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THE MAGAZINE OF THE EUROPEAN PHYSICAL SOCIETY

# Council report, 1-2 April 2011
# 25 years of Europhysics letters - epl
# More light from organic diodes
# EPS directory: summary and website
# ECHOPHYSICS, physics history center

42/4
2011
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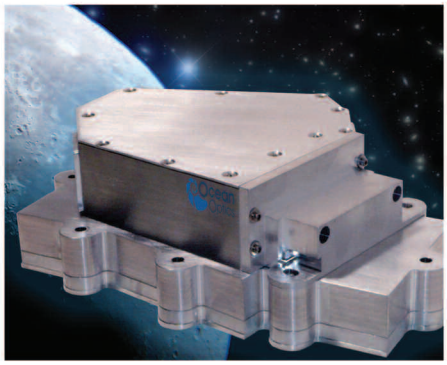

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# europhysicsnews

**Cover picture:** Pöllau Castle - The former Augustinian Canonry of Stift Pöllau. See the museum review on p.28. © ECHOPHYSICS Pöllau

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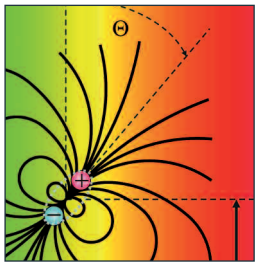
**25 years of Europhysics letters**



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**ECHOPHYSICS, Physics history center**

## EDITORIAL



## NEWS



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## EPS DIRECTORY



## MUSEUM REVIEW

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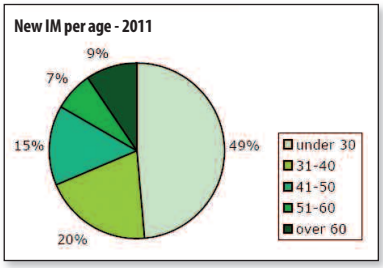
# **Good news** for the EPS

This year the society has seen a sizeable increase in membership, more so than in the past few years; with the numbers at 291, 220 and 407 new individual members (IMs) in 2009, 2010 and 2011 respectively. Note also that the 2011 additions have only been counted up to the end of June; thus, further recruitment in 2011 is, in principle, still possible. The total number of IMs today exceeds 3200.

Moreover, the percentage of new IMs under the age of 30 has increased from 25-30 to 50 % over the last three years – and from around 55 to 70 % for under 40s; we hope this might signify a new interest by younger people in the activities of the EPS. Despite this, a lot still has to be done in the area of gender equality; the percentage of female IMs, however, has increased from 15 to 23 % from 2009 to 2011, which is a good trend.

A small report, with more details about the status of EPS individual membership, can be downloaded from e-EPS. The most significant figures are shown herein.

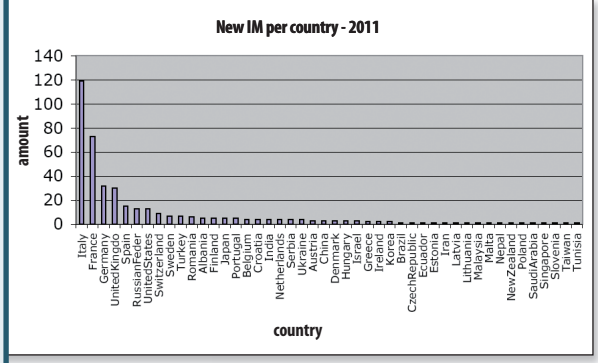



In addition, a few prestigious institutions (such as the European Gravitational Observatory [EGO], the Istituto Italiano di Tecnologia [IIT] and the Museo Storico della Fisica e Centro Studi e Ricerche 'E. Fermi' [Centro Fermi]) and firms (CAEN) are joining the EPS as associate members (AMs), contributing to the renown and weight of the society.

Concerning the electronic newsletter *e*-EPS, our readership is continuing to grow – with over 35,000 subscribers – and we are now receiving many spontaneous submissions by our members for *e*-EPS issues.

Let me end by signalling two nice EPS initiatives. The first is from the EPS Nuclear Physics Division, with the preparation of a series of three articles on the legacy of Ernest Rutherford, to appear in EPN in 2011. These will celebrate the 100$^{th}$ anniversary of the publication of Rutherford's seminal paper - which first identified the atomic nucleus and its essential role in the structure of matter. This crucial discovery marked the birth of nuclear physics and led to enormous advances in our understanding of nature. The first article by the Nuclear Physics Division is a historical recollection of Rutherford's discovery; the second will be a discussion of future prospects for nuclear research in Europe, in particular in the framework of NuPECC; and the last will show how Rutherford's scattering ideas are being applied to experiments at CERN, to study the properties and substructure of nucleons.

The second initiative is from the EPS History of Physics group, which plans to contribute, in 2012, to the worldwide celebrations of Victor Francis Hess' discovery of the cosmic radiation in 1912. The most relevant event for the EPS HoP group will be an international conference held in both Innsbruck (Tyrol) and Poellau (Styria): Hess' scientific and native lands. To be followed in *e*-EPS. ■




**Luisa Cifarelli,**
President of the EPS

# Council report, 1-2 April 2011

**The EPS Council was held in Mulhouse on 1-2 April 2011. Over 60 delegates attended representing the 41 EPS Member Societies, Divisions, Groups, Individual Members and Associate Members.**

Alexis Rinckenbach, the Executive Director of the Université d'Haute Alsace welcomed the EPS Council. Strengthening the networks and developing joint activities between the EPS and the UHA are among his priorities. Recent changes in the organisation of universities in France, including more autonomy for universities, and the rapprochement with the Université de Strasbourg will open other areas of cooperation ad collaboration.

## President's Report

**Maciej Kolwas**, EPS President reported on the activities of the Society in 2010. The EPS is dedicated to strengthening and serving the European physics community. The EPS has established its credibility as a representative of this community through activities such as the organisation of many leading conferences, publications, and policy statements. The EPS covers the whole of Europe, not just the EU27, as well as all the fields of physics. Its activities include physics education, history of physics, outreach and communication.

After more than 40 years as a learned society, the EPS decided to review its strategic priorities at its Council Meeting in 2010. To undertake this review, a group was formed with representatives of the EPS Member Societies, Individual and Associate Members, a well as Divisions and Groups.

The Strategy Working Group was chaired by the incoming President, Luisa Cifarelli. After many intense meetings, and a broad consultation with EPS Members, a draft Strategy Plan was presented at an Exceptional EPS Council Meeting, which took place in November 2010.

**The EPS covers the whole of Europe, not just the EU27**

The SWG examined the mission and structure of the EPS, and identified a dual mission for the EPS. First, in a federative role, the EPS is to pilot activities that have additional impact on a European/International scale, or in collaboration with other learned societies. The EPS also play a role in broadening the impact of the activities of its member societies. Secondly, acting as a learned society, the EPS supports a community of individual physicists, building networks for communication, research and career development. The EPS also provides the opportunity and means for individual physicists to be actively involved in EPS activities, such as the exchange of best practice, and to provide input on Science information and Science policy.

Council 2011 approved the Strategy Plan 2010+. Implementation would begin in 2011, and progress will be monitored periodically.

## Highlights 2010

Physics education remained a priority for the EPS in 2010. The EC funded study of the Bologna Reforms in Physics Studies entered into its final phase. This project brings together partners in 26 EPS Member Societies and over 200 universities around Europe to monitor the implementation and impact of the Bologna reforms. The study of the Physics Masters was completed and the study of the Doctoral level was started. B. Kehm, from the International Centre for Higher Education Research (Kassel, DE) presented the current status of the Doctoral level study, which will be completed by September 2011.

The EPS Physics Education Division undertook a study of the existing EPS Position papers on Physics Education. The EPS Executive Committee received a first draft, which highlights the need for high quality physics education. The PED will continue to work on the new Position paper, and will complete the new draft in the second semester 2011.

The EPS was also a partner in two EC financed projects in the field of education and outreach. The first is COSMOS, which brought together 11 partners in 8 countries. The project aims to create a virtual experimental laboratory for students and teachers and to improve science instruction at schools and universities more information: www.ea.gr/ep/cosmos/). The second project was Learning with Atlas at CERN, which brought together 11 partners in 10 countries. The project is an experimental laboratory for students, teachers and science museum visitors. The aim is to improve science instruction by expanding the resources for teaching and learning in schools, universities and science centers & museums, providing more challenging and authentic learning experiences. (more information: www.learning-withatlas.eu/).

▼ A. Schopper, AM delegate and C. Rossel, President of the Swiss Physical Society discuss with A. Neiderberger, chairman of the Young Minds Committee

The EPS Young Minds Project was also started. Aimed at university physics students, EPS YMs provides resources for local outreach projects in physics. It provides a network for the exchange of best practice and provides young physicists with an opportunity to develop communication and leadership skills. 5 sections from around Europe were created in 2010. (more information: http://epsyoungminds.org/)

The EPS was also involved in communication activities. The EPS Forum Physics and Society organised a workshop in El Escorial (SP) that brought together scientists (physicists) and experts in the field of science journalism, scientific communication and public media to discuss challenges related to scientific communication, the responsibility of the scientists and media in presenting relevant scientific results and best practice where EPS and other organizations could have influence. The conclusions of the meeting are available here: http://fps.epscommittees.org/madrid-program/summary-conclusions

In preparation for the EPS reply to the Consultation on the EC Green Paper on a Common Strategic Framework for future EU Research and Innovation Funding, C. Kurrer from the European Commission was invited to present the consultation and provide his advice on areas where EPS should reply. The EPS reply is available here: http://ec.europa.eu/research/csfri/index_en.cfm?pg=responses&showtoo=&show=european_organisations.

The EPS and the Association of Asia Pacific Physical Societies are undertaking the organisation of the second Asia -Europe Physics Summit, together with the Deutsche Physikalische Geselleschaft, the Société Française de Physique, and the Polish Physical Society. ASEPS 2 will take place from 26-29.10.2011, at the Wroclaw Research Centre EIT in Wrocław (PL). (More information: www.eitplus.pl/en/asia-europe_physics_summit_-aseps-_-_26-29_10_2011__wroclaw/1939/)

▲ Pr. Claude Sébenne (right) and Pr. Maciej Kolwas during the Gero Thomas prize ceremony

**EPS Young Minds provides young physicists with an opportunity to develop communication and leadership skills.**

## Decisions

**Council approved the following individuals as Honorary Members of the EPS**

Norbert Kroo (Hungary)
Michèle Leduc (France)
Herwig Schopper (Germany)
Gerard 't Hooft (the Netherlands)
(more information: www.eps.org/directory/honorary-members)

**Council approved the following individuals as fellows of the EPS:**

Dominique Bolmont (France)
Zoltan Fodor (Hungary)
Michael Poole (UK)
Christophe Rossel (Switzerland)
Ryszard Sosnowski (Poland)
Friedrich Wagner (Germany)
Simon White (UK)
Nikolay Zheludev (UK)

**Council approved the award of the Gero Thomas Memorial Medal to Claude Sébenne.**

**Council approved the modification of Article 17 of the EPS Constitution and Rule 14 of the EPS by-laws** relating to the composition and election of Executive Committee members. The EPS Executive Committee will now have: A President, a President-elect (or in years where no election is planned, a Vice-President), 1 member from each Member Society with more than 10,000 members, 3 members representing other member Societies, 4 members from Divisions and Groups, 1 member representing Individual Members, and 1 member representing Associate Members.

## Invited Speaker

**S. Randjbar-Daemi**, acting deputy Director of the International Center for Theoretical Physics gave and invited talk to Council Members. He summarised the work and history of the ICTP, highlighting its role in training physicists in developing countries.

I would like to thank the EPS staff for their hard work and dedication for making this year's Council meeting a memorable experience. ■

**David Lee**,
EPS Secretary General

# L'Oréal UNESCO Prizes 2011: a woman physicist for Europe

**"The world needs Science and Science needs women" is the keyword of the programme "For women in Science" promoted by l'Oréal, with the cooperation of UNESCO. This project is successfully bringing everybody's attention to a novel image of women, who are able to stand out in any professional field, including the highest scientific levels, much beyond the traditional roles usually given to them.**

The way the project is presented is quite original: every year five excellent scientists, one per continent, are awarded the L'Oréal UNESCO prizes for their outstanding contribution to scientific research. The geographical division highlights the particular and sometimes difficult context in which women scientists work, beyond absolute excellence.

The presentation of the prestigious award – at its 13th edition – took place on 3 March 2011 at UNESCO headquarters, in Paris. The awards (100.000$ each) have been assigned to women researchers who distinguished themselves for the quality and the continuity of their activity in science, for their remarkable contribution to scientific research and to the realization of significant changes, for the worldwide impact of their work.

Ahmed Zewail, Nobel laureate for chemistry in 1999, and Christian de Duve, Nobel laureate for medicine in 1974, chaired the sixteen members award committee. Professor Zewail acknowledged the importance of the programme "For women in science": "It is a great pleasure for me to chair this jury and to promote this programme, which is of major international importance. The women scientists from all over the world who are receiving the L'Oréal-UNESCO Awards make it possible for us to hope for a better future."

Irina Bokova, UNESCO Director General, pointed out the small number of women researchers and students in scientific and technological areas. When awarding the prizes, together with Lindsay Owen-Jones, President of L'Oréal Paris and the L'Oréal foundation, she declared: "So much talent is wasted because girls turn away from these types of fields… By encouraging women in science and technology we hope to change the face of research."

"More than ever, the world needs science and science needs women; it also needs heart and passion" commented Sir Lindsay Owen-Jones.


▲ 2011 L'Oréal-UNESCO Awards Laureates (left to right): Irina Bokova, Director General of UNESCO, Jillian Banfield (USA), Faiza El-Kharafi (Kuwait), Vivian Wing-Wah Yam (China), Silvia Torres-Peimbert (Mexico), Anne L'Huillier (Sweden), Sir Lindsay Owen-Jones, Chairman of L'Oréal. © Abaca Press for L'Oréal Corporate Foundation

• The prize for Europe was given to **Anne L'Huillier**. Born and schooled in France, she teaches Attosecond Physics at the Lund University (Sweden). She is a member of the American Physical Society and the Swedish Academy of Science. Professor L'Huillier was one of the first scientists to receive a large grant from the European Research Council for her work on the interaction between light and matter, which is at the basis of the so-called " Science of the Attosecond". She leads the European project called Alma, focused on the theoretical and experimental study of the behaviour of electrons within atoms, molecules and complex systems, accomplished by using a well-controlled sequence of light pulses. For the first time, it was possible to track an electron leaving the atom to which it was bound and drifting with the laser beam that struck it: the most rapid and very special camera, indeed. The basic phenomenon is the production of higher order harmonics, the interaction between a highly intense laser beam and a gas target being non-linear.

• **Fazia Al-Kharafi**, from Egypt - professor of Electrochemistry at the

Kuwait University - has been selected as representative for Africa and Arabic States. Her research focuses on catalysis and corrosion in saline environment. Her new methods to inhibit corrosion have an obvious impact on water treatment and oil-chemistry, definitely noteworthy for the costal areas of Kuwait and Saudi Arabia.

• The prize for the Asia-Pacific area was awarded to **Vivian Wing-Wah Yam**, professor of Chemistry and Energy at the University of Hong Kong. It acknowledges her innovative solutions for solar energy capture and storage and for the development of new photoactive materials for energy conversion.

• Australian born **Jillian Banfield**, North America representative winner, teaches Geochemistry and Microbiology at the University of Berkeley. She is also an expert in the management of environmental resources. Her pioneering results on the behaviour of materials and bacteria under extreme conditions and her skilled approach of the physical, chemical and biological interactions in these complex systems have been recognized.

• **Silvia Torres-Peimbert**, professor of Astrophysics at the National University of Mexico, was chosen to represent Latin America for her significant contribution to the study of the chemical composition of nebulae, at the basis of the understanding of the evolution of galaxies.

Until now the L'Oreal-UNESCO programme has honoured 67 women scientists; nevertheless it has not forgotten brilliant junior women researchers to whom 1019 grants have been attributed in 103 countries since its creation.

Yet many talented women can't express their potential: this is a consequence of the gap between genders that can be observed in every position in scientific institutions all around the world. Cultural awareness, which has to be supported by institutions with precise and approved political strategies, is critical to reach equality in both educational and professional areas. From this point of view, projects like L'Oréal UNESCO " For women in Science", aiming to enlarge the number of women scientists, are vital in a sector that needs deep interventions.

**Projects like L'Oréal UNESCO "For women in Science", aim to enlarge the number of women scientists**

"The world needs Science and Science needs women" is a simple but essential principle given the general crisis and the lack of human and material resources which strike the scientific world nowadays, even in developed countries. We hope the example set by L'Oréal UNESCO to be soon followed by other industrial giants and by organizations promoting worldwide scientific research and the development of all countries as an institutional mission. ■

**Patrizia Cenci and Angela di Virgilio**, for the Italian Physical Society

## Executive Committee Meeting, Sofia/BG, 20-21 May 2011 - Summary

- The EPS Executive Committee met at the Sofia University, Bulgaria
- The first issue **EPS' newsletter e-EPS** was sent out on 6 May to IMs, AMs, MS and D/G. Its appearance will be monthly; the call for information is permanent. (www.epsnews.eu)
- EPS has replied to the **EU Green Paper Consultation** with the input of its MS and D/G.
- The possibility of association with another body for **Brussels lobbying** is explored.
- First steps of an improved **communications** strategy have been discussed.
- EPS intends to prepare a study on "Physics and the European economy" along the IOP model.
- A review of EPS participation in **PhysNet** is ongoing; a new agreement with the ISN, Oldenburg has to be negotiated. The long-term interest of PhysNet was discussed.
- The new **eps-website** will be online by the end of 2011. It will contain a restructured member area with increased member benefits. Inspired by the World Directory of Crystallographers, EPS individual members will be able to publish their scientific profile. A central repository for e-proceedings of D/G conferences will also be included.
- EPS will intensify the recruitment of **AMs**, suggestions are welcome.
- Following the example of APS, EPS proposes labelling of **Historic Sites**. A form will be made available on the Website.
- In its next council session (30/31 March), **ExCom members** will be proposed in certain categories. 4 members of the existing ExCom have the possibility to stand for re-election.
- Reciprocal support for policy statements and development was discussed with Amy Flatten, Director of International Relations of **APS**. Guidelines for the publication of common statements are to be elaborated. Mutual announcement of e-bulletins will be implemented.
- Various joint approaches for **Physics of Development** were discussed with A Flatten (APS) and S Palmer (DIR of IOP); a common initiative will be organized. EPS plans a campaign for donations to finance for example travel awards, science and training projects etc.
- The ExCom met with representatives from the **Union of Bulgarian Physicists** and the **Balkan Physical Union**. Discussions highlighted their activities (publications, conferences, ..) and problems (lack of funding, declining student numbers, Bologna process, teaching). EPS will make a survey on actual physics teaching hours and curricula in high schools Europe.
- The **ASEPS workshop** will be held from 26-29 October 2011 in Wroclaw, PL; www.aseps.net, EPS 15 is scheduled to be a part of this event.
- The **World Year of Light** will take place in 2014 or 2015. It will be launched by the workshop "Passion for Light" to be held in Varenna/It on 16 Sept 2012. Organizers are SIF and EPS.
- The next ExCom meeting will be held prior to ASEPS in Wroclaw/Poland on 25th October 2011.

**Martina Knoop**, Sofia, 21 May 2011

# American Physical Society in Dallas

## European projects and the shaping of regional identities through research funding policies

**On March 23rd, 2011, Prof. Luisa Cifarelli, president-elect of the European Physical Society, participated in the March Meeting of the American Physical Society (APS), held in Dallas, to give an invited talk in the session entitled "Shaping Regional Identities through Research Funding Policies".**

This session was organized by the Forum on International Physics (FIP) of APS and provided an overview of major research projects and funding agencies in Europe, India, Brazil, Middle East and the US. The idea behind this session, which was chaired by G. Pancheri, member of the FIP Executive Committee, was to identify fundamental research and research funding as a powerful agent towards building regional identities.

Luisa Cifarelli opened the session. She presented an overview of physics research in Europe and illustrated the role of the various funding agencies, outlining the differences and similarities between the European and the US scenarios. In Europe funding of fundamental research is based on regional, national and Intra-European agencies, with the funding by European Union (EU) playing an increasing role through a number of programmes, which she illustrated, including the Seventh Framework Programme (FP7), the European Research Council (ERC), the European Science Foundation (ESF), the European Strategy Forum on Research Infrastructures (ESFRI). Cifarelli described the role of the EPS in fostering research through its scientific activities, and the strategy plan. An overview of major European facilities and projects in all the aspect of physics research included the Synchrotron light and Neutron sources, facilities for Nuclear, Subnuclear, and Astroparticle physics, environmental and energy projects, and Education.

▲ Invited speakers and session chair at the APS FIP session on "Shaping Regional Identities through Research Funding Policies", Dallas, Texas, March 23rd, 2011. From left: Harriet Kung, US DOE, Giulia Pancheri, INFN Frascati, Rohini Godbole, IIST India, Herman Winick, Stanford National Accelerator Center, Luisa Cifarelli, EPS President-elect, Carlos Alberto Aragão de Carvalho, Brazil Research Council. (Photograph courtesy of Noemie Koeller, former FIP President)

Cifarelli's presentation of the European scenarios underlined the strength and vitality of European research and the strong commitment by both national and international agencies to excellence and innovation. Her extensive presentation was followed by a talk on "Technology and innovation in Brazil" by Carlos Aragao de Carvalho, former President of Brazil Research Council, and by a description of the Indian experience on Mega physics projects by Rohini Godbole, Professor of Physics from the Indian Institute for Science and Technology, in Bangalore, and Fellow of the Indian Academy of Science. Herman Winick, from the Stanford National Accelerator Laboratory and Professor Emeritus of Stanford University, described an initiative by Helmut Dosch, the Director of the DESY Laboratory in Hamburg. The DESY programme uses scientific partnerships with institutions in the Middle East North Africa (MENA) region to promote the development of a long-term reliable, sustainable and economic energy supply. An agreement is being developed between DESY and SESAME, the facility for Synchrotron-light for Experimental Science and Applications in the Middle East, to promote concentrated solar power plants in MENA, initially to power SESAME and the local region, with larger future plants transmitting power to DESY and elsewhere in Europe. The session was closed by Dr. Harriet Kung Director of Basic Energy Science, US DOE, who illustrated the strategies of the DOE Office of Science on "Science for Energy".

**G. Pancheri,**
INFN Frascati National Laboratories

# Highlights from European journals

PARTICLE PHYSICS

## Electroweak model without a Higgs particle

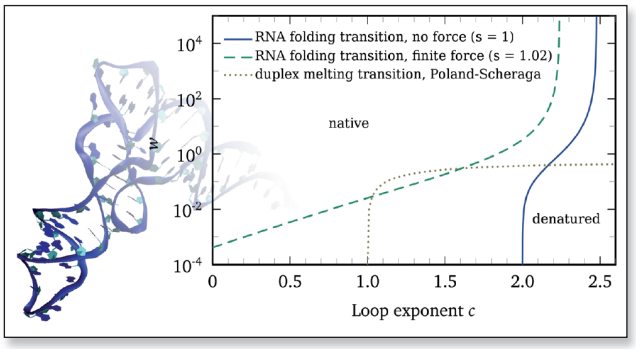
Thanks to the great accuracy in predicting experimental data, the standard model of particle physics is widely considered to be a building block of our current knowledge of the structure of matter. In spite of this success, we are still lacking an essential piece of evidence, namely the detection of the Higgs boson, a hypothetical massive elementary particle whose existence makes it possible to explain how most of the known elementary particles become massive. In this paper, an alternative electroweak model is presented that assumes running coupling constants described by energy-dependent entire functions. Contrary to the conventional formulation the action contains no physical scalar fields and no Higgs particle, even if the foreseen masses for particles are compatible with known experimental values. In addition the vertex couplings possess an energy scale for predicting scattering amplitudes that can be tested in current particle accelerators. As a result the paper provides an essential alternative to the current established knowledge in the field and addresses an issue that might soon be resolved, as the Large Hadron Collider could provide the experimental evidence of the existence or non-existence of the Higgs boson. ■

**J.W. Moffat**,
'Ultraviolet complete electroweak model without a Higgs particle', *Eur. Phys. J. Plus* **126**, 53 (2011).

ATOMIC AND MOLECULAR PHYSICS

## Secondary structure of homopolymeric single-stranded nucleic acids

Loops are essential secondary structure elements in folded DNA and RNA molecules and proliferate close to the melting transition. Using a theory for nucleic acid secondary structures that accounts for the logarithmic entropy -c ln m for a loop of length m, we study homopolymeric single-stranded nucleic acid chains under external force and varying temperature. In the thermodynamic limit of a long strand, the chain displays a phase transition between a low temperature / low force compact (folded) structure and a high temperature / high force molten (unfolded) structure.




▲ Phase diagrams displaying a folded (native) and an unfolded (denatured) RNA phase in the w-c plane with and without applied force; w is the Boltzmann factor of base pairing and c is the loop exponent. The dotted line depicts the classical Poland-Scheraga result for the melting of a double-stranded nucleic acid chain.

The influence of c on phase diagrams, critical exponents, melting, and force extension curves is derived analytically. For vanishing pulling force, only for the limited range of loop exponents 2 < c < 2.479 a melting transition is possible. A force-induced melting transition with singular behaviour is possible for all loop exponents c < 2.479 and can be observed experimentally by single molecule force spectroscopy. These findings have implications for the hybridization or denaturation of double stranded nucleic acids. The Poland-Scheraga model for nucleic acid duplex melting does not allow base pairing between nucleotides on the same strand in denatured regions of the double strand. If the sequence allows these intra-strand base pairs, we show that for a realistic loop exponent c ~ 2.1 pronounced secondary structures appear inside the single strands. This leads to a lower melting temperature of the duplex than predicted by the Poland-Scheraga model. ■

**T.R. Einert**, **H. Orland** and **R.R. Netz**,
'Secondary structure formation of homopolymeric single-stranded nucleic acids including force and loop entropy: Implications for DNA hybridization',
*Eur. Phys. J. E* **34**, 55 (2011).

FIELD THEORIES

## Another way in field theories

S. Demir and M. Tanish, from Anadolu University of Eskisehir (Turkey), propose yet another piece of the puzzle of treating field theories in a unified, mathematically elegant way. Since the mid-seventies there have been several attempts to work with unified field theories by using the algebras of quater-

nions and octonions. These algebras are the more restrictive two of the four algebras allowed by the Hurwitz theorem (the other two are the algebra of the real numbers and the algebra of the complex numbers).

Starting with real numbers each subsequent algebra becomes more restrictive: the quaternions are associative but non-commutative; the octonions are not only non-commutative but also non-associative, the hardest algebra to work into a field theory. Characteristic of these algebras is that they each double the "algebraic dimensions", starting with one-dimensional real algebra, the next being the two-dimensional complex algebra, then the four-dimensional quaternionic algebra, and finally the eight-dimensional octonionic algebra, with interesting consequences for the field theories worked out through these algebras.

Through the use of biquaternionic formalism (still within the algebra of quaternions) Demir and Tanish combine gravitomagnetic monopole terms with a Proca-type generalization of gravity in one compact form. This formalism also provides similar results for unified Maxwell's equations with non-vanishing photon mass and Dirac monopoles. Demir and Tanish have also devised a compact gravitational wave equation with Proca-type generalization of Heaviside monopoles, and developed the most generalized form of homogeneous Klein-Gordon equation for the graviton. Finally, the authors demonstrate that all field equations of the gravity can be transcribed as one biquaternionic equation.

Consequently, the biquaternionic formalism used in this paper presents a compact, simpler, and more elegant tool for deriving alternative formulations related to gravito-electromagnetism. ■

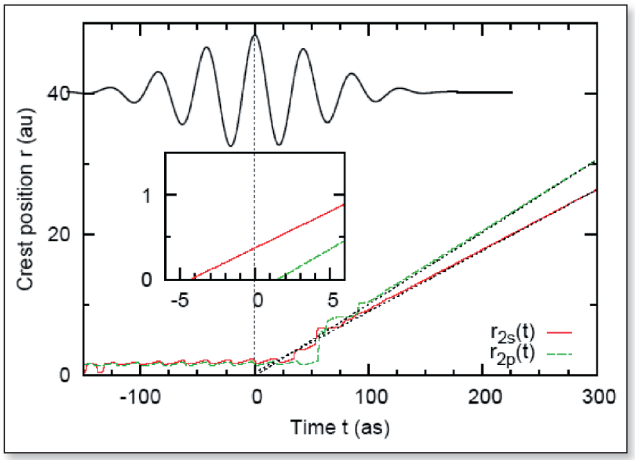
**S. Demir** and **M. Tanish**,
'Biquaternionic Proca-type generalization of gravity',
*Eur. Phys. J. Plus* **126**, 52 (2011).

ATOMIC AND MOLECULAR PHYSICS

## Atomic photoionization: When does it actually begin?

Among other spectacular applications of the attosecond streaking technique, it has become possible to determine the time delay between subjecting an atom to a short XUV pulse and subsequent emission of the photoelectron. This observation opened up a question as to when does atomic photoionization actually begin.

We address this question by solving the time dependent Schrödinger equation and by carefully examining the time evolution of the photoelectron wave packet. In this way we establish the apparent "time zero" when the photoelectron leaves the atom.




▲ The crest position of the electron wave packet after the end of the XUV pulse is fitted with the straight line, which corresponds to the free propagation. In the inset, extrapolation of the free propagation inside the atom is shown. The XUV pulse is over-plotted with the black dotted line.

At the same time, we provide a stationary treatment to the photoionization process and connect the observed time delay with the quantum phase of the dipole transition matrix element, the energy dependence of which defines the emission timing.

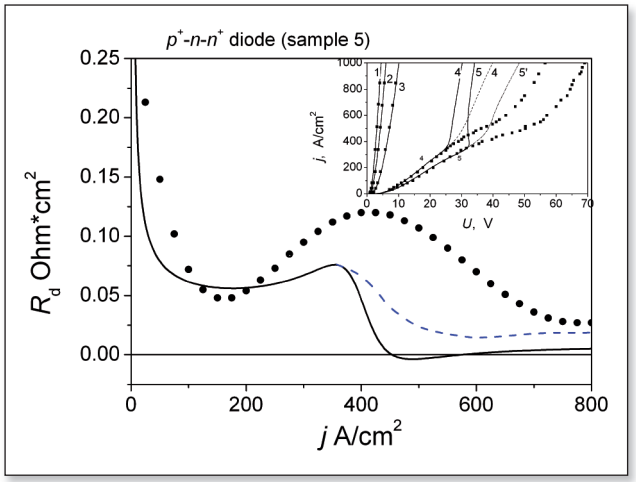
As an illustration of our approach, we consider the valence shell photoionization of Ne and double photoionization (DPI) of He. In Ne, we relate the opposite signs of the time delays $t_0(2s)<0$ and $t_0(2p)<0$ (Figure) with energy dependence of the *p* and *d* scattering phases which is governed by the Levinson-Seaton theorem. In He, we demonstrate that an attosecond time delay measurement can distinguish between the two leading mechanisms of DPI: the fast shake-off (SO) and the slow knockout (KO) processes. The SO mechanism is driven by a fast rearrangement of the atomic core after departure of the primary photoelectron. The KO mechanism involves repeated interaction of the primary photoelectron with the remaining electron bound to the singly charged ion. ■

**A.S. Kheifets**, **I.A. Ivanov** and **I. Bray**,
'Timing analysis of two-electron photoemission',
*J. Phys. B: At. Mol. Opt. Phys.* **44**, 101003 (2011).

APPLIED PHYSICS

## New approach of **carrier transport in semiconductors**

The principles on which bipolar semiconductor devices (diodes and thyristors) operate under a forward bias were formulated and developed in the early 1960s. Hundreds of original papers, tens of reviews, and numerous monographs have been devoted to analysis of various operation modes. The most exhausting description of the results obtained can




▲ Dependences of the differential resistance $R_d(j)$ on the current density for the diode with the n-base ($p^+$-$n$-$n^+$-structure) for the lifetime value of $\tau = 1.8$ µs. The circles represent the experimental points.

be found in the classical book [M.A. Lampert, P. Mark, *Current Injection in Solids* (Academic Press, 1970)]. All the necessary references can also be found in this book.

Experimental data and numerical calculations show, however, that the "classical" line of approach to describe the quasi-neutral carrier transport becomes unsuitable at high current densities and large *W/L* ratios. It was shown recently, that along with the well-known *quasineutral diffusion and quasi-neutral drift modes, a new quasineutral mode*, Diffusion Stimulated by Quasineutral Drift (DSQD) can be put into effect in bipolar semiconductor structures under a forward bias. In addition, it was demonstrated, that the equations describing the carrier distribution in the quasineutral approximation should be changed by taking into account the field dependence of the mobility.

In this paper, we report some theoretical predictions made in terms of this new approach and present experimental evidence in favor of the validity of this approach. ■

**V.B. Shuman, T.T. Mnatsakanov, M.E. Levinshtein, A.G. Tandoev, S. N. Yurkov** and **J. W. Palmour**, 'Experimental verification of a new approach to analysis of the quasineutral carrier transport in semiconductors and semiconductor structures', *Semicond. Sci. Technol.* **26** 085016 (2011).

MATERIAL SCIENCE

# Practical limits for **detection of ferromagnetism**

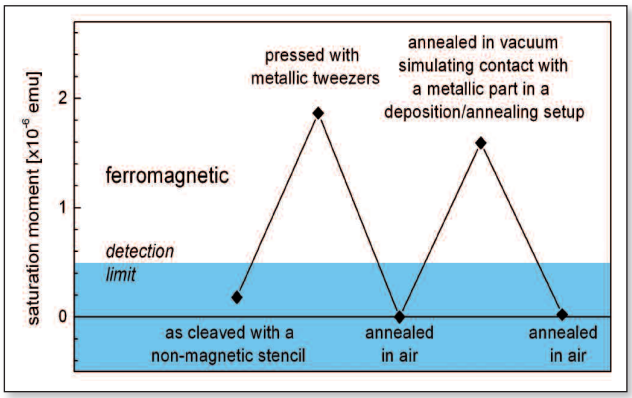
Over the last ten years, signatures of room-temperature ferromagnetism have been found in thin films and nanoparticles of various materials that are non-ferromagnetic in bulk. The implications of such high-temperature ferromagnetism are in some cases so extraordinary, *e.g.* dilute magnetic semiconductors (DMS) with carrier-mediated ferromagnetism well above room temperature would revolutionize semiconductor-based spintronics, that they triggered an enormous volume of materials research and development.

However, the magnetics community soon started realizing the dangers of measuring the very small magnetic moments of these *nanomagnets* (nanometer sized materials with nano-emu magnetic moments). Pushing state-of-the-art magnetometers to their sensitivity limits, where extrinsic ferromagnetic signals originating from magnetic contamination and measurement artefacts are non-negligible, these new nanomagnets raise a number of challenges to magnetometry techniques and, most of all, to its users' methods and procedures. While new nanomagnets continue being "discovered" based on magnetometry measurements, the general opinion is moving towards the notion that finding a signature of ferromagnetism by means of magnetometry, *i.e.* a magnetic hysteresis, is only necessary but not sufficient to claim its existence.

Through an extensive analysis of various materials subject to different experimental conditions, the authors aim at re-establishing the reliability limits for detection of ferromagnetism using high sensitivity magnetometry. The paper provides a roadmap describing how extrinsic ferromagnetism can be avoided or otherwise removed, its magnitude when such optimum conditions cannot be guaranteed, and to what extent its characteristics may or may not be used as criteria to distinguish it from intrinsic ferromagnetism. ■

**L.M.C. Pereira, J.P. Araújo, M.J. Van Bael, K. Temst** and **A. Vantomme**, 'Practical limits for detection of ferromagnetism using highly sensitive magnetometry techniques', *J. Phys. D: Appl. Phys.* **44**, 215001 (2011).

▼ Ferromagnetic saturation moment of a ZnO substrate measured in five consecutive stages, exemplifying two of the most common sources of ferromagnetic contamination and showing a type of reversibility upon annealing under different atmospheres, which is often observed in some of the recently discovered nanomagnets mentioned in the text (the detection of ferromagnetism below $5\times10^{-7}$ emu is hindered by setup-related artefacts).



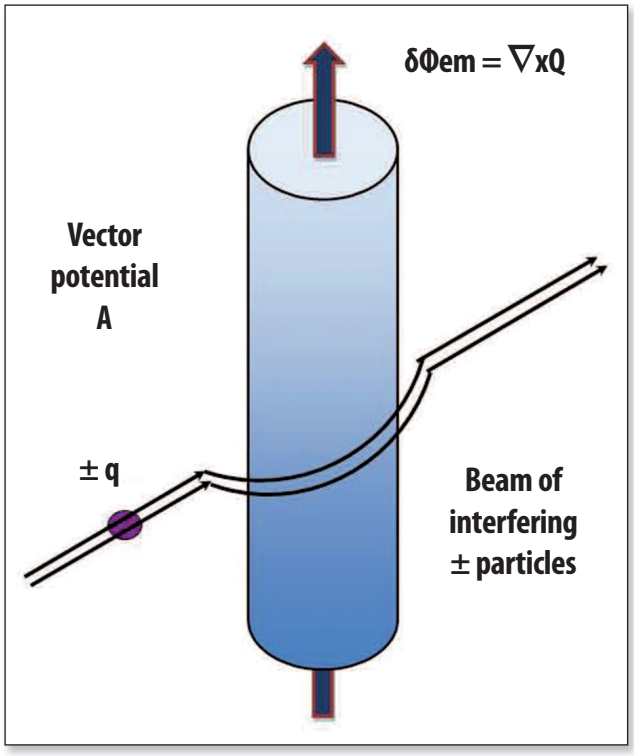
QUANTUM PHYSICS

# Classical and quantum approaches to the photon mass

Since Proca's prediction in 1936 that the rest mass of the photon, $m_\gamma$, may not be zero, there have been several searches for evidence for a possible finite photon mass. In fact, for even a very small value of $m_\gamma$, fascinating physical implications arise such as breakdowns of Coulomb's law, wavelength dependence of the speed of light in free space, existence of longitudinal electromagnetic waves, presence of an additional Yukawa potential for magnetic dipole fields, and effects that a photon mass may have during early-universe inflation and the resulting magnetic fields on a cosmological scale.

Traditionally, limits on $m_\gamma$ of $< 10^{-49}$g have been obtained by means of classical approaches, such as searches for departures from Coulomb's law. What happens if we instead exploit quantum approaches? Could better limits be achieved? This is the novel objective of the present work, in which quantum physics is applied to the photon mass question. We first examine the implications that the Aharonov-Bohm class of quantum effects (Figure) have on searches for $m_\gamma$, and then move on to explore the quantum electrodynamics scenario with an approach that employs measurements of the electron's g-factor. Within the quantum framework, we show that competitive new lower limits on the photon mass may reach the range $10^{-54} < m_\gamma < 10^{-53}$g. We provide an assessment of the state of the art in these areas and a prognosis for future work. ■

▼ In new effects of the Aharonov-Bohm type, coherent superpositions of particles possessing opposite electromagnetic properties are used. For the one shown in this figure, charged particles interact with the magnetic vector potential A of a solenoid. If the photon mass is not zero, the electromagnetic interaction is modified. Measuring the corresponding change of quantum phase shift with an interferometer leads to an estimate of $m_\gamma$.

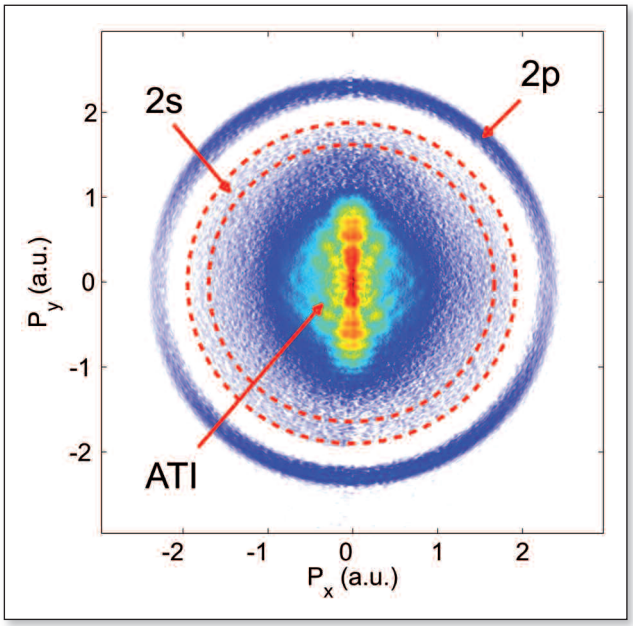



**G. Spavieri**, **J. Quintero**, **G.T. Gillies** and **M. Rodrıguez**, 'A survey of existing and proposed classical and quantum approaches to the photon mass', *Eur. Phys. J. D* **61**, 531 (2011)

ATOMIC AND MOLECULAR PHYSICS

# Attosecond imaging of XUV-induced photoemission

The excitation of atoms with extreme-ultraviolet (XUV) light can lead to the ejection of deeply bound electrons and the creation of transient core hole states. The unfolding ultrafast dynamics on a few hundred attosecond to femtosecond timescale can be resolved utilizing the attosecond transient recorder (ATR). In ATR the electron is photoemitted in the presence of a strong external near-infrared (NIR) field, which maps the time-structure of the emission onto its final kinetic energy. ATR measurements allow retrieving both the XUV and NIR fields and the photoemission dynamics. In order to gain further insight into the dynamics and challenge current theoretical models, it is highly desirable to record the full three-dimensional (3D) momentum of the electrons.




▲ Attosecond image of the two-color (XUV and NIR) photoemission in Ne.

We used velocity-map imaging in combination with ATR to record the photoemission dynamics with full 3D momentum resolution in Ne and Xe induced by an isolated, 230 attosecond long XUV pulse at 85 eV in the presence of a synchronized 4 fs, phase-stabilized near-infrared laser pulse.

The figure shows as an example a retrieved cut through the 3D momentum map for the photoemission in Ne. The XUV-induced 2p photoemission is seen as the outermost ring, followed by a weak, isotropic distribution at smaller momentum for the 2s photoemission. Electrons originating predominantly from the above-threshold ionization (ATI) in the strong NIR field are seen towards the centre. We recorded ATR data for the electron emission dynamics in Ne and the Auger decay dynamics in Xe. The experimental results demonstrate the power of the attosecond imaging method and are in good agreement with model calculations. ■

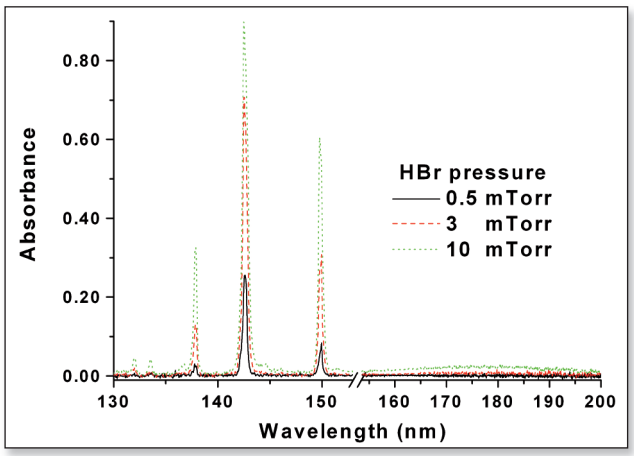
**S. Zherebtsov, A. Wirth, T. Uphues, I. Znakovskaya, O. Herrwerth, J. Gagnon, M. Korbman, V.S. Yakovlev, M.J.J. Vrakking, M. Drescher** and **M.F. Kling**, 'Attosecond imaging of XUV-induced atomic photoemission and Auger decay in strong laser fields', *J. Phys. B: At. Mol. Opt. Phys.* **44**, 105601 (2011)

MATERIAL SCIENCE

## UV absorption spectroscopy to monitor reactive plasma

A new high sensitivity technique is developed by extending the broad-band absorption spectroscopy to the vacuum ultraviolet (***VUV***) spectral region. It is well adapted for the detection and density measurement of closed-shell molecules that have strong electronic transitions in the 110-200 nm range. Among them, molecules such as $Cl_2$, HBr, BrCl, $Br_2$, HCl, $BCl_3$, $SiCl_4$, $SiF_4$, $CCl_4$, $SF_6$, $CH_2F_2$ and $O_2$, used in the microelectronics industry for etching or deposition processes, are of prime interest. In our system, the light of a deuterium lamp crosses a 50 cm diameter industrial etch reactor containing the gas of interest. The transmitted light is recorded with a 20 cm focal length *VUV* scanning spectrometer backed with a photomultiplier tube (***PMT***). The attached figure shows the absorbance at three pressures of the HBr gas, which is used in silicon gate etching processes. Peaks at 137, 143 and 150 nm, which show a non-linear, but very strong absorbance, correspond to transitions to Rydberg states of the molecule and can be used for the detection of very small HBr densities. In our present experiment, an absorption rate of 2%, corresponding to about 0.03 mTorr of HBr, can be easily detected on the 143 nm absorption peak. Replacing the *PMT* detector by a *VUV* sensitive CCD camera, would permit to reach the same signal to noise ratio with a few seconds acquisition time. For HBr pressures in the 1 to 100 mTorr range, the continuum part of the absorption spectrum (160-200 nm), which shows a weak but linear absorbance can be used. The technique is applied to monitor in $Cl_2$-HBr mixture the dissociation rate of HBr and the amount of $Br_2$ molecule formation at different plasma conditions. ■

▼ Absorbance of the HBr gas at three pressures, as used in silicon gate etching processes.



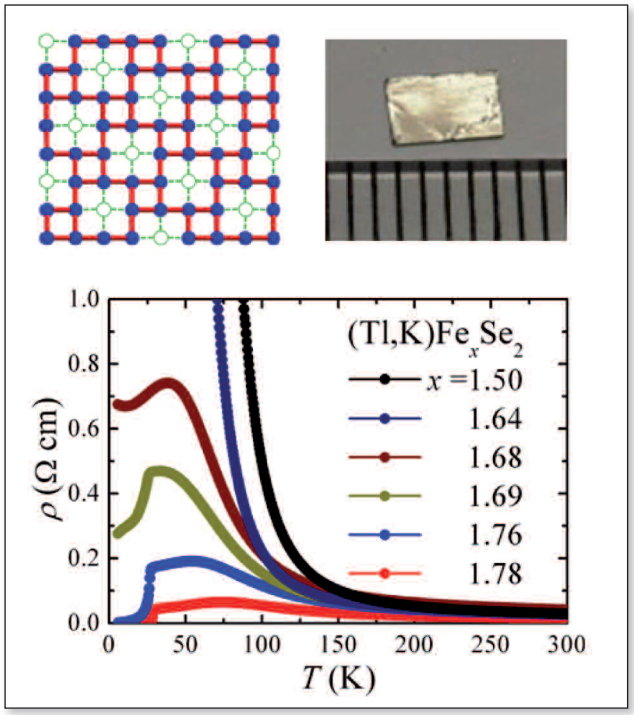

**G. Cunge, M. Fouchier, M. Brihoum, P. Bodart, M. Touzeau** and **N. Sadeghi**, 'Vacuum UV broad-band absorption spectroscopy: a powerful diagnostic tool for reactive plasma monitoring', *J. Phys. D: Appl. Phys.* **44**, 122001 (2011)

CONDENSED MATTER

## Superconductivity and anti-ferromagnetism in (Tl,K)$Fe_xSe_2$

Fe-based compounds and cuprates are two families of high $T_c$ superconducting materials. All the iron-based superconductors share a common layered structure based on a square planar $Fe^{2+}$ layer. It is now widely believed that such $Fe^{2+}$ layers are responsible for the observed superconductivity, similar to the common $CuO_2$ layer in the cuprates. A common feature in both families is that superconductivity emerges as antiferromagnetic (AFM) long range order is suppressed. While the parent compound of cuprates is a Mott insulator due to electron repulsion, the parent compound of Fe-based materials is metallic, implying weaker electron correlation. There are currently two schools of thoughts, which respectively consider electron correlations in the iron-based compounds to be very weak or sufficiently strong to place the materials close to a Mott transition. A key strategy to clarify this issue is to explore the possibility of tuning these materials into an insulating state.

In this report, an antiferromagnetic (AFM) insulator is realized by orderly introducing Fe vacancies in (Tl,K)$Fe_xSe_2$. Bulk superconductivity with $T_c$=31 K appears as these vacancy sites are partially filled by Fe atoms. A $T_c$ as high as 40 K is observed for a higher Fe content. This discovery identifies the first Fe-based high $T_c$ superconductor on the verge of becoming an AFM insulator, suggesting the importance of electron correlations.




▲ Bottom: Temperature dependence of resistivity for (Tl,K)$Fe_xSe_2$ crystals, which gives evidence for an evolution from an insulator to a superconductor with increasing Fe content. Top left: possible Fe-vacancy ordering pattern for (Tl,K)$Fe_{1.60}Se_2$, where each Fe-atom has three equivalent neighbors. This Fe-vacancy ordering phase seems to be the parent compound of this system. Top right: photo of the superconducting $Tl_{0.64}K_{0.36}Fe_{1.88}Se_2$ crystal with the highest Fe content.

This system may provide a bridge for understanding the high temperature superconductivity in both cuprates and Fe-based superconductors. ■

**Ming-Hu Fang**, **Hang-Dong Wang**, **Chi-Heng Dong**, **Zu-Juan Li**, **Chun-Mu Feng**, **Jian Chen** and **H.Q. Yuan**, 'Fe-based superconductivity with $T_c$ = 31 K bordering an antiferromagnetic insulator in (Tl,K)$Fe_xSe_2$', *EPL* **94**, 27009 (2011)

CONDENSED MATTER

## Flexibility and phase transitions **in zeolite frameworks**

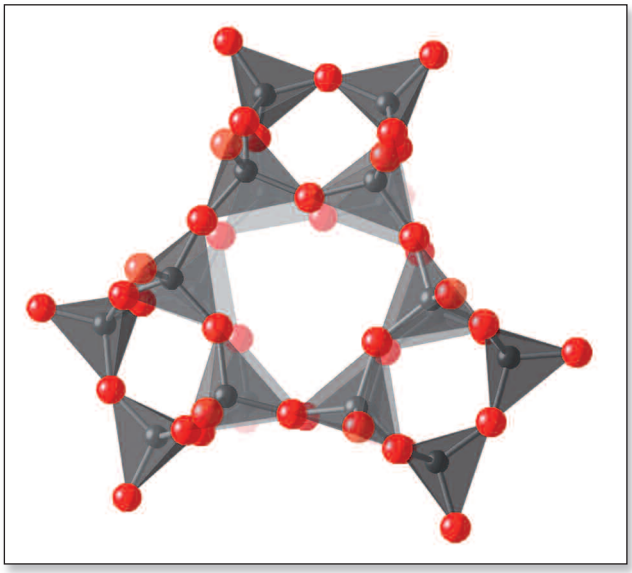
The zeolites are a group of minerals whose complex and beautiful atomic structures are formed by different arrangements of a very simple building block- a group of four oxygen atoms forming a tetrahedron, with a silicon or aluminum atom at the centre. Each oxygen atom belongs to two tetrahedra, so the structure can be viewed as a network of tetrahedra linked at the corners.

Zeolites have found widespread applications in chemical industry, particularly as catalysts. Their chemical properties depend on the shape of the pores and channels that run through the structure, containing water molecules, ions and even small organic molecules. More than a hundred different frameworks are known to exist in natural minerals or have been synthesised by chemists.

A fundamental geometric question is whether it is possible for the tetrahedra of the framework to exist in an undistorted, geometrically ideal form, or whether distortions are inevitably caused by the linking together of the tetrahedral units to form the structure. A new study links this question to the compression behaviour of zeolites in the analcime group. Four different structures display a common behaviour: they exist in a high-symmetry form at low pressures when the tetrahedra can exist without distortions, but transform to low-symmetry forms under pressure when distortions become inevitable. A deeper understanding of the rules governing the formation of zeolite structures may one day allow us to synthesise structures with specific properties on demand. New insights into the physics and geometry of frameworks are an important step in this direction. ■

**S.A. Wells**, **A. Sartbaeva** and **G.D. Gatta**, 'Flexibility windows and phase transitions of ordered and disordered ANA framework zeolites', *EPL* **94**, 56001 (2011)

▼ Detail of a zeolite structure built from corner-sharing tetrahedral units.



CONDENSED MATTER

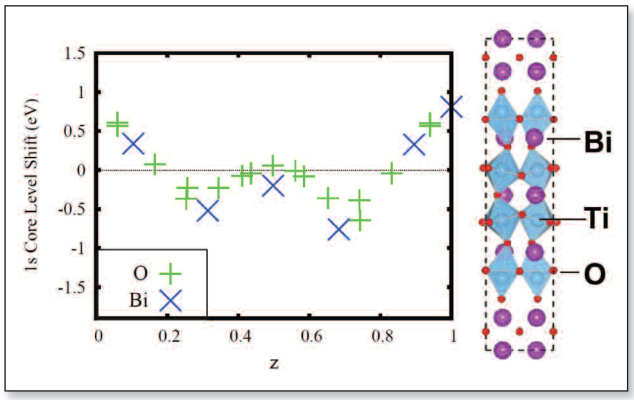
## **Design** of a low band gap oxide ferroelectric: $Bi_6Ti_4O_{17}$

The manipulation of band gaps in oxides while retaining function is a long standing problem. Xu and co-workers discuss a strategy based on manipulation of the Coulomb potential by artificial layering and illustrate its use to produce a titanate ferroelectric with a band gap below 2 eV. This is 1 eV below the lowest band gap of a titanate ferroelectric compound and is in a range that is potentially useful for solar and other optical applications. They start with the known ferroelectric $Bi_4Ti_3O_{12}$,

which has a band gap of approximately 3 eV. This compound may be regarded as a layered system consisting of stacks of alternating perovskite and fluorite structure blocks. Importantly, the ferroelectric polarization is substantial and close to the plane of the layers. The authors used a combination of first principles relaxations and electronic structure calculations to show that they could alter the Coulomb potential enough to shift the relative positions of the cation derived conduction bands relative to the O 2p valence bands by 1 eV, while nonetheless retaining a sizable ferroelectric polarization. This manipulation of the Coulomb potential is illustrated in the Figure, which shows the calculated shifts in the 1s core levels of the Bi and O atoms as a function of position along the layer stacking direction in the unit cell. The mechanism that the authors use is general and could be applied to other layered oxide systems including other ferroelectrics. The ability to shift bands in engineered oxide structure on the eV scale may also be important for other applications such as oxide electronics and photo-catalysis. ■

**Bo Xu, D.J. Singh, V.R. Cooper and Yuan Ping Feng**, 'Design of a low band gap oxide ferroelectric: $Bi_6Ti_4O_{17}$', *EPL* **94**, 37006 (2011)

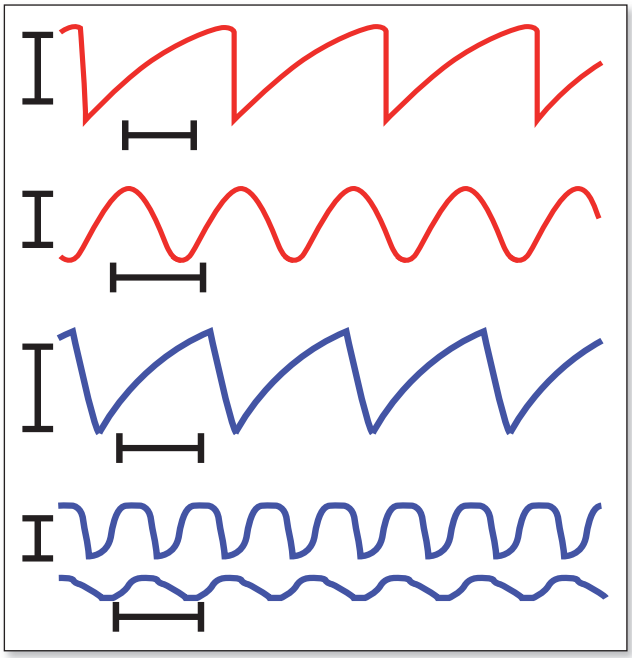
▼ D-1s core level variation for O and Bi along the long axis of the unit cell as shown on the right. This represents the variation in the Coulomb potential that is induced by the layer stacking in this material.




ATOMIC AND MOLECULAR PHYSICS

## **Molecular motors** in the rigid and crossbridge models

In cells, motor proteins use chemical energy to generate motion and forces. Motors often interact and form clusters because they are connected to a single rigid backbone. In a muscle the backbone is made by association of the motor tails. The backbone motion results from the action of all the motors, and feeds back on each motor. Previous works suggest that motor assemblies are endowed with complex dynamical properties, including dynamic instabilities and spontaneous oscillations, which may play a role in the mechanisms of heartbeat, flagellar beating, or hearing. In this paper, we study two models of motor assemblies: the rigid two-state model and the classical crossbridge model widely used in muscle physiology.



▲ Examples of spontaneous oscillations of motor assemblies in the crossbridge model (red) and the rigid model (blue).

Both models predict spontaneous oscillations. In the rigid two-state model, they can have a "rectangular" shape or a characteristic "cusp-like" shape that resembles cardiac sarcomere and "stick-slip" oscillations. The oscillations in the vicinity of the Hopf bifurcation threshold can be much faster than the chemical cycle. This property, not found in the crossbridge model where protein friction slows down the motion, could be important for the description of high frequency oscillations, such as insect wingbeat. Experiments based on the response of a motor assembly to a step displacement are also well described by both theories, which predict non-linear force displacement relations, delayed rise in tension and "sarcomere give". This suggests that these effects are not directly dependent on molecular details. We also relate the collective properties of the motors to their microscopic properties accessible in single molecule experiments: we show that a three state state crossbridge model predicts the existence of instabilities even in the case of an apparent load decelerated detachment rate. ■

**T. Guérin, J. Prost** and **J-F. Joanny**, 'Dynamical behaviour of molecular motor assemblies in the rigid and crossbridge models', *Eur. Phys. J. E* **34**, 60 (2011)

**Erratum**

In the Fig.1 caption of "The Croatian Physical Society" - *EPN* **42/2**, 22 (2011) - names must read right to left instead of of left to right.

# 1986-2011 : 25 years of Europhysics letters - epl

■ Angela Oleandri - DOI: 10.1051/epn/2011401
■ SIF Editorial Director and Member of the EPLA Board of Directors

**In the beginning...**
**After years of the most thorough discussions on the needs, the means, the structure, the people... during which the physics community of Europe through the EPS Divisions and the national societies has been fully consulted, EPS is able to formally announce the publication from 1 January 1986 of a new fortnightly journal: Europhysics Letters incorporating Journal de Physique Lettres and Il Nuovo Cimento Lettere**

With these words - published on the front page of the June 1985 issue of Europhysics News (see the picture) - the journal venture officially started.
The negotiations actually had been going on for 5 years. In fact the first proposal for a European Letters Journal had been formulated in 1980 under the EPS Presidency of Antonino Zichichi, while the final partnership agreement was signed in March 1985 under the Presidency of G.H. Stafford. The initiative was reflecting the collective European effort to harmonize the physics publications in Europe to create a high-quality letters journal that would publish the best communications on new physics wherever it was done: be it from Europe or worldwide.
In the 1980s the European Scientific publication landscape was (and partly still is) quite fragmented and having just one flagship letters journal, created from merging two national letters journal, was seen as a good starting point towards a deeper unification.

## Ownership

The partners that made the initial investment, i.e. the French Physical Society (SFP), the Italian Physical Society (SIF) and the UK Institute of Physics (IOP), together with the European Physical Society (EPS) that provided the scientific background, were the initial owners and were supported from the start by several other national societies that guaranteed further capital, should this be needed.

## Publishers

Les Editions de Physique (now EDP Sciences), the publishing subsidiary of SFP, and the publishing section of SIF presented a joint proposal to the call for tenders and were awarded the contract for the publishing operations of the journal. EDP Sciences and SIF, that were respectively the publishers of the two merging journals, Journal de Physique Lettres and Lettere al Nuovo Cimento, mutually agree to split the tasks as follows: editing, typesetting and pre-press services were carried out in Bologna (SIF); printing, dispatching and subscription services were handled in Paris (EDPS).

## Editorial Management

The scientific control was vested in EPS; the Editor-in-Chief and the Board of Co- Editors in charge to exercise that control, through panel of existing referees, were

**The first Editorial Board of Europhysics Letters, in 1986**

***Editor-in-chief***: N. Kurti, United Kingdom
***Co-Editors:***

| | |
|---|---|
| G. Barbiellini, Italy | C.J. Joachain, Belgium |
| F. Bassani, Italy | M. Kaufmann, Fed. Rep. Germany |
| E. Brézin, France | T.W.B. Kibble, United Kingdom |
| B. Cagnac, France | F. Mezei, Hungary |
| J. Demaret, Belgium | R.H. Siemssen, The Netherlands |
| D. Faddeev, U.S.S.R. | J.P. Toennies, , Fed. Rep. Germany |
| P. Fulde, Fed. Rep. Germany | G. Weber, Fed. Rep. Germany |


chosen by EPS, in consultation with the other owners. Listed on p.16 is the composition of the first Editorial Board. The Editorial Office, to manage all editorial steps from paper submission to acceptance, was installed in EPS which had its headquarters located in Geneva at that time.

## Management Board (now Board of Directors)

The business management of the journal was exercised by a Management Board (MB). Each of the four initial partners nominated one member to the MB, and the delegate of EPS was acting as the Chairman of the Board. The first MB was so composed: W. Buckel (EPS), F. Read (IOP), J. Des Cloizeaux (SFP-EDPS), A. Taroni (SIF). The Executive Secretary of EPS, G. Thomas (acting as the journal business manager) and the Editor-in-Chief of the journal, N. Kurti, were non-voting members of the MB.

## Growth

Europhysics Letters was launched as scheduled on January 1st, 1986 and the contributions began to come in quite steadily allowing to fill in the issues in time. One of the main challenges of the journal was to reach a high scientific standard and reputation, but, as one can guess, not less challenging was the complexity of the project. The main publishing tasks were in fact split among three partners based in three different European countries: France, Italy and Switzerland. In the light of present technologies this could seem banal, but in 1986 communications were only by telephone and the exchange of information went only through surface mail: no fax, no e-mail, and no electronic file exchanges. Every step required a perfect coordination, high professionalism and great experience to keep the production time at a competition level. But the people involved in this "complex system", i.e. Christine Bouldin, as Staff Editor in Geneva, myself, as Production Editor in Bologna, and Jeanne Berger as Publications Editor in Paris, assisted by Susan Mckie, immediately synchronized on the same wavelength and the operations went on very smoothly from the start.

The papers began to come in with a regularly increasing rate and so the journal soon left the cradle. Also the circulation was very healthy, at the outset, reaching already in the first year almost 1000 library subscriptions according to the projections of the publication contract.

**The second set of owners of Europhysics Letters**

- The Austrian Physical Society
- The German Physical Society
- The Hungarian Physical Society
- Institut "Ruder Boskovic"
- The Netherlands Physical Society
- The Portuguese Physical Society
- Pool of Scandinavian Physical Societies:
  - Danish Physical Society
  - Finnish Physical Society
  - Icelandic Physical Society
  - Norwegian Physical Society
  - Swedish Physical Society
- The Swiss Physical Society
- The Turkish Physical Society


▶ **FIG. 1:** (a) The first cover of Europhysics Letters, (b) a new cover of Europhysics Letters, (c) present style of EPL covers

Already at the end of 1986 the unexpected great success of the journal forced the management to print more pages than allowed by the contract. But the continuation of this success and the increasing inflow of papers created a huge backlog (a disaster for a letters journal) that was partly eliminated by printing an extra volume at the end of 1987. Nevertheless, since the cost could not be recovered from the subscriptions income, the owners had to take the resolution to use the guarantee capital provided by the associated members, who were then asked to become full-partners. A new partnership agreement was signed accordingly in Dresden in March 1988.

Under the new agreement the ownership changed, the new societies combined holding a similar share as each of the initial owners. The new partners societies (see list) also had the right to elect one delegate to the MB, thus the actual members of the MB became five.

A new period started in a true positive European spirit with 17 countries participating in the journal, perfectly in line with the aim of the project.

**The Editors in Chief of Europhysics Letters then *EPL***

| | |
|---|---|
| **Europhysics Letters** | |
| 1986-1989 | N. Kurti, United Kingdom |
| 1989-1992 | W. Buckel, Germany |
| 1992-1995 | R. Balian, France |
| 1995-1997-2001 | F. Gianturco, Italy (2 terms) |
| 2001-2004 | H. Müller-Krumbhaar, Germany |
| 2004-2007 | D. Jérome, France |
| ***EPL*** | |
| 2007- 2010 | V. Dose, Germany |
| 2010-now | M. Schreiber, Germany |

## Maturity

During 1991 the number of accepted papers was greater than any of the first five years. Again, to keep the acceptance to publication times within the current standard, the resolution was taken to publish the last 1991 volume on a weekly basis, rather than semi-monthly, so that it was completed already in October, while the first volume of 1992 was anticipated by two months, keeping the weekly periodicity until the backlog was worked out. Since it was clear that the journal had steadily grown, starting from 1993 the periodicity was changed to three issues per month.

But the 1990s will be remembered as the years of the revolutionary innovation that deeply affected the scientific publishing landscape: Internet and online publications. Since the physics community pioneered this change, the physics journals were the first to switch to the new technologies. So, in 1995 a new production contract that included also the online version was negotiated between EDPS and SIF and already in January 1995 EDPS began to host and distribute on its website the electronic version of the journal. This change of scenario also coincided with the slow but continuous decline in subscriptions - a general phenomenon involving all scientific publishers. Luckily the new production technologies were less expensive, so the loss in income could be balanced by the decrease in expenses. During the remainder of the 1990s the manuscript inflow showed a small decline, and since the frequency of the issues was no longer so important, in mid-1997 the journal switched back again to a semi-monthly periodicity, followed by a change in the cover design.

In 1995 another important event happened. The Council of EPS, for financial reasons, decided to move the EPS Secretariat from Geneva, Switzerland to Mulhouse, France. The EPS President, H. Schopper, offered the MB of *EPL* the opportunity to move at the same time, but in the first place this offer was declined. As a result of the movement of the EPS Secretariat to Mulhouse at the end of 1996, the

*EPL* Editorial Office remained isolated in Geneva and the *EPL* organization lost its institutional umbrella.

It was necessary to form an independent association having as a mission the promotion of the advancement of Physics in Europe and worldwide. The *EPL* Association (EPLA), that mirrored the existing partnership, was founded and all the partners in Geneva signed the articles of the new association in March 1997. EPLA is presently still ruled by that document.

At the beginning of the 2000s though, the EPLA MB (now the Board of Directors) decided that the Geneva office was becoming too expensive and made a call for tenders for a new location for the Editorial Office. All four founding partners submitted their offers, but the EPS President of that time, M. Ducloy, firmly invited the BoD to make the more politically convenient choice, i.e. to have again the Editorial Office at the EPS Secretariat in Mulhouse. The BoD accepted and in January 2004 the Editorial Office had moved.

## Rebranding

At the turn of the century it was clear that the journal was quite static both in size and impact while the traditional subscriptions continued to decline. At the same time, it was also clear that the electronic journals were superseding the paper ones, which were progressively serving only archival purposes.

As a consequence new and more flexible distribution channels, like electronic-only subscriptions packages, consortia, pricing by size of institutions etc., appeared on the scene. In 2004 the EPLA management called for a brainstorming session to analyse the status of the journal and discuss possible ways to increase its prestige, visibility and distribution. It was decided that *EPL* needed a clearer definition of the marketing strategy and that the production process had to be redefined and streamlined. A new production contract taking into account the changing environment of the journal was needed.

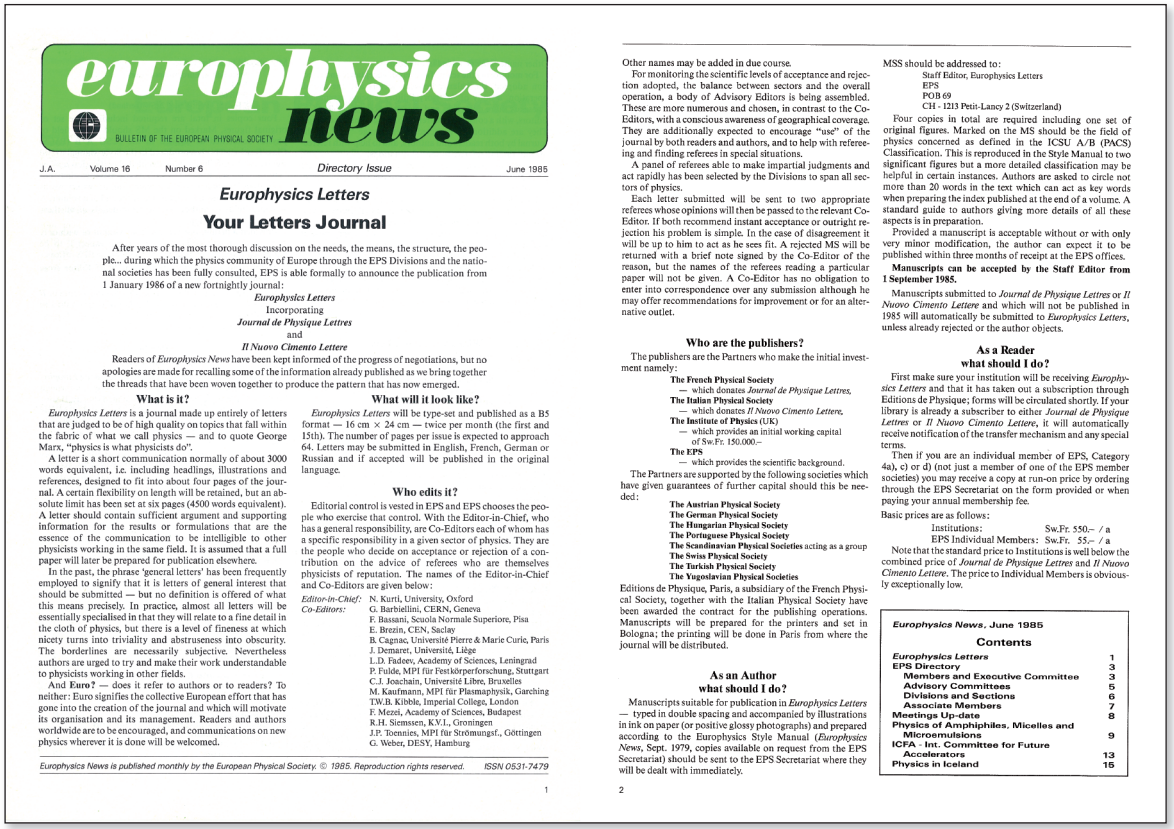
IOP, SFP and SIF were invited to tender an offer for production either separately or jointly.

Since none of the presented bids reached the required majority, the Board of Directors called for a meeting of the Presidents of the founding members in order to find guidance on how to resolve the stalemate. The presidents of the respective societies, M. Huber (EPS), Sir J. Enderby (IOP), E. Brezin (SFP), G.F. Bassani (SIF), who attended the summit, privileged a solution that would include all the three partners, in line with the spirit of *EPL*.

The challenge was to identify an equilibrated and mutually satisfactory task redistribution that exploited each partner's own expertise. It took a lengthy negotiation process and the true will of IOP, SFP, and SIF to collaborate, a solution was found and the new contract signed in Bologna in February 2006.

The journal was successfully re-launched in January 2007 with a new format and a new cover image (see picture). I can only add that I pride myself on having participated all along to this so challenging European venture.

Happy birthday *EPL*! ■



europhysics news

BULLETIN OF THE EUROPEAN PHYSICAL SOCIETY

J.A. Volume 16 Number 6 Directory Issue June 1985

*Europhysics Letters*

**Your Letters Journal**

After years of the most thorough discussion on the needs, the means, the structure, the people... during which the physics community of Europe through the EPS Divisions and the national societies has been fully consulted, EPS is able formally to announce the publication from 1 January 1986 of a new fortnightly journal:

*Europhysics Letters*
Incorporating
*Journal de Physique Lettres*
and
*Il Nuovo Cimento Lettere*

Readers of *Europhysics News* have been kept informed of the progress of negotiations, but no apologies are made for recalling some of the information already published as we bring together the threads that have been woven together to produce the pattern that has now emerged.

**What is it?**

*Europhysics Letters* is a journal made up entirely of letters that are judged to be of high quality on topics that fall within the fabric of what we call physics — and to quote George Marx, "physics is what physicists do".

A letter is a short communication normally of about 3000 words equivalent, i.e. including headlings, illustrations and references, designed to fit into about four pages of the journal. A certain flexibility on length will be retained, but an absolute limit has been set at six pages (4500 words equivalent). A letter should contain sufficient argument and supporting information for the results or formulations that are the essence of the communication to be intelligible to other physicists working in the same field. It is assumed that a full paper will later be prepared for publication elsewhere.

In the past, the phrase 'general letters' has been frequently employed to signify that it is letters of general interest that should be submitted — but no definition is offered of what this means precisely. In practice, almost all letters will be essentially specialised in that they will relate to a fine detail in the cloth of physics, but there is a level of fineness at which nicety turns into triviality and abstruseness into obscurity. The borderlines are necessarily subjective. Nevertheless authors are urged to try and make their work understandable to physicists working in other fields.

And **Euro?** — does it refer to authors or to readers? To neither: Euro signifies the collective European effort that has gone into the creation of the journal and which will motivate its organisation and its management. Readers and authors worldwide are to be encouraged, and communications on new physics wherever it is done will be welcomed.

**What will it look like?**

*Europhysics Letters* will be type-set and published as a B5 format — 16 cm × 24 cm — twice per month (the first and 15th). The number of pages per issue is expected to approach 64. Letters may be submitted in English, French, German or Russian and if accepted will be published in the original language.

**Who edits it?**

Editorial control is vested in EPS and EPS chooses the people who exercise that control. With the Editor-in-Chief, who has a general responsibility, are Co-Editors each of whom has a specific responsibility in a given sector of physics. They are the people who decide on acceptance or rejection of a contribution on the advice of referees who are themselves physicists of reputation. The names of the Editor-in-Chief and Co-Editors are given below:

*Editor-in-Chief:* N. Kurti, University, Oxford
*Co-Editors:* G. Barbiellini, CERN, Geneva
F. Bassani, Scuola Normale Superiore, Pisa
E. Brezin, CEN, Saclay
B. Cagnac, Université Pierre & Marie Curie, Paris
J. Demaret, Université, Liège
L.D. Fadeev, Academy of Sciences, Leningrad
P. Fulde, MPI für Festkörperforschung, Stuttgart
C.J. Joachain, Université Libre, Bruxelles
M. Kaufmann, MPI für Plasmaphysik, Garching
T.W.B. Kibble, Imperial College, London
F. Mezei, Academy of Sciences, Budapest
R.H. Siemssen, K.V.I., Groningen
J.P. Toennies, MPI für Strömungsf., Göttingen
G. Weber, DESY, Hamburg

 *ISSN 0531-7479*

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Other names may be added in due course.

For monitoring the scientific levels of acceptance and rejection adopted, the balance between sectors and the overall operation, a body of Advisory Editors is being assembled. These are more numerous and chosen, in contrast to the Co-Editors, with a conscious awareness of geographical coverage. They are additionally expected to encourage "use" of the journal by both readers and authors, and to help with refereeing and finding referees in special situations.

A panel of referees able to make impartial judgments and act rapidly has been selected by the Divisions to span all sectors of physics.

Each letter submitted will be sent to two appropriate referees whose opinions will then be passed to the relevant Co-Editor. If both recommend instant acceptance or outright rejection his problem is simple. In the case of disagreement it will be up to him to act as he sees fit. A rejected MS will be returned with a brief note signed by the Co-Editor of the reason, but the names of the referees reading a particular paper will not be given. A Co-Editor has no obligation to enter into correspondence over any submission although he may offer recommendations for improvement or for an alternative outlet.

**Who are the publishers?**

The publishers are the Partners who make the initial investment namely:

**The French Physical Society**
— which donates *Journal de Physique Lettres,*
**The Italian Physical Society**
— which donates *Il Nuovo Cimento Lettere,*
**The Institute of Physics** (UK)
— which provides an initial working capital of Sw.Fr. 150.000.–
**The EPS**
— which provides the scientific background.

The Partners are supported by the following societies which have given guarantees of further capital should this be needed:

**The Austrian Physical Society**
**The German Physical Society**
**The Hungarian Physical Society**
**The Portuguese Physical Society**
**The Scandinavian Physical Societies** acting as a group
**The Swiss Physical Society**
**The Turkish Physical Society**
**The Yugoslavian Physical Societies**

Editions de Physique, Paris, a subsidiary of the French Physical Society, together with the Italian Physical Society have been awarded the contract for the publishing operations. Manuscripts will be prepared for the printers and set in Bologna; the printing will be done in Paris from where the journal will be distributed.

**As an Author what should I do?**

Manuscripts suitable for publication in *Europhysics Letters* — typed in double spacing and accompanied by illustrations in ink on paper (or positive glossy photographs) and prepared according to the Europhysics Style Manual (*Europhysics News*, Sept. 1979, copies available on request from the EPS Secretariat) should be sent to the EPS Secretariat where they will be dealt with immediately.

MSS should be addressed to:
Staff Editor, Europhysics Letters
EPS
POB 69
CH - 1213 Petit-Lancy 2 (Switzerland)

Four copies in total are required including one set of original figures. Marked on the MS should be the field of physics concerned as defined in the ICSU A/B (PACS) Classification. This is reproduced in the Style Manual to two significant figures but a more detailed classification may be helpful in certain instances. Authors are asked to circle not more than 20 words in the text which can act as key words when preparing the index published at the end of a volume. A standard guide to authors giving more details of all these aspects is in preparation.

Provided a manuscript is acceptable without or with only very minor modification, the author can expect it to be published within three months of receipt at the EPS offices.

**Manuscripts can be accepted by the Staff Editor from 1 September 1985.**

Manuscripts submitted to *Journal de Physique Lettres* or *Il Nuovo Cimento Lettere* and which will not be published in 1985 will automatically be submitted to *Europhysics Letters*, unless already rejected or the author objects.

**As a Reader what should I do?**

First make sure your institution will be receiving *Europhysics Letters* and that it has taken out a subscription through Editions de Physique; forms will be circulated shortly. If your library is already a subscriber to either *Journal de Physique Lettres* or *Il Nuovo Cimento Lettere*, it will automatically receive notification of the transfer mechanism and any special terms.

Then if you are an individual member of EPS, Category 4a), c) or d) (not just a member of one of the EPS member societies) you may receive a copy at run-on price by ordering through the EPS Secretariat on the form provided or when paying your annual membership fee.

Basic prices are as follows:

Institutions: Sw.Fr. 550.– / a
EPS Individual Members: Sw.Fr. 55.– / a

Note that the standard price to Institutions is well below the combined price of *Journal de Physique Lettres* and *Il Nuovo Cimento Lettere*. The price to Individual Members is obviously exceptionally low.

*Europhysics News*, June 1985

**Contents**



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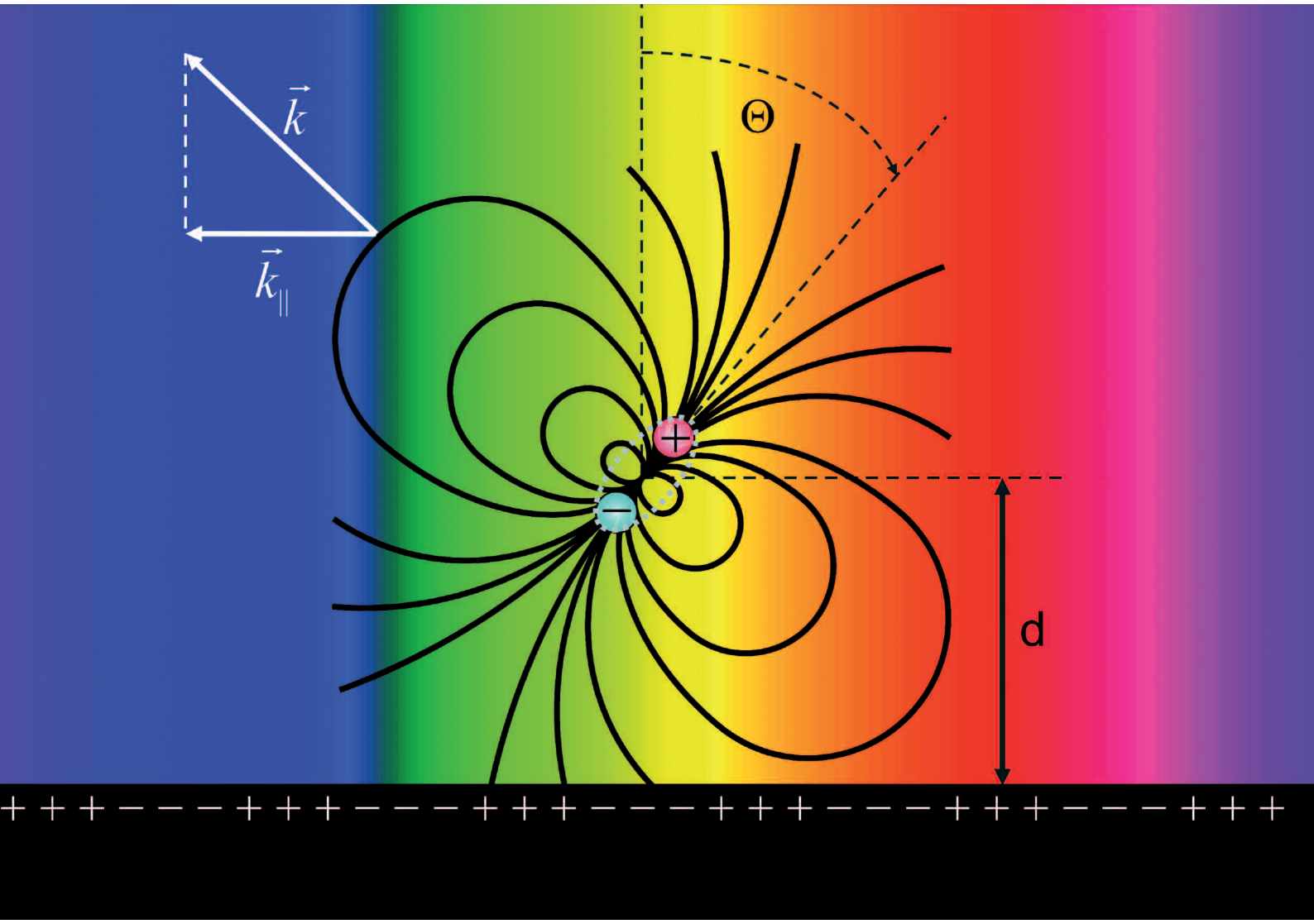
**FIG. 2:** EPN announcement of Europhysics Letters in 1985

# More light

## from organic light-emitting diodes

■ Wolfgang Brütting, Jörg Frischeisen, Bert J. Scholz, and Tobias D. Schmidt - DOI: 10.1051/epn/2011402
■ Institute of Physics, University of Augsburg, 86135 Augsburg, Germany - Email: wolfgang.bruetting@physik.uni-augsburg.de

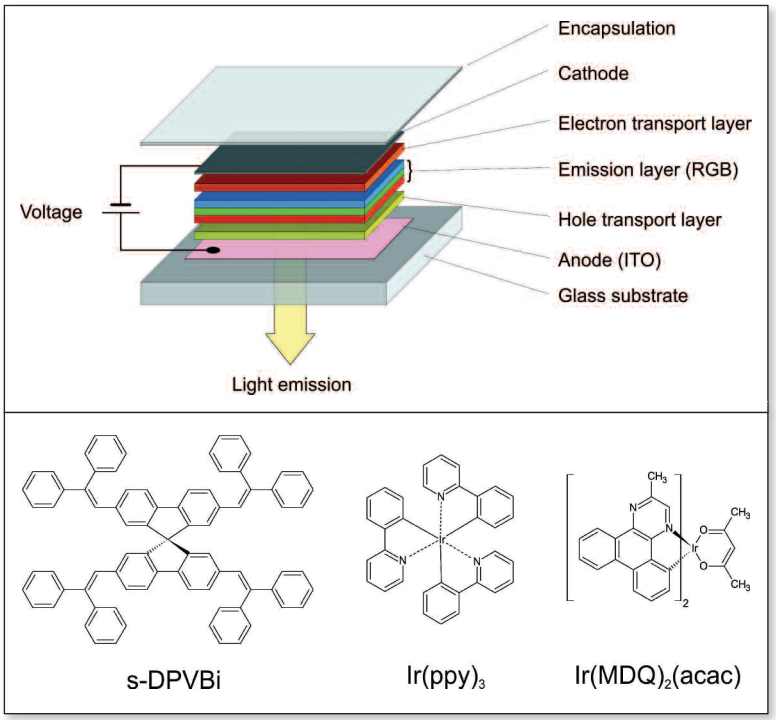
**Organic light-emitting diodes (OLEDs) are efficient large-area light sources facing their market entry. Still, the development of stable and more efficient blue emitters and the enhancement of light outcoupling remain challenges for further device improvements. Here, we review the working principles of OLEDs and highlight ongoing efforts to improve their efficiency.**




▼ Oscillating electrical dipole

The availability of artificial light has been a seminal cultural development of mankind. After open fires for thousands of years, the introduction of electricity together with the invention of the light bulb in the second half of the 19th century has revolutionized our daily life. Having dominated the lighting market for more than 100 years, however, the light bulb faces its decline due to the need for technologies that convert electricity more efficiently into visible light. Besides fluorescent lamps, which are already well established in the market, the availability and progress in white light-emitting diodes, both inorganic and organic, has led to a new lighting technology called solid-state lighting over the last decade. Its working principle, namely the radiative recombination of injected electron-hole pairs in a solid, a process termed electroluminescence, is fundamentally different from existing techniques and holds the promise for highly efficient, long-lived and environmentally friendly light sources.

In contrast to their inorganic counterparts, organic light-emitting diodes (OLEDs) are flat and thin large-area light sources that could rather lead to complementary luminaires than competitors. Historically speaking, electroluminescence in organic molecular crystals dates back to the early 1960s. However, the important step towards applicable devices was the demonstration of thin-film organic light-emitting diodes by researchers at Eastman Kodak in 1987 using vacuum-deposited molecular materials and by a group at Cambridge University in 1990 making use of a solution-processed conjugated polymer [1]. Inspired by these publications, intense research and development throughout the 1990s has lead to the introduction of first commercial products based on OLED displays. Since 2000, however, the focus in many laboratories shifted towards OLEDs for lighting applications, *i.e.*, to white OLEDs. After steady improvements in efficiency and lifetime over the years, the commercialization of OLEDs for general lighting has just recently started in 2010 [2]. (For an overview of various technical aspects of OLED lighting and the current state of the art see, *e.g.*, Ref. [3]).




▲ **FIG. 1:** Typical layer stack of a small molecule OLED with a hole injecting and transporting unit deposited onto an optically transparent indium tin-oxide anode sitting on a glass substrate, followed by one or more emission layers (RGB), an electron delivering unit on top of it and finally an opaque metal electrode at the top. The whole layer stack is protected against ambient environment by an encapsulation which is typically a second glass plate combined with a desiccant. At the bottom some prototype OLED emitter materials are shown. In this case, the material for blue (s-DPVBi) is a fluorescent emitter, while green ($Ir(ppy)_3$) and red ($Ir(MDQ)_2(acac)$) are phosphorescent emitters.

## White OLEDs

The first report on white OLEDs dates back to 1994, when a Japanese group combined red, green and blue (RGB) laser dyes in a common matrix and achieved light emission over a broad spectral range [4]. Despite its simplicity in preparation, achieving white light emission with good and stable colour quality in this way is not that straightforward, because charge recombination and energy transfer processes between the different dyes need to be well controlled. Thus it is nowadays more common to employ distinct emission layers for RGB that can either be directly stacked on top of each other in one OLED (see Fig. 1) or in three separated OLEDs – one for each colour – that are in turn vertically stacked by optically transparent electrical interconnecting units.

The development of OLEDs will continue to rely on the availability of tailor-made functional organic materials that can be applied to well-controlled thin films in the 10 to 100 nanometres thickness range. Thereby the requirements to the materials are manifold: starting from processibility and film formation, via electrical transport to optical properties. The key factor is obviously the availability of efficient and stable light emitters in the full visible spectral range. In this respect one has to distinguish between fluorescent and phosphorescent materials (see box). A seminal step was the introduction and further development of emitters based on heavy-metal centred metal-organic complexes, as shown in Fig. 1, where strong spin-orbit coupling mixes singlet and triplet states much more than in pure hydrocarbons, so that phosphorescence becomes an allowed transition [5].

> **“A strong benefit of OLEDs is that the light is distributed homogeneously over a large area”**

In the meantime, impressive efficiency data have been published for OLEDs based on these materials [6], however, the bottleneck is still the limited availability and stability of deep-blue phosphorescent emitters.

## Optical losses and light outcoupling

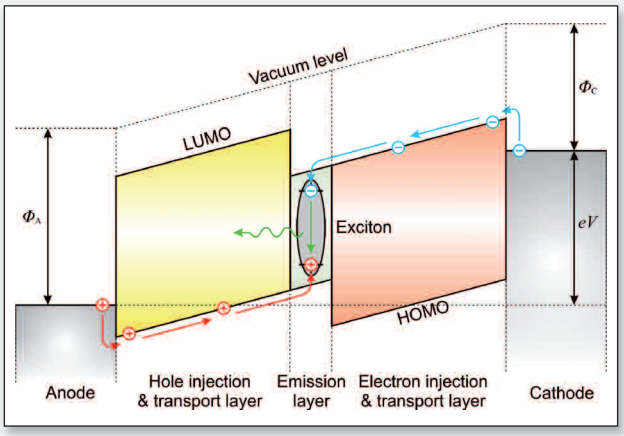
With the above said, the internal quantum efficiency of OLEDs can be brought up towards the theoretical limit of 100%, if charge carrier injection and recombination are well balanced, if phosphorescent emitters are used and if non-radiative exciton quenching processes are suppressed (see also box). Nevertheless, only a fraction of the light will in the end be able to leave the device to the outside world. The reason is that light is generated in a region of the OLED stack with higher refractive index than the glass substrate and, obviously, ambient air. Thus, an excited molecule can couple to different optical modes in such a thin film structure (see Fig. 2). Viewed from the emitter position the light-escape cone has an opening angle of some 30° with respect to the surface normal and the energy it contains is typically less than 20% of the total energy. This is followed by the

### BOX 1: Working principle of OLEDs and their efficiency

The external quantum efficiency $\eta_{EQE}$ of an OLED, *i.e.*, the number of emitted photons per injected carrier pair, is given as the product of four different factors, each standing for a specific physical process in the device [14]:

$$\eta_{EQE} = \gamma \cdot \eta_{S/T} \cdot q_{eff} \cdot \eta_{out}$$

Therein γ is the charge-carrier balance factor, describing whether or not equal amounts of electrons and holes are injected and what fraction of them recombines to form an exciton, as indicated in Fig. The second factor $\eta_{S/T}$ gives the fraction of excitons that is allowed to decay radiatively by spin statistics. As both, electrons and holes, carry spin ½ there are three possibilities to form a triplet exciton with total spin S=1 and just one for the formation of a singlet exciton with S=0. For fluorescent emitters only singlets are allowed to decay radiatively making this factor 0.25 in this case, while for phosphorescent emitters, where singlets as well as triplets can emit light, it is 1. The third factor $q_{eff}$ indicates how many of the spin-allowed excitons actually do decay by emitting a photon (instead of dissipating the excitation energy non-radiatively to their environment). Finally, the last factor $\eta_{out}$ determines which fraction of the generated photons are in the end able to leave the device to the outside world. Hence the external quantum efficiency can be split into an internal quantum efficiency ($\eta_{IQE}$) times the outcoupling factor ($\eta_{out}$).




To quantify the amount of light reaching the observer, one has to consider the sensitivity of the human eye. The luminous flux $\Phi_L$ (measured in Lumen (lm)) is obtained by multiplying the spectral flux of radiation $\Phi_R$ (measured in watt per nanometre (W/nm)) with the response curve of the eye ($V(\lambda)$) and integrating over the visible spectral range (see Fig.):

$$\Phi_L = K_m \cdot \int_{380nm}^{780nm} V(\lambda) \cdot \Phi_R(\lambda)\, d\lambda$$

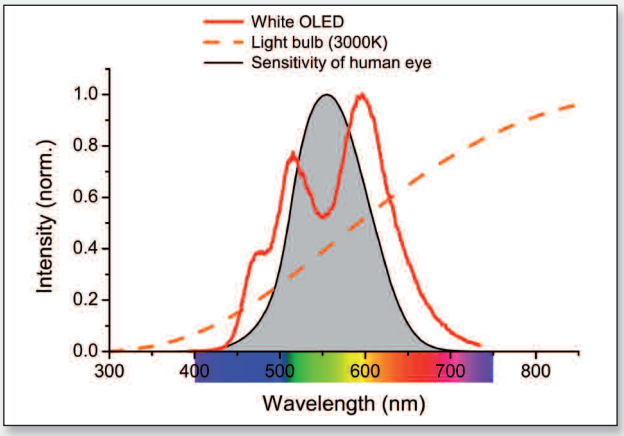
The photonic constant $K_m$ = 683 lm/W determines the maximum luminous efficacy obtained for a monochromatic green emitter at a wavelength of 555 nm.

Given the electrical drive conditions (voltage *V* and current *I*) and the luminous flux $\Phi_L$ it is possible to calculate the luminous efficacy $\eta_L$ according to:

$$\eta_L = \frac{\Phi_L}{V \cdot I}$$

◀ Schematic energy level diagram showing the injection of electrons and holes from two electrodes with suitable work function ($\Phi_{A/C}$) under an applied bias voltage (*V*). Charge carriers are transported either in the highest occupied molecular orbital (HOMO) of the hole transport layer or in the lowest unoccupied molecular orbital (LUMO) of the electron transport layer, respectively, before they recombine in the emission layer.

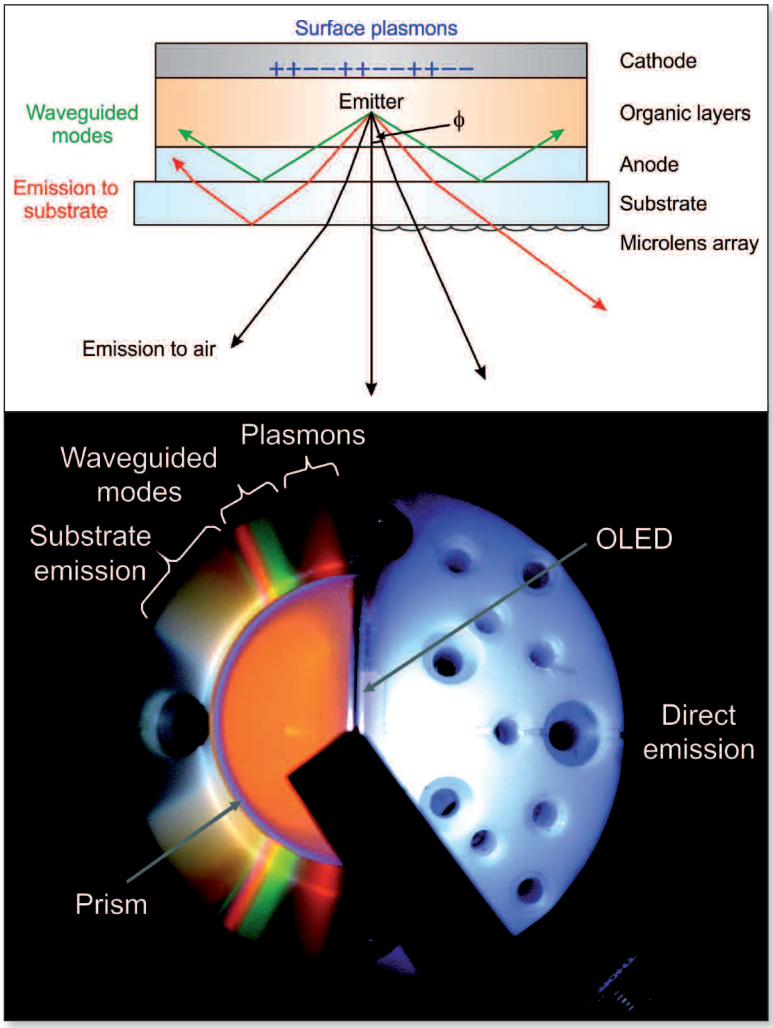
▼ Emission spectrum of a white OLED together with the sensitivity curve of the human eye and the spectrum of a light bulb at a radiation temperature of 3000 K.



contribution of substrate modes, where total internal reflection at the glass-air interface is the limiting process. This contribution is comparable in energy also at around 20%. For higher emission angles the light can not even reach the glass substrate, but is wave-guided in the organic layers (including the transparent indium-tin oxide electrode) and in the end lost by residual absorption or edge emission. Finally, the emitter can couple to the evanescent field of surface plasmon polaritons travelling at the interface between the metal electrode and the organic layers. Quantitative calculations, treating the emitting molecules as classical electrical dipoles (*cf. the sketch on the title page of this article*), reveal that in planar OLED stacks typically around 50% of the light is trapped in waveguided and plasmon modes [7]. As an example, Fig. 3 shows how the contribution of different optical channels varies as a function of the distance of the emission layer to the cathode, due to interference effects and coupling to trapped modes. It is therefore not surprising that developing new concepts for improving light extraction efficiency has been a major issue over recent years (for an overview see, *e.g.* Ref. [8]).

## Improving efficiency

In the following some of these approaches will be highlighted. The extraction of light trapped in the glass substrate is quite straightforward. This fraction can be made accessible by modifications of the backside of the substrate, *e.g.*, by micro-lens arrays or scattering foils, which are commercially available. Nevertheless, if the unique form factor of OLEDs (large-area, thin and flat) is to be preserved, these devices typically extract only part of the trapped light. Next, the propagation of waveguide modes can be suppressed by scattering at photonic crystal structures or by random scattering structures. The effectiveness of this approach relies on the spatial overlap of the waveguide modes with such features; in other words, they have to be employed close to the emission zone of the OLED [9]. Another approach relies on matching the refractive index of the organic materials, where the light is generated, with the substrate supporting the OLED layer stack [10]. Though impressive efficiency values larger than 40% have been reported using high-index glass substrates, the overall cost of the OLEDs would increase considerably by this approach. Finally, there is the contribution of surface plasmon losses. Owing to their evanescent nature, the simplest way to avoid them is to increase the distance between the emitter and the metal electrode. This means, however, that one has to increase the overall organic layer thickness, which in turn implies that more energy is coupled into waveguided modes. Scattering approaches, as discussed above in the context of waveguided modes, are also applicable to surface plasmons




▲ **FIG. 2:** (a) Different optical modes to which an excited emitter molecule can dissipate its energy (see text for further details). Note that in a real OLED the substrate is much thicker than all the other layers. In (b) a high index prism is used in order to extract trapped light in a white OLED. The OLED is mounted vertically on a teflon table with the prism attached to its semitransparent metal cathode. On the right hand side one can see the ordinary white light emission through the glass substrate, while on the left hand side different contributions are distinguishable under different viewing angles.

provided that the mode has sufficient overlap with the scatterers [11,12]. Another way to avoid the excitation of surface plasmons, even if the emitter is rather close to the metal, is to control the orientation of the emitting molecules and thus of their transition dipole moments (*cf. the sketch on the title page*). Keeping the radiation pattern of a classical electrical dipole in mind and considering that surface plasmons are transverse magnetic modes, one readily concludes that perfectly horizontally oriented dipoles would only very weakly couple to these plasmons. This effect has been known for many years in polymeric OLEDs. Only very recently, however, we have been able to show that

> **“Impressive numbers are obtained with white OLEDs reaching more than 60 lm/W”**

orientation effects also play a role in small molecule OLEDs fabricated by vacuum deposition, where the fluorescent or phosphorescent dyes are embedded with only a few percent content in a matrix material [13].

## Conclusion

By now, commercially available white OLEDs are specified with luminous efficacies of about 25 lm/W [2], *i.e.*, they are no more efficient than the best halogen lamps. However, several laboratories have reported values exceeding 60 lm/W for devices with good colour compliance being currently under development. Of course there is room for improvement regarding the impressive numbers obtained with inorganic LEDs reaching more than 100 lm/W. But as already mentioned such a comparison is of limited relevance. A strong benefit of OLEDs is their unique form factor, with the light being distributed homogeneously over large area and thus being glare-free. Hence, (almost) no additional fixtures are needed: the OLED already is the luminaire! ■

## Acknowledgment

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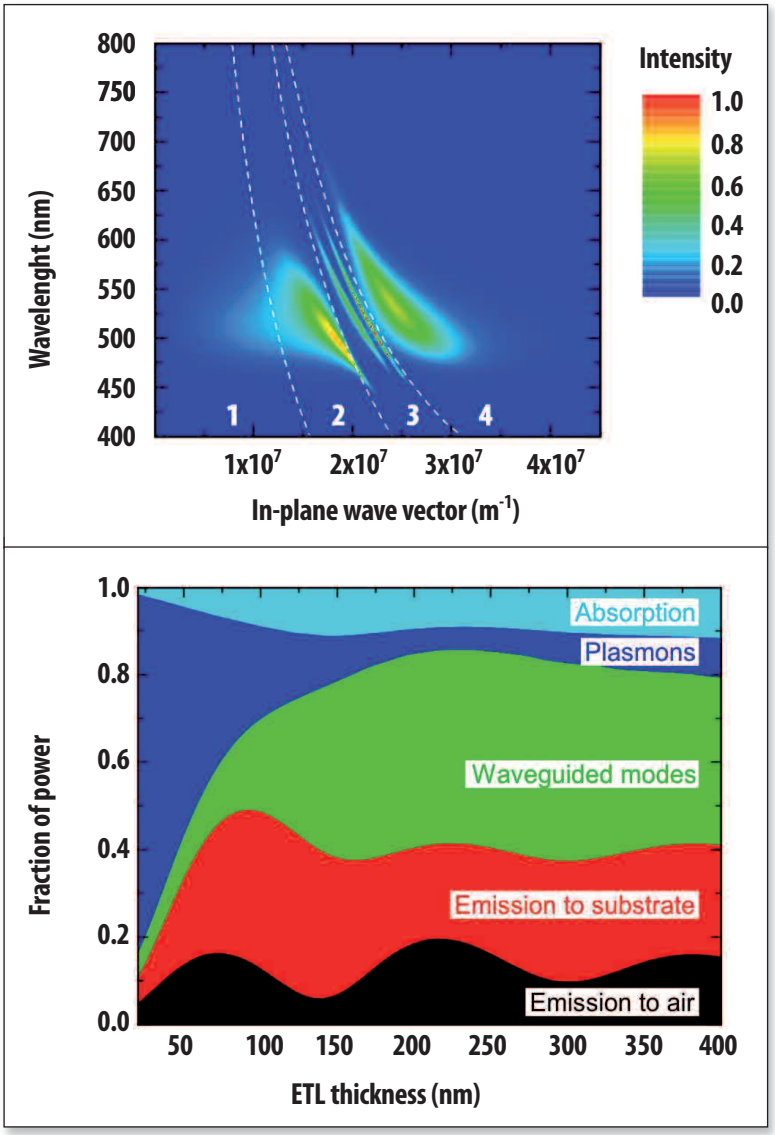
▼ **FIG. 3:** (a) The amount of energy dissipated into different optical channels as a function of wavelength and wave-vector for a prototypical green OLED. Region (1) is direct emission, (2) stands for emission to the glass substrate, (3) represents waveguided modes and (4) surface plasmons. In (b) the relative contribution of different modes is plotted vs. the distance of the emission zone to the top electrode. (For details of the simulations we refer to Ref. [7].)

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■ The Editors and the Cartoonist - DOI: 10.1051/epn/2011403

# The Plenary Speaker

A high-level conference can only be a High-Level Conference if it is able to ensure the attendance of some stars from the field, who will serve as strong magnets to attract a big crowd of attendees, and thus make the event a success.

*Plenary Speakers* are very well known for their brilliant accomplishments, be it sometimes long ago. They know how to give a fascinating show without too much preparation, helped by their collaborators who love to bring them their latest results provided that they are cited during the talk. The *Plenary Speaker* can be either formally dressed (European style, to underscore the fact that he *really* is an magnificent choice) or very casually (US style, to show that he knows how to connect with the young).

Before the readers start shouting at us for being male chauvinists by writing *he* when referring to the Plenary speaker, and not *he/she* (or, even better: *she/he*), let us be clear: It is unfair and unfortunate, but almost always the Plenary Speaker is a he. It's even worse. Plenary Speakers form a small panel of men rushing between conferences that have been wisely chosen by their wives for their nice beaches or good shopping.

During the talk, it is the charm, the style, the changing rhythm and the jokes which make the talk a smashing success, more so than the slides. Except for fascinating video shots: STM images of atoms dancing a tango along a perfect crystal surface, for example. And should the talk be incomprehensible: no problem. Undoubtedly, there will be another chance to hear the same talk once again at some other conference.

*Plenary Speakers* are busy. In fact, they are so busy that they usually can't attend the whole conference. It is difficult for ordinary scientists to find an opportunity to exchange even a single idea with them. Joined by their wife, they arrive the day before the talk, around lunchtime if the place is worth visiting. Otherwise even later, but making sure not to miss the excellent dinner offered by the Conference Chairperson. It is out of the question to pay for hotel or meals. Of course, they talk for free, but it happens that the conference treasurer may reimburse the plane ticket in cash. After all, the registration fees may be used as a perfect cash machine, but who cares? The simple, well-publicized fame and presence of the *Plenary Speaker* has brought more attendees, and therefore much more cash than the ticket costs. It is so easy to make everybody happy! ■

**Editor's note**

Our favourite author of "Physics in daily life", Jo Hermans, also Science Editor of EPN, is taking some rest and will save his contributions for the time being. "Europhysics News" wishes to continue to bring smile to readers' faces so the Editors will attempt to fill the section with a series of short texts, serious or not. Let us start here with a "portrait", illustrated by our regular cartoonist, Wiebke Drenckhan. Nobody will ever recognize himself or herself here, of course!
Our readers are most welcome to submit contributions, knowing that we keep our absolute power of (arbitrary) decision about their publication and illustration.

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# ECHOPHYSICS

## The first European Centre for the History of Physics in Poellau (Austria)

Hartmut Kahlert [1], Heinz Krenn [2] and Lily Wilmes [3] - DOI: 10.1051/epn/2011404

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**In 2010, the Austrian scientific community celebrated the foundation of the Vienna Institute of Radium Research in 1910, then affiliated with the former Imperial and Royal Academy of Sciences of the Austro-Hungarian Monarchy. In 2012, another centennial event will take place: the 100th anniversary of the discovery of cosmic rays by the Austrian physicist Victor F. HESS, who was awarded the Nobel Prize for Physics in 1936.**

ECHOPHYSICS combines the complete heritage exhibits of both these commemorative events. It was the author and physicist Peter Maria SCHUSTER*, who, besides his concern for the rescue and conservation of historically valuable experimental physics equipment, foresaw the two upcoming centennials of world-wide scientific interest, founded the Victor F. Hess Society in 2007, and established the first European Centre for the History of Physics in 2008. Both institutions are hosted in a former Augustinian Canonry of Stift Poellau in Styria, Austria.

▲ The Poellau Centre

### The ECHOPHYSICS initiative

To facilitate the public access to the records about the early research on radioactivity, on the earth-bound nuclear and on the cosmic radiation, and to the first complete heritage of Victor Francis Hess, has needed first to rescue and gather the original instruments, specimens and paraphernalia he used with other physicists. Furthermore, it was desirable to present the documentation in an appealing, spacious and secure location. The creation of the first permanent and bilingual exhibition "Radiation and Mankind" (*Strahlung, der ausgesetzte Mensch*) followed, the Grand Opening of which taking place in May 2010 at the first European Centre for the History of Physics (ECHOPHYSICS) and the related Victor F. Hess Research and Heritage Centre at Poellau Castle in Styria, Austria. This site between Vienna and Graz is within a one-hour drive from

**Note**

* Dr. Peter Maria SCHUSTER is the initiator and director of ECHOPHYSICS and the president of the Victor Francis Hess Society; Dr. SCHUSTER is Chair of the EPS/History of Physics Group; pm.schuster@echophysics.org

both cities. The material on display comes mostly from Austrian universities (Vienna, Innsbruck and TU Graz) and the Austrian Academy of Sciences. Some comes from private collectors, but also from interested companies like Carl ZEISS. Without the unremitting engagement of a quite large team of physicists, most of whom are emeritus professors, from Austria and abroad, who set up the documentation and sorted and took care of the instruments to be shown, the task to set up ECHOPHYSICS and the exhibition could not have come true.

## The objective of ECHOPHYSICS

In a novel approach, ECHOPHYSICS aims at intensifying the awareness of the scientific history of physics: the exhibition "Radiation and Mankind" is accompanied by meetings of physicists and historians of physics interested in the emergence of discovery. In 2010, ECHOPHYSICS and the Victor F. Hess Society hosted two international conferences in Poellau: "The Roots of Physics in Europe" (May 28 – 30) and the "Georg von Peuerbach Symposion" (October 8 – 9): "Models of the Real World–from the Late Middle Ages until the Age of Enlightenment".

These are examples of activities planned to accomplish the organizers ambition to raise the awareness for the pioneering discoveries in Late Habsburg Austria particularly in the field of radiation physics. The instrumentation and related pieces of evidence had long been hidden and, as a long term goal, their importance as crucial contributions to the emergence of Modern Physics in Europe needs to be shown.

## Touring "Radiation and Mankind", the first exhibition at ECHOPHYSICS

More than 80 illustrated bilingual text panels, a rich collection of original documents and a mesmerizing set of nearly 600 valuable historical instruments accompany the visitor along the path through a sequence of nine exposition halls or sections, each being put in a vivid colour from the visible spectrum thus escorting the spectator through the conceptual evolution of physics general notion of radiation. The exhibition "Radiation and Mankind" reopens in Poellau Castle on the 7th of May, 2011.

▲ Viktor F. Hess desk

**More than 80 illustrated bilingual text panels, a rich collection of original documents and a mesmerizing set of nearly 600 valuable historical instruments**

The large entrance hall displays the over-life-sized portraits of the famous Austrian physicists, who are related to radiation physics: Christian Doppler, Joseph Loschmidt, Josef Stefan and Ludwig Boltzmann. Besides, the explaining panels and showcases inform about their biography and scientific career, including most valuable historical documents. A caloric motor designed and patented by Loschmidt in 1868 and the original instruments used by Stefan to prove his $T^4$ law for the radiation of heat are on exhibit.

From light and sound propagation (Doppler) to the bricks and building schemes of matter (Loschmidt), from radiation of heat (Stefan) through energy conversion (Boltzmann) and ionisation plus static electricity, the way to radioactivity is well documented.

A photomontage of the entrance portal to the Vienna *Institut für Radiumforschung* invites the visitor to view the rich historical heritage – provided by the Vienna University – of this famous 'Radium Institute' as it was commonly named, which had been established with the financial aid of Carl Kupelwieser in 1910, before the *Institut Curie* in Paris. The 'Radium Institute' benefited from the rich uranium ores mined from deposits at Joachimsthal (today Jáchimov in the Czech Republic), which made it, besides Paris, Berlin and Manchester, an early and internationally renowned centre for the radium research.

Some luminescent uranium-rich minerals can be seen at this section of the exhibition as well as the greatest part of the original instruments of the 'Radium Institute'. The original office desks and chairs of both Stefan Meyer and Victor F. Hess, can be admired. This section also includes detailed information on the exploration and discovery of the ionising particles in the atmosphere – a phenomenon named cosmic radiation by its discoverer Victor F. Hess.

The difficult access of the lay public to the section on mechanical waves and shock-waves is being smoothened by a hands-on facility in the upcoming 2011 season, where also a state-of-the-art information on research on, and applications of, shock-waves, with a related early experimental set-up according to Ernst Mach, is shown.

The panels and exhibits of the next hall describe the historical evolution of the two distinct phenomena: electricity and magnetism and how the exploration of these twin effects had led to the unified theory of electromagnetism. The shelves of a multitude of huge glass boards bear the rich collection of the various relevant historical apparatus – including an attractive replication of Guglielmo Marconi's wireless transmission of radio-waves using a spark-discharge and a 'fritter' as receiver.

From electromagnetism to light radiation, eye-catching crystals explain the physics behind the visible colours and the refraction, diffraction and fluorescence effects.

Viewing the minerals under UV exposure or by a microscope gives repeatedly rise to ravishing exclamations by the spectators. 'Handling' light radiation and its effects requests the application of optics to produce a variety of optical components and to assemble these into measuring equipment: the largest hall with its baroque stucco and fresco decorated ceiling is dedicated to this subject and shows the entire range of historical optical instruments.

Emphasis is also given to medical application in ophthalmology and gynaecology.

Taking up again the Doppler Principle from the very beginning of the exhibition tour leads to the next hall, which is devoted to exploring the space beyond the earth's atmosphere and to understanding our cosmos. Panel texts and impressive illustrations explain satellite laser ranging, satellite telescoping with the CoRot spacecraft aiming at the study of star-quakes and at the search for exo-planets. One learns also about the cosmic rays and the implications of cosmic microwave background radiation–opening our eyes for the evolution of the universe from the Big Bang on.

The explanations and illustrations about the currently largest accelerator system LHC at CERN with the purpose of studying the basic constituents and the structure of matter might remind the attentive visitor of how Loschmidt had dealt with a similar question although at an almost tangible earth-bound level. Furthermore, the *Atominstitut*, the 'Vienna Institute of Atomic and Subatomic Physics', founded in 1958 is presented with its early realization of a neutron interferometer, which showed first the wave nature of neutrons in 1974.

The non-specialist may be happy to find a concluding dual panel on the risks of X-ray and nuclear radiation and on the risks of microwaves, radio waves, radar and infrared to soothe his tantalizing questions about the risks of the gigahertz radiation from his mobile phone.

## The Victor F. Hess Research and Heritage Centre

The 'Victor F. Hess Research and Heritage Centre', associated to ECHOPHYSICS, shows the inheritance, both of the physicist and of the private person Hess. This collection makes an invaluable part of "Radiation and Mankind". All the exhibits devoted to Victor F. Hess have thematically been integrated into the main topic of 'Radiation'. They include on the one hand – lent by the Vienna University – the scientific instruments and the original furniture from his stay at the Vienna *Institut für Radiumforschung*, where Hess had worked out the data from his decisive balloon ride in 1912, and, on the other hand, his entire private heritage (medals and certificates of awards, photos, notes, letters, including also the original Nobel Prize Certificate) generously let by Victor's step-grandsons Arthur and William Breisky at the Poellau based 'Victor F. Hess Society' since May 2010. Moreover, an original hot-air balloon from the Vienna Arsenal illustrates how the courageous young Victor F. Hess rode up to 5.350 metres and discovered that the ionising or cosmic radiation is of extraterrestrial origin. A last panel displays a warm though posthumous welcome back home to Austria for Victor F. Hess, who, dispensed of his professorship at Graz University by the Nazi regime in 1938, had lived in exile in the USA during World War II and continued working at Fordham University, NY, since then.


▲ Viktor Franz Hess Nobel Prize

"Radiation and Mankind" reveals the links between the pioneering discoveries in the field and the modern research on hard cosmic rays (beyond $10^{15}$ eV). Thus a viewing of the Namibia experiment, called "H.E.S.S."–High Energy Stereoscopic System– informs the visitor that, in the present day gamma-astronomy, the registered H.E.S.S. signals are understood as a fingerprint of the hard primary cosmic rays.

In 2012, the centennial of the discovery of cosmic rays by Victor F. Hess will be celebrated throughout the world. An international conference for and by physicists that centres on the related historical research will be held at the European Centre for the History of Physics ECHOPHYSICS in Poellau. This Poellau ECHOPHYSICS conference is only one of a series of international specialists conferences on this topic that will be held in Vienna and Innsbruck, in Denver, Moscow and in Bad Saarow/Pieskow near Berlin. It is planned to take place in May/June 2012, after the starting conferences in Vienna and Innsbruck. ■

▼ Hess Nobel Prize on the Balloon nacelle used for cosmic ray detection

# KOREA INSTITUTE FOR ADVANCED STUDY (KIAS)

## Research Fellow and Visiting Scholar Positions in Theoretical Physics

The School of Physics at Korea Institute for Advanced Study (KIAS) invites applicants for the positions at the level of postdoctoral research fellows and visiting scholars in theoretical physics.

**Applicants for the research fellow position in** theoretical physics are expected to have demonstrated exceptional research potential in the fields of astrophysics & cosmology, particle physics & phenomenology, quantum field theory & string theory, or statistical physics & condensed matter theory.

The starting date of the appointment is negotiable, and can be as early as March 2012.
The initial appointment will be for two years with a possibility of renewal for up to two more years, depending on the research performance of an individual and also on the needs of the program at KIAS. The annual salary ranges from approximately US$ 34,000 ~ US$ 64,000 (equivalent to 37,000,000 ~ 70,000,000 in Korean won). In addition, research fund in the amount of approximately US$ 9,000 ~ US$ 14,000 (equivalent to 10,000,000 ~ 15,000,000 in Korean won) is provided each year.

Those interested are encouraged to contact a faculty member in their research areas at http://www.kias.re.kr/sub02/sub02_03_02_03.jsp. Also, for more information please visit http://www.kias.re.kr/sub03/sub03_02_07.jsp.
Applicants should send a cover letter specifying the research area, a curriculum vita with a list of publications, and a summary of research plan, and arrange three recommendation letters to be sent to:

School of Physics:
Mr. Jaeyoung Jun (phys@kias.re.kr)
KIAS, 207-43 Cheongnyangni-dong
Dongdaemun-gu, Seoul, 130-722, Korea

Email applications are strongly encouraged. We accept applications all year round but applications for the 2011 research fellow positions should be submitted by Dec 1, 2011 for full consideration.
The application deadline for astrophysics & observational cosmology is Dec 31, 2011.

**The visiting scholar program** is mainly for established scientists for short-term or long-term visits including sabbatical leaves. The successful candidates are expected to collaborate with research groups at KIAS. Collaborations with other visiting scholars or researchers in other institutions in Korea are also encouraged. Those interested should contact via e-mail one of the faculty members in the related field as a potential host. The appointment requires a curriculum vita with a list of publications and a summary of research plan.

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