to create a higher degree of transparency and accountability – perhaps with independent monitoring of article charges – to avoid the excesses perpetrated in the past, many of which are still with us in the present system.

This is where the learned societies can play an important role. Instead of trying to turn the clock back they should accept the challenge and participate actively in shaping the transition into the new Open Access era. They can learn from the vision and foresight that led IoP and DPG to set up *New Journal of Physics* – against considerable opposition – fifteen years ago. ■

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