

Kattowice, Sept 1997

Herwig Schopper was present at the 23rd Conference of the Polish Physical Society, and gave the opening lecture. The following is a shorter version

The Future of Physics and the role of the European Physical Society

Sometimes the opinion is expressed that the ending century was the high time of physics whereas the coming century will be that of biology. Certainly biotechnology will play an increasing part but physics will remain to be essential for the future of society.

Physics is a fascinating part of human culture. Why do we find order in nature? What is the position of man in the cosmos? What is matter and how can we understand the origin and development of the universe? The answers to these and many other questions provided by modern physics have shaped our conception of the world (*Weltbild*). But physics of today is also the technology of tomorrow. Our

present standard of living is due to the technological revolution based on basic physics. To maintain our standard of living and to improve it in developing countries, physics will still be needed in the next century, *eg* for energy production, distribution and saving; environmental problems; informatics, networks, computing; physics in medical diagnostic and therapy.

The frontiers of physics progress in three directions: into the microcosms (atomic physics, nuclear physics, elementary particle physics); into the macrocosms (astronomy, astrophysics, cosmology); and the understanding of complexity (condensed matter physics, deterministic chaos, fluids, *etc*).

Physics is an intellectual adventure which shapes our way of thinking by exploring the unknown. Has the end of physics come? This has been predicted several times already in the past and is certainly not true today. Many open fundamental questions remain to be answered and completely unknown territory is in front of us. As in the past, new fundamental discoveries will lead to qualitative jumps in technology. Hence it remains an important task of society to

support physics, or more generally in spite of other pressing problems like unemployment, state debts or hunger in underdeveloped countries. Only if this is done can our competitiveness and even survival be guaranteed in the long term.

EPS has carried out in the past a great number of important tasks, *eg* publications (*Europhysics News*, *Europhysics Letters*, *European Journal of Physics*), organization of conferences and workshops, management of the mobility scheme for students, cooperation between East and West, activities in education, *etc*. These activities are being taken care of by the Divisions, Interdivisional Groups and Action Committees and Task Forces. To demonstrate its vitality EPS is adapting to new political and economic conditions by introducing a Strategy Plan which was approved by the EPS Council in spring 1996. It is the hope that by this plan ongoing activities will be intensified and new activities can be started. In this way the relevance of EPS to its Member Societies, spanning the geographical region from the Atlantic to the Ural and representing about 70,000 physicists, will be increased. The four main topics with high priority in the Strategy Plan are the following.

from previous page Koenig made use of both devices in different forms of his magnificent 'manometric resonator'. In these, instead of being held to the ear, one end of each resonator was connected to a 'manometric capsule', a hollow chamber containing a central membrane. The sound to be analysed – which could, for example, be from a tuning fork, a human voice or a musical instrument – was produced near the other end of the banks of resonators in the analyser, and these would amplify their corresponding frequencies, producing oscillating air on one side of the membranes in the capsules. The other side of the capsules led to burning gas flames, and the vibrations caused the flames to dance. These dancing flames were observed by means of a revolving four-sided rectangular mirror. If the flame was quiescent a horizontal trace was seen. But when the flames responded to the sound vibrations a sinusoidal trace was seen (due partly to the phenomenon of retention of vision).

In Koenig's 1889 catalogue, his 'Analyser du timbre des sons à flammes manométriques' was available in two forms, the larger (costing 650 French

francs) had fourteen 'universal' (adjustable) Helmholtz resonators, and the smaller (similar to *fig 1*, at 325 francs) had eight resonators of fixed frequency from 128 cycles per second to 1024 cps. (Middle C on the piano is 256 cps, 128 cps is an octave below, and 1024 cps is two octaves above.)

Koenig (1832-1901), son of a mathematics professor, was born in Koenigsberg (Prussia), but moved to Paris in 1851. There he was an apprentice in the workshop of the famous violin maker Jean Baptiste Villaume (1798-1875). He left in 1858 and set up his own business to manufacture acoustic instruments. According to scientific instrument historian Paolo Brenni: "The name of Koenig is synonymous with the heyday of nineteenth century physical acoustics. His instruments were among the most beautiful, efficient and accurate of his time."

Koenig never married, and he worked and carried out all his business in the apartment house where he lived on the Quay d'Anjou, not far from Notre Dame. He made a surprising number of sophisticated instruments in this small workshop, and many have survived in collections

throughout Europe and elsewhere – for example in the Science Museum in Ghent, the Physics Department in Porto, University College Dublin, the Istituto Tecnico Toscano in Florence, and the University of Naples.

Source Rudolph Koenig, *Catalogue des Appareils D'Acoustique Construits par Rudolph Koenig, Docteur en Philosophie, Paris, 27 Quay d'Anjou, 1889*, pp. 100 – the manometric resonators are illustrated on pages 86 and 87

Further Reading

Paolo Brenni, 'The triumph of experimental acoustics: Albert Marloye (1795–1874) and Rudolph Koenig (1832–1901)', *Bulletin of the Scientific Instrument Society*, No. 44, March 1995, pp. 13–17
Gerard L'E. Turner, *Nineteenth Century Scientific Instruments*, Sotheby Publications, London, 1983, p. 141

This is the first part of a new series called Instrumental Background – the Europhysics News display shelf, a guide to odd pieces of apparatus that are relics of the progress of experimental science but don't belong on a bottom shelf

1. Issues of professional physics with topics such as: relations between academia and industry, promotion of multidisciplinary activities (bio- and medical physics), relations between physicists working at large facilities and in small science, training of teachers and teaching of physics, improving ties with other scientific societies, register of 'qualified physicists'.

2. Care for the next generation of physicists: providing statistics of employment conditions and the job market, support for participation in international conferences and workshops, meetings with industrialists, guidance for applying for jobs, activate the role of young physicists in EPS affairs.

3. East-West cooperation: The time when global help was needed has passed and individual needs have to be determined. For this purpose a new task force has been established.

4. Public awareness and information dissemination. Some measures which should make politicians and the public aware of the importance of physics and physicists, even when employed outside the physics domain are: strengthening the relations with media, studies of specific problems of

general interest involving physics (eg environmental issues, radioactive waste, electro-smog), active interaction with EU authorities in Brussels, issues of electronic communication and publishing.

In order to provide the necessary financial and personal resources to put this Strategy Plan into action some radical measures had to be taken. The most important is the move of the EPS Secretariat from Geneva to Mulhouse in France which took place on 1 January 1997 and which involved some personal sacrifices and difficulties. This move has provided, however, essential savings which can be used to fund some of the activities. The EPS Council has also decided to change the currency of the unit fee from Swiss Francs to the ECU since this represents an average over some major European currencies and is less subject to fluctuations. Of course, a transition period will be necessary before all these changes will be implemented and before the new system can function in a prefect way.

The meeting was attended by about 700 physicists, most of them of course from Poland, writes *Herwig Schopper*. The talks

were given in Polish, except for 5 invited talks: Introductory lecture: The future of physics and the role of the European Physical Society, by Herwig Schopper; 4 Lectures by Nobel Laureates: H. Kroto, Buckminsterfullerene; R. Mössbauer, The solar neutrino problem; H. Hauptmann, A probabilistic approach to the phase problem of X-ray crystallography, J. Bednorz, Novel Two-dimensional Perovskites.

The presence of the Nobel Laureates was of course used widely for PR activities. My presence as representative of EPS was also appreciated.

In the discussion among different physical societies, two main requests were addressed to EPS:

- In most East European countries the governments do not give sufficient support to science. Hence EPS is asked to help to convince the politicians to do more in this respect. Visits to the capitals are one possibility.
- EPS is asked to find ways of how to allow physicists from Eastern countries to spend longer periods in laboratories in the West. Invitations should be initiated. This is considered to be necessary in addition to the TMR programmes of the EU.

Taipei, August 1997

Herwig Schopper attended a Symposium in Memory of C.S.Wu: 40 Years of Experimental Work since Parity Violation

On 16 February this year Chien-Shiung Wu – or Madame Wu as her colleagues called her – passed away at the age of 84. She was one of the great scientists of this century and her name will always be related to the experimental proof of parity violation implying that the laws of nature should be invariant under mirror reflection.

The Institute of Physics of the Academia Sinica in Taiwan organised in honour of her a Symposium sponsored by the Academy, the National Central University and the C.S.Wu Foundation.

Besides recalling the great achievements of C.S.Wu this event provided also a good occasion to review the enormous progress in nuclear and particle physics since the discovery of parity violation exactly 40 years ago. I started by summarising the Wu experiment and the other

work that definitely proved the maximal violation of mirror reflection and particle-antiparticle exchange, two of the fundamental symmetry principles thought to be 'a priori' valid. He stressed that although physicists have become accustomed to these violations, no real understanding exists so far. The discovery of the heavy quarks and the bosons (gluons, W and Z particles) which are the carrier of forces were further subjects of review. The importance of accelerator and detector development where mentioned as being essential elements for the progress of particle physics. The precise confirmation of the Standard Model was illustrated by describing some of the results from the largest existing storage ring, the 27 km circumference LEP, at CERN. He concluded with some remarks on a possible relation between parity violation and the origin of life revealed by the handedness of amino acids and sugars in living organisms.

Cecilia Jarlskog explained the significance of the small violation of the combined PC operation. Y.H.Chu reviewed the strong relations between particle- and astrophysics covering the topics from the Great Annihilator to White Dwarfs. Whereas the previous talks concerned mainly the past and present Felicitas

Pauss gave a report about future activities concentrating on the possible discovery of the Higgs-particle. She presented the planned experimental programme at the Large Hadron Collider LHC at CERN. Finally L.L.Chau concluded the meeting with general remarks about the violation of discrete symmetries, but above all she revoked reminiscences by a video film showing C.S.Wu during one of the last conferences she attended.

Luke Yuan, the husband of C.S.Wu thanked at the end to all who had come to render homage to one of the outstanding woman scientist. She was not only respected in Taiwan where she has participated in science policy advice until her passing away, but equally in mainland China. At Nanjing, in whose vicinity she was born, an International Conference has taken place in her honour from 16 to 18 August 1997.

The visit to Taiwan on this occasion gave me the possibility to compare the development since my first visit about 15 years ago. The progress and change is impressive. At that time only a handful of physicists existed. By providing a good infrastructure many Chinese physicists from foreign countries could be encouraged to

come back and now there is a respectable community of physicists. Because of the existing political tensions I was surprised to meet at the Institute of Physics colleagues from mainland China co-operating in nuclear and particle physics experiments. The future role of science is perceived with great optimism. In discussions

with the President of the Academia Sinica we learned that yearly budget increases for science of about 10% are foreseen and Taiwan is approaching expenditure for science of 2.5 % of the GNP, comparable to other developed nations.

The daily life is running quite smoothly and corresponds, including prices, to that

in industrialised countries. For foreigners staying less than two weeks there are no particular entry formalities. A visit to the National Palace Museum is a must, since an incredible collection of old Chinese art is displayed there, objects brought along from mainland China when Chiang Kai Check moved to Taiwan.

Lindau, June 1997

Simon Newman

Students meet Nobel Laureates

The annual reunion of Nobel Laureates, the 47th in the series, took place at the end of June in the island town of Lindau on Lake Constance. This year's subject, physics, attracted a record attendance of over 600 students from 30 countries worldwide. Among them for the first time, a group of 10 students from eight universities in Britain and Eire. They were the finalists in competitions organized by Nexus, the student section of the Institute of Physics, London.

Lectures given by 18 Laureates covered a variety of themes such as, Quantum Mechanics (Lamb), Polarons (Muller), Lasers (Schawlow), Fractional Charges (Perl), Neutrinos (Mossbauer), Superfluidity (Osheroff), and stretching from Living Cells (Glauber), via Human Vision (Glaser) to the Universe (Hewish) with such 'extraneous' matter as the Mind (Josephson), Game Theory (Selten),

Population Growth (Bloembergen) and Nuclear Weapons (Steinberger) thrown in.

Apart from listening to lectures the students had, above all, many opportunities for personal encounters and helpful discussions with the 20 or so eminent scientists present who, in turn, were confronted with the problems faced by a new generation preparing for a career in science. Started in 1951 by Laureates in medicine under the patronage of Count Lennart Bernadotte, and later covering also chemistry and physics in turn, the meetings at first had largely German audiences. Since then they have become more broadly

based and for the last ten years have been held under the presidency of his wife, Countess Sonja, with the financial support of science foundations, academic institutions, industry and commerce. The enthusiasm these unique occasions inspire in the students will do much to strengthen their international character and, from now on, more students from Britain may well wish to join in.

Below Countess Sonja Bernadotte with the group of British students at Lindau. On the right, flanked by your reporter, Dr. Sue Jackson, Student Liaison Officer of the Institute of Physics, who organized the competition from which these finalists were selected (A. Jacobs)



Ballerup, June 1997

Hans Fuchs

Technikum Winterthur, Switzerland

First European Conference on Physics Teaching in Engineering Education (PTEE97) From 4 to 6 June, physicists, engineers and educators gathered at the Engineering College of Copenhagen (IKT) in Ballerup, outside of Copenhagen.

The invited talks addressed the question of the importance of physics in engineering education (Chr. F. Rovsing, Member of the European Parliament, Denmark; and R. Van Overstraaten, Belgium), discussed engineering in the training of physicists (J. Young, Sheffield-Hallam University, UK), and introduced the participants to

an exiting new form of teaching large groups of students (the studio approach, by J. Wilson, Rensselaer Polytechnic Institute, Troy, NY, USA).

A couple of kegs of beer – sponsored by a brewery in Liberec and accompanied by 25 participants from Eastern and Central European countries – made it all the way to Copenhagen by bus, reminding us that physics teaching is only one of the activities worth pursuing during a lifetime.

The conference proceedings are available in electronic form at www.PTEE97.cph.ih.dk. You may also contact the chairman of PTEE97, Erik Oehlschlaeger, by e-mail (eoec@cph.ih.dk). The organizing committee decided to have the next PTEE conference in three years, in the year 2000.

Cheb, June 1997

Gunnar Tibell

Chairman of the EPS Forum on Education

The 10th International Young Physicist's Tournament (IYPT) was held in Cheb, Czechia, 2 to 6 June of this year. Starting almost twenty years ago as a purely Soviet Union event, this competition became international in 1989. In Cheb, a small Bohemian town, close to the German boarder, 15 teams from 11 different countries participated in the qualifying rounds on Monday and Tuesday. Out of these, 9 continued to the semifinals on Wednesday and three teams remained for the Thursday final. Each team consisted of up to five pupils from secondary schools, nor-

mally in their last or next to last year. They were accompanied by two team leaders. In addition some 'independent' persons participated in the event, as jury members or as lecturers. I represented the EPS Forum on Education – there were also representatives from the Union of Czech Mathematicians and Physicists and from European universities, with an interest in establishing useful relations between schools and academic researchers.

The competition is based on open problems in physics, distributed to the participating schools already in November of the previous year. The problems cover a large part of all physics subdisciplines. For preparing their solutions the teams can use any means they like: study visits to laboratories, consultation with experts and experimental work of their own. The work done during the few months up to the time of the competition was demonstrated during each round, called a 'physics fight'. It was indeed impressive to see the results of the efforts of these pupils, and hard for the jury to decide the ranking of the teams. In the final there was a draw for first place between the team from Hungary and a Czech team from Prague. The Belarusian team took an honourable third position. In the distribution of prizes and diplomas some EPS awards were given to the members and team leaders of the the two winning teams.

Next year the XIth IYPT will be held in Donaueschingen, Germany, 31 May to 6 June.

Portici, May 1997

Ionel Solomon, Laboratoire P.M.C., Ecole Polytechnique, Palaiseau, France

Annick Suzor-Weiner, Université Paris 6, (Chairman of IGPD-EPS)

Solar Cells: A New Challenge for the Mediterranean Area

Physics of Materials for Solar Energy Conversion
26-30 May 1997

This workshop, initiated by two committees of EPS (the Interdivisional Group of Physics for Development and the Action Committee for Physics and Society) was originally planned as a satellite of the 10th General Conference of the European Physical Society, September 1996, in Seville (Spain), but could not be held for material reasons. It was then postponed for a few months and hosted by ENEA Photovoltaic Research Centre, in Portici (Italy), a beautiful and sunny location near Naples. ENEA (Ente per le Nuove Technologie, l'Energia e l'Ambiente) is the Italian institute dealing with renewable energies.

The attendance was very diversified, with participants from the majority of mediterranean countries, from Southern Europe and North Africa. As implied by the subtitle of the workshop, the emphasis in the programme was given to an exhaustive presentation of the physics of photovoltaic: crystalline, amorphous and polycrystalline thin film devices. As an example of the most recent progress, the use of porous silicon to improve the efficiency was presented and discussed. But it was quite clear during the organisation of the workshop that the problems of management of photovoltaic (PV) systems cannot be separated from the PV 'hardware': all the benefits of high efficiency solar panels can be ruined by bad management. 'Case studies', ranging from fabrication of PV materials to the presentation of full-size photovoltaic achievements, were presented and lively discussed, allowing the participants to share their experience on different practical subjects. One of the highlights of the workshop was the presentation of the Intersudmed project. It is an ambitious programme, involving several

countries around the mediterranean sea, reasonably well financed by the EU Commission, and aimed at providing PV electricity to more than 40,000 households too far from the grid to be connected. Also was organised a visit of the participants to the 3.3 MW

photovoltaic plant, located in SERRE and run by ENEL, the national Italian electrical utility.

This workshop confirmed the existence of specific problems and special solutions for the mediterranean countries, different from that of northern Europe or mainland Africa. This justifies the interest and sponsoring of different organisations or agencies deeply involved in the problems of these countries. Besides EPS, the Italian ENEA provided most of the financial support and could offer grants to the young participants from mediterranean countries. The workshop was also sponsored by the I.C.T.P. of Trieste and by the Network of the Academies of Mediterranean countries. This last association is a working committee of UNESCO-ROSTE in Venice, with the participation of more than 20 Academies of different countries.

The feeling of the participants, as well as that of the organisers, was that solar energy is certainly a very significant topic for mediterranean countries. Most importantly, such small size meetings provide excellent opportunities for young researchers from less advanced countries to meet representatives of the best and most active teams in Europe and to find post-doctoral positions which often initiate fruitful long-term collaborations.

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Kolobrzeg, May 1997

Baltá-Calleja, Ezquerra, Roslaniec

Structure-Physical Properties Relationships of Block Copolymers and Polymer Blends
The Europhysics Conference on Macromolecular Physics on the topic that heads this report was held from 5 to 8 May in Kolobrzeg, Poland. The conference, organized by Z. Roslaniec from the Technical University of Szczecin, Poland, focused on the newest results on the relation between structure and proper ties of block copolymers and blends. The location of the conference in a seaside resort located on the Baltic Sea shore was very appropriate to encourage the exchange of ideas and results among colleagues from laboratories of all different parts of Europe. During these days, we heard about the development and applications of a

Nächster Einsendeschluß für Anträge auf Magnetzeit (Zuteilung Februar 1998 bis Juli 1998) am

Grenobler Hochfeld Magnetlabor

ist der 21. November 1997.

Wissenschaftler aus EG- und angeschlossenen Ländern (Island, Israel, Liechtenstein, Norwegen) können ihre Anträge im Rahmen des „Access to research under high magnetic field“ Programms stellen. Antragsformulare sind auf Anfrage erhältlich.

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new class of materials, the so-called gradient polymers and copolymers (M. Kryszewski, Lodz, Poland). Special emphasis was given to the recent advances of the large family of thermoplastic elastomers (K. Dijkstra, DSM, Geleen, Netherlands) and in the future perspectives of these materials (V. Duchacek, Prague, Czechia). The importance of morphology in the understanding of the phase structure was brought up. In particular the use of real time methods including dielectric relaxation measurements and X-ray scattering by means of synchrotron radiation emerge as powerful characterization tools (A. Nogales, Madrid, Spain). New results were

presented on the use of promising techniques like ultrasonic methods (J. Majszczyk, Szczecin, Poland), micro hardness (F.J. Balta-Calleja, Madrid, Spain) and neutron reflectivity (D.N. Manda, London, England) to provide information about structure and phase separation in copolymers. The study of fatigue behaviour of blends (V. Alstadt, Hamburg-Harburg, Germany) and the light scattering of these systems under flow (P. Navard, Marseille, France) are emerging methods which can furnish new information on structure-property relationships relating to the role of interphases in the solid and in the molten state (G. Papanicolaou, Patras,

Greece). The role of liquid crystal polymers in the mechanical and physical properties of thermoplastic polymer/liquid crystal blends has been emphasised with reference, among others, to recycling properties (D. Pietkiewicz; Z. Tar takowski, Szczecin, Poland). Polymer blends based on polyaniline were shown to be of potential interest to obtain processable conducting materials with enhanced thermal stability (K. Pielichowski, Krakow, Poland). Simulation techniques have also been shown to be of value in explaining phase behaviour of copolymers (T. Pakula, Mainz, Germany). See *Europhysics Conference Abstracts* vol.21 A.

from page 155 esting results were presented and discussed. Also the poster sessions were very successful and lively interaction took place. Here we review the highlights.

Physical phenomena in mesoscopic systems and in nanostructures, semiconducting, metallic and superconducting, attracted great interest at the Leuven conference. Quantum transport has been studied to probe non-local and quantum interference effects in various types of nanostructures, including nanowires with dangling ends and loops. Multiphonon optical absorption, photoluminescence and Raman spectra of semiconductor nanocrystals are now interpreted treating these systems as non-adiabatic. Electron heating effects in mesoscopic AuFe wires suggest that the thermopower becomes size-dependent below 100 nm. Intriguing phenomena have been reported which are related to the real geometry of both normal-phase and superconductor mesoscopic structures. The classical action functional at sharp corners in the sub-micron resonant tunnelling diodes has a pronounced effect on the quantum states of the so-called 'quantum elbows' and induces a kind of quantum dots which are electrostatically self-assembled by the conduction electrons. Self-assembly of quantum dots in two-dimensional V-grooves opens new possibilities for optoelectronics, eg quantum dot lasers. Also, novel methods to probe the optical properties of quantum dots have been developed, such as scanning tunnelling luminescence.

Particularly in the area of semiconductors we also mention nuclear-spin dynamics in heterostructures, ballistic transport in nanostructures and the physics of quantum dots. Other lectures focussed on the electronic structure of artificial atoms and molecules, semiconductor light emit-

ters based on microcavities and non-linear transport in mesoscopic conductors and condensates in electron-hole double layers.

The physics of superconducting nanostructures appears as a crossing of two traditional topics - superconductivity and mesoscopic physics. For superconducting mesoscopic square loops, a substantial difference in the nucleation of the superconducting phase has been revealed as compared circular rings. Non-local behaviour of phase boundaries was discussed for a mesoscopic square loop with leads. Interesting new results were reported on the proximity effect in the mesoscopic regime and on the Andreev reflection phenomena.

Studies of the high- T_c superconductors have been supplemented by the investigation of novel materials. Among them we mention A_3C_{60} superconductors, doped spin ladder compounds, magnetic nanoparticles, spin glasses and Kondo systems, spin-Peierls compounds and magnetic multilayers. The lectures on From 1- to 2D quantum magnets; The cuprate ladder materials and on Two leg ladder compounds attracted special attention.

Spin coherence and transport in magnetic quantum structures, single nanoparticle magnetism and magnetic anisotropy in ultra-thin films are examples of state of the art contributions in the fields of magnetism and metals. Inelastic X-ray scattering studies are now used to probe electronic correlations in metals with impressive detail. Recent experimental results on the properties of quasicrystals were discussed. In the soft matter symposia the interest was concentrated on collective excitations in liquid crystals, stress and flow in quantum materials and properties of polymers. Contributions to

the physics of carbon nanotubes treated as a set of double helical DNA structures and to the factors limiting the resolution in electron microscopy were much appreciated. We also mention calculations on Co-adsorption of K and O_2 on Graphite.

New insights have been derived from experimental and theoretical investigations of the Bose-Einstein condensation. Engineering of the bandstructure to favour pairing has been realised in two-dimensional electron-hole double layers subject to uniaxial strain. The formation of condensed excitonium was discussed. A theoretical approach, based on a generalisation of symmetrized density matrices in combination with path-integral generating functions, allows us to describe in detail the thermodynamical properties of identical particles in a parabolic confining well subjected to a homogeneous magnetic field and to interpret recent experiments on the Bose-Einstein condensation.

In the surface physics sessions some of the recent developments include advances in theory for surface reactions, femtosecond electron dynamics at adsorbate covered surfaces, surfaces without bulk, low dimensional electron states on metal surfaces. Other emerging topics are surface science by optical techniques, optical microscopy beyond the diffraction limit, magnetic resonance force microscopy.

In this short overview we probably missed a contribution, which later might turn out to be the basis of a major breakthrough. We can only hope that this is indeed the case.

This conference of the Condensed Matter division of the European Physical Society took place under the Patronage of Luc Van Den Brande, the Minister-President of the Government of Vlaanderen (Flanders) and was sponsored by the Fonds voor Wetenschappelijk Onderzoek-Vlaanderen and Pfeiffer Vacuum Belgium NV/SA.