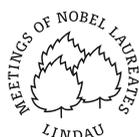




19TH FORUM DEDICATED TO PHYSICS – PLATFORM FOR
THE DIALOGUE BETWEEN SCIENTIFIC GENERATIONS

58th Meeting of Nobel Laureates at Lindau Retrospects and Prospects 2008

Kuratorium für
die Tagungen
der Nobelpreisträger
in Lindau
Council for the Lindau
Nobel Laureate Meetings



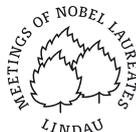
Stiftung Lindauer
Nobelpreisträgertreffen
am Bodensee
Foundation Lindau
Nobelprizewinners Meetings
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by Countess Bettina Bernadotte af Wisborg



Countess Bettina Bernadotte

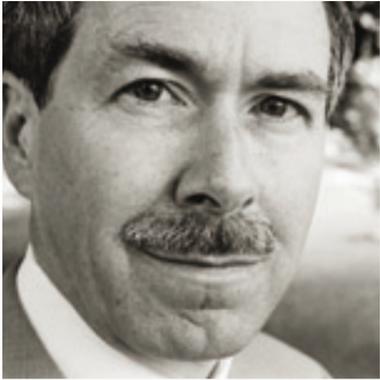
President-designate of the Council for the Lindau Nobel Laureate Meetings

2008 has been an exceptional year for physics. With the Large Hadron Collider (LHC) coming into operation at CERN in Geneva, new doors have been opened for the discipline, posing new questions and promising exciting new answers. In Lindau, the 58th annual Nobel Laureate Meeting was dedicated to physics. Once again, it gave young scientists and the Laureates many opportunities to exchange new ideas, to inspire one another with their experiences and to stimulate their scientific curiosity.

The start-up of the LHC was an important theme in the scientific programme, in the face-to-face discussions between Nobel Laureates and young researchers, as well as in the media reports of the meeting. It is the largest experiment the world has ever seen. It brings together theoreticians and experimenters, nuclear physicists and astrophysicists, engineers and maintenance experts. They all have very different ways of communicating and they come from a variety of national backgrounds, but they are all working together for the common goal.

The participants at the Lindau Meetings are characterised by a similar diversity. This makes the Nobel Laureate Meetings unique in the world and a model of the kind of visionary cooperation which science will increasingly need in the future. Indeed, it is clear that it will rarely be possible to meet the scientific challenges of the future even by outstanding researchers working alone. On the contrary, scientific progress will need to be firmly anchored in international and interdisciplinary networks of individuals working together. Lindau provides the stimulus for such networks to take root and grow. It is precisely so as further to strengthen the international character of the Lindau Dialogue that new partnership agreements are being concluded with leading scientific institutions from around the world, and during the 58th Nobel Laureate Meeting, Memoranda of Understanding with Lithuania, Thailand and Switzerland were signed.

The Lindau Dialogue is only possible thanks to the support of a great number of individuals and institutions. First and foremost among the individuals are of course the Laureates themselves, and this year 24 Nobel Laureates “invested” a week of their time for the benefit of the next generation of promising young scientists. A range of institutions active in the fields of science and politics, as well as foundations and companies, have through their support made it possible to organise this year’s meeting. They are thereby also safeguarding the future of this unique platform for scientific dialogue between the generations. We owe them all on behalf of the Council for the Nobel Laureate Meetings at Lindau and the Foundation Lindau Nobelprizewinners Meetings at Lake Constance our heartfelt thanks.



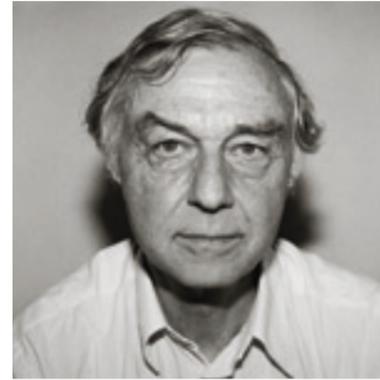
Gerardus 't Hooft (Netherlands)
Physics, 1999



Werner Arber (Switzerland)
Physiology or Medicine, 1978



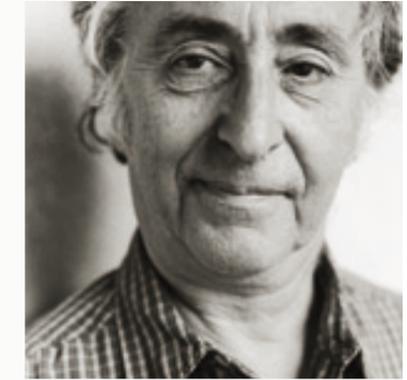
Nicolaas Bloembergen (Netherlands)
Physics, 1981



Robert Huber (Germany)
Chemistry, 1988



Theodor Hänsch (Germany)
Physics, 2005



Brian Josephson (United Kingdom)
Physics, 1973



Johann Deisenhofer (Germany)
Chemistry, 1988



Manfred Eigen (Germany)
Chemistry, 1967



Riccardo Giacconi (Italy)
Physics, 2002



Hartmut Michel (Germany)
Chemistry, 1988



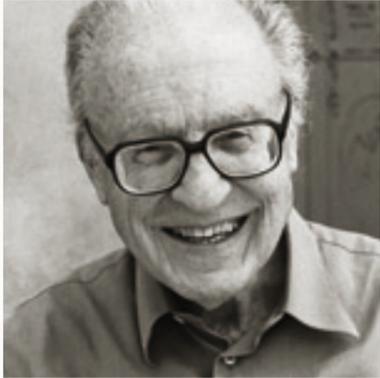
Douglas Osheroff (United States)
Physics, 1996



William Phillips (United States)
Physics, 1997



Ivar Giaever (Norway)
Physics, 1973



Donald Glaser (United States)
Physics, 1960



Roy Glauber (United States)
Physics, 2005



Robert Richardson (United States)
Physics, 1996



Carlo Rubbia (Italy)
Physics, 1984



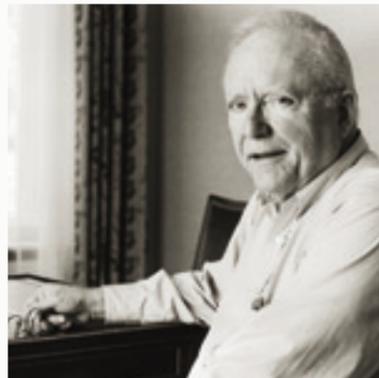
George Smoot (United States)
Physics, 2006



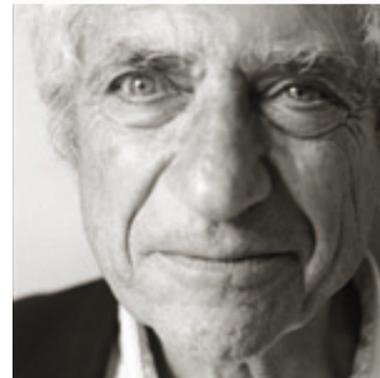
David Gross (United States)
Physics, 2004



Peter Grünberg (Germany)
Physics, 2007



John Hall (United States)
Physics, 2005



Jack Steinberger (United States)
Physics, 1988



Martinus Veltman (Netherlands)
Physics, 1999



Klaus von Klitzing (Germany)
Physics, 1985



“ The Meeting of Nobel Laureates was an invaluable experience for me, a chance to chat (this is the right word for it because of the informal spirit of scientific discussions and conversations during the boat trip to the Island of Mainau) with very wise, kind and intelligent people. Controversial opinions and thoughts of the Nobel Laureates gave me a deeper insight in physics and what is most important - in life of a physicist, so I could make some decisions about my future scientific research and feel proud and satisfied with my occupation. This was a week full of excitement, joy, curiosity, talks and new acquaintances that I will never forget. **Lasma Alberte, Latvia/FELLOW OF THE UNIVERSITY OF LATVIA** ”

“ This meeting is one of the best chances we will have to establish new links between different groups involved in similar aims. It also gave us a unique opportunity to discuss with the Laureates deeply and to be in first terms with them, generating the right atmosphere to feel comfortable and not to be ashamed of the doubts we had. Besides, the organisation and the Government of Bavaria and Baden-Württemberg worked hard to make us feel as we were at home or even better. **Mario Amado Montero, Spain/FELLOW OF THE COSCE** ”



“ The Lindau Meeting was an extraordinary gathering. It was definitely the most amazing experience and I believe this would be one of the turning points which relate me more to science. The Laureates have shown us that it takes more than just the lab work to be a superb scientist and that you need to take your time to cherish everything around you to be successful in life. **Dr. Azwani Sofia Ahmad Khair, Malaysia/FELLOW OF THE ACADEMY OF SCIENCES MALAYSIA** ”

Dr. Azwani Sofia Ahmad Khair, Malaysia/FELLOW OF THE ACADEMY OF SCIENCES MALAYSIA ”

“ The Lindau Nobel Laureate Meeting was a unique and very motivating experience. I was astonished and delighted to what extent the participants were sociable and interested in the variety of scientific and cultural backgrounds present in Lindau. Both the talks and the discussions provided plenty of food for thought and are a great inspiration. **Simon Gerber, Switzerland/FELLOW OF THE SCHWEIZERISCHE STUDIENSTIFTUNG** ”



“ The Lindau Meeting of the Nobel Laureates and students is an experience of a lifetime, I was fortunate enough to get this opportunity at a very young stage of my academic career. Listening to the pioneers in physics during morning lectures and afternoon discussions helped me understand many things not only about physics but also about life. The interaction with students across the world further strengthened my views, that knowledge knows no boundaries of caste, creed, colour, sex, region or religion. I'll cherish this wonderful experience for a long time. Thanks to the Lindau Council for coming up with such an amazing idea! **Jyoti Aneja, India/FELLOW OF THE DEPARTMENT OF SCIENCE AND TECHNOLOGY** ”



“ Assisting to this meeting has been a marvellous opportunity to know and learn from the Nobel Laureates, as well as interact with my young scientist colleagues. The variety of topics that the Laureates research gives me a general picture of where the physical science is going. Their lectures also supply me a vision of how a high level research should be performed. In the other hand, the possibility to meet with so many young researchers is a great chance to debate and know more about how scientific research is doing in other places. **Daniel Escaff, Chile/FELLOW OF THE ACADEMY OF SCIENCES** ”

Daniel Escaff, Chile/FELLOW OF THE ACADEMY OF SCIENCES ”



“ The Lindau Meeting was a truly unique and inspirational experience. The lectures were accessible and thought provoking, while panel discussions provided an excellent opportunity to discuss ideas in more depth. You can't beat careers advice from the most experienced and respected researchers in the world. Although the Laureates were occasionally monopolised by a few individuals, I would highly recommend the meetings as a chance to network with your peers from all over the globe – I've never met so many interesting and motivated people from so many different countries in just one week. **Sarah Bohndiek, Great Britain/FELLOW OF THE INSTITUTE OF PHYSICS** ”

Sarah Bohndiek, Great Britain/FELLOW OF THE INSTITUTE OF PHYSICS ”

“ I consider myself fortunate as I got the opportunity to participate in the 58th Lindau Meeting. I was enriched by the knowledge of so many wise and humble persons, which (...) would inspire me to devote myself to the advancement of science only for the sake of the development and welfare of people of the whole universe. I am deeply thankful to the Nobel Laureates for spending a week of their precious time with us, and to the organisers for such unique meeting. **Goutam Paul, India/FELLOW OF THE DEPARTMENT OF SCIENCE AND TECHNOLOGY** ”



Goutam Paul, India/FELLOW OF THE DEPARTMENT OF SCIENCE AND TECHNOLOGY ”



“ The Lindau Meeting was very wonderful in my feeling, especially in the meaning of getting opportunity to be able to directly hear the lectures of Nobel Laureates and discuss with them. Although the scientific issues were very broad from elementary particles, atoms, to the universe, they gave me meaningful ideas and much knowledge in a short time. I think this meeting will affect strongly my future work. **Chol-Jun Yu, North Korea/FELLOW OF THE GOTTLIEB-DAIMLER- AND KARL BENZ-FOUNDATION** ”

Chol-Jun Yu, North Korea/FELLOW OF THE GOTTLIEB-DAIMLER- AND KARL BENZ-FOUNDATION ”

“ I feel very inspired and eager to work harder and more learn not only about my own research field, but touch more deeply the other ones also. This meeting was perfectly organised and I have appreciated the efforts of organisers for the ability to work, learn and rest at the same time. Please allow me to show my deepest gratitude to the Nobel Laureates for their efforts to share their knowledge and experience with us, the young scientists for their discussions and questions, and organisers for their excellent works. Thank you for new experience, knowledge and scientific spirit. **Jelena Tamulienė, Lithuania/FELLOW OF THE LITHUANIAN ACADEMY OF SCIENCES** ”



Jelena Tamulienė, Lithuania/FELLOW OF THE LITHUANIAN ACADEMY OF SCIENCES ”

“ For some reason the Meeting of Nobel Laureates is poorly known in Finland, or at least none of my colleagues had heard of it before. At one point we even suspected that the e-mail we had received about the meeting was a hoax. I decided to apply despite my doubts, and boy, was I proven wrong! Not only did the meeting turn out to be the real deal, but it was also flawlessly executed. This meeting will serve as my reference for all future conferences in organisational, recreational and scientific aspects. If only I could attend a second time... **Matti Laakso, Finland/FELLOW OF THE INTERNATIONAL UNION OF PURE AND APPLIED PHYSICS** ”



Matti Laakso, Finland/FELLOW OF THE INTERNATIONAL UNION OF PURE AND APPLIED PHYSICS ”

“ I feel the best experience at the Lindau Meeting was the opportunity to interact with so many other young researchers/ students from different nations. As these people represent the future direction of world physics research, making connections with them should prove extremely valuable in the coming years as I begin my own research career. **Matthew Vannette, USA/FELLOW OF THE DEPARTMENT OF ENERGY (DOE)** ”



Matthew Vannette, USA/FELLOW OF THE DEPARTMENT OF ENERGY (DOE) ”



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58TH MEETING OF NOBEL LAUREATES

What is it that holds the world together in its deepest recesses but also keeps it apart from the outermost reaches of the cosmos? These profound questions were more frequently heard as subjects of discussion in Lindau in the first week of July 2008 than anywhere else in the world. With their discoveries, the 24 Nobel Laureates in Physics who met in the island town of Lindau on Lake Constance have probed deep into the secrets of the microcosm and macrocosm.

From 29 June until 4 July they shared their knowledge and discussed the latest developments with 558 outstanding young scientists from 66 countries at the 58th Lindau Nobel Laureate Meeting. Lectures, podium discussions and numerous events in the social programme provided them with opportunities to engage in conversation, to learn from one another, and to find motivation and inspiration for their own scientific work.

The list of participating Laureates ranged from Donald Glaser, the 1960 Nobel Laureate in Physics, who was awarded the prize in recognition of his invention of the bubble chamber which demonstrated the existence of elementary particles, to last year's prize winner, Peter Grünberg, without whose discovery of giant magnetoresistance, today's high-performance storage media would not have been possible. The attraction of the Lindau Meetings is also to be found in their modern-day relevance: seven of the Laureates at the Lindau Meeting this year received their Nobel Prizes within the past six years.

Education, Inspiration, Connection – the way they address these three objectives make the Nobel Laureate Meetings unique in the world. And it is with these goals clearly in mind that the organisers of the Nobel Laureate Meetings – the Council for Lindau Nobel Laureate Meetings and the Foundation Lindau Nobelprize-winners Meetings at Lake Constance – structured the programme this year as well. Two Council members, Professor Lars Bergström (Stockholm/Sweden) and Professor Burkhard Fricke (Kassel/Germany), managed the scientific coordination of the 58th Nobel Laureate Meeting, and were responsible for the international selection process for the young participants as well as for organising the scientific programme.

The meetings' unique character and reputation ensure that the best young researchers apply to take part and that Nobel Laureates regularly return to Lake Constance. A three-stage evaluation process, which subjects even the previously established high standards for the Nobel Laureate Meetings to continuous reassessment, further helps ensure the positive development of the meetings. In the first place, the Council and the Foundation conduct their own evaluation of each meeting, during which the meeting's organisation, the selection process, the cooperation with Academic Partners, and the communications and media work are scrutinised and assessed. Secondly, the views of the young researchers are sought and this year no less than 98% of them took part in the survey and took the time to fill in a questionnaire extending over several pages. This stage of the process already provides valuable insights into the quality and international diversity of the young researchers, the meeting's main areas of focus and its didactic impact, but also in relation to the wider organisation of the meeting, to data management, the services provided as well as the meeting infrastructure. These inputs, when combined with all other relevant information available to the organisers, help provide a truly comprehensive assessment of the meeting. In a third and final stage, the Nobel Laureates were asked to give their feedback on the 58th Nobel Laureate Meeting as well.

As a result, the evaluation report brings transparency to the work of the Council, Foundation and executive secretariat, and provides an account of the challenges which have been overcome in the preceding months. The report can be downloaded as a PDF file at the Nobel Laureate Meeting website: www.lindau-nobel.de, and the meeting's scientific programme can be viewed there as an on-demand video.

Professor Hans Rosling during his presentation
"A Fact-Based World View".

**NOBEL LAUREATES AND
YOUNG RESEARCHERS**

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NOBEL LAUREATES AND YOUNG RESEARCHERS

In all, 24 Nobel Laureates accepted the invitation issued by the Council and the Foundation at Lake Constance. No less than 558 young researchers from 66 countries qualified to attend following a multi-stage selection process after they had been nominated by more than 200 institutions around the world. All in all, more than 20,000 young researchers had expressed interest in taking part. In the past few months, the international network of Academic Partners of the Nobel Laureate Meetings has also been extended, with institutions in Austria, Japan, Lithuania, Malaysia, Mexico, the Netherlands, Switzerland and Thailand signing new cooperation agreements.

NOBEL LAUREATES

The Lindau Nobel Laureate Meetings present science at the highest level to the scientific elite of tomorrow and beyond. In their lectures, the Laureates speak on topics which they themselves have chosen. The result is a rich diversity of themes, giving the participants much food for thought and promoting lively discussions between individuals and between different areas of scientific specialisation. The lecture themes at the 58th Nobel Laureate Meeting ranged from an appeal to address issues with which the next generation of researchers will be confronted (e.g. the

lecture given by Professor Steinberger: "What Future for Energy and Climate?"), through fascinating insights into the speakers' own research work (e.g. the lecture given by the winner of the 2007 Nobel Prize in Physics, Professor Grünberg: "From Spinwaves to Giant Magnetoresistance (GMR) and Beyond"), to the question of how scientific progress can be achieved (Professor Osheroff: "How Advances in Science are Made"). One core theme was cosmology, and in the light of the anticipated switch-on of the Large Hadron Collider at CERN in Geneva, the Nobel Laureates' lectures on this theme generated particular interest among the young researchers.



“ The Lindau Meeting has left unforgettable memories in my mind. The whole event was great, fantastic and fabulous. I got challenges, inspirations and connections with scientific generations that has made me sit tight on my PhD work. Discussions with the Laureates were refreshing and stimulating. I hope to come back to Lindau as a Nobel Laureate. I also hope there will be a higher quota for participants from Africa, especially Nigeria.

Nzekwe Martins, Nigeria/FELLOW OF THE LADOKE AKINTOLA UNIVERSITY OF TECHNOLOGY ”

It can fairly be said that for one week Lindau was the knowledge capital of the world, where intense discussions on the origins and the future of physics converged in its special atmosphere. Riccardo Giacconi (Nobel Prize in 2002), who is generally considered to be the spiritual father of the Hubble telescope, was one of those who took part in the 58th Nobel Laureate Meeting. George F. Smoot also spent the week together with the 558 young researchers from all corners of the globe. His differentiated calculations of cosmic background radiation earned him the 2006 Nobel Prize. Klaus von Klitzing (Nobel Prize in 1985) presented to his audience in Lindau the prospects for electronic circuits on a carbon basis instead of a silicon basis. In his summary lecture, Nicolaas Bloembergen (Nobel Prize in 1981) demonstrated the unimaginably short times and distances – deep into the atomic range – which can be meas-

← Nobel Laureate Ivar Giaever and participant on the boat to the Isle of Mainau.



18 of the 24 Nobel Laureates attending the 2008 Lindau Meeting: (First row, from left) Professors R. Giacconi, B. Josephson, G. 't Hooft, R. Glauber, J. Deisenhofer, H. Michel, D. Gross, M. Eigen and D. Glaser. (Second row, from left) Professors P. Grünberg, T. Hänsch, R. Richardson, D. Osheroff, W. Phillips, G. Smoot, R. Huber, I. Giaever and J. Hall.

ured today with the help of high-precision lasers. And finally, John Hall (Nobel Prize in 2005) focused on the question of where the limits of measurability lie – and whether ultra-precision lasers could one day even be able to reveal natural constants as time-dependent variables. Seven of the Laureates taking part in this year's meeting had received their Nobel Prize since the year 2000, (including the 2007 Nobel Laureate in Physics, Peter Grünberg).

As already mentioned, a key feature of the meetings is that the Laureates choose the theme of their lectures themselves. This makes the discussions which take place during the meeting particularly varied, opening up new perspectives and generating new ideas. Whereas scientific conferences usually dictate a restricted framework and are aimed at a specialist audience, the Nobel Laureate Meetings actively invite young researchers to cross the boundaries of their own fields of research. The participants' feedback clearly shows that it is precisely this aspect of the meetings which they particularly value and consider to be a real benefit to them personally and to the way they approach their scientific research. Indeed, in the participant survey, almost 90% of the participants confirmed that the meeting succeeded in initiating a dialogue between the different specialist fields of physics (cf. Results of the Participant Survey on page 108).

During the Nobel Laureate Meeting, George F. Smoot became a member of the Founders' Assembly of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance. He thus becomes the 187th Laureate to formalise his support for the Nobel Laureate Meetings as an unrivalled forum for the scientific elite of today to meet with the potential elites of tomorrow and to exchange their thoughts and ideas.

Thanks especially to the support of the Nobel Laureates Arber, Grünberg, Michel and von Klitzing, it was possible to draw particular attention to the "Mission Education" of the Council and Foundation. In addition to their own lectures and the concluding discussion with young researchers from around the world, the personal efforts of these Laureates show how even younger generations can be helped to achieve a greater understanding of science and technology. During the week of the meeting, Professor Arber and Professor von Klitzing each spent an afternoon with high school students from Lindau, discussing questions about global warming (Professor Klaus von Klitzing) and the opportunities and risks of genetic technology (Professor Werner Arber). Professor Grünberg visited a Lindau kindergarten and joined even the youngest children in getting to the bottom of scientific matters. The kindergarten is taking part in the nationwide "Tiny Tots Science Corner" initiative. "I'm delighted to see how these young researchers become so very enthusiastic



“ I learned a lot of things from the talks of the Nobel Laureates and my discussions with them: the importance of being brave enough to pursue your dreams and taking risks, the power of devoting yourself to what you are studying and the significance of self-dependence during your research. There were students from all around the world, whose language, culture and looks are different from each other, but we had something in common; something excites each of us tremendously and shapes our lives: Physics. The Lindau Meeting was fantastic, I got back to my research with immense motivation and a lot of unforgettable images.

Cihan Kurter, Turkey/FELLOW OF THE ARGONNE NATIONAL LABORATORY ”



Nobel Laureate John Hall engages in a discussion right after his lecture.



Last chance for a discussion with Nobel Laureate Gerardus 't Hooft on the boat trip to the Isle of Mainau.



Professor Grünberg during his visit to a Lindau kindergarten.



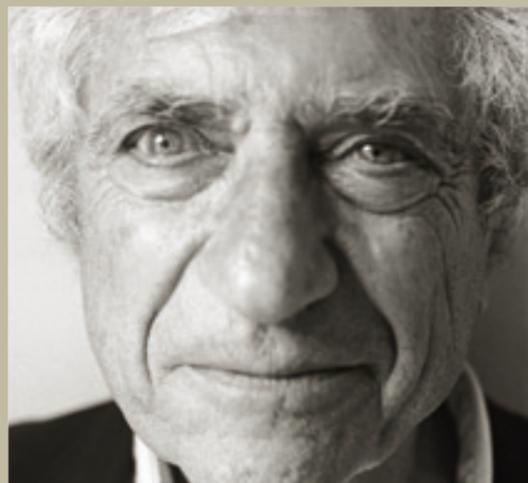
Professor Michel and young researchers from the Helmholtz Association during a live broadcast from Lindau to Leipzig.

about scientific phenomena. I'm happy to give my support to the "Tiny Tots Science Corner" initiative in their efforts to give all children in day-care centres and kindergartens in Germany the opportunity to experience the beauty and wonders of scientific and technical phenomena in a playful environment," said Prof. Grünberg following his visit to the kindergarten.

In a live broadcast from Lindau to Leipzig, Professor Michel, the 1988 German Nobel Laureate in Chemistry (together with Professors Deisenhofer and Huber, who also participated in the meeting), answered questions posed by an inter-school student council, in which 100 students from Leipzig and its surrounding areas took part. The council was meeting as part of the annual science fair under the banner of the "Year of Mathematics".

In special partnership with CERN in Geneva, there was also a media briefing on the theme of the Large Hadron Collider as part of the 58th Nobel Laureate Meeting. Together with the Chief Scientific Officer of CERN, Jos Engelen, and the LHC Project Manager, Lyn Evans, the Laureates David Gross, Carlo Rubbia, George Smoot, Gerard 't Hooft and Martin Veltman discussed the forthcoming activation of the LHC and their expectations regarding the scientific results from the project. More than 50 international journalists followed an exciting – and sometimes controversial – debate, and other scientific journalists around the world also joined in via a webcast.

More generally, thanks to their participation in the meeting, all Laureates made a substantial contribution to supporting the Council and Foundation's "Mission Education". Their willingness to debate the issues arising from the lectures and the podium discussions with the young researchers, including in numerous face-to-face discussions, facilitated a real dialogue between different generations of scientists, which was both inspiring and motivational – and not only for the younger generation. It cannot be too much emphasised that this direct exchange of knowledge and ideas between Laureates and young researchers is the very centrepiece of the Lindau Meetings. Moreover, thanks to the recording of the scientific programme, science enthusiasts around the world can view the lectures as video on demand at www.lindau-nobel.de in a newly created online mediatheque, where there are also lectures from previous meetings and direct access to abstracts, as well as more detailed information about the Laureates' curricula vitae. There is also a plan to make audio recordings of Nobel Laureate Meeting lectures from the 60s, 70s and 80s available online. With this unique range of materials, the website really is bringing scientific history to life. Lectures given by Laureates such as Werner Heisenberg ("Cosmology in Present-Day Atomic Physics", 1968) and André Frédéric Cournand ("Science, Scientists and Society", 1981) will then be made available as audio files.



“ I have participated in Lindau now several times, and appreciate this very much, for several reasons. Perhaps what I enjoy the most is the contact with young physicists. I think it must also be quite useful for these to have contact, not only with the old Nobels, but with other young colleagues, and this, it seems to me, has taken a big step forward with the internationalisation of the young physicists. Perhaps the number, 500, is a larger than what might be most effective; I would guess something around 300 would work out better, but I am not sure. I very much appreciated the opportunity to address what to me is the most pressing social challenge of the moment: energy and climate. Finally, I would like to thank the members of the Bernadotte Family for their enormous efforts to help everybody, and for the great hospitality. **Jack Steinberger, Physics 1988** ”



Young researchers during the boat trip to the Isle of Mainau.

YOUNG RESEARCHERS

No fewer than 558 young researchers from 66 countries took part in the 58th Nobel Laureate Meeting. This included a European contingent of 337 “best talents”. Asia was represented by 86 up-and-coming scientists. From North America, 78 young researchers took part. Latin America sent 19 best talents, the Arab states 20, Australia 10, and Africa 8. These were all nominated by an international network of Academic Partners. This year, almost 200 institutions participated in the process, and more than 20,000 young scientists expressed an interest in taking part in the meeting and submitted themselves to the selection process.



With a notably high proportion of female participants (167) for the physics discipline, the 2008 Lindau Dialogue continued the positive trend of recent years. It confirmed the success of the Nobel Laureate Meetings’ strategy of urging the Academic Partners to give careful consideration to the nomination of good female scientists in their allocations. Top-level research cannot afford not to make full use of the potential of young women in addressing future challenges in the field of physics. It is therefore a particular ambition of the Council and Foundation to help through their participation in the Lindau Dialogue to integrate at the outset young female researchers into the international scientific networks of tomorrow.

This year, for the first time, the Wilhelm and Else Heraeus Foundation bore the costs of the meeting for 100 German participants. In so doing and as a partner of the Lindau Council and Foundation, it followed the organisers’ principle of selecting young researchers solely on the basis of their scientific achievements. The Wilhelm and Else Heraeus Foundation promotes research and education in the discipline of natural sciences and is the most significant private funding institution for physics in Germany. All the young researchers funded by the Wilhelm and Else

Heraeus Foundation successfully passed the multi-stage selection process, in which the final choice is made by a Council review panel. Members of this committee were: Prof. Dr. Burkhard Fricke, Prof. Dr. Wolfgang Lubitz, Prof. Dr. Helmut Sies, Prof. Dr. Jürgen Uhlenbusch, and Dr. Leonore Uhlenbusch. Support for the young researchers during the selection process and also before and during the meeting was in the hands of Nadine Gärber, Sabine Harder and Andreas Schmidt. We should like to extend our sincere thanks and appreciation to all those involved.

Young scientists from throughout the world meet with Nobel Laureates in Lindau. The Lindau Meetings have acquired an excellent reputation among the next generation of researchers, and the expectations of the Nobel Laureate Meetings are correspondingly high. In the participant survey, specific questions were asked about these expectations and the results confirm that the participants’ expectations have been successfully fulfilled. 28% of the respondents said that their expectations had been exceeded, and for 66% they had been met. Only 6% of the participants were disappointed and felt that their expectations had not been fully met. The range of services

“ I very much enjoyed the meeting in Lindau and feel privileged to have taken part, I was also lucky enough to be part of the fascinating but exhausting post-conference tour. The lectures and discussion sessions at the meeting were very interesting, though I do wish the debate had involved more audience participation.

The Laureates I spoke with were very generous with their time and happy to answer questions, I feel I gained a lot from our conversations and have learnt that a combination of intelligence, dedication and luck are required for success in physics. As Vice-President of the International Association of Physics Students I know well the benefits of exchanging ideas with fellow students from all over the world, so I was particularly pleased to meet young physicists from so many different countries. Perhaps this meeting will lead to research collaborations between some of the young scientists who attended, as well as individually inspiring each of us to strive to be the best we can in our careers as physicists.

Laura Rhian Pickard, United Kingdom/FELLOW OF THE INSTITUTE OF PHYSICS ”



provided by the Nobel Laureate Meetings (overall organisation, registration, Internet in the Inselhalle, etc.) were rated by the participants as being good to very good (see also page 107). Out of all the items surveyed, Internet access in the hotels of Lindau was rated worst. As can be inferred from comments made in the questionnaires, internet access was either not available, could only be activated at excessive cost or only worked inadequately. The overall assessment is reproduced in this report and can be found from page 100 onwards.

The objective of the Nobel Laureate Meetings is to promote the development of international networks of qualified young researchers, and great importance is attached to personal contact – both in terms of acquainting the scientific elite of today with that of tomorrow as well as enabling young researchers to network among themselves. It is precisely this focus which characterises the concept of the Lindau Meetings, and numerous events in the supporting programme serve this purpose. At the invitation of the German Minister for Education and Research, Dr. Annette Schavan, for example, 25 selected participants from Germany and India respectively had the opportunity to take part in a boat trip on the evening prior to the meeting’s official opening, where they were able to converse and get to know each other better. At an evening meal together on board the MS Lindau, not only did they talk about their expect-

tations of the forthcoming meeting, but they also engaged in equally animated conversation with Dr. Annette Schavan and H.E. Kapil Sibal, the Indian Minister for Science and Technology, about the basic underlying conditions for top-level research in Germany and India.

For the first time, the state of Baden-Württemberg had invited 20 young researchers to take part in a follow-up programme in the region. This not only involved visits to universities, research institutes and companies, but they also got to know a bit about the State’s top tourist spots. The Nobel Laureate Meetings are a beacon for the science and research region of Lake Constance, which now shines right around the world. The programme helped to further illustrate to highly talented young researchers what opportunities there are for science and research in the Lake Constance region.



H.R.H. Princess Maha Chakri Sirindhorn (center) attended the signing of the Memorandum of Understanding between Thailand and the Lindau institutions during the 58th Meeting of Nobel Laureates. **Professor Wolfgang Schürer** (from left), **Countess Bettina Bernadotte**, **Professor Jürgen Uhlenbusch** and **Dr. Sakarindr Bhumiratana** (President of the National Science and Technology Development Agency) together with young researchers from Thailand after the ceremony.

ACADEMIC PARTNERS OF THE LINDAU DIALOGUE

The Academic Partners of the Nobel Laureate Meetings are selected institutions around the world which identify the young researchers for participation in the Lindau Meetings and nominate them to the Council review panel. These can be science academies, universities and other scientific institutions, foundations or ministries. In recent years, the Council and the Foundation have initiated an international network for this purpose which is continuously being expanded. In view of the increasing numbers of applicants, the institutions also support the Nobel Laureate Meetings in systematically selecting the participants based on their scientific achievements. Each year, they enable the Council and Foundation to welcome the best young researchers from the disciplines of medicine, physiology, physics and chemistry to Lake Constance. The increasing quality of the participants – as also perceived by the Laureates – and the increasing internationalisation of the meetings would scarcely be possible without the efforts and preliminary work of these institutions.

Almost 200 institutions nominated young researchers for participation in the 58th Nobel Laureate Meeting, ranging from the A*Star Graduate Academy in Singapore, through a number of science academies (including in Australia, Bangladesh, France, Malaysia and the Czech Republic) and internationally recognised research institutes at home and abroad (Fraunhofer-Gesellschaft, Human Frontier Science Program, Max Planck Institutes, Weizmann Institute of Science – Israel), to the best universities in Germany (University of Göttingen, University of Heidelberg, University of Konstanz, RWTH Aachen).

During the meeting, the Council and Foundation admitted new members to the international network of Academic Partners. At a festive ceremony, Memoranda of Understanding were concluded with the National Science and Development Agency of Thailand, the Lithuanian Academy of Sciences, and also with the Swiss National Science Foundation. The signing of these memoranda supports the general



Professor Dieter Imboden (center) signed the Memorandum of Understanding on behalf of the Swiss National Science Foundation. He has been appointed president of the European Heads of Research Councils (EuroHORCs) in October 2008.

The President of the Mexican Academy of Sciences, **Dr. Juan Pedro Laclette** (right), and **Countess Sonja Bernadotte** during the signing ceremony at Berlin, together with the Mexico's ambassador to Germany, H.E. Jorge Castro-Valle Kuehne.

principle of guaranteeing the participation of highly talented young researchers from these countries in the Nobel Laureate Meetings. The institutions in these countries – as well as partner institutions in, for example, Australia, China, India, Israel, Malaysia, Mexico, Norway, Pakistan, Poland, Slovenia, Hungary and the USA – stage national competitions for participation in the Lindau Dialogue. Observing the strict Lindau selection criteria is an essential component of the partnership agreement. The daughter of the King of Thailand, H.R.H. Maha Chakri Sirindhorn, Princess of Thailand, attended the signing of the Memorandum of Understanding with Thailand. She had previously participated in the opening of the 58th Nobel Laureate Meeting, and on the first day of the meeting she was also one of the audience members in the Inselhalle.

As part of the official trip to India undertaken by the German Chancellor, Dr. Angela Merkel, and the Research Minister, Dr. Annette Schavan, in November 2007 the Memorandum of Understanding between representatives of the Indian Department of Science and Technology (DST) and representatives of the Lindau Nobel Laureate Meetings was signed. The participation of young Indian researchers in the meetings had until then been based on a cooperation

agreement dating from 2004. With the signature of the memorandum, this already successful partnership is now being taken to a new level. One component of this cooperation is the organisation of a national selection process for participation in the meeting by the DST.

In October 2007, it had already been possible to sign the cooperation agreement with the Mexican Academy of Sciences. At the invitation of the Federal Minister, Dr. Schavan, the Council for Lindau Nobel Laureate Meetings held its autumn conference in the premises of the Ministry for Education and Research in Berlin. Following the conference, Countess Sonja Bernadotte, the President of the Council, welcomed the President of the Mexican Academy, Prof. Dr. Juan Pedro Laclette, and also the Mexican Ambassador in Berlin, H.E. Jorge Castro-Valle Kuehne, to the ceremonial signing of the Memorandum of Understanding. This agreement ensures that young Mexican science researchers and young economists can participate in the annual meetings in Lindau. With such an agreement, Mexico therefore becomes the first country in Latin America to guarantee its best talents access to the international networks being developed in Lindau in the coming years. Following the 58th Nobel Laureate Meeting, it was also possible to bring



Professor Zenon Rokus Rudzikas (right), President of the Lithuanian Academy of Sciences, **Countess Bettina Bernadotte** and **Professor Jürgen Uhlenbusch** after signing the Memorandum of Understanding.

H.E. Kapil Sibal (left), Indian Minister for Science and Technology, and participants during a boat ride on Saturday evening. The Memorandum of Understanding with the Indian Department for Science and Technology was signed in Fall 2007.

negotiations with the Conselho Nacional de Desenvolvimento Científico e Tecnológico in Brasil to a successful conclusion. Further memoranda of understanding were signed in 2008 with the following institutions: the Federal Ministry of Science and Research (Austria), the Japan Society for the Promotion of Science (JSPS), the Royal Netherlands Academy of Arts and Sciences and the Academy of Sciences, Malaysia.

Working in close cooperation with the Council, the Chairman of the Board of the Foundation, Prof. Dr. h.c Wolfgang Schürer, is initiating new partnerships and conducting negotiations with scientific institutions. Discussions are currently under way with institutions in Egypt, Belgium, Ireland, Italy, Romania, Russia, and the Association of Southeast Asian Nations (ASEAN), as well as with the OPEC Fund for International Development. Professor Schürer is supported in this work by Dr. Urs V. Arnold, Senior Research Fellow.

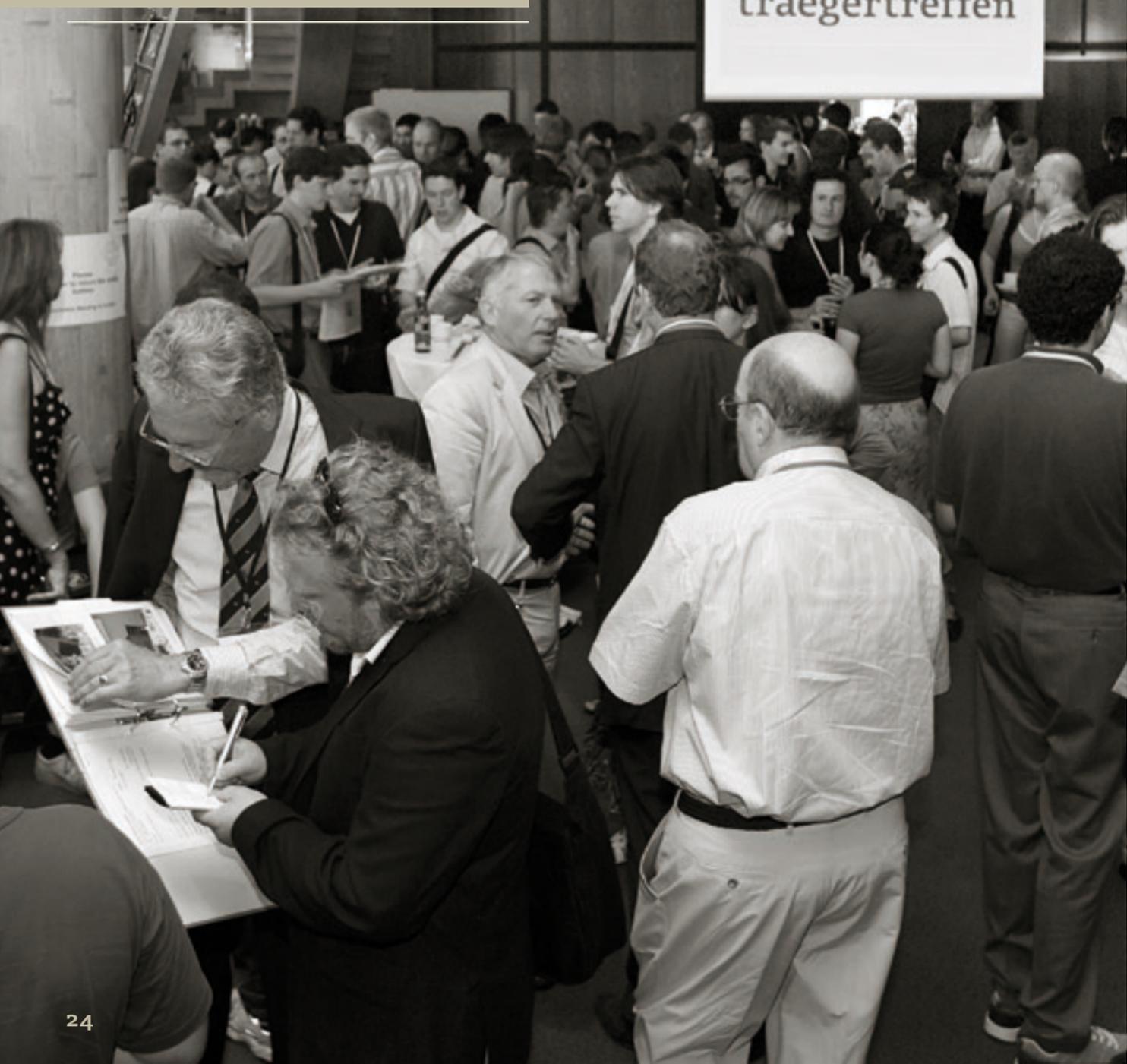
During the 58th Nobel Laureate Meeting, the Council and the Foundation invited representatives of the Academic Partners to participate in an exchange of views and ideas. The Vice President of the Council, Prof. Dr. Jürgen Uhlenbusch, who was also a mem-

ber of the review panel for the meeting, led the conference. The focus of attention was on the new database, with which the entire selection process had been organised for the first time. In order to provide all those participating – nominated young researchers, nominating Academic Partners, scientific directors and, last but not least, the employees who work in the offices – with the best possible working conditions, a multi-stage evaluation process was put into operation. The feedback from the Academic Partners was very positive. Specific requests for change were discussed and agreed. They are to be implemented in time for the beginning of the new selection process in the autumn of 2008.

There was an intensive discussion focused on when the selection process should start and on the general schedule of the process. It was agreed that, in line with the unanimous opinion of the Academic Partners, it should already begin in September rather than only in December, as had previously been the case. This will ensure that the young researchers and the nominated or selected partner organisations have sufficient time for this demanding process. Furthermore, the scientific directors stressed that only complete profiles can be considered in the peer review process.

PROGRAMME OF THE 58TH NOBEL LAUREATE MEETING

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PROGRAMME OF THE 58TH NOBEL LAUREATE MEETING

"Science Education" is the aim of the Nobel Laureate Meetings, and this is achieved through numerous discussions between Laureates and young scientists, but also through lectures, panel discussions, seminar discussions, and numerous events in the social programme. The Lindau Dialogue between the scientific elites of today, tomorrow and beyond provides a forum for the exchange of ideas, knowledge and experience, without which the challenges which lie ahead would be difficult to meet. In the spirit of globalisation, the responsibility of scientists to help ensure the sustainable development of our world is growing – and these encounters at the Lindau Meetings in a very real sense represent the passing of the baton in a "cross-generational relay race" for the future of mankind.

OPENING DAY

The opening day of the 58th Nobel Laureate Meeting showed that the Lindau Meetings are not only perceived to be a significant event within the "scientific community". As a beacon for the whole educational and research landscape of the area around Lake Constance, they help not only Nobel Laureates and young scientists to become acquainted with the region, but also the other distinguished guests and discussion partners from the fields of science, politics and economics who take part. Accompanied by a high-ranking delegation, Princess H.R.H. Maha Chakri Sirindhorn of Thailand took part in the first two days of the meeting. As herself a scholar of the humanities, she became actively involved in the Lindau Dialogue, prior to which she had demonstrated her special interests by visiting high-tech companies in the Lake Constance region which are generally considered to be particularly innovative.

Countess Bettina Bernadotte Opened the Meeting.

Countess Bettina Bernadotte, the designated President of the Council, opened the 58th Nobel Laureate Meeting. In her welcome speech, she highlighted the aims by which the Lindau Meetings have allowed themselves to be guided from the very beginning. "The core of the vision of my late father Count Lennart Bernadotte can be summed up as "Education". To connect, to motivate and to educate: these are the ideals that inspire our annual meetings. They shape the



Guests from the worlds of science, politics and economy attended the opening ceremony.

scientific programme as much as the distinctive nature of the coming days. We stay committed to the steady advance of this vision and our mission."

She expressed her sincere thanks for the commitment shown by the numerous Academic Partners around the world "The initiative for excellence, which aims to encourage highly-qualified emerging scientists to participate in these meetings, would not be possible without the extraordinary dedication of many distinguished scientists from all over the world, acting as ambassadors of the Lindau mission." These scientists organise contests and selection events with candidates in their own national institutions and, on this basis, provide the Council's review panel with proposals which they themselves have checked in advance.

Countess Bettina Bernadotte thanked the donors and benefactors for their support. The re-working of the website, with its expanded range of information material and the newly created “Knowledge media-theque”, would scarcely have been possible without the support of the Free State of Bavaria and the International Lake Constance Conference. She made special reference to the German Federal Ministry for Education and Research, and thanked the Federal Minister of Education, Dr. Annette Schavan, for her considerable support: “Her commitment goes much further. Dr. Schavan engages in regular strategy meetings with the Lindau Institutions. We are indeed most grateful to her.” The work of the Council and the Foundation also benefits from sponsorship by institutions such as that provided by, for example, the Robert-Bosch Foundation, the German Research Foundation, the Wilhelm and Else Heraeus Foundation and the Deutsche Telekom Foundation.

Nobel Laureate Meetings Honoured as “Landmark in the Land of Ideas”.

As part of the opening ceremony, the Nobel Laureate Meetings received the award of “Selected Landmark in the Land of Ideas”. The jury justified their selection with the stated aim of the meeting: “To foster progress in this country with innovative solutions that inspire”. The Federal Minister for Education, Dr. Schavan, gave the laudation and presented the prize together with Thomas Keller of Deutsche Bank AG, the project partners of the contest. More than 1,400 locations and cities in Germany have applied for this prize. “Germany – Land of ideas” is the joint initiative of the Federal Government and German industry, represented by the Federation of German Industries (BDI). The patron of the initiative is the German President, Professor Horst Köhler.

In her laudation, Dr. Schavan emphasised how “Lindau has long become a byword for top-level international scientific exchanges”. As a platform for encounters between the scientific elites of today and tomorrow,



Countess Bettina Bernadotte, President-designate of the Council, opened the meeting.



Dr. h.c. Klaus J. Jacobs



Federal Minister Dr. Annette Schavan during her laudation.



Pamela Mars Wright



Prof. Jürgen Uhlenbusch (from left), Federal Minister Dr. Annette Schavan, Countess Bettina Bernadotte and Thomas Keller (Deutsche Bank AG).



Prof. Dr. rer. nat. Martin Winterkorn

the Lindau Meetings promote scientific progress – and this depends not only on the wisdom of the Nobel Laureates, but equally on the inquisitiveness of the younger generation. “This meeting is not only very special here in Germany; it is unique worldwide. The Lindau Meetings transcend the boundaries between cultures, disciplines and generations and encourage networks of scientific excellence.” The Nobel Laureate Meetings help to make Germany more attractive to scientists from around the world as the “Land of Ideas” and “set new standards in this respect”, Dr. Schavan concluded.

New Members of the Honorary Senate.

During the opening ceremony, the Foundation Lindau Nobelprizewinners Meetings at Lake Constance admitted three new members to its Honorary Senate: Dr. h.c. Klaus J. Jacobs, Pamela Mars Wright and Prof. Dr. Martin Winterkorn. In doing so, the Foundation is honouring their hard work in support of the promotion of science and excellence in Germany and around the world. The Honorary Senate functions as an advisory committee to the Foundation’s board and comprises well-respected figures from science, economics and politics, including the former German President, Professor Roman Herzog, the German Chancellor, Dr. Angela Merkel, the Spokesman of the Board of SAP, Professor Henning Kagermann, and the General Secretary of the European Research Council, Professor Ernst-Ludwig Winnacker.

Dr. h.c. Klaus J. Jacobs devoted himself to the concept of lifelong learning. The Jacobs Foundation, which he established, has made it its aim to promote the interests of young people in two ways: with a view to demonstrating their technical ability and also their social responsibility. This notion of an educational mission also forms the focal point of the Nobel Laureate Meetings. Klaus J. Jacob passed away on 11th September 2008. The Foundation’s Board and the Founders’ Assembly will always remember Klaus J. Jacobs with respect and gratitude.

The promotion of up-and-coming research talent has a long-standing tradition in the Mars family. Since it is thanks to the personal dedication of Pamela Mars Wright that MARS, Inc. has committed itself as a Principal Patron for the Lindau Nobel Laureate Meetings, the Foundation's Board is honouring Ms. Mars Wright by admitting her to the Honorary Senate. Pamela Mars Wright regularly and actively participates for several days in this globally unique dialogue between Nobel Laureates and the highly qualified young scientists.

Prof. Dr. rer. nat. Martin Winterkorn himself symbolises the lively, reciprocal interchange between science and economics. He not only dedicates himself to promoting the development of new, innovative solutions for the mobility of the future within the Volkswagen Group, but also by giving guest lectures at a variety of universities and engaging in partnerships with research institutes and scientific establishments around the world. Furthermore, he represents the close integration of fundamental and applied research and Dr. Winterkorn attaches particular importance to the promotion of young scientists and engineers.

Lennart Bernadotte Medal Awarded.

Countess Bettina Bernadotte awarded a special distinction, the Lennart Bernadotte Medal, to the Chairman of the Board of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance, Professor Wolfgang Schürer. On behalf of the entire Council for the Lindau Nobel Laureate Meetings and the Bernadotte family, she thanked him with the award for his outstanding commitment to aiding the development of the Lindau Meetings as an international forum for dialogue between the scientific elites of today and tomorrow. "We greatly value and appreciate your important and tremendous commitment to the Lindau spirit. The Lindau Meetings of today and how they are perceived worldwide owe you a lot," said the designated President of the Council.



Professor Wolfgang Schürer, Chairman of the Board of the Foundation, was awarded the Lennart Bernadotte Medal.



The rousing lecture by Prof. Hans Rosling was enthusiastically received by the audience of the opening ceremony.



Minister of Justice Dr. Beate Merk (center) and Petra Meier to Bernd-Seidl (right), Mayor of Lindau.

The Foundation, headed by Professor Schürer, has served its ideal of "Mission Education" since it was founded. Since its formation in 2000, it has significantly expanded the meetings' contacts with scientific institutes all over the world and, in doing so, has given the Academic Partners' network a new quality. The trust funds have been increased from an initial EUR 50,000 to currently approximately EUR 15 million. To date, 187 Nobel Laureates are members of the Foundation's assembly and support the idea of the Lindau Nobel Laureate Meetings.

The Lennart Bernadotte Medal is named after the spiritus rector of the Nobel Laureate Meetings, Count Lennart Bernadotte (1909–2004). It has been awarded since 2002, and last year, Michael Sohlman, Executive Director of the Nobel Foundation in Stockholm, received this accolade. Other recipients include the former Lindau Lord Mayor and long-standing Vice-President of the Council, Josef Steurer, the Nobel Laureate, Prof. Dr. Ernst Otto Fischer, and Prof. Dr. Willis Eugene Lamb, as well as Baron Stig Ramel, who was Michael Sohlman's predecessor as Executive Director of the Nobel Foundation.

Opening Lecture: "A Fact-Based World View".

The opening lecture – "A fact-based world view" – was given by Prof. Dr. Hans Rosling from the Karolinska Institutet in Stockholm, where his work focuses primarily on the connection between the economy and health in Africa, Asia and Latin America. Before an international audience of young scientists from all corners of the globe, including established scientific nations as well as ambitious, young research countries from all continents, he showed in his presentation how the traditional division of the world into "first" and "third" world countries no longer represents the true picture.

In his lecture, Professor Rosling expounded five theses: 1) There are no longer two types of countries in the world: rather than industrialised and developing



Professor Gross and young researchers from Thailand during the reception of the Foundation.



Council members Professor Wolfgang Lubitz (from left) and Thomas Ellerbeck, Professor Gerhart von Graevenitz (Rector of the University of Konstanz) and Guntram Bauer (Human Frontier Science Program).



Professor Jack Steinberger and Federal Minister Dr. Annette Schavan.



Nobel Laureate **Professor George Smoot** and **H.E. Kapil Sibal**, Indian Minister for Science and Technology.

countries, they form a continuum of socio-economic development. 2) Most Asian countries are modernizing twice as fast as Europe did. 3) A new dichotomy may form between one billion people stuck in the vicious circle of poverty and instability outside the rapidly growing global economy of more than five billion people. 4) All progress towards better health and wealth has been achieved at the cost of greater CO2 emissions. 5) The main reason for optimism regarding the future is that the world is so badly managed at present (in other words, there are endless opportunities to improve the world).



H.R.H. Princess Maha Chakri Sirindhorn (left), **Prof. Wolfgang Schürer** and Federal Minister **Dr. Annette Schavan**.

The rousing lecture by Professor Rosling was enthusiastically received by the participants, Nobel Laureates and honorary guests. With the help of the software "Gapminder" (<http://www.gapminder.org>), developed by Prof. Rosling himself, he was able to show the long-term development of individual countries and groups of countries, which was often surprising and always thought-provoking. Statistics were transformed into moving (in both the literal as well as the metaphoric sense), interactive graphics. He made an appeal to invest more money in the future (in science and technology) instead of the past (such as aid to farmers). In view of the international diversity of the participants at the Nobel Laureate Meeting, Professor Rosling expressly welcomed the Council and Foundation's wish to bring young researchers from all around the world together at Lake Constance.

The Foundation's Festive Dinner.

On the evening of the opening day, the Foundation Lindau Nobelprizewinners Meetings at Lake Constance invited honorary guests from science, economy, politics, public life, and also members of the Council to a festive dinner.

Professor Wolfgang Schürer, Chairman of the Foundation's Board, welcomed the guests. He highlighted the successful continuation of the work being carried out together with partners at home and abroad –



Professor Hans Rosling and **Pamela Mars Wright**.



“ The Lindau Meeting presents a unique opportunity to meet those who are the top players of Science. Nobel Laureates are the living proof of what one can accomplish with dedication and enthusiasm. It's inspiring to meet scientists that have accomplished the ultimate recognition and are still passionate about the pursuit of knowledge. We come from the meeting with a renewed sense of what is to be a scientist. To enlighten, to educate and learn from those who surround us and to never forget the responsibility we have to society.

Paulo Pinto, Portugal/FELLOW OF THE EUROPEAN COMMISSION ”

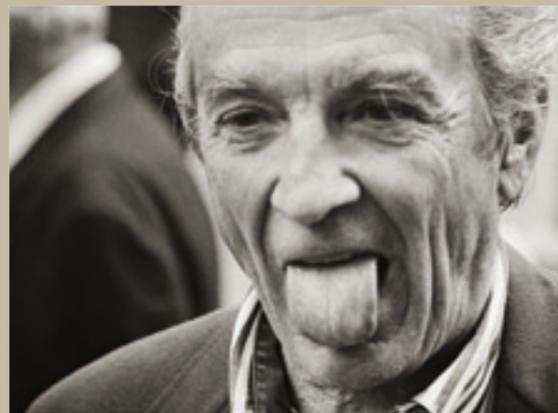
such as the German Federal Ministry of Education and Research, the International Conference at Lake Constance, the Free State of Bavaria, and the State of Baden-Württemberg. He also announced new sponsorship agreements with Bosch GmbH, the Principality of Liechtenstein, RWE AG and Volkswagen AG. "Public Private Partnerships work very well in the context of the Lindau Project," said Professor Schürer. The guests on this evening also included representatives of those institutions with which the Council and the Foundation are working together as Academic Partners. In view of this continuously increasing international network, the Chairman of the Foundation's Board thanked all partners who had signed a Memorandum of Understanding. These partnership agreements are "important because they establish the basis of a cooperation serving excellence".

In her address, H.R.H. Princess Maha Chakri Sirindhorn expressed her delight that Thailand is also sending young scientists to Lindau. She made reference to the connection between science and prosperity, which needs to be fostered in the developing countries in particular: "As we all know, scientific discovery generates wealth, a portion of which was then used in further research and discovery to achieve more wealth, and so on, like a virtuous circle. For much of the past century, the developed countries have benefited a great deal from this circle of science and success. Whereas in the developing countries, such a circle has hardly ever occurred, making the development gap between the advanced and developing countries wider. To solve this problem, it is imperative that scientific institutes and scientists make a strong commitment to bring the benefits of science to all. In this respect, I am glad to learn that

this meeting will cover the issue of science education and the responsibility of scientists on sustainable development of our world, which I think are very important in the age of globalization."

The Indian Minister for Science and Technology, H.E. Shri Kapil Sibal, indicated in his speech that participation in the meetings in Lindau can have a long-lasting effect on the careers of young researchers: "While it may not be apparent what such interactions yield in the short term, each interaction has the potential of lighting a match to a candle, of igniting young minds in ways that can change the face of the earth". In particular, a country such as India, which in spite of its economic growth faces vast societal and social challenges, is dependent on science and technology, said the Minister. He therefore called on the Indian participants at the Nobel Laureate Meeting "to be alive to the needs of the rest of humanity and make the best use of this opportunity to make the world a better place for us to share and live in".

The Minister of Justice of the Free State of Bavaria, Dr. Beate Merk, welcomed the guests on behalf of the Minister President, Dr. Günther Beckstein. "Every year Lindau turns into a centre of science and learning. We are honoured that we are able to welcome the Laureates each year; that for a short while once a year we can welcome the high society of research to Lindau." She highlighted the uniqueness of the Lindau Meetings: "Discussions between young and old, between teachers and learners, between the experienced and those who are hungry for experience. The discussions in Lindau are characterised by the fact that they are never one-way. It is not only the young who listen and it is not only the experienced who speak here."



“ I have attended the Lindau Physics meetings regularly since 1975 and I have attended a few interdisciplinary meetings as well, so by now I consider myself an expert on these meeting. Let me first state that I thoroughly enjoyed them all.

One reason is that this is maybe the only place you can meet other Nobel Prize winners; I had the opportunity to interacting with legends like Paul Dirac, Felix Block or Isador Rabi, to mention a few. Another reason is that the atmosphere during the meeting makes me feel like an important person even though I know I was mostly lucky to end up here. Thirdly it is fun to interacting with the students, and I hope they learn that anybody can succeed, and that Nobel Prize winners are really ordinary people. (...)

That the Nobel talks were limited to 30 minutes was good, most of the speeches we give are often too complex and not very suited for the students anyway. (...) To conclude let me say what I miss from the past is interacting with Count Lennart Bernadotte (...) and from more recent years the gracious way Countess Sonja in her beautiful hats took over the traditions. But I am very impressed with how Countess Bettina with the skillful help from Count Bjorn ran the meeting this year. They are to be congratulated!

Ivar Giaver, Physics 1973 ”

SCIENTIFIC PROGRAMME



The scientific programme of the 58th Nobel Laureate Meeting was opened on Monday 30 June with the lecture “Towards a quantum laboratory on a chip” by Professor Theodor Hänsch, Nobel Laureate for Physics in 2005. He was followed by the physics Nobel Laureate from 2007, Professor Peter Grünberg, who gave the lecture “From spinwaves to giant magnetoresistance (GMR) and beyond”.

What lay ahead of the participants was the four days of the scientific programme with 21 high-quality lectures, which in the afternoons would be expanded into small discussion groups between the Nobel Laureates and young researchers. Traditionally, there is no one all-embracing topic for the Nobel Laureate Meetings. Consequently, Laureates have the opportunity to freely choose the topic of their lecture themselves. This leads directly to the broad diversity of topics which helps make the Lindau Meetings so special. This aspect was also rated extremely positively in the participant surveys. In response to the question of whether the 2008 Nobel Laureate Meetings had succeeded in promoting a dialogue between the various disciplines in the field of physics, almost 90% replied “yes” or “rather yes” (cf. overall results from page 108).

Lasers are one of the groundbreaking discoveries of the 20th Century in the field of quantum physics. With Professors Nicolaas Bloembergen, John Hall and Theodor Hänsch, three of the pioneers in this research discipline were present in Lindau. Without laser light which is harnessed into coherent mode, it would not be possible to transmit information in glass fibres, construct modern skyscrapers or pinpoint coordinates for navigation systems. Lasers can measure and cut, depict and attach, transfer energy and store data. They are one of the consequences of quantum physics which have fundamentally changed our everyday lives – and also for physicists themselves who, with the help of laser spectroscopy, can



measure the inside of atoms with hitherto unknown accuracy. The Monday of this week of meetings was devoted to quantum physics.

Cosmology – the science of our universe – is a relatively recent discipline in physics, the revival of which only began after the Second World War when rockets and measuring devices became available for tracing beams from outer space other than just visible light. Since then, our image of the world has changed fundamentally. Talented up-and-coming scientists from around the world were able to follow the important stages in this development during personal discussions in Lindau, including in conversations with Riccardo Giacconi and George F. Smoot, who were also involved in making an exact science out of what was once merely speculative cosmology. On the Wednesday of the meeting, in addition to the lectures given by Professors Giacconi and Smoot, other fascinating insights into cosmology were also on the programme.

The topic of climate change was another of the programme’s main areas of focus. Here, Professor Jack Steinberger presented his thoughts on “thermal solar technology with overnight storage”. Climate change and the energy crisis were also the topic of the related panel discussion.

**Panel Discussion:
“Global Warming and Energy Challenges”.**

On Tuesday, seven Nobel Laureates in physics and chemistry gathered to discuss matters relating to climate change and the energy crisis: Professors Johann Deisenhofer, Ivar Giaever, Hartmut Michel, Douglas Osheroff, Carlo Rubbia, Klaus von Klitzing and Jack Steinberger. The moderators of this high-calibre round of discussions were Prof. Dr. Burkhard Fricke from the University of Kassel, a member of the Council and one of the two scientific co-ordinators at the meeting, and also Prof. Dr. Hans Joachim Schellnhuber from the Potsdam Institute for Climate Impact Research (PIK).

At the beginning of the discussion, Professor Schellnhuber put forward three options for discussion on how to deal with climate change: “The first is mitigation, reducing green house gas emissions. The second is adapting to climate change, so can we do this on a planetary scale? The third option is called ignoring the problem, and that is a very powerful option. The question is can we do that?” He emphasised that, in contrast to the 1970s and 1980s, politics and the economy are now increasingly turning to science and technology, which offers hope for the future.

The participants in the podium discussion were generally of the opinion that more nuclear power and solar energy should be used in order to protect the environment, but at the same time, also to be able to cope with the increasing demand for energy. Organic fuels were harshly criticised by some of the discussion participants. In order to be able to deal with climate change, the appropriate technologies have to be implemented now. However, they could only be effective if governments, scientists and civil society jointly supported their implementation.

The first introductory statement was made by Professor Douglas Osheroff, the 1996 Nobel Laureate in Physics: “Certainly I think climatic changes will affect our ability to put food on the table. When you look at the floods in the US mid-west, that’s an example of what I think we can expect to happen over and over again.”

Professor Ivar Giaever (Physics Laureate in 1973) expressed scepticism regarding climatic change. He emphasised that it is by no means certain that mankind is even able to influence the climate: “I’m sceptical. [...] Acid rain, the forests dying, the hole in the ozone layer – mankind has always been threatened by horror scenarios, but so far, as we all know, we have managed to survive. Global warming has become a new religion, and every day we hear about the large number of scientists who support it. But it is not the number which is important, but those who are proved to be right.” With reference to the lecture given by Professor Hans Rosling as part of the opening of the 58th Nobel Laureate Meeting (see page 29), Giaever said: “There are better ways of spending money”.

Professor Carlo Rubbia, Nobel Laureate in Physics in 1984, made reference to the connection between the constantly growing world population, the associated increase in the demand for energy, and the effects on climatic change. An increasing number of people are consuming an increasing amount of energy, which is leading to greater CO₂ emissions – which can therefore scarcely be avoided. Professor Rubbia saw solar energy and nuclear energy in particular as being forms of energy with which the increased demand for energy could be met in an environmentally friendly manner in the near future. The technologies required for this, said Rubbia, are already available.

In his introductory statement, Professor Klaus von Klitzing, the 1985 Nobel Laureate in Physics, made it clear to those young scientists who were present that it is they who would have to solve the “big problems” of the future. In agreement with the previous speaker, Professor Rubbia, he saw a close connection between the rapid increase in the global population and the energy crisis and climatic change. Scientists should point out that the facts regarding climate change are well known and what is needed now are “clever ideas” in order to be able to tackle the energy crisis and climate change. To do so, it is essential to make greater investments in research in particular.



Panel Discussion on “Climate Changes and Energy Challenges”: (from left) Professors H. Michel, J. Steinberger, D. Osheroff, B. Fricke, H. J. Schellnhuber, C. Rubbia, K. von Klitzing, I. Giaever and J. Deisenhofer.

His colleague, Professor Johann Deisenhofer, the Nobel Laureate in Chemistry 1988, advocated prompt action: “Really it can be. It can make no difference what we do in 20 years. It is important what we do now”.

In the podium discussion, Professor Hartmut Michel, the 1988 Nobel Laureate in Chemistry, once again criticised organic fuels. In his lecture as a participant at the Nobel Laureate Meeting in 2007 (physiology or medicine), he had already demonstrated the inefficiency of organic fuels as being unsuitable for solving the energy crisis. He posed the question of whether more energy is used to produce it than is ultimately gained from it. Professor Michel made it clear that through photosynthesis not even 1% of the sun’s energy is stored in biomass. For 3 billion years, nature has been trying to increase this proportion and has so far been unsuccessful. This is why we should be seeking alternatives with better energy efficiency. Here, he was focusing in particular on the power of the sun: solar thermics and photovoltaics, supplemented by wind energy.

In reference to the previous speaker, Professor Jack Steinberger, the Nobel Laureate in Physics in 1988, pointed out that the technical solutions for dealing with climate change and the energy crisis “exist, but cost a certain price”. Furthermore, implementing them requires the cooperation of all governments, which is “very difficult to achieve”.

Questions from the auditorium then gave young up-and-coming scientists the opportunity to participate in the discussion. One participant, for example, asked just how certain it is that mankind is responsible for climate change. Whereas Professor Giaever does not see there being sufficient scientific evidence to support this, Professor Osheroff pointed out that there is a strong correlation for this connection which should be further observed. The head of the podium discussion, Professor Schellnhuber, also made reference to the work of the UN’s Intergovernmental Panel on Climate Change (IPCC), of which he is a member: using the data available, they had been able to confirm with a high degree of certainty that mankind is the main cause of climatic change.

The podium discussion closed with a call to use the existing knowledge and available technologies in order to be able to deal with the challenges arising from climate change. Professor Osheroff emphasised that there is a particular need for application-oriented research. In the future, perhaps one of the Nobel Prizes would be awarded for discoveries which have made a contribution to solving the energy crisis and climate change. Within the context of this fascinating and in-depth podium discussion, perhaps the “Einstein of the 21st Century”, as Professor von Klitzing put it, were even sitting in the hall as members of the audience.

ABSTRACTS

FROM THE 58TH MEETING OF NOBEL LAUREATES

Professor Nicolaas Bloembergen

FROM MILLISECOND TO ATTOSECOND LASER PULSES

A historical overview is presented of the experimental development of ever shorter laser pulses from 1960 to the present. Already in the early sixties nanosecond pulses were achieved and the entry into the picosecond domain was reached in the late sixties with a neodymium glass laser. First sub-picosecond pulses were accomplished in 1974 with a broad gain dye-laser medium in combination with a saturable dye-absorber film. A true revolution in femtosecond generation occurred with a titanium-aluminium oxide laser crystal. Non-linear effects are essential not only in the generation of picosecond and femtosecond pulses, but also in their measurement and evaluation. In this talk the development from the millisecond to the attoseconds within the last 50 years will be reviewed.





Professor Johann Deisenhofer

STRUCTURAL BIOLOGY – QUO VADIS?

Since the 1950s, with the first 3-D structures of DNA and hemoglobin/myoglobin, structural biology has made amazing progress. The Protein Data Bank now holds atomic coordinates for over 50,000 individual macromolecular structures (~43,000 determined by X-ray crystallography, ~7,000 by nuclear magnetic resonance, and ~170 by electron microscopy). Much of the success has been enabled by progress in related fields, such as recombinant DNA technology, computing, synchrotron X-ray sources, superconducting magnets, etc.

While methods development in crystallography, NMR, and Electron Microscopy is continuing, new opportunities for experimental structure determination will arrive when the free electron lasers currently under construction in Stanford (LCLS, 2009) and Hamburg (XFEL, 2013), become operational. Because of the intensity and the time structure of the radiation generated at these facilities, it may become possible to collect X-ray scattering data from a single biological macromolecule within a few femtoseconds. This may lead to a whole new approach to structure determination.

An area in which progress has been slower than many of us hoped is the theoretical understanding of macromolecules, including computer simulations and predictions about their function and their behaviour in response to mutations or to changes in their environment. Here may be the greatest opportunity for today's young generation of scientists to make significant contributions to biomedical science.

In 1938 cosmic rays with energies in excess of 1 PeV were discovered by the French physicist Pierre Auger. In 1963 a cosmic ray with energy about 100 EeV was discovered. One hundred EeV is 16 joules of energy. There is no clear understanding how astrophysical objects can accelerate protons or nuclei to such high energies, a macroscopic energy in a microscopic particle. To try to answer this question an international collaboration of 16 countries has built a large Observatory in Argentina. The detector covers an area of 3000 square kilometers. The Pierre Auger Observatory has been operating since Jan 1, 2004. The first results have revealed at the highest energies a large anisotropy. There is some evidence that the cosmic rays come from nearby (< 50 Mpc) extragalactic matter.



Professor Dr. Riccardo Giacconi

THE IMPACT OF BIG SCIENCE ON ASTROPHYSICS

In the period 1990 to 2001 many powerful new astronomical observational facilities have become operational. Hubble Space telescope was launched in 1990; it was followed by the construction of Keck I in 1992 and Keck II in 1996, by the completion of the Very Large Telescope in 1998, the launch of the X ray observatory Chandra in 1999 and of the infrared Spitzer Telescope in 2001. I will focus my discussion on three telescopes systems in whose development I was personally involved: Hubble, VLT and Chandra.

The Chandra and Hubble Telescopes are in space and each costs (through operations) several billion dollars. VLT is on the ground but over 20 years of operations will also cost in excess of a billion. They all fall therefore in the category of what I consider Big Science, and they have required new technology and management tools to be developed particularly with regard to data management. I will highlight some of the major findings obtained with these observatories, some by a single facility, some in cooperative research programs. These findings are among the most unexpected and baffling results in astronomy. They include the study of intergalactic plasmas, of super massive black holes and of the properties of dark matter as well as the discovery of dark energy. We now believe that dark matter and dark energy constitute most of the matter in our universe. Since neither the nature of dark matter nor of dark energy is understood, astronomy is posing some of the most fundamental questions on the nature of the physical universe we live in.

I will briefly discuss how astronomy is carried out when confronted with the very large quantities of data produced by these telescopes and of the development of end to end data systems for data retrieval and archiving. The effects of these methodological changes have been profound for all astronomers and they have also changed the sociology of the field. Some concerns for the future exist regarding the concentration of technical expertise in a few groups building the facilities while the remainder of the community become consumers of data.

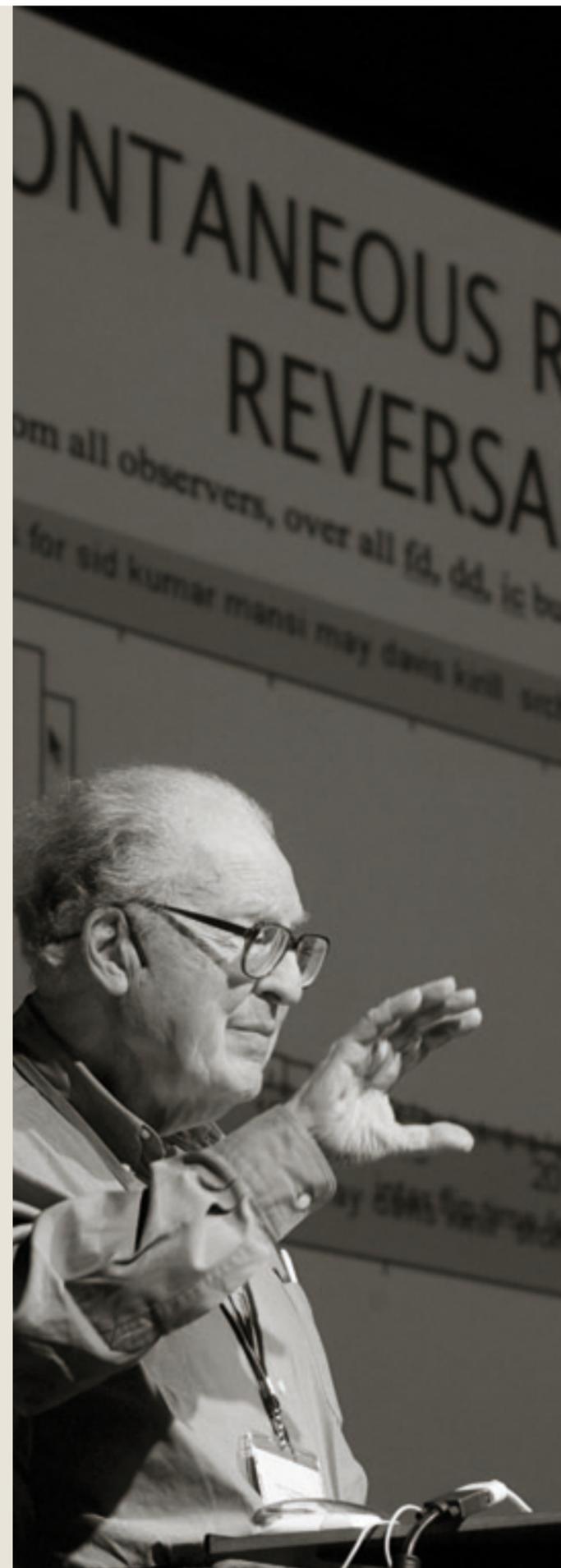
A separate but important development has been the exponential increase of high quality astronomical information shared with the general public, with as yet unknown effects.



Professor Dr. Ivar Giaever

DISCOVERY OF SUPERCONDUCTING TUNNELING

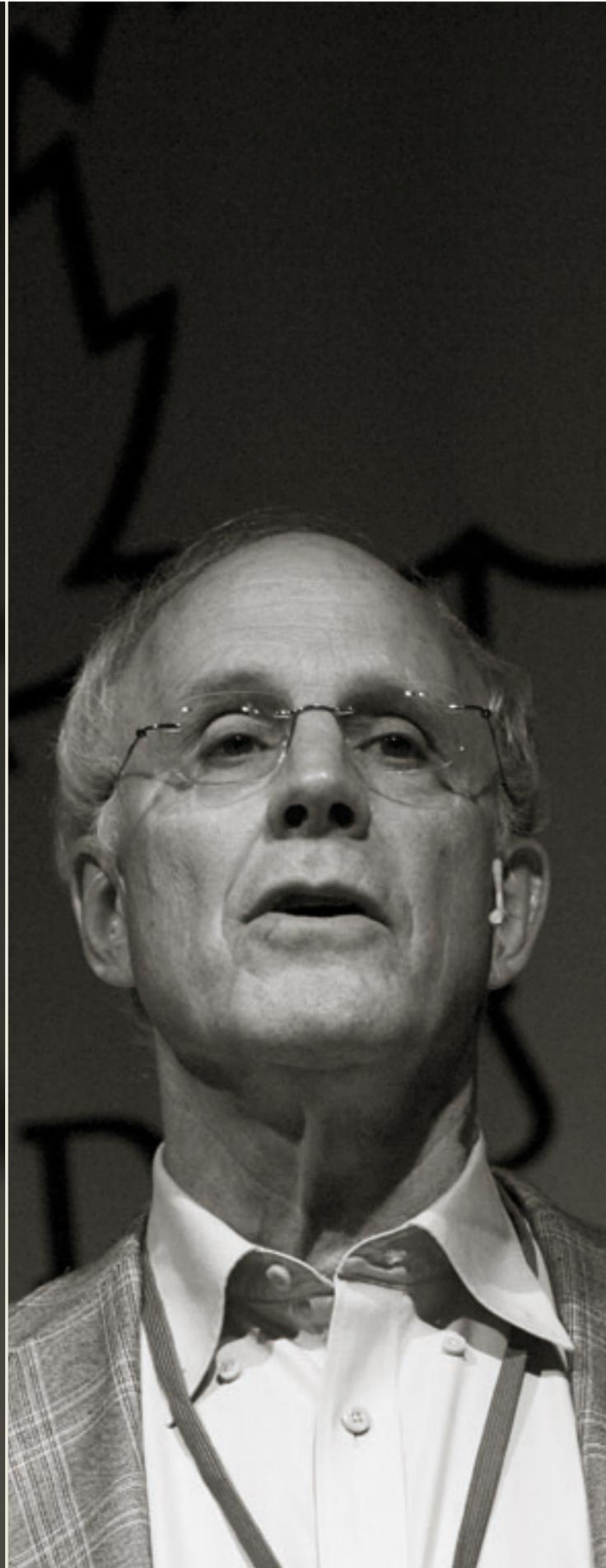
I had the great fortune to receive a Nobel Prize in Physics for using electron tunneling to measure the energy gap in superconductors. In this talk I will recollect some of the events that led to this discovery and hopefully I will be able to convey to you some of the fun and excitement of that area. My great fortune was to be at the right place at the right time, where I had access to outstanding and helpful physicists. If you become really interested you may find a written version in my Nobel Prize talk: "Electron Tunneling and Superconductivity" on the web site <http://nobelprize.org>.



Professor Dr. Donald Glaser

ROLE OF CORTICAL NOISE IN VISION

Our brains are always generating electrical signals, even if we close our eyes, plug our ears, and lie in a warm bath. These signals are called cortical noise because they don't correlate with any sensation or thought of which we are aware. I will discuss how this noise is essential for several common brain functions.



Professor Dr. Roy J. Glauber

THE INDIVIDUALITY OF LIGHT QUANTA

Light quanta are the fundamental units of radiant energy. When propagating freely they travel at the fastest attainable speed and live forever. These properties recommend them as the ideal messengers for communication of all sorts. Ordinary light sources generate quanta in such an overwhelming abundance however, and in such random states, that we ordinarily lose sight of their ultimate separability and individual behavior.

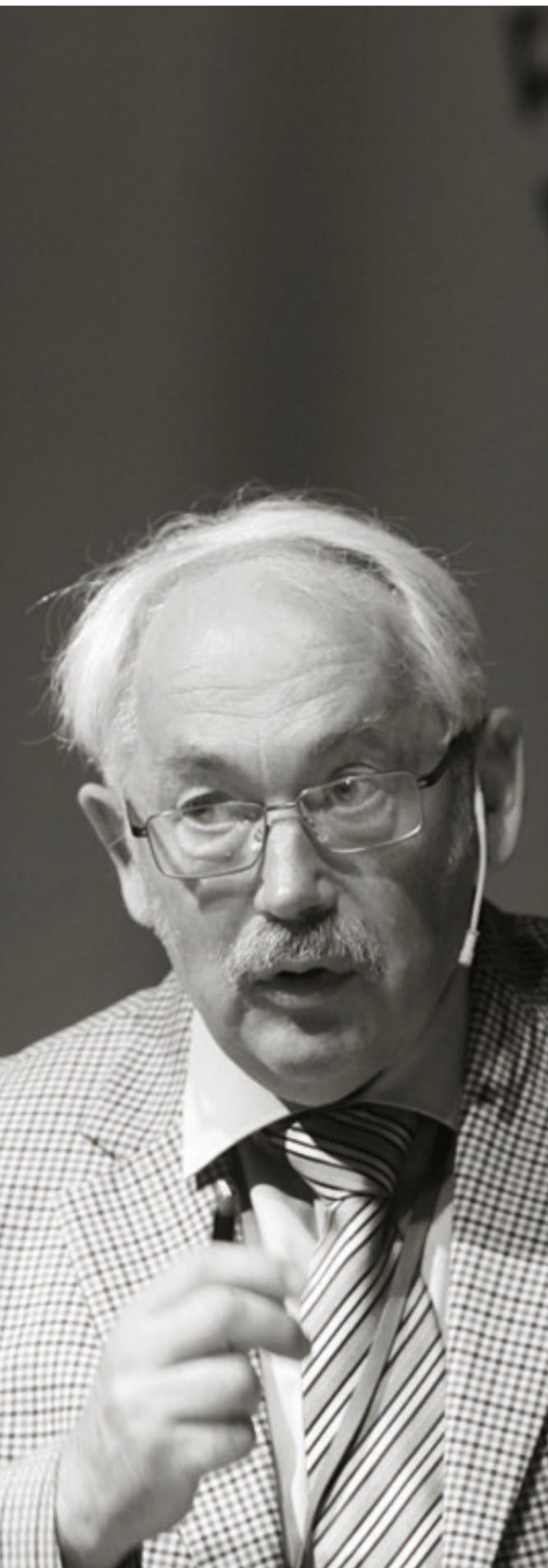
The realization of this separability is about 100 years old. Its apparent contradiction of the well-established wave picture of light led to a succession of theoretical dilemmas that could only be resolved by the fully developed quantum field theory of electrodynamics, some years later. Those years have also seen the development of a succession of experimental techniques for generating individual light quanta or small numbers of them in controllable states and investigating their properties.

We shall discuss several of these.

Professor Dr. David Gross

THE LARGE HADRON COLLIDER AND THE SUPER WORLD

Some of the profound questions about elementary particles and forces and the universe will be described; questions that might be answered as the Large Hadron Collider at CERN turns on this year. For example: What gives mass to elementary particles? Do all the forces between particles arise from a single basic force? What is the dark matter that makes up one fourth of the universe and is critical to the formation of galaxies? One speculative theory that seeks to address some of these questions is called supersymmetry. It uses quantum variables to describe space and time and suggests that every known particle has a yet-undiscovered superpartner particle. These new particles may soon be discovered at the Large Hadron Collider.



Professor Dr. Peter A. Grünberg

FROM SPINWAVES TO GIANT MAGNETORESISTANCE (GMR) AND BEYOND

Standing spinwaves and surface waves in layered magnetic structures can be used for the detection and quantitative evaluation of interlayer exchange coupling (IEC). Using this method antiferromagnetic IEC has been found in Fe/Cr/Fe layered structures. This was applied to switch the alignment of the magnetizations of the Fe films in an external field from antiparallel to parallel whereby the Giant Magnetoresistance (GMR) effect was discovered. Currently the interest focusses on "Current Induced Magnetic Switching" (CIMS) which can be understood as inverse GMR effect. For all three effects, IEC, GMR and CIMS there are many interesting applications.



Professor Dr. John L. Hall

THE OPTICAL FREQUENCY COMB – A REALLY VERSATILE TOOL

The Optical Frequency Comb concept and technology exploded in 1999–2000 from the synthesis of advances in independent fields of Laser Stabilization, UltraFast Lasers, and NonLinear Optical Fibers. The Comb was developed first as a method for optical frequency measurement, enabling a thousand-fold advance in optical frequency measurement, and searches (in the 16th digit) for time-variation of physical "constants". The Comb methods also empower enhanced time-domain control, with broad applications in spectroscopy, metrology, and the extension of nonlinear optics into the XUV range and beyond. A comb-excited Cavity Ringdown measurement allows massively multiplex spectroscopy, sensitively to detect disease-marker molecules within human breath. In Comb-based length metrology, the incredible resolution is accessible ALONG WITH intrinsic resolution of the integer fringe question: two great applications will be control/calibration of next-generation interferometric planet-finder missions, and cold-start dimensional metrology for accurate photolithography of large semiconductor wafers.



Professor Dr. Theodor Hänsch

**TOWARDS A QUANTUM LABORATORY
ON A CHIP**

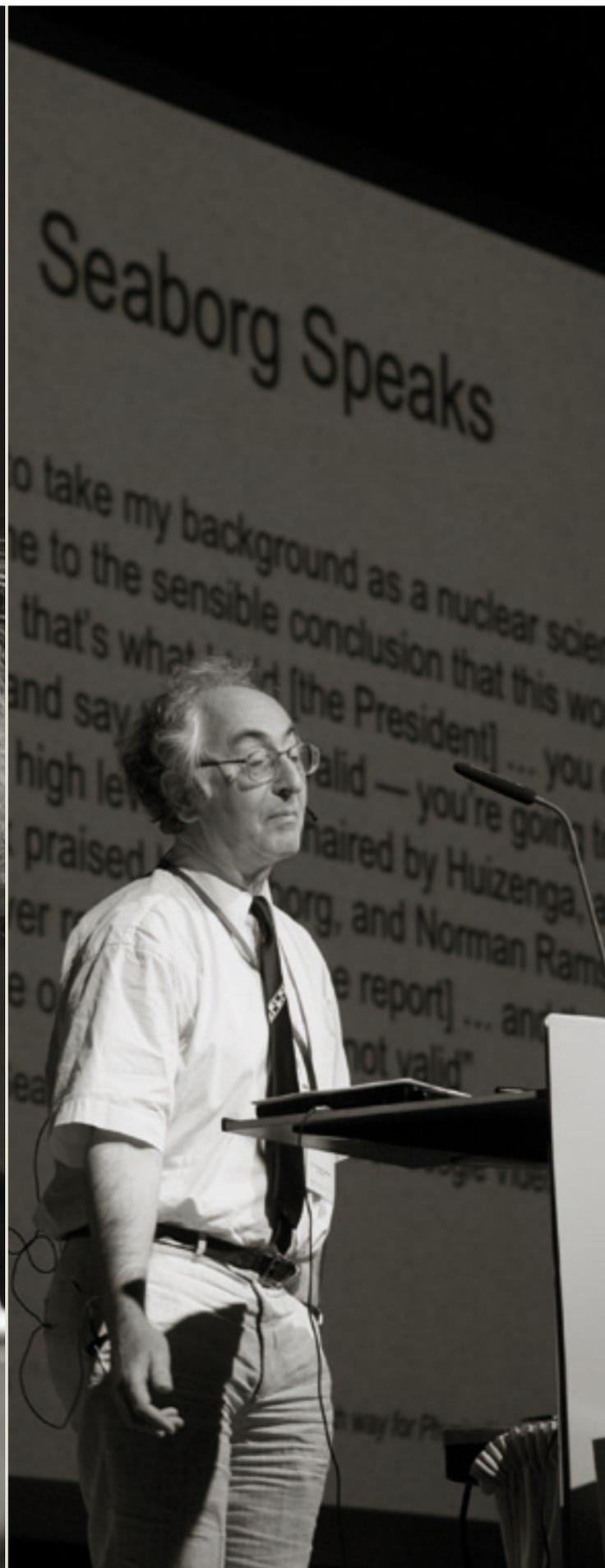
Microfabricated magnetic traps, waveguides, and other elements for the manipulation of ultracold atoms can be combined to form a quantum laboratory on a chip. Devices such as miniaturized atom lasers, atom interferometers, and atomic clocks have been implemented in this way. Atom chips are also offering intriguing perspectives for quantum simulations and quantum information processing. Recent experiments at Munich will be reviewed.

Professor Dr. Gerardus 't Hooft

HUMANITY IN THE COSMOS

In the recent past, rapid scientific and technological developments have had tremendous impact on human society. Notably the pc, internet and mobile telephony changed the world and shrank our planet. These developments are vastly different from the forecasts by science fiction authors, who promised us space travel and intelligent humanoid robots. Could real scientists have done a better job in forecasting the future? What can we say about the future now? Many SF fantasies will never materialize. Some will, but only over time spans of millions of years rather than a couple of centuries. Nature's laws are very strict and forbidding but also show gaps that might promise fantastic possibilities for a scientific future, even within our lifetime. Humanity will be able to conquer the cosmos, but how?





Professor Dr. Robert Huber

BEAUTY AND USEFULNESS OF THE BUILDING BLOCKS OF LIFE: THE ARCHITECTURE OF PROTEINS

Atomic views of protein structures are determined with increasing pace in the last twenty years by a rapid development of methods and instrumentation of protein crystallography, electron microscopy, and nuclear magnetic resonance, allowing the determination of very large and complex protein structures. These structures document the beauty and unlimited versatility of the proteins' architecture, but reveal also unexpected relationships, allowing views on biological evolution far back in time. The structures are a basis for understanding the proteins' binding specificities and catalytic properties (chemistry), their spectral and electron transfer properties (physics), and their roles in physiological systems (biology and medicine). They allow design and development of specific ligands of target proteins opening novel strategies for therapeutic intervention and development of new medicaments and for plant protection.

Professor Brian Josephson

WHICH WAY FOR PHYSICS?

This talk describes a new approach to the problem of characterising physical reality, one with the potential to fill in gaps in the conventional understanding of nature. It is based on a different view from the usual one of structure at the finest levels, which structure is taken to be highly irregular, as in systems at the 'edge of chaos', but with self-organisation leading to the emergence of more regular behaviour at higher levels including those familiar in today's science. In this picture the basic processes involve collections of agents cooperating to create, and survive in, a 'lifeworld', which can be viewed as a biological equivalent to the kinds of cooperative processes familiar in the context of physics.

This picture is characterised by the infusion of meaning (identified with the ways in which the various agents cooperate through information exchange) into a domain that, through the lack of a clear interpretation of quantum indeterminacy, is normally regarded as a no-go area for physics. Since meaning seems to be an essential part of our experience, the new perspective could well have the status of correcting a previous incomplete view of nature so as to include for example our subtler human capacities. In any event, the way 'agents' emerge naturally in this picture already serves to clarify key issues in the quantum realm, such as the postulated 'observer-participancy' of Wheeler.

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<http://tinyurl.com/5lpo6g>
- Stuart Kauffman, The Origins of Order
- Steven M. Rosen, The Self-Evolving Cosmos



Professor Dr. Klaus von Klitzing

CARBON ELECTRONICS

The talk summarizes new developments in the field of nanoelectronic devices based on carbon. Two different allotropes of carbon are at present in the focus of research, the carbon nanotubes (CNT) and graphene, a one atom thick layer of carbon.

Nanotubes are discussed as one-dimensional wires for interconnects and switching devices in electronic circuits whereas graphene seems to be an ideal two-dimensional electron system with fascinating new properties including the observation of the quantum Hall effect at room temperature. Recent experiments in this field will be presented.

Professor Dr. Hartmut Michel

CYTOCHROME C OXIDASE: STRUCTURE AND MECHANISM OF A PROTON PUMP

In biology, membranes are barriers for the transport of ions and polar substances. They are even electric insulators. These properties have allowed nature to use mitochondrial and bacterial membranes for energy transduction via electric voltages (potentials) and ion gradients. Cytochrome c oxidase is an enzyme which transfers electrons from cytochrome c onto oxygen and consumes protons to form water as a product. This reaction creates an electric voltage and a pH difference across the membrane, because cytochrome c delivers its electrons from the outer surface of the membrane whereas the protons originate from the inner surface of the mitochondria or bacteria. In addition, the enzyme translocates ("pumps") four protons from the inner to the outer surface per reaction cycle enhancing the both electric voltage and pH difference. This so-called "electrochemical proton gradient" drives protons back via the ATP-synthase leading to the synthesis of the universal biological energy carrier adenosine-5'-triphosphate ("ATP") from adenosine-5'-diphosphate ("ADP") and inorganic phosphate. The reaction catalysed by the cytochrome c oxidase is understood insufficiently and the subject of controversial discussions. The active site of the enzyme, where oxygen is reduced and water is formed, consists of a heme-iron and a copper atom. It is located in the center of the membrane. There are proton transfer pathways in the enzyme which allow and control the access of protons, required for water formation, to active site. One of these pathways is also used for protons to be pumped. However, it is e.g. unclear which chemical entity is bound in the active site when the enzyme is in its oxidized form. The author's view, based on X-ray structures of the enzyme, will be presented.



Professor Douglas D. Osheroff

HOW ADVANCES IN SCIENCE ARE MADE

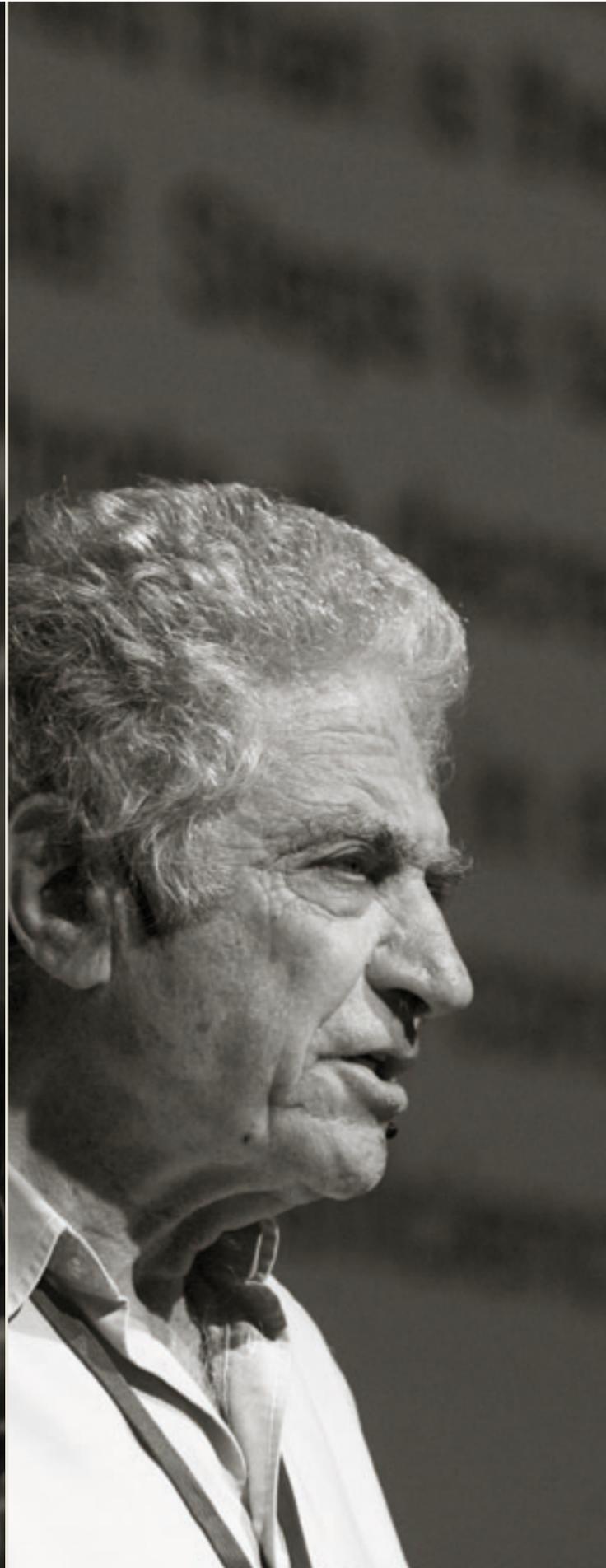
How advances in science are made, and how they may come to benefit mankind at large are complex issues. The discoveries that most influence the way we think about nature seldom can be anticipated, and frequently the applications for new technologies developed to probe a specific characteristic of nature are also seldom clear, even to the inventors of these technologies. One thing is most clear: Seldom are such advances made by individuals alone. Rather, they result from the progress of the scientific community; asking questions, developing new technologies to answer those questions, and sharing their results and their ideas with others. However, there are indeed research strategies that can substantially increase the probability of one's making a discovery, and the speaker will illustrate some of these strategies in the context of a number of well known discoveries, including the work he did as a graduate student, for which he shared the Nobel Prize for Physics in 1996.

Prof. Dr. William D. Phillips

**COLD ATOMIC GASES:
THE INTERSECTION OF CONDENSED MATTER
AND ATOMIC PHYSICS**

During the past decade laser cooling and evaporative cooling of atoms have produced quantum degenerate gases both of bosons (Bose-Einstein condensates) and of fermions (gases with temperatures below the Fermi temperature). Such gases can provide analogs to the behavior of condensed matter systems. A prominent example is that of atoms in optical lattices (periodic potentials created by light), which can simulate the motion of electrons in the periodic potential of a solid state crystal lattice. Such analog systems can exhibit behavior that is difficult to observe in solids and provide new insights into condensed matter phenomena.





Prof. Dr. George F. Smoot

THE BEGINNING AND DEVELOPMENT OF THE UNIVERSE

By careful investigation of relic left on the cosmic scene we have very good evidence and constraints on what has occurred since the beginning of the Universe. This talk reviews the evidence including images and information from the very first light about the early universe and its subsequent development.

Since that epoch we have seen the formation of stars and galaxies as well as eventually solar systems. All of this hangs together in a simple model with some exciting new features.

Prof. Jack Steinberger

WHAT FUTURE FOR ENERGY AND CLIMATE?

We are using the planet's fossil fuel resources in a time which is very short compared to that of human evolution. In the same process we are changing the planet's climate and sea level, threatening the future of large segments of the global population. The presentation will try to review the present situation. Avoiding future catastrophe would require immediate, substantial and globally collaborative changes in the behaviour of our society, which might be possible, but represent a formidable social challenge. I will end with a discussion of the possibility for the production of the dominant part of the global electric power using thermal solar technology with overnight storage.



Professor Martinus J. G. Veltman

THE DEVELOPMENT OF PARTICLE PHYSICS

Particle physics mainly developed after World War II. It has its roots in the first half of the previous century, when it became clear that all matter is made up from atoms, and the atoms in turn were found to contain a nucleus surrounded by electrons. The nuclei were found to be bound states of neutrons and protons, and together with the idea of the photon (introduced by Einstein in 1905) all could be understood in terms of a few particles, namely neutrons, protons, electrons and photons. That was the situation just before WW II.

During WW II and directly thereafter information on the particle structure of the Universe came mainly through the investigation of Cosmic rays. These Cosmic rays were discovered by Wulf (1909) through measurements on the top of the Eiffel tower and Hess (1911) through balloon flights. It took a long time before the nature of these cosmic rays became clear; just after WW II a new particle was discovered by Conversi, Piccioni and Pancini. This particle had a mass of 105.65 MeV (compare the mass of the electron, 0.511 MeV and the mass of the proton, 938.272 MeV). The development of photographic emulsions led in 1947 to the discovery of another particle, the charged pion (mass 139.57 MeV), by Perkins. In subsequent years yet more particles were discovered, notably the K-mesons and the "strange baryons" such as the Lambda (mass 1115,683 MeV). Gradually the phenomenology of all these particles developed, new quantum numbers were invented and classification schemes developed. At the same time, the development of new devices and methods—greatly furthered the knowledge of elementary particles. The most important of these are the particle accelerators, the cyclotron and developments thereof, and the detection instruments such as bubble chamber and spark chamber.

In the beginning sixties Gell-Mann and Zweig came up with the idea of elementary constituents called quarks. These quarks did have unusual properties, the main one being that they did have non-integer charge, in contrast to all particles known at the time that did have integer charge (such as the electron

and muon with a charge of -1). For this reason the quarks were not immediately accepted by the community. In addition, as we know now, they can only occur in certain bound states such that the charge of these bound states is integer. Thus the quarks by themselves are confined to bound states. The reason for this confinement became clear much later, around 1972.

The theory of the forces seen to be active between these particles is quantum field theory (QFT), a theory of such complexity that its development stretched over many years. Around 1930 Dirac, Heisenberg and Pauli formulated the foundations of QFT, but it was soon discovered that the theory as known then was very defective, giving rise to infinite answers to well defined physical processes. Fermi was the first to apply QFT to weak interactions, notably neutron decay. The theory developed by Fermi was a perturbation theory, with answers given in terms of a power series development with respect to some small constant, the coupling constant. The lowest order approximation of Fermi's theory was quite successful, but any attempt to go beyond the lowest order met with failure. In any case, Fermi's theory involving the then hypothetical neutrino postulated by Pauli, was successful enough to cement acceptance of that particle.

A breakthrough was due to Kramers, who already before WW II discovered that QFT implied certain corrections to the atomic spectra. Experiments by Lamb actually measured such corrections (Lamb shift), and Kramers ideas found acceptance by the community. In addition, Kramers introduced the idea of renormalization, a procedure whereby the infinities of QFT were localized, and where outside these isolated parts perfectly precise calculations could be done. Feynman, Schwinger and others took up these ideas and developed the QFT of electromagnetic interactions, allowing very precise calculations of the Lamb shift and other corrections, commonly called today radiative corrections. These developments, including very successful experimental confirmations, took place around 1948.

The development of QFT of the weak interactions was very difficult and lasted till about 1971. A new idea, the interplay of forces arranged in a very careful manner such as to avoid the occurrence of infinities, was developed. This is known under the name of gauge theories. In such a theory there is a multitude of forces and particles such that all irreparable bad features cancel out. Thus the theory thereby predicted the existence of certain new particles, necessary to complete the complex structure of balancing infinities. The actual discovery of these particles, notably the Z₀ and the charmed quark, topped by the discovery of the top quark in 1995, has firmly established the gauge theory of weak interactions.

The strong interactions, the forces responsible for the interactions between quarks and notably supposedly responsible for quark confinement, profited from the development of gauge theories. In the wake of the gauge theory of weak interactions also a gauge theory of strong interactions was formulated and investigated. An important step was taken with the establishment of asymptotic freedom for the gauge theory of strong interactions. By 1980 the Standard Model of Weak, em and strong interactions was settled; the Higgs sector of that model remains still to be tested, which hopefully will be done at least partially using the new machine L(arge) H(adron) C(ollider) at CERN, planned to start operation in 2008.

It's not every day that you witness several Nobel laureates locked in a lively two-hour debate about the future of their field. But then Lindau meetings are quite unique. This year's event saw 18 physics Nobel prize winners assemble on Lake Constance to meet with 558 young researchers from 66 different nations.

The Lindau tradition helps inspire the next generation of physicists. But this year's meeting had an especially timely edge: the biggest physics experiment in history – the Large Hadron Collider (LHC) – was nearing completion a few hundred kilometres away at the European laboratory for particle physics CERN outside Geneva. The 27km-circumference machine, which has since begun operation, is the world's most powerful particle collider and was the subject of much discussion. Indeed, some of the talks that led to the creation of CERN in 1954 were held during the first Lindau meetings, for example by quantum mechanics pioneer and winner of the 1932 Nobel physics prize Werner Heisenberg. Fourteen years in design and construction, lying 100m beneath the French-Swiss border, the LHC will shunt protons in opposite directions to almost the speed of light and then collide them at four points around the ring. Tracking the collision debris are four cathedral sized "digital cameras", each weighing thousands of tonnes and taking 40 million snapshots per second. In this extreme environment, physicists hope to discover new fundamental particles and forces that could deepen our understanding of the most fundamental layer of reality. It's the ultimate reductionist's dream.

The LHC's roots lie in over a century of Nobel-prize winning research, dating back to chemistry laureate Ernest Rutherford's discovery of the atomic nucleus in 1910. Almost half of the laureates present at Lindau this July had some connection with the LHC or particle physics. Take Douglas Osheroff, who in 1971 co-discov-

ered that helium-3 becomes a frictionless "superfluid" below a certain temperature. This weird quantum mechanical system, which has given rise to some nine laureates, is now keeping the LHC's thousands of superconducting bending magnets at their -271°C operating temperature.



Donald Glaser invented the bubble chamber, which drove numerous discoveries of new particles in the 1960s and paved the way for the "standard model" of particle physics. CERN physicist Jack Steinberger co-discovered the muon neutrino in 1961. Even more directly related to the LHC are theorists Martinus Veltman, Gerard 't Hooft and David Gross, who won their Nobels for theoretical input to the standard model.

During Wednesday's particle-physics themed talks, Veltman put the six billion Swiss Franc LHC into perspective by presenting the history of accelerators with flair. He was followed by Gross, who gave a supremely clear vision of the "superworld" of heavy new particles that many hope the LHC will discover, telling the young audience what a rare and exciting time it is to be working in fundamental physics. Two talks delivered earlier in the day by cosmologist George Smoot and astrophysicist Riccardo Giacconi highlighted the increasing connections between the their fields (which concern the very largest scales) and particle physics (the very smallest), for instance via the mysterious "dark matter" that seems to dominate the universe. But the most exciting particle-physics action at Lindau this year took place the day before.

Nobel dreams

On Tuesday afternoon, Lindau hosted a press conference in conjunction with CERN specifically devoted to the LHC – and to the hopes and expectations of some of the most qualified physicists around. Smoot, who trained as a particle physicist, Gross, Veltman and 't Hooft were joined by former CERN Director General [NOTE: this is how CERN refer to the position] Carlo Rubbia, who led the discovery of the W and Z bosons and is widely regarded as the godfather of the LHC. The distinguished panel of laureates was completed by CERN's deputy director general Jos Engelen and LHC project leader Lyn Evans, with a live link to the CERN Control Centre. After a brief status report of the LHC and experiments from Evans and Engelen, the 30 or so members of the press (and others watching the event live over the Web) were given rare insight into the relationship between theorists and experimentalists in high-energy physics.

It began with 't Hooft stating that he is practically certain that the Higgs boson – the particle thought to explain mass and the last missing piece of the Standard Model – exists and that, if so, the LHC will find it. He spoke for everyone when he said he hopes that the LHC will find something that guides theo-



rists beyond the standard model towards a deeper understanding of nature. Smoot said he has very high hopes, "perhaps too high", for what the LHC will find. He wants it to explain what dark matter is, but really wishes for signs of extra spatial dimensions. "So many new things and great ideas would come out of that," he said. Gross views the discovery of the Higgs more like yesterday's news and thinks extra dimensions and other gravitational phenomena rather unlikely.

His hopes lie in supersymmetry, and the discovery of a host of new particles that would reveal new internal structure to nature and may even explain dark matter. "Supersymmetry would not only be a profound discovery but would open up a new world to explore," he said. "But like many of our speculations, it could be wrong, and something even weirder could show up."

Veltman brought the conversation down to Earth, pointing out that the enormous rate of proton-proton collisions at the LHC [600m per second] will make the job of filtering out the occasional Higgs particle or anything else a "monstrous" task. "It will take time and patience, and things will go wrong," he told the audience. Although Veltman accepted the possibility that new particles could turn up, he was sober about the chances of finding the Higgs and dismissed supersymmetry and string theory as being based on little more than "belief". He concluded by saying that if the LHC sees nothing, then it could spell the end of particle physics.

The discussion then went a little off-piste, to great effect. Rubbia claimed that theorists have had rather too much time on their hands to dream up fancy new theories, a sentiment later expressed by Smoot, and asked Veltman whether he would return his Nobel prize money if the Higgs didn't turn up. After playfully pointing out that his former student 't Hooft had introduced the Higgs, Veltman said he'd already spent the money and asked whether [since the standard model had brought Rubbia the prize] he would be handing back his prize money if the Higgs didn't turn up!

Echoing Veltman's sincere hope that the LHC doesn't just find the Higgs, Gross said this scenario is a "real nightmare" because it would give experimentalists no idea what energy a future collider should have. Smoot was more optimistic that further experiments will be built, and Rubbia offered some experimental-

ist's wisdom by stating: "nature is smarter than physicists, so we should have the courage to let nature tell us what is going on." 't Hooft rightfully pointed out that if the LHC "dies" having only produced the Higgs and confirms everything about the standard model, then it would be judged as a success.



After being taken through magnet preparations live from CERN, the press had more than an hour to question the panel – which ranged from how much the electricity the machine consumes will cost [about €19m per annum], to when the first Higgs boson will be produced. Lively exchanges between the laureates continued, with Veltman describing as "blather" claims by the media and physicists that the LHC will recreate conditions that existed immediately after the Big Bang. The panel also stressed repeatedly that

it will take years before the LHC is running at peak performance and even longer before any new particles will be discovered, especially the Higgs. "Rumours will come flying out because people are going to be so excited about what they're seeing," said Smoot. "But as scientists we have to doubt ourselves."

Which way for physics?

Particle physics was by no means all that was discussed at Lindau. Indeed, Steinberger closed Wednesday's session by talking about the future of energy use, and on Tuesday was one of seven laureates to sit on a high-profile panel to debate climate change. Furthermore, the reductive approach epitomized by the LHC is not all there is to physics. Some researchers have long argued that more holistic or emergent approaches – such as complexity – are needed to make sense of physical reality.

Condensed matter physicist Douglas Osheroff thinks both approaches are necessary. "In my own field, it is simply impossible to start with fundamental particles and quantum mechanics and predict the behaviour of systems with 10²³ particles," he said. Atomic physicist William Philips agrees: "Reductionism has been good to me!" he said in a press conference at Lindau this July.

Ted Hansch, caught while stepping off the boat on the Island of Mainau on the last day of the week, said people are always asking whether reductionism has run its course and talking about 'the end of science'. "Complexity is a huge subject that's only beginning to be understood," he said. "Fields will merge. Physics will be okay."

Whatever views people have about the future of physics, few could have wished for a better backdrop to this year's physics meeting. After all, surveys show that particle physics is one of the main

things that attracts students into physics in the first place. Perhaps the next Lindau physics meeting will be buzzing with talk of the LHC's discoveries, and with luck the following one might be able to extend an invitation to Professor Higgs himself.

By Matthew Chalmers





Traditional dance during the Bavarian Get-Together.

“ I started to expect the Lindau Meeting since four years ago, and I feel very lucky to attend this “once-in-a-life-time” event. I enjoy very much the atmosphere created during the meeting, where young researchers from all of the world got valuable advice from the Nobel Laureates and shared experience and opinions with others. I really appreciate the suggestions given by the Nobel Laureates, from which I once again obtain the motivation to encourage myself to proceed with my research. I want to give my sincere thanks to all the participants, the organisers and everyone else who made this meeting a very pleasant memory for me.

Ying Fan, China/

Peking University, Fellow of the Sino-German Center for Research Promotion ”

SOCIAL PROGRAMME

Educate. Inspire. Connect. – The Nobel Laureate Meetings promote the exchange of knowledge and of experiences through personal encounters at Lake Constance. This facilitates the creation of long-term networks which will be able to deal with future challenges. The numerous fringe events which accompany the scientific programme also provide opportunities for networking, in line with the fundamental philosophy of the meetings and thereby adding to that “special Lindau atmosphere”, for which the Nobel Laureate Meetings are known around the world.

The events in the social programme are subjected to constant scrutiny and continuous improvement. Last year, for example, the welcome events were staged for the first time on the Sunday evening, a pattern which was repeated this year. A new element was introduced in the form of the “Bavarian Get-Together” on Thursday. The results from the participant survey indicate that the social programme events are very much appreciated by the participants. In addition to the lectures and seminar discussions in the afternoons, the Monday evening get-together, the concert given by the UBS Verbier Festival Chamber Orchestra, and the trip to the Isle of Mainau on the closing day, are some of the events in the programme which are appreciated most by the participants (cf. overall results page 105).

Welcome Parties.

On the evening of the opening day, all the up-and-coming scientists were invited to establish initial contacts at an evening meal and to get to know more about the other young researchers from in total more than 60 countries. To enable them to socialise a little more easily, two welcome parties were organised simultaneously. At the invitation of the US Department of Energy (DOE), the National Science Foundation (NSF), the Oak Ridge Associated Universities (ORAU) and MARS, Inc., the American delegation



Professor David Gross and a participant dance at the Get-Together Evening on Monday.

gathered together with participants from other countries in the Inselhalle. In a tent next to the Inselhalle, the European Commission invited other participants. The European soccer championships final was taking place at the same time, and therefore the whole evening was very much under the influence of sport, and especially so for the participants from Spain and Germany. Whatever their own sporting inclinations, the young researchers made the most of these opportunities to indulge in intense discussion. Over the course of the week, many of the topics which came up were discussed at greater length or considered from a new perspective, at the prompting of what had been said in the lectures and in the seminar discussions.

Get-Together Evening.

The traditional Monday evening get-together brings Nobel Laureates and young scientists together in an informal setting. This event has been a permanent fixture in the meeting programme for decades. The participants’ feedback shows that the informal atmosphere of this evening event and the personal con-

tacts which it promotes are very much appreciated. In some of the comments, however, it became very clear that the evening's music was felt to be inappropriate and no longer in keeping with the times!

Dinners with the Academic Partners.

The establishment of long-term networks of outstanding scientists is only possible thanks to the cooperation of the Lindau Institutions with prominent science institutions around the world. During the course of their own events on the Tuesday evening, these Academic Partners bring together in small groups the participants they have nominated together with the Nobel Laureates. In the informal setting of an evening meal, the young researchers can network better with one another and interact more easily with world experts in their field. The Alexander von Humboldt Foundation, the US Department of Energy (DOE), the German Academic Exchange Service (DAAD), the Deutsche Telekom Foundation, the Elite Network of Bavaria, the Helmholtz Association, the Max Planck Society and the Nobel Foundation also invited young researchers and Nobel Laureates to dinners at a number of restaurants in Lindau.

For all German participants there was also a reception organised by the Wilhelm and Else Heraeus Foundation. Professor Joachim Treusch (Member of the Board of Directors) welcomed 98 young researchers as well as Nobel Laureates Professors Werner Arber, Robert Huber and Jack Steinberger at the old Town Hall. In the presence of Wilhelm Heraeus (Member of the Board of Directors), Professor Bernhard Kramer (Member of the Advisory Council) and Dr. Ernst Dreisigacker (Managing Director), Professor Treusch said: "The Wilhelm and Else Heraeus Foundation is proud and pleased to enable you – the Physics students who have been selected by your universities and institutes – to participate in the Nobel Laureate Meeting in Lindau. This opportunity to meet prominent figures from our field of specialisation will, as I know from personal experience, leave a lasting impression on your life." At the din-



Nobel Laureate **Professor Robert Huber** (from left), **Professor Joachim Treusch** and **Wilhelm Heraeus** at the reception of the Wilhelm and Else Heraeus Foundation.

ner afterwards, young scientists had the opportunity to engage in conversation with the Nobel Laureates and representatives from the Wilhelm and Else Heraeus Foundation.

Concert by the UBS Verbier Festival Chamber Orchestra.

On Wednesday evening, young scientists and Nobel Laureates were invited to attend a concert, where seven young musicians from China, France, Israel, Serbia, Turkey and the USA played works by Beethoven. Since its creation in the year 2000, the UBS Verbier Festival Orchestra, whose Executive Director Martin T:son Engstroem attended the concert, has achieved an outstanding international reputation for quality, vitality and commitment. Mr. Engstroem extended a warm welcome to the audience at the Stadttheater and expressed his pleasure that the Lindau mission and the Verbier mission have so much in common. The Orchestra itself is composed of 100 musicians aged 17 to 29 from over 30 countries. The UBS Verbier Festival Chamber Orchestra, created in 2005, is a formation composed of current and former Orchestra members.



The **UBS Verbier Festival Chamber Orchestra** gave a concert at Lindau.



State Minister **Dr. Thomas Goppel** received the new coffee table book "Nobels" with portraits of Nobel Laureates by **Peter Badge**.



Christina V. Kraus was one of four young researchers from the Elite Network of Bavaria who presented their current scientific work at the Bavarian Get-Together.

Bavarian Get-Together.

Once the scientific programme had ended on Thursday, a "Bavarian Get-Together" was organised in the Inselhalle. The Free State of Bavaria presented itself as a centre of science and research to the Nobel Laureates and to young researchers from almost 70 countries. The State Minister, Dr. Thomas Goppel, welcomed the guests to this special evening, at which the State's elite from the fields of science, education and research acted in perfect harmony with their counterparts from the fields of Bavarian cuisine and beer brewing! "You really get to know a country when you have eaten what they eat, drunk what they drink, and laughed as they laugh," State Minister Goppel said. And because one gets to know a country even better "when you discover how they think there", four young scientists from Bavaria presented their latest research projects. As members of the Elite Network of Bavaria, they are among those up-and-coming scientists who might one day return to Lindau as Bavarian Nobel Laureates – just like Professor Theodor Hänsch (Nobel Laureate in Physics in 2005), who introduced them to the audience.

SPEAKERS AND TOPICS

Witlief Wieczorek (International Doctorate Programme Quantum Computing, Control and Communication): "**Multiphoton Entanglement**".

Andreas Fichtner (International Doctorate Programme THE-SIS- Complex Processes in the Earth: Theory, Experiment, Simulations): "**Seismic Waveform Tomography. Improved Tsunami Warnings and Insights into the History of the Solid Earth**".

Andrei Constantin (Elite Master Programme Theoretical and Mathematical Physics): "**String Theory. Dynamical Transitions between Landscapes**".

Christina V. Kraus (International Doctorate Programme Quantum Computing, Control and Communication): "**Pairing in Fermionic Systems**".

Closing Day

Together with the Lindau Institutions, the State of Baden-Württemberg invited the Laureates and the young scientists, as well as prominent representatives from science and the economy in Baden-Württemberg, to take part in the traditional boat trip and subsequent visit to the Isle of Mainau to conclude the 58th Nobel Laureate Meeting. During the trip on the MS Zeppelin to the Isle of Mainau, universities, research institutes and companies from the state of Baden-Württemberg presented themselves for the first time. All participants at the Nobel Laureate Meeting were invited to take this opportunity to get to know Baden-Württemberg a little better – and the State's strategic expansion of its scientific potential through cross-border partnerships with the leading science establishments of its neighbours and around the world. On the way to the Isle of Mainau, the State's Minister for Science, Research and Art, Prof. Dr. Peter Frankenberg, personally presented Baden-Württemberg as a centre of science.

The official closing event of the 58th Nobel Laureate Meeting took place in front of the Bernadotte family residence on the Isle of Mainau, to which Countess Bettina Bernadotte warmly welcomed the Minister President of the State of Baden-Württemberg, Günther H. Oettinger, and the Rector of the University of Constance, Prof. Dr. Gerhart von Graevenitz.

In his address, the Minister President made reference to the long-standing history of the Nobel Laureate Meetings. "In the early 1950s, in the aftermath of the Second World War, Count Lennart Bernadotte had the idea of inviting Nobel Laureates to meet young scientists from all over the world at Lake Constance. In doing so, he was making an invaluable contribution not only towards promoting international science but also towards enhancing the reputation of Germany in those years. All this was many decades ago, and the Lindau Meeting has developed into an important event with global impact." Baden-Württemberg, Mr. Oettinger continued, has been home to a large number of outstanding scientists: Johannes



Closing ceremony in front of the Mainau castle: Young researcher **Dr. S. K. Hodak**, Countess **Bettina Bernadotte**, Count **Björn Bernadotte**, Nobel Laureate **Professor D. Gross**, Professor **G. von Graevenitz**, Minister President **G. H. Oettinger**, and the Mayor of Konstanz, **Horst Frank**.

Keppler, Heinrich Hertz, Karl Steinbuch and Albert Einstein. For society and politics, it is now a matter of ensuring that the torch can be passed on to the next generation. "And it is precisely this task that underlies the tradition of the Lindau Nobel Laureate Meetings. Their main goal is to facilitate contact and dialogue between generations – in other words to enable 'science education' to take place."

The meeting ended traditionally with the closing words of one Nobel Laureate and one young female scientist. Professor David Gross spoke to the guests on behalf of all Laureates, a task which he had already performed at the 2nd Interdisciplinary Meeting in 2005. He praised the quality of the young scientists, which – according to Prof. Gross – had further increased compared to 2005. At the same time, the "spirit" of the Nobel Laureate Meetings had not changed, to which the hospitality, the beauty of the surrounding landscape, and also the "comradeship between Nobel Laureates and young researchers" all



“ While Thailand is trying to promote scientific development, there is an enormous amount that we can learn from the international scientific community. This is a great opportunity to establish academic connections with the most recognised contemporary scientists, the Nobel Laureates and talent young researchers from around the world. I attended and really enjoyed all the lectures. It was wonderful talking and discussing with the Nobel Laureates, and made friends with people in the meeting. I would like to thank the Lindau foundation for the hospitality and organising this unique and unforgettable event. This is the great experience, especially when I was giving the speech on behalf of all young scientists at the farewell ceremony that I will never forget.

Satreerat Kampangkeaw Hodak, Thailand/

FELLOW OF THE NATIONAL SCIENCE AND TECHNOLOGY DEVELOPMENT AGENCY ”

contribute. Finally, he spoke about the various "conveniences" which being awarded the Nobel Prize brings. Being able to participate in the Nobel Laureate Meetings is one of these benefits and is "one of the best residuals of all". Besides the opportunity to meet up with colleagues, there was the considerable added benefit of the young scientists themselves, who are "so bright, excited and full of energy".

On behalf of all the young scientists, the Thai participant, Dr. Satreerat Hodak from Chulalongkorn University (Bangkok/Thailand), thanked the Bernadotte family and the Council and Foundation of Nobel Laureate Meetings for their hospitality and for the organisation of the event. "It is absolutely unique to be one of the participants from 67 nations from around the world. This meeting brings together young researchers and Laureates from Argentina to Uzbekistan, from Germany to South Africa", said the young researcher. "We have greatly enjoyed spending this time in the historic city of Lindau and on the most beautiful Isle of Mainau. Special thanks also go to the States of Bavaria and Baden-Württemberg for their invitations." She closed her address with one final sentence in German: "Vielen herzlichen Dank für diese einmalige Tagung".



Impressions from the boat trip to the Isle of Mainau which was organised by the State of Baden-Württemberg.

MAECENATES, PATRONS,
BENEFACTORS AND DONORS

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MAECENATES, PATRONS, BENEFACTORS AND DONORS

The generous support of people and institutions in science, economics, and politics enables the Council and the Foundation to organise and advance the annual Meetings of Nobel Laureates in their current, time-tested form and with a growing number of participants. A great number of these companies, associations, foundations, private donors, ministries, and international organisations have already been contributing to "Mission Education" for several years. Together with the new partners of the Council and the Foundation, they secure the future of the Lindau Meetings, ensuring their continuing relevance and their further development in accordance with the vision of their "Spiritus Rector", Count Lennart Bernadotte – as a dynamic forum and a "window to the world".

SPONSORS & PROJECT PARTNERS OF "MISSION EDUCATION"

Prior to the 58th Meeting of Nobel Laureates, the Foundation was able to welcome some new donors. RWE AG now belongs to the "Maecenates" of the Foundation. Volkswagen AG and the Principality of Liechtenstein were accepted into the circle of "Principal Patrons". Robert Bosch GmbH has since become one of the "Patrons" of the Foundation. Holcim Ltd. and the LGT Group Foundation now count amongst the "Principal Donors". Boehringer Ingelheim GmbH, the Hilti Foundation, Hovalwerk AG, Ivoclar Vivadent AG, and Liechtensteinische Landesbank AG are new "Foundation Donors". The ring-fenced foundation assets, from which interest dividends help fund the Lindau Meetings, amounted to a sum of € 15 million in July 2008. In their work together, the donors ensure the future and further development of the Meetings of Nobel Laureates for years to come.



In addition to these external donations, the Foundation also raises project-related funding. The support of the European Commission, the Federal German Ministry of Education and Research (BMBF), the German Research Foundation (DFG), the Deutsche Telekom Foundation, the Fritz Thyssen Foundation, and the Robert Bosch Stiftung GmbH made the internationalisation of this year's meeting possible. The Meetings of Nobel Laureates are a platform for the exchange of knowledge and ideas between the best scientists of today and those of tomorrow and the future. This is made possible by a selection process for the meeting participants which is based solely on their scientific achievements. Thanks to the institutions listed above,

up-and-coming scientific communities in Asia, Eastern Europe, and South America could also send participants to the 58th Meeting of Nobel Laureates.

The further development of the Internet site www.lindau-nobel.de into a platform for science education makes it clear that the Meetings of Nobel Laureates are not only intended to inspire and foster knowledge amongst those attending the meeting, but also to make a superior level of scientific knowledge accessible to people all over the world. Cooperation with the European Broadcasting Union (EBU) serves this very purpose. The development was made possible through the support of the International Lake Constance Conference (IBK) and the Free State of Bavaria.

Thanks to their sponsorship, lectures by the Nobel Laureates could be broadcast live on the Internet and could then be archived in an online knowledge media-theque where they will remain available along with more detailed information on the Laureates' curricula vitae and abstracts of the lectures. The scientific archive is the only one of its kind in the world and more lectures from past decades will be added over the coming months. The clips are currently being digitalised and processed through the support of the Gerda Henkel Foundation.

The Wilhelm and Else Heraeus Foundation covered the meeting participation fees for 100 young German scientists. This development means that, for the first time, the Council and the Foundation have been able to work with a partner dedicated specifically to promoting the participation of talented and promising German scientists at the Lindau Dialogues. The commitment made by the Wilhelm and Else Heraeus Foundation allowed the Lindau Institutions to use other resources to invite more up-and-coming scientists from the rising stars among scientific nations outside Europe and to support their participation with scholarships. It is planned that this cooperation will be continued for future meetings in physics as well.

Other contributors to the success of the 58th Meeting of Nobel Laureates included the Deutsche Bank Foundation, the Berg Foundation in the Stifterverband für die Deutsche Wissenschaft (German Donors' Association for Science), the Deutsche Telekom Foundation, EnBW AG, Klaus Tschira Stiftung gGmbH, the Dr. Meyer-Struckmann Foundation, the Stiftung van Meeteren, and the Wilhelm Sander-Foundation.

Donations in kind make an important contribution to the practical organisation of the Lindau Meetings. A good number of well-known companies have established themselves as donors in this context, and the Council and the Foundation acknowledge their support with gratitude. The support of these partners ensured not only that the participants could as usual enjoy a level of service appropriate to an international conference of this standing, but also that further improvements were possible.

Once again this year, AUDI AG supplied a limousine service for the Laureates. As the official carrier for the meetings, Deutsche Lufthansa AG brought Laureates from all over the world to Lake Constance.

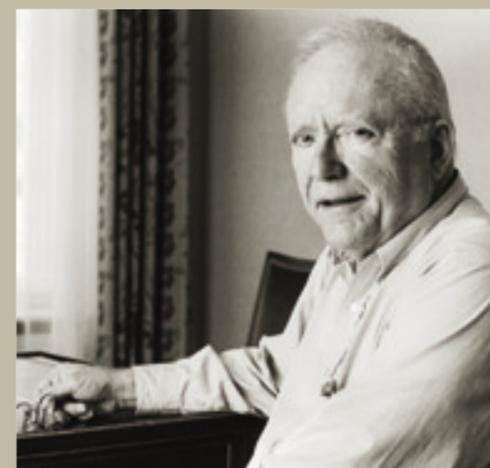
Deutsche Telekom AG provided an Internet café that had even grown in size from the previous year, as well as a WLAN network in the Inselhalle.

The Free State of Bavaria invited all of the participants to dinner at a "Bavarian Get-Together" (see also p. 65) and introduced the students of the Elite Network of Bavaria, with the help of Nobel Laureate Theodor Hänsch, who is working and living in Munich. The State of Baden-Württemberg worked together with the organisers of the meetings of Nobel Laureates to enhance the closing day of the meeting, which features the traditional boat trip to the Isle of Mainau. Not only did the State offer its help in determining the content and organisation of this part of the event, it assumed financial responsibility for it as well (see also p. 66).

Sennheiser electronic GmbH & Co. KG provided – just as in previous years – a high-quality sound system for all of the rooms in the Inselhalle. An associate from the company stayed on-location during the entire week as a technical advisor for the organisational team. Business Wire supported the Meeting's press relations by distributing press releases worldwide.

Countess Sonja Bernadotte has charged Professor Wolfgang Schürer – Chairman of the Board of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance and member of the Council – with the task of initiating new funding and cooperation agreements, as well as with the tasks of ensuring the continuing support for and further development of existing agreements. Senior Research Associate Dr. Urs V. Arnold and Nikolaus Turner, a Member of the Foundation Board and Treasurer of the Council, actively support him in the process. Together they have invested over 400 working days in activities which will benefit the long-term financial security of the Lindau Dialogue. Like all the members of the Foundation's Board and of the Council, their work is provided on a pro-bono basis. The success of the 58th Meeting of Nobel Laureates is due in no small part to their dedication.

The Council and the Foundation would like to thank the associates in the Executive Secretariat in Lindau for their immense commitment this year, which was characterised by a particularly heavy workload arising from the renovations which are described in more detail in the next section. The team, under the leadership of Dr. Andreas Gundelwein, made a vital contribution to the success of this year's meeting.



“ From my perspective, this 2008 Lindau Physics Meeting was a pure joy for the participants, and for both age groups. The number and enthusiasm of the young scientists seems larger and even stronger than I remembered from before. Indeed, if a failure mode for the Meetings would be in sight, it will be the need to schedule too tightly in order to include all those who will wish to participate. (...)

A second unexpected GOOD THING was to find my Lindau talk available on your website. Ideally, one can hope that the availability of these talks may be a helpful thing in helping spark some interest in Science, particularly in developing countries where the prospect for travel cannot compete in priority with other needs for the resources. **John Hall, Physics 2005** ”



EXPANSION AND RENOVATION OF THE FACILITIES



Over the years, the Meetings of Nobel Laureates at Lindau have evolved into an internationally recognised platform for generations of scientists. The keys to their successful development were not only the reinforcement of the programme's excellence and the broadening of the participation of up-and-coming scientists. It has also been due to the professionalism and quality of the overall organisation. This has been subjected to continuous evaluation in order to identify all possible improvements. Foremost amongst these was the need to update the Lindau Institutions' office accommodation, which was impracticable and much too small for their purpose, indeed it was filled to the brim. It is thanks to the generous support of individuals and companies that the Lindau Meetings could complete an important stage with the expansion and renovation of these facilities, in time for the 58th Meeting of Nobel Laureates.

The rooms were modernised and new offices were added on the top floor. An added complication was that the renovations took place during the preparations for both of the 2008 Meetings – first the Meeting of Nobel Laureates in Physics, followed by the August Meeting in Economics. In addition to the renovation of the pre-existing rooms, the facilities were expanded by converting adjacent space into an office for the Foundation Lindau Nobelprizewinners Meetings at Lake Constance. The new extension provides space for the archives as well as the library, which is currently under development. All of the rooms are now ready for use. They serve as a highly represen-

tational headquarters in Lindau for the Meetings of Nobel Laureates. Appropriately, visitors are greeted by Peter Badge's portraits of the Nobel prize winners as they enter.

The renovation and expansion of these facilities including the Foundation's office would not have been possible without the generous support of a number of individuals and companies. The Council, Foundation and all the staff now able to take advantage of these excellent facilities would like to express their special thanks to these benefactors for the up-to-date environment in which they are now able to work.

The expansion, renovation, and redesign of the office facilities of the Council for the Lindau Nobel Laureate Meetings in Lindau have been made possible thanks to the generosity of:

EnBW Energie Baden-Württemberg AG / Holcim Ltd / Boehringer Ingelheim GmbH / Lista Office Vertriebs AG / Zumtobel Lighting GmbH / Professor Dr. h. c. Artur Fischer / ETO Magnetic KG / Foundation Lindau Nobelprizewinners Meetings at Lake Constance / and an anonymous donor

The expansion, renovation, and redesign of the office facilities for the Foundation Lindau Nobelprizewinners Meetings at Lake Constance and the space for its archives have been made possible thanks to the generosity of:

Dr. h.c. Klaus Tschira / and the Klaus Tschira Foundation gGmbH



The Foundation's office includes a meeting room and provides space for the archive of the meetings and the portrait collection.

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Media representatives joined Professor Grünberg on his visit to a Kindergarten at Lindau.

COMMUNICATIONS AND MEDIA WORK

100 journalists from 35 countries covered the 58th Meeting of Nobel Laureates. For the first time ever, the activities at the meeting were accompanied by a blog. New cooperative agreements were concluded with organisations of scientific journalists in the USA and Latin America, demonstrating the ever greater internationalisation of media coverage of the event. A media briefing on the Nobel Laureates' expectations for the Large Hadron Collider (LHC), organised in conjunction with CERN, was received with great interest. Indeed, with the further development of the Nobel Laureate Meetings' Internet platform to create an online knowledge mediatheque, the Council and the Foundation have given a further impetus to their "Mission Education".

With the presence of so many journalists from so many countries, the 58th Meeting of Nobel Laureates received more extensive and more international news coverage than ever before. For the first time, journalists who had been nominated through cooperative agreements with the National Science Writers Association (USA) and the Ibero-American Association of Scientific Journalism participated in the conference. Russian scientific journalist Viola Egikova made an important contribution in establishing partnerships between associations for scientific journalists and the Lindau Meetings. As in the previous year, cooperation with the European Union of Science Journalists Associations (EUSJA) and the Arab Science Journalists Association was continued. The European Commission also invited representatives of the media to Lindau. Some of the journalists had already participated in Lindau Meetings in the past. Others, such as the representatives from Argentina, Brazil, Chile, Estonia, Cameroon, Mexico, and Sudan, were welcomed for the first time at Lake Constance. It was encouraging also to note the extensive coverage of the Lindau Meeting in leading newspapers, such as Argentina's La Nation, Israel's Yedioth Ahronoth, Chile's El Mercurio, Spain's El Pais, and France's La Recherche, to name just a few. Indeed, careful evaluation of the published reports confirms that the news coverage not only grew in quantity, but also in quality – at the same time as becoming more international than ever before.

Focus: Scientific Communications.

An important objective of the press and communications activities at this year's Nobel Laureate Meeting



was to emphasise the essentially scientific character of the meeting while at the same time drawing out its key messages in a form which would be accessible to the general public. The scientific journalist Joachim Pietzsch played a key role in this respect. In particular, he prepared advance information for the media on all the numerous topics to be presented at the meeting, as well as himself conducting interviews with the Nobel Laureates. Reports of these interviews were published by a number of regional newspapers.

Television and Radio.

As in the previous year, the European Broadcasting Union transmitted the lectures and panel discussions live to television stations all over Europe. Stations in Estonia, Greece and Portugal, and the Arabic station Al-Jazeera used this material for their own news



More than 50 international science journalists took part in the **Media Briefing on the LHC** which was organised in cooperation with CERN.

Erwin Beck, Wolfgang Schürer and **Peter Wieser** (from left) during the Press Meeting on “Lake Constance: A Place for Education and Research”.

coverage. Chinese tv station CCTV covered the participation of Chinese participants for a 45 minute talk show feature.

Gross, Carlo Rubbia, George Smoot, Gerard 't Hooft and Martin Veltman answered questions posed by international journalists. A live feed from the CERN Control Centre in Geneva took all the participants into the very heart of the action surrounding the LHC. The event was broadcast live as an Internet webcast, so that even scientific journalists not present in Lindau could participate. Matthew Chalmers hosted this media briefing.

Targeted approaches were made in respect of radio broadcast coverage and, as a result, radio stations in Germany, Austria, and Switzerland carried coverage of the event. This included within the space of two days, no less than 17 personal interviews with young scientists who talked animatedly about their experiences in Lindau. It was evident that the content of the panel discussion on climate change was likely to have a particular impact and the contributions of the panel participants and of the young researchers in the audience were made available to radio stations in the form of a finished programme. A second programme was made available covering the opening ceremony of the meeting. It is estimated that these radio programmes reached a total audience of almost 7 million in Germany, Austria, and Switzerland.

More than 50 journalists attended the fascinating discussion actually in Lindau and many more – including for example at the Neue Zürcher Zeitung (Switzerland) and at Scientific American (USA) – took advantage of the webcast in order to see the discussion live.

Professor Grünberg Visits Lindau Kindergarten.

Peter Grünberg, the 2007 Nobel Laureate in Physics, marked the occasion of the 58th Lindau Meeting of Nobel Laureates by visiting St. Ludwig Kindergarten in Lindau and conducting scientific experiments on air and magnetism with the boys and girls there. A large number of journalists joined him.

St. Ludwig Kindergarten is a member of the network “Tiny Tots Science Corner” (in German: “Haus der kleinen Forscher”). Initiated by the Helmholtz Association, McKinsey & Company, Siemens AG, and the Dietmar Hopp Foundation. This educational initiative aims

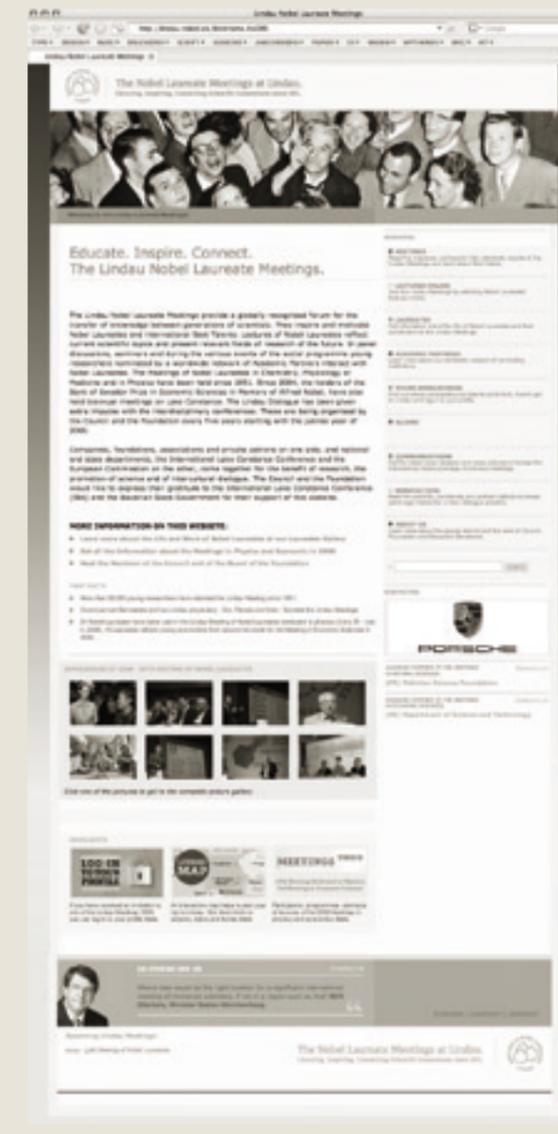
at getting children at a young age all across Germany interested in science and technology through play. Under the patronage of Germany’s Federal Minister of Education and Research, Annette Schavan, the “Tiny Tots Science Corner” also receives additional funding from the Federal Ministry of Education and Research. Both the Council and the Foundation of the Nobel Laureate Meetings supported the visit, as a part of their “Mission: Education” is to spark enthusiasm for science even among the youngest. Indeed, the Executive Secretary of the Council, Andreas Gundelwein, is himself a volunteer at the Tiny Tots Science Corner in Lindau.

Development of the Internet Platform.

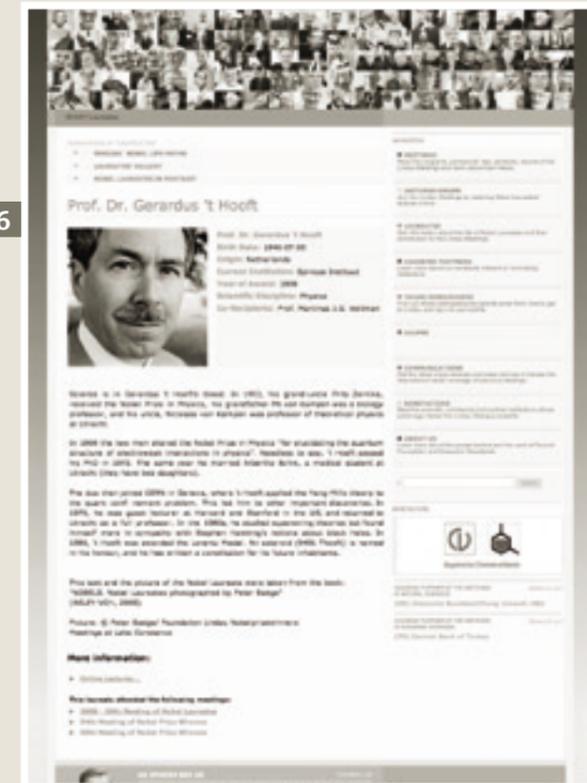
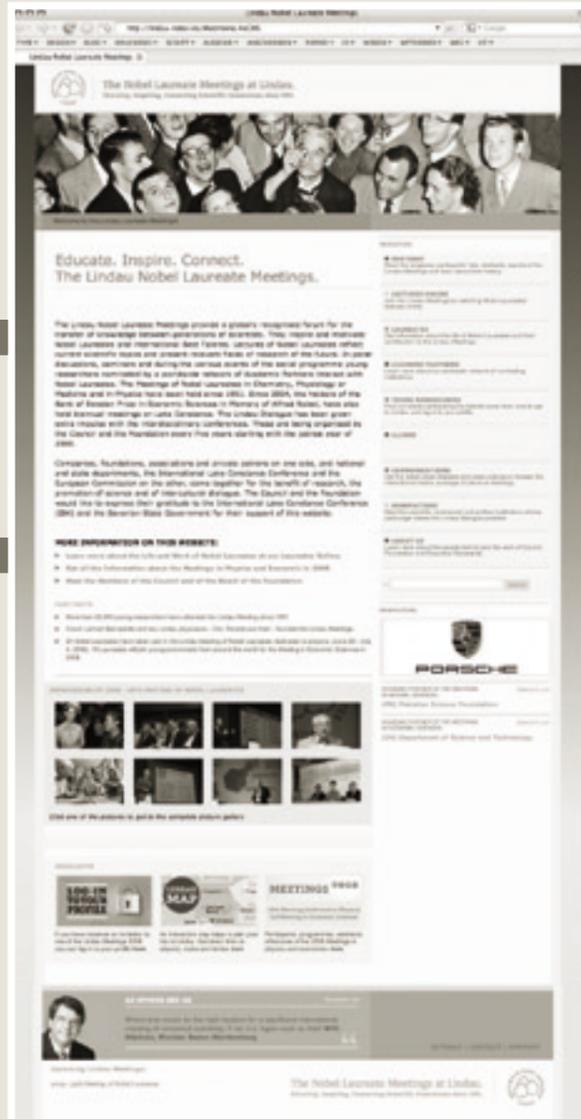
The new website of the Lindau Meetings of Nobel Laureates is now faster, more up-to-date and offers more information. The entirely re-designed www.lindau-nobel.de website was launched two weeks before the Meeting. This work was supported by the International Lake Constance Conference (IBK) and the Free State of Bavaria. The new format is intended to be more user-friendly and accessible for universities and schools in particular. Nobel Laureate lectures and comprehensive information can be accessed at any time of the day and from anywhere around the globe. The new site provides much easier access to the unique resources of our archives and is especially attuned to the Internet habits of the “Web 2.0 generation”.

As a first step, 45 lectures by Nobel Laureates were placed online, together with summaries of the lectures and resumés of the Laureates themselves, thus offering already extensive resources. The lectures from both of the 2008 Meetings – Physics and Economics – were added immediately following their broadcast live on the Internet.

In the coming months, audio clips from lectures at Meetings of Nobel Laureates from the 60s, 70s, and 80s will be added and made available online. This unique resource will allow visitors to the website to experience living scientific history. For example, such lectures as those by Laureates Werner Heisenberg (“Cosmology in Present-Day Atomic Physics”, 1968) and André Frédéric Cournand (“Science, Scientists and Society”, 1981) will be available as audio files. These wholly unique sound clips from earlier Meetings will be prepared and set in their scientific context by Anders Bårány (Deputy Director of the Nobel



WWW.LINDAU-NOBEL.DE



New Features of WWW.LINDAU-NOBEL.DE

1 Informative texts introduce visitors to the website to various aspects of the Nobel Laureate Meetings: from the role played by Academic Partners and an overview of the sponsors and project partners of the Lindau Dialogue to the “Lindau Institutions” – the Council and the Foundation – and the history of the meetings.

2 In the newly created “Lectures Online” section, science enthusiasts around the world have the opportunity to watch lectures given by Nobel Laureates whenever they like, where

ever they like. Thanks to the combination of a user-friendly layout and database, visitors to the website can gain direct access to all available lectures given by a specific Nobel Laureate or from one particular meeting.

3 Each year, more than 20,000 young scientists are interested in taking part in the Nobel Laureate Meetings. They are looking for information which is clearly laid out, and navigating the reworked website has been tailored to meet the needs of these numerous “new” visitors to the website.

4 Picture galleries provide direct access to a wide range of impressions from previous Nobel Laureate Meetings. These are on display in a “mediatheque” together with various Laureates’ lectures and a 10-minute introductory film about the aims and history of the meetings.

5 The “Knowledge Mediatheque” contains the archive of lectures given by Nobel Laureates, picture galleries from previous meetings, as well as a 10-minute film about the Meeting. The lectures can be organised accord-

ing to meetings, disciplines and Laureates. A full-text search in the corresponding abstracts provides further opportunities for research.

At present, there are 60 lectures in the database, and this number will increase further in 2009. The online Knowledge Mediatheque is currently in the process of being set up. 60 lectures by Nobel Laureate Meetings from the years 2004 to 2008 are already online. More lectures will follow, thereby transforming several decades of scientific history into a remarkable audio-visual experience.

6 A broad range of information about Nobel Laureates is provided in the “Laureates’ Gallery”. The Laureates’ profiles include details outlining their scientific careers and provide direct access to the respective Laureate’s lectures which are available online.

In redesigning our new website, user-friendliness was one of the primary objectives. Direct links to particularly popular content make it easy to quickly and easily find the information the visitor is looking for.

7 In a newly created download section, all annual reports dating back to 2005 are available online as PDF files. Here, potential participants can obtain initial information about previous Nobel Laureate Meetings in a compact format.

www.scienceblogs.de/ nobelpreistraegertreffen

Museum in Stockholm until August 2008 and currently the museum's Senior Advisor). No comparable archive of such historic scientific material is available anywhere in the world, extending as it does over a period of nearly 60 years.

Official Meeting Blog.

This year marked the introduction of the first-ever official Meeting blog, which was organised thanks to the support of MARS, Inc. The goal of the blog was to make the "closed event" of the Meeting of Nobel Laureates accessible to interested members of the public – extending beyond news coverage in the "conventional" media. Scienceblogs.de, the largest worldwide author network of researchers and scientific authors, was ready to cooperate in this venture. Currently, 37 authors contribute, in their respective subjects, to 25 blogs and 3 guest blogs for the German platform. The main site, Scienceblogs.com, is one of the most networked websites in the world, achieving more than two million page views per month with around 70 authors. Burda Research & Development (REID) developed the German site Scienceblogs.de.

For the 58th Meeting of Nobel Laureates, Wolfgang Denzler and Laura Höflinger, students in Scientific Journalism at the University of Darmstadt, led the blog. In addition, 20-minute video interviews with the Nobel Laureates were released thanks to the support of MARS, Inc. The focal point of the interviews was "Science Education" – the Laureates giving accounts of their own careers in research, thereby providing unique and very personal glimpses into scientific history. These "video portraits" of the Laureates were very much in the same spirit as the portrait photographs taken by Peter Badge, in that they help us to discern the personality behind the Nobel Prize. In addition to the original German language blog, English summaries were created and made available – along with the video interviews – on the main website, www.scienceblogs.com, in the USA as well. The cooperation with Scienceblogs means that the Meetings of Nobel Laureates are made accessible to

... on the panel discussion "Climate Change and Energy Challenges":

"When one of the young students asked 'Can we be sure that humans are responsible for climate change?' at the end of the discussion, Schellnhuber finally jumped to the aid of the Laureates, who had been going back and forth on the topic, and said that the question couldn't be answered with 100% certainty. Too many different figures from too many different fields of research played a role. "But we can be about 60% certain." And that's when he gave us one of his lovely, colourful examples. If a pilot would say to his passengers "We only have 60% certainty of a plane crash today," as they were boarding the plane, most of them probably wouldn't get on."

... on Giacconi's lecture:

"435457355 stars had to be charted before the Hubble Telescope could function correctly." Riccardo Giacconi, Nobel Prizewinner in Physics, began today's series of lectures with the story of x-ray astronomy and the Hubble Telescope. (...) in his lecture on "The impact of Big Science on Astrophysics" – and by "Big Science" he especially meant the large-scale projects that are currently in progress, like the various telescopes or the VLT (Very Large Telescope) at the ESO – and Giacconi played a significant role in many of these projects."

... Commentary on the interviews with participants:

"It's nice to see that science and research doesn't fulfil the everyday cliché of an old man with a beard any more. Young researchers from all over the world meet in rural Lindau to exchange ideas and build networks. That's where the old men with the beards come in – but in a positive way. That's because you have the chance to "build bridges" between the old and the young here, and that's absolutely an added benefit for both sides. Taking advantage of synergy – experience paired with fresh approaches to thinking about the world."

... Daria's commentary on the Meeting of Nobel Laureates:

"That was a really intense and outstanding week! I was especially impressed by the fact that the Nobel Prizewinners mixed right in with the young scientists. They drank coffee with us during the break and had discussions, they didn't let themselves be intimidated by the large number of interested people and put on an act ;) I need some time to digest all of these different impressions. I hope that more students will be persuaded to join the blog after this."

... Conversation with Professor Fricke on the boat to the Isle of Mainau:

"Prof. Fricke, Member of the Council for the Lindau Nobel Laureate Meetings, talked about the days of 1965 and thereafter in Lindau. Back then, they would just take the car with their professor and ride to Lindau with 5 people in the car to meet the Laureates. In 1965, there would be about 10 students at every table in the former theatre that would sit across from the Prizewinners after the lectures. The students would then switch tables after a while."

The screenshot shows the ScienceBlogs website interface. At the top, there is a search bar and navigation tabs for Home, Naturwissenschaften, Medizin, Kultur, Politik, and Geistes- & Sozialwissenschaften. The main content area features a post titled "Ausblick - Prospect" with a video player showing a man speaking. Below the video, there are several recent posts listed, including "Flowing Magnetism - Peter Grünberg im ScienceBlogs-Interview" and "Researchers in Los Alamos - Roy Glauber im ScienceBlogs-Interview". The sidebar on the left contains a "Profil" section with a photo of a woman and a "Letzte Einträge" section listing recent blog entries.

the very people who could be applicants to attend future meetings, as well as those – members of the Web 2.0 generation – who prefer to access their information over the Internet and for whom the on-line lecture portfolio meets their needs. The number of hits (more than 30,000 visitors to the blog) has encouraged the Council and the Foundation in their aim to expand and advance this important resource at forthcoming Meetings of Nobel Laureates.

The video interviews were produced by the Journal of Visualized Experiments – JoVE. JoVE is a scientific journal that publishes video articles of biological experiments at leading academic institutions. JoVE recently became the first and only video-based scientific journal to be indexed in MEDLINE and PubMed, the official repositories of the National Library of Medicine (NLM) at the National Institute of Health (NIH). The interviews produced in Lindau will be referenced, archived and remain “forever” accessible there in the future. In this way they are directly introduced into the scientific communication process.

Press Meeting “Lake Constance: A Place for Education and Research”.

The focal point of the collaboration between the States and Cantons of the International Lake Constance Conference is the promotion of education, science, and research right in the centre of the common cultural area around Lake Constance. The goal is to improve the Lake Constance region as a scientific hub, which includes research, education, and their application. The efforts of the Internationale Bodenseeuniversität (IBH) and the Lindau Meetings of Nobel Laureates, together with those of other institutions, combine to create a highly visible beacon of light, which not only draws attention to the region but also brings the project itself into sharper focus. During the meeting, representatives of the three institutions – the IBK, IBH, and the Lindau Meetings – all came together for the first time to discuss such questions as: What do the IBH and the Meetings of Nobel Laureates provide which will benefit the

Lake Constance region? How does the Lake Constance region present itself as a hub for science and for higher education? What kind of perspectives can regional collaboration in areas of education and research offer, bearing in mind the ever increasing importance of “Knowledge” as a resource? Participants in the meeting were Erwin Beck, Rector of the Pädagogische Hochschule for the Canton of St. Gallen, Peter Wieser, International Lake Constance Conference, and Wolfgang Schürer, Member of the Council and Chairman of the Board of Directors of the Foundation Lindau Nobelprizewinners Meetings at Lake Constance.

NATURE Brings Film Team to Lindau.

The scientific journal NATURE was represented in Lindau with a very special delegation. Edmund Gerstner, Senior Editor of Nature Physics, provided coverage of the meeting for the magazine. David Swinbanks, Publishing Director of the Nature Publishing Group,

also took part in the meeting and was introduced to the comprehensive archive featuring lectures by Nobel Laureates, amongst other things. A film team accompanied the director, Martin Freeth, who brought together Nobel Laureates and the young scientists, documenting the resulting conversations and discussions. Five films were created (length: ca. 15 minutes). The film “premiere” took place in October 2008 at “Nature’s Island in Second Life”. The films offer a unique glimpse into personal encounters between up-and-coming scientists and Nobel Laureates. They can be viewed online at <http://www.nature.com/video/lindau/index.html>.

Thomas Ellerbeck, Member and Speaker of the Council as well as a Member of the Foundation’s Board of Directors, is responsible for the communications activities surrounding the Meetings of Nobel Laureates. Christian Rapp, the communications associate of the Executive Secretariat, is responsible for implementing the communications strategy, which is set in agreement with the Council and the Foundation.

Films by NATURE

Dark Matter, Dark Energy

George Smoot’s Nobel Prize was awarded for his analysis of that whisper from the Bing Bang, the cosmic microwave background radiation. Today he hopes CERN’s data will again transform our understanding of the universe. Young scientists Bilge Demirkoz and Benjamin Joachimi question him about how Dark Matter and Dark Energy fit into this picture.

The Quantum Lattice

Awarded a Nobel Prize for using lasers to control and cool atoms, producing the Bose-Einstein condensation, William Phillips is eager to hear about new theories from young scientists like Hannah Venzl. An excited dialogue develops between them on a boat trip on Lake Constance as they dream up new collaborative experiments in the quantum world.

Fibre and Sunlight

Fine tuning the frequencies of light gave John Hall a Nobel Prize, and helped transform the fields of precision measurement and information transmission. Iris Choi



and Andrei Ghicov are young scientists excited by the ways physics can change our world. Hall, now in his seventh decade, inspires them with his own excited enthusiasm for practical science.

Abolishing Time?

David Gross’s Nobel Prize was for work on the ‘strong’ force which acts between quarks inside the atom. Now he works on string theory, hoping to understand how all the forces of nature could be united. He believes the next steps may involve throwing out all our ideas about both space and time. But he makes young theoretician Itzhak Fouxon, who shares these views, work hard to justify them.

Strings and Particles

Gerardus ’t Hooft’s Nobel Prize was for ‘elucidating the quantum structures of electro-weak interactions’. In this film he meets cosmologist, Benoit Famaey, and theorists Vincenzo Calo and Kristen Koopmans. He tells them that the world of science is littered with wrong ideas – but as young scientists they must not be frightened to publish theirs wherever they may lead.

Auf Flügeln der Physik ins Reich der Protein

JOCHIM PRESSER

Die Physik ist die Mutter der Biochemie. Wie im 19. und 20. Jahrhundert haben die physikalischen Methoden den Bereich des Lebens – zugehörig genannt: Proteine, die wichtigsten Moleküle des Lebens, wenn die Größe der Moleküle über 50.000 Dalton beträgt – in den Bereich der Biophysik überführt. Ein Beispiel ist die Entwicklung der NMR-Strukturanalyse. Dieser Fortschritt gelang dem Cambridgeer Peter D. Bartlett, der 1962 den Nobelpreis für Chemie erhielt. In der Folgezeit wurden in ähnlicher Weise die physikalischen Methoden in die Biologie übertragen und damit der Biophysik ein neues Gesicht verliehen. Die Biophysik hat sich in den letzten Jahren zu einer eigenständigen Disziplin entwickelt, die die physikalischen Methoden der Biologie mit den Methoden der Biologie verbindet. In der Folgezeit wurden in ähnlicher Weise die physikalischen Methoden in die Biologie übertragen und damit der Biophysik ein neues Gesicht verliehen.



Adam Rutherford

PRESS REACTIONS

"It's at meetings such as this one in Lindau where the brilliant vitality of physics emerges."

Adam Rutherford on guardian.co.uk

Spiegel Online, Germany

"Furthermore, the meeting's organisers have unearthed a gem: in one researcher's estate there just happened to be recordings of old meetings. When word of this got round, more and more people sent in recordings. The archive currently contains unprocessed tapes with lectures dating from 1953 up to the present day, initially audio recordings and later videos. The voices of Werner Heisenberg and Otto Hahn are there, as are discussions ranging from the nuclear debate to genomic mapping. Over the course of time, everybody should be able to download them in an Internet mediatheque of the meetings. The prestigious science journal "Nature" has already registered its interest in accessing these unique documents."

EOS, Belgium

"When answering the question of a journalist who asked for the status of current physics latter said "physics is certainly not yet dead," despite the fact this has sometimes been claimed at the end of the previous decade. Back then many shared the opinion that "nothing could be discovered anymore in physics". "The claim that physics is on a dead track," says Phillips, "was made at the end of the 19th century as well. But a few years later physics made its two biggest breakthroughs: the special and general theory of relativity, and quantum mechanics. So the message at the beginning of this Nobel Laureate Meeting at Lindau is clear: physics is alive and kicking, and it is up to the young research workers present here to new make discoveries, because they are up for grabs".

La Nation, Argentina

"Rubbia, who attended yesterday the Meetings of Nobel Laureates, which gather together 24 laureates and 558 young scientists from 66 countries on this small island of the Lake of Constance, in South Germany, and who is currently a star of science – capable of winning over swarms of journalists around him as if he were a famous actor or a rock idol – is an example of how important an opportunity can be at the right moment. Just like hundreds of young artists who would spend the night outdoors if they might win the right to exhibit their works in an exhibition room of La Recoleta and the young scientists who attend this week of discussions, conferences and exchanges, an opportunity might make the whole difference. The persons who are filling the room of the Inselhalle in Lindau, gathered from all over the world after a selection in their country of origin as well as an evaluation by their peers, are not only meeting other persons who are thinking about the same problems, but are also allowed to converse face to face with some of the most prominent minds of current science."

El Pais, Spain

"The confluence of both disciplines – along with some critics from persons who think that the emphasis put on cosmological targets for the LHC is a bit forced and showy – became evident last week at the 58th Nobel Conference, which was celebrated in Lindau (Germany). 24 laureates and 558 young researchers (30% were women and 70% were men) from 66 countries took part in the meeting and listened to the stellar masters, but debated with them in search of experience and inspiration as well. The traditional conference, which, this year, took place by the Lake of Constance, was devoted to physics. Those meetings, which were organised by the Foundation Lindau Nobelprizewinners Meetings and with the sponsorship of, among others, the European Commission, are aimed at feeding the dialogue between generations of researchers, covering various areas of the scientific disciplines which are awarded the prizes each year in Stockholm."

في الفترة بين 1945 و 1948 أجري جيفر أبحاث في الفيزياء النووية في جامعة كولومبيا في نيويورك. كان جيفر من أوائل من استخدموا مصادمات الجسيمات في الفيزياء النووية. عمل جيفر في مختبر أبحاث فيزياء الجسيمات في جامعة كولومبيا في نيويورك. عمل جيفر في مختبر أبحاث فيزياء الجسيمات في جامعة كولومبيا في نيويورك. عمل جيفر في مختبر أبحاث فيزياء الجسيمات في جامعة كولومبيا في نيويورك.



ENTORNO. - Jefe de Lago Constance, la ciudad de Lindau en Alemania albergó el evento

Cómo se hace física en los países

"La mejor que pueden hacer es países en desarrollo es educar a sus jóvenes científicos, y crear un ambiente de investigación".

"Es muy complejo hacer la transición a la ciencia en países en desarrollo. Hay que potenciar a las personas que quieren salir a completar su formación".

ni Big Bang

io Nobel de Física George (2006), David Gross (2004), Veltman (1999), Jack Steinberger (1988) y Carlo Rubbia (1984). Pero ni Joe Engelen, director del CERN presente en la discusión, ni los cinco Nobel presentes desconfían de las estrictas medidas de seguridad que se han implementado. "Son teorías borrosas", dijeron varios de los expertos en Física presentes en el podio sobre la posibilidad de recrear el Big Bang en un colisionador de partículas.

formal en marzo pasado en una corte de Hawaii para restringir la operación del LHC.

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"Son teorías borrosas", dijeron varios de los expertos en Física presentes en el podio sobre la posibilidad de recrear el Big Bang en un colisionador de partículas.

Breve recue

La recreación del Big Bang ha producido polémica:



et m...
con l...
flow...
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torces...
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The...
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In person

Born: 4/1/1944, Washington, D.C., U.S.A.



berg, galardonado en 2007, enseñó ayer en un jardín de infantes

menzó otra "ci

St. Galler Tagblatt, Switzerland

"Thinking out of the box – What can be learned from the Nobel Laureate Meetings? One thing in particular: how to think and act beyond conventional boundaries."

Istvestija, Russia

"On the initiative of a Swedish family, the Nobel Laureate Meetings have been taking place in the town of Lindau on Lake Constance in Germany since 1950. The Nobel Laureates come in order to communicate with young scientists in lectures, discussions, and also in informal surroundings. The best scientists of our time came, as did almost 700 young researchers from throughout the world: from Malaysia, Chile, and even such exotic locations as Lesotho. The participants are recommended by their national academies and major scientific institutions. Private communication between the best scientists in the world can hardly be underestimated. It is the best possible contribution to securing the future of our country."

La Recherche, France

"And it is not just a summer retreat which is restricted to a select group of Nobel Laureates. It is much more about the intellectual exchange between generations, just how the founders of the Lindau Meetings had envisaged them. (...) William Phillips stands by the objective of his "mission". "The topics that I talk about could be presented by other scientists and other talented lecturers... But they asked me to attend, and I'm the one they're asking a thousand and one questions because of my status. I owe it to myself to comply with this request, here, surrounded by young scientists."

Handelsblatt, Germany

"Today, up-and-coming scientists from throughout the world can apply, and there are thousands of people interested in attending from China and India alone. A strict selection process ensures that only the best will make it to Lindau. "Discussions with the students are at a very high level," confirms Klaus von Klitzing. "We Laureates can also benefit from this – and we can show that we're completely normal people."

El Mercurio, Chile

"They started the opening slowly, signing agreements with national science academies and promoting activity in the field. Four years ago, they focused on Latin America. Unbelievably, they hardly received any answer. To share 5 days with about twenty Nobel Laureates did not seem to be enough. But this year things changed, with 19 Latin American students, the three Chilean students among them, participating in the meeting. Schürer is convinced that this has a snowball effect: "The students return to their country with the experience they lived and the inspiration they acquired and, with the time, more and more people get interested." He is waiting for Chile to sign an agreement in order to speed up and increase the exchange and ensure quotas. The applications for the chemistry meeting 2009 opens in September. It is not only a matter of internationality, but also of gender. They aimed at attracting women. At the beginning, there were no women; this year, they are 167. But it still is not enough. On Monday night, a huge dinner gathered all of them together. After dinner, two separate ranks, men on one side and women on the other side, met at the centre of the stage. "He" presented "her", his dance partner at random, with a red carnation. Some of them remained with the flower in the hand without

being able to dance the first piece: a waltz. Students are allowed to attend the Lindau Meetings only once. After receiving a Nobel prize, they will be able to go back as many times as they want."

Nature Physics, Great Britain

"The themes of the lectures included historical accounts of the laureates' paths to Stockholm, "words of advice to young people" on what it takes to do good science – with Iver Giaever providing the most comprehensive list of advice including to be curious, competitive, creative, stubborn, self-confident, sceptical, patient and, most of all, lucky – to their take on emerging developments at the cutting edge of scientific research, from carbon electronics to particle physics. (...) But the real magic occurred in the afternoons, when the young researchers were given the opportunity to engage face-to-face with the laureate (or laureates) of their choice."

Yedioth Ahronoth, Israel

"On Sunday lunchtime, the entrance hall of the congress centre in the town of Lindau in Germany looks like the reception room in the tower of Babel might have looked. A mixture of languages and colours completely filling the room long before the opening ceremony of the 58th Lindau Meeting has even begun. Younger as well as older up-and-coming scientists dressed in casual clothing stand next to participants wearing more traditional garments, and they converse in 20 different languages. A few hours later, everyone has switched to one language and they all have the same ambition: to exchange information on topics which are at the forefront of research in the field of physics."



OUTLOOK



The Lindau Nobel Laureate Meetings will continue to follow the path of systematic internationalisation in the coming year too. New partnership agreements with renowned science institutions on four continents are currently in the process of being prepared. The excellent work carried out together with Academic Partners of the international network of the Lindau Meetings enables the organisers of the Lindau Dialogue to integrate the best young scientists into the programme. The Council and Foundation would like to give thanks for their considerable commitment in support of promoting the next generation of scientists.

The Nobel Laureate Meetings in Lindau are experiencing growing recognition and generating new resonance. More and more media are reporting about the Lindau Meetings. Partnerships with accredited unions of science journalists were set up and expanded in the past two years, with members from the USA, Latin America, Europe and the Arabian world taking part in the meeting this year. Further partnerships are due to follow.

The science journal "Nature" will be providing support for the Nobel Laureate Meetings in presenting the meetings' contents to those members of the public who are interested. This year, a team has already documented the fascinating interaction between Nobel Laureates and young scientists in a series of short films. Anyone who is interested is now able to follow what is otherwise reserved for the meeting participants: the personal encounter between scientific generations and the exchange of ideas, experience and knowledge in a unique atmosphere. In doing so, Nature has at least partially lifted the lid on the best-kept secret of the Nobel Laureate Meetings. It is thanks to the format chosen by Nature that the discussions taking place in the afternoons maintain their exclusivity for the participants who are there, and yet those people around the world who have an interest in science are given an insight into the meetings at Lake Constance. A similar project is planned for the Meeting of Nobel Laureates in Chemistry in 2009.

Two anniversaries are transforming 2009 into a truly special year: firstly, the Federal Republic of Germany will be celebrating the 60th year of its foundation, and the history of science in the country and ideas developed in Germany – especially those for the

future – will be the focal point of interest. Secondly, together with the Bernadotte family, the Nobel Laureate Meetings will be commemorating the 100th birthday of the "spiritus rector" of the Lindau Dialogue, Count Lennart Bernadotte. He recognised the Nobel Laureate Meeting as contributing to the introduction of young people to international science at a very early stage and promoted them accordingly. The Nobel Laureate Meetings were characterised by internationality from the very beginning. Count Lennart recognised the significance of the Lindau Meeting for the reconciliation of the peoples of post-war Europe early on and systematically developed it.

His role as a pioneer in matters of sustainability represents an equally fascinating aspect of the influence of Count Lennart Bernadotte. In view of the current discussion about sustainability in the economy and society, the pioneering role of Count Lennart Bernadotte will open up an interesting perspective – especially in the significance of sustainability for education and research. On 20 April 1961, the "Green Charter" was agreed upon. 15 years before the first state laws for nature conservation, 25 years before the formation of a Federal Ministry for Environmental Protection, Nature Conservation and Nuclear Safety, and 11 years before the first report of the Club of Rome, the charter was already calling for sustainability in the handling of resources. Count Lennart Bernadotte is the initiator of this document, which was signed by farsighted, opinion-forming personalities.

Internationality and sustainability – in its almost 60-year history, the Nobel Laureate Meetings have found their own answers to both of these challenges. The year 2009 – with the 60th anniversary of the founding of the Federal Republic of Germany and the 100th birthday of Count Lennart Bernadotte – will provide an opportunity to convey this message to a wider public. In doing so, the special role played by the Laureates will become clear. They have not only enabled the continuous development of the Lindau Meetings, but have also always actively participated in them. A visible sign of this support is the membership of 187 Nobel Laureates in the Founders' Assembly. They are all owed the heartfelt thanks of the Council and the Foundation, because the Lindau Dialogue not only lives on their commitment, but also inspires promising young scientists from all around the world.



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**REPRESENTATION OF
YOUNG RESEARCHERS BY COUNTRY**

558 highly talented scientists of tomorrow from 66 countries have attended the 58th Meeting of Nobel Laureates in Lindau. Having been nominated by numerous universities, foundations or international research institutes, they have all successfully passed a multi-stage and international selection procedure. With participants from 66 countries and regions, the Nobel Laureate Meeting will have an international character as never before. A particularly pleasing aspect here is that 167 young female scientists took part at the 58th Nobel Laureate Meeting. The percentage of women nominated by the academic partners was also very high.

Argentina	1	Hungary	9	Portugal	1
Australia	8	Iceland	1	Puerto Rico	1
Austria	6	India	30	Republic of Korea	3
Bangladesh	3	Iran	2	Romania	6
Belgium	3	Ireland	3	Russian Federation	15
Belorus	1	Israel	10	Saudi Arabia	2
Brazil	7	Italy	11	Singapore	1
Cameroon	2	Japan	3	Slovakia	2
Canada	6	Kazakhstan	1	Slovenia	2
Chile	3	Latvia	3	Spain	14
China	32	Lithuania	2	South Africa	1
Columbia	1	Macedonia	1	Sweden	10
Cyprus	1	Malaysia	4	Switzerland	10
Czech Republic	6	Mexico	6	Thailand	3
Denmark	1	Moldova	1	Turkey	3
Egypt	5	Netherlands	4	Ukraine	3
Estonia	1	New Zealand	2	United Arab Emirates	1
Finland	2	Nigeria	5	Uruguay	1
France	11	North-Korea	2	USA	71
Germany	165	Norway	6	Usbekistan	1
Great Britain	11	Pakistan	6	Venezuela	1
Greece	6	Poland	11		

These numbers correspond to a proportion of 337 European Best Talents. Asia is represented by 86 young scientists of tomorrow, 78 young researchers from North America will be attending, while the Arab states will be sending 20, Latin America 19, Australia 10 and Africa 8 Best Talents respectively.

Almost 200 institutions have nominated young researchers. They all belong to the worldwide network of Academic Partners set up by the Council for the Lindau Nobel Laureate Meetings and the Foundation Lindau Nobelprizewinners Meetings at Lake Constance.

Council and Foundation signed Memoranda of Understanding with the following institutions since the Meeting of Nobel Laureates in 2007.

Austria	Federal Ministry of Science and Research
Brazil	Conselho Nacional de Desenvolvimento Científico e Tecnológico
India	Department of Science and Technology
Japan	Japan Society for the Promotion of Science
Lithuania	Lithuanian Academy of Sciences
Mexico	Mexican Academy of Sciences
The Netherlands	Royal Netherlands Academy of Arts and Sciences
Switzerland	Swiss National Science Foundation
Thailand	National Science and Technology Development Agency

INTERNATIONAL ACADEMIC PARTNERS

Armenia	L'Académie Nationale des Sciences d'Arménie
Australia	Australian Academy of Science
Austria	Federal Ministry of Science and Research Industriellenvereinigung Wien
Bangladesh	Bangladesh Academy of Science
Belgium	Fonds National de la Recherche Scientifique
Brazil	Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)
Canada	Natural Science and Engineering Research Council of Canada (NSERC)
Chile	Academia de Ciencias
China	Sino-German Center for Research Promotion
Czech Republic	Academy of Sciences of the Czech Republic
Denmark	Danish Agency for Science Technology and Innovation
Egypt	Ministry of Higher Education and Scientific Research
Estland	Estonian Academy of Sciences
Finland	Academy of Finland
France	Academy of Sciences Centre National De La Recherche Scientifique (CNRS)
Great Britain	Research Councils Swansea University The Institute of Physics The Royal Society
Greece	Onassis-Foundation
Hungary	Hungarian Academy of Sciences
India	Department of Science and Technology
Ireland	Dublin Institute for Advanced Studies Science Foundation Ireland
Israel	Weizmann Institute of Science
Italy	International Balzan Foundation Università degli Studi di Pavia
Japan	Japan Society for the Promotion of Science
Korea	Korea Science and Engineering Foundation (KOSEF)
Latvia	University of Latvia
Lithuania	Lithuanian Academy of Sciences
Malaysia	Academy of Sciences Malaysia
Mexico	Mexican Academy of Sciences
The Netherlands	Royal Netherlands Academy of Arts and Sciences (KNAW)

New Zealand	The Royal Society of New Zealand
Nigeria	Ladoke Akintola Universität Technology
Norway	University of Oslo
Pakistan	Pakistan Science Foundation
Poland	Foundation for Polish Science
Saudi Arabia	King Saud University
Singapore	A*Star Graduate Academy
Slovenia	Slovenian Academy of Sciences and Arts
Spain	Confederación de Sociedades Científicas de España (COSCE)
Sweden	Nobel Foundation
Switzerland	Eidgenössische Technische Hochschule Zürich (ETH) Swiss National Science Foundation (SNSF) Swiss Study Foundation University of Bern University of Zurich Université de Genève
Thailand	National Science and Technology Development Agency
United Arab Emirates	Higher Colleges of Technologies
USA	Argonne National Laboratory Department of Energy National Academy of Sciences National Science Foundation (NSF) Oak Ridge Associated Universities

INTERNATIONAL INSTITUTIONS AS ACADEMIC PARTNERS

European Organisation for Nuclear Research (CERN)
 European Molecular Biology Organisation (EMBO)
 European Commission / Marie Curie Programme
 European Physical Society
 Human Frontier Science Program
 International Council for Science
 International Union of Pure and Applied Physics
 TWAS - the Academy of Sciences for the Developing World

ACADEMIC PARTNERS IN GERMANY

Alexander von Humboldt Foundation	Helmholtz Association of German Research Centres
Bavarian Academy of Sciences and Humanities	Industrie-Club e.V.
Berlin Institute of Technology (TU Berlin)	Klaus Tschira Foundation gGmbH
Biologie-Olympiade	Konrad Adenauer Foundation
Charité Berlin	Max Planck Institute for Dynamics and Self-Organisation
Cusanuswerk	Max Planck Institute for Solid State Research
Deutsche Telekom's Charitable Foundation	Max Planck Institute Garching
Düsseldorf Entrepreneurs Foundation	Max Planck Society for the Advancement of Science
Elite Network of Bavaria	Professor-Rhein-Stiftung
Fraunhofer-Gesellschaft	Robert Bosch Stiftung
Fulbright Commission	Stiftung Jugend forscht e.V.
German Academic Exchange Service (DAAD)	Verein Deutscher Ingenieure e.V.
German Academy of Science and Engineering (acatech)	Wilhelm Sander-Stiftung
German Aerospace Center (DLR)	Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e. V.
German Research Foundation (DFG)	X-Lab Göttingen
Gottlieb Daimler- and Karl Benz-Foundation	

Nobel Laureate Peter Grünberg and a participant during the Get-Together Evening on Monday.



SCIENTIFIC PROGRAMME

MONDAY, JUNE 30TH	TUESDAY, JULY 1ST	WEDNESDAY, JULY 2ND	THURSDAY, JULY 3RD
<p>9:00 LECTURE (see page 46) Prof. Dr. Theodor W. Hänsch (Physics 2005) Towards a Quantum Laboratory on a Chip</p>	<p>9:00 LECTURE (see page 38) Prof. Dr. Johann Deisenhofer (Chemistry 1988) Structural Biology–Quo Vadis?</p>	<p>9:00 LECTURE (see page 39) Prof. Dr. Riccardo Giacconi (Physics 2002) The Impact of Big Science on Astrophysics</p>	<p>9:00 LECTURE (see page 41) Prof. Dr. Donald A. Glaser (Physics 1960) Role of Cortical Noise in Vision</p>
<p>9:30 LECTURE (see page 44) Prof. Dr. Peter Grünberg (Physics 2007) From Spinwaves to Giant Magnetoresistance (GMR) and Beyond</p>	<p>9:30 LECTURE (see page 49) Prof. Dr. Robert Huber (Chemistry 1988) Beauty and Usefulness of the Building Blocks of Life: The Architecture of Proteins</p>	<p>09:30 LECTURE (see page 55) Prof. Dr. George F. Smoot (Physics 2006) The Beginning and Development of the Universe</p>	<p>9:30 LECTURE (see page 36) Prof. Dr. Nicolaas Bloembergen (Physics 1981) From Millisecond to Attosecond Laser Pulses</p>
<p>10:00 LECTURE (see page 40) Prof. Dr. Ivar Giaever (Physics 1973) Discovery of Superconducting Tunneling</p>	<p>10:00 LECTURE (see page 51) Prof. Dr. Hartmut Michel (Chemistry 1988) Cytochrome c Oxidase Structure and Mechanism of a Proton Pump</p>	<p>10:00 LECTURE (see page 56) Prof. Dr. Martinus J.G. Veltman (Physics 1999) The Development of Particle Physics</p>	<p>10:00 LECTURE (see page 43) Prof. Dr. Roy J. Glauber (Physics 2005) The Individuality of Light Quanta</p>
<p>10:30 BREAK</p>	<p>10:30 BREAK</p>	<p>10:30 BREAK</p>	<p>10:30 BREAK</p>
<p>10:45 LECTURE (see page 50) Prof. Dr. Klaus von Klitzing (Physics 1985) Carbon Electronics</p>	<p>11:00 PANEL DISCUSSION (see page 34) Climate Changes and Energy Challenges Prof. Dr. Johann Deisenhofer (Chemistry 1988) Prof. Dr. Ivar Giaever (Physics 1973) Prof. Dr. Klaus von Klitzing (Physics 1985) Prof. Dr. Hartmut Michel (Chemistry 1988) Prof. Dr. Douglas D. Osheroff (Physics 1996) Prof. Dr. Carlo Rubbia (Physics 1984) Prof. Dr. Jack Steinberger (Physics 1988)</p>	<p>10:45 LECTURE (see page 43) Prof. Dr. David Gross (Physics 2004) The Large Hadron Collider and the Super World</p>	<p>10:45 LECTURE (see page 52) Prof. Dr. Douglas D. Osheroff (Physics 1996) How Advances in Science are Made</p>
<p>11:15 LECTURE (see page 52) Prof. Dr. William D. Phillips (Physics 1997) Cold Atomic Gases: the Intersection of Condensed Matter and Atomic Physics</p>	<p>CHAIRPERSONS: Prof. Dr. Burkhard Fricke Scientific Co-ordinator of the Meeting Prof. Dr. Hans Joachim Schellnhuber Director of the Institute for Climate Impact Research, Potsdam/Germany</p>	<p>11:15 LECTURE (see page 55) Prof. Dr. Jack Steinberger (Physics 1988) What Future for Energy and Climate?</p>	<p>11:15 LECTURE (see page 49) Prof. Dr. Brian D. Josephson (Physics 1973) Which Way for Physics?</p>
<p>11:45 LECTURE (see page 45) Prof. Dr. John L. Hall (Physics 2005) The Optical Frequency Comb – a Really Versatile Tool</p>		<p>11:45 BREAK</p>	<p>11:45 LECTURE (see page 47) Prof. Dr. Gerardus 't Hooft (Physics 1999) Humanity in the Cosmos</p>
<p>12:15 BREAK</p>	<p>12:30 BREAK</p>		<p>12:15 BREAK</p>
<p>15:00–17.00 SCIENTIFIC DISCUSSION in Individual Groups between Nobel Laureates and Young Researchers</p>	<p>15:00–17.00 SCIENTIFIC DISCUSSION in Individual Groups between Nobel Laureates and Young Researchers</p>	<p>15:00–17.00 SCIENTIFIC DISCUSSION in Individual Groups between Nobel Laureates and Young Researchers</p>	<p>15:00–17.00 SCIENTIFIC DISCUSSION in Individual Groups between Nobel Laureates and Young Researchers</p>

PROGRAMME CHAIRS OF THE 58TH MEETING OF NOBEL LAUREATES

Prof. Dr. Lars Bergström

Professor Bergström is Professor in Theoretical Physics of the Physics Department on Cosmology, Particle Astrophysics and String Theory at the Stockholm University. Professor Bergström spent two years at CERN, Geneva, working further on theory of elementary particles. He was elected Secretary of the Nobel Committee for Physics from 2004. He plays the role of a corresponding member of the Council for the Lindau Nobel Laureate Meetings also since 2004, and took part in organising the scientific part of the meeting of Physics Laureates in Lindau in 2004.



Prof. Dr. Burkhard Fricke

Burkhard Fricke is Professor in Theoretical Physics at the University of Kassel where he was the vice president of the University of Kassel from 1990 to 1994 and where he is the dean of the newly founded Faculty of Natural Sciences since 2003. His most important activities outside the University were board member of the Deutsche Physikalische Gesellschaft (DPG) and senior referee of Physics at the Deutsche Forschungsgemeinschaft (DFG). From 2003 to 2004 he was a guest scientist at University of Auckland, New Zealand.



SELECTION CRITERIA

ALL SELECTED PARTICIPANTS SHALL

- show a genuine interest in science and research,
- show a strong commitment both to their principal field of studies and to the interdisciplinary dialogue with the international academic community,
- receive an unequivocal support of their application by their academic advisor and/or by internationally renowned scientists,
- be fluent in English and an active participant in discussions,
- be familiar with societal impacts of scientific knowledge and its applications,
- not have participated in previous Lindau Meetings,
- belong to the top 10 per cent of their class, and
- deliver fully completed applications.

IT IS MOST WELCOMED TO HAVE A GOOD BALANCE BETWEEN THESE THREE GROUPS:

- (1) Undergraduate students shall exhibit a solid general knowledge in the natural sciences, have done some research work.
- (2) Master and Doctoral students shall have excellent academic accomplishments, have produced outstanding research, have tutoring experience.
- (3) Postdoctoral scientists shall have published results of scientific investigations in refereed journals, have presented research reports at international conferences, have acquired experience in tutoring and teaching.



I. APPLICATION AND SELECTION PROCESS

The partners of the Meetings of Nobel Laureates at Lake Constance – the most renowned academic establishments in the world – make up a global network. They ensure that the best up-and-coming researchers in various countries apply to take part in the dialogue in Lindau. Consistent with previous years, the majority of the participants (70%) became informed of the event by Academic Partners such as these. This number is nearly 20% higher than in 2007, which can be attributed to the fact that the Council and the Foundation have been closing cooperative agreements with an increasing number of scientific institutions all over the world.

The Meetings of Nobel Laureates are known for their internationality and scientific excellence. The internationally organised, multistage selection process plays an important role in maintaining this excellence. The cooperative agreements allocate countries a guaranteed number of participants; standard selection criteria additionally ensure scientific quality. Almost half (47%) of the participants were acquainted with the selection process and the required criteria. Yet the Council and the Foundation still stand before the task of further expanding the feedback process in cooperation with the nominating institutions (only 20% receive professional feedback).



“ This experience was quite unique in many ways: first of all, it was a tremendous opportunity to discuss with Nobel Laureates about their views on the future of physics, which was extremely interesting in itself. But it was also worthwhile to hear the Nobel Laureates debating between themselves, as during the panel discussion. Organising more of these panel discussions would be a good asset for future Lindau Meetings. Then, this meeting was also an extraordinary opportunity to discuss and exchange with young researchers working in completely different fields of physics: indeed, experimentalists and theoreticians, or e.g. astronomers and condensed matter physicists, do not communicate that often since they usually do not go to the same meetings. Finally, the fact that so many nations were represented was extremely enriching too, and made the meeting even more unique in every aspect.

Benoit Famaey, Belgium/FELLOW OF THE FONDS NATIONAL DE LA RECHERCHE SCIENTIFIQUE (FNRS) ”

• **How did you hear about the 2008 Nobel Laureate Meeting in Physics?** [TOTAL: 472]

Academic Institution/University	70 %	331
Funding organisation (foundation etc.)	23 %	108
Corporate Institutions	1 %	5
Media coverage/Internet	2 %	10
Other	4 %	18

• **What was your experience with the selection process?** [TOTAL: 488]

I heard about the meeting and approached then a nominating institution	19 %	92
I was asked by a nominating institution if I wanted to apply for the meeting	81 %	396

• **What was your experience with the selection process?** [TOTAL: 457]

I was aware of the selection procedures and selection criteria	47 %	214
I had professional feedback from my nominating institution	16 %	72
I only received a confirmation from the Review Panel via Internet	37 %	171

II. ACADEMIC CREDENTIALS OF THE MEETING

Educate. Inspire. Connect. – The Meetings of Nobel Laureates’ mission statement is coupled with the high expectations of the participants. They expect a one-of-a-kind forum for dialogue between scientific generations and disciplines. Consequentially, the meeting’s concept deliberately provides numerous opportunities for the scientific elite of both today and tomorrow to have personal encounters and to exchange ideas. The goal is to live up to the expectations of the Nobel Laureates and those of the young scientists. Survey results have shown that it’s been successful: 94% of those asked reported that their expectations had been exceeded (28%) or fulfilled (66%). The ambitious scientific programme consisted of lectures by the Laureates in the morning, the “Climate Change and Energy Challenges” panel discussion and discussions between the Laureates and the students in the afternoon. Certain elements of the programme, such as the panel discussion, underlined the Meeting’s interdisciplinary approach: Nobel Laureates in Physics and Chemistry discussed the causes of climate change and opportunities for overcoming it. Participants rated the scientific programme very positively overall (General Impression

of the Scientific Programme: 38% Very Good, 56% Good). The Laureates’ lectures received particularly good evaluations. The students discussions in the afternoon were given less favourable ratings, also in comparison to the previous year. The survey’s participants made it clear in their commentary that they considered the size of the groups to be too large, and that the room situation (too few rooms, too far away from the Inselhalle) also played a role.

The unique character of the Lindau Nobel Laureate Meetings emerges from the synergy that forms between the scientific and informal programmes, which include the traditional Get-Together Evenig, the concert by the UBS Verbier Festival Chamber Orchestra, and the traditional boot ride to the Isle of Mainau on the last day. These events make the Lindau Nobel Laureate Meetings a once-in-a-lifetime experience for all of the participants. In addition to lectures by the Laureates (listed 322 times) and the afternoon discussion rounds with the Laureates (listed 286 times), the Get-Together banquet on Monday (275) and the concert on Wednesday (186) counted as events that participants especially appreciated.

• How do you assess the conceptual orientation of the meeting?

My expectations were [TOTAL: 516]

exceeded	28 %	143	
met	66 %	340	
not met	6 %	33	

Internationality [TOTAL: 524]

Too international	4 %	24	
Appropriate	89 %	465	
Not sufficiently international	7 %	35	

Interdisciplinarity [TOTAL: 530]

Too interdisciplinary	7 %	35	
Appropriate	86 %	458	
Too focused	7 %	37	

Lecture topics [TOTAL: 514]

Too specific	19 %	98	
Appropriate	73 %	374	
Too broad	8 %	43	

Panel topic [TOTAL: 468]

Too specific	4 %	20	
Appropriate	83 %	388	
Too broad	13 %	60	

Panel discussion [TOTAL: 489]

Too controversial	5 %	23	
Appropriate	67 %	328	
Not sufficiently controversial	28 %	138	

Student involvement [TOTAL: 515]

Too much	3 %	14	
Appropriate	61 %	312	
Too little	36 %	189	

Interaction with other participants [TOTAL: 512]

Too much	4 %	19	
Appropriate	81 %	415	
Too little	15 %	78	

SURVEY RESULTS-ACADEMIC CREDENTIALS OF THE MEETING

• Please assess the following parts of the programme

General impression of the scientific programme [TOTAL: 517]

Excellent	38 %	197	
Good	56 %	291	
Fair	5 %	23	
Poor	1 %	6	

Plenary lectures (mornings) [TOTAL: 484]

Excellent	28 %	134	
Good	61 %	296	
Fair	10 %	49	
Poor	1 %	5	

Student discussions with Laureates (afternoons) [TOTAL: 389]

Excellent	31 %	120	
Good	39 %	152	
Fair	24 %	95	
Poor	6 %	22	

Panel discussion "Climate Change and Energy Crisis" (Tuesday) [TOTAL: 477]

Excellent	17 %	79	
Good	41 %	198	
Fair	32 %	155	
Poor	10 %	45	

Opening ceremony [TOTAL: 438]

Excellent	25 %	108	
Good	44 %	191	
Fair	25 %	111	
Poor	6 %	28	

Overall balance of the programme [TOTAL: 482]

Excellent	27 %	129	
Good	66 %	318	
Fair	6 %	31	
Poor	1 %	4	

• Which events of the meeting did you enjoy particularly? (several choices possible)

Lectures	322
Student Discussions	286
Opening Ceremony	51
Welcome Parties on Sunday	52
Get-Together Evening on Monday	275
Panel discussion on Tuesday	139
Dinner with Academic Institution	124
Concert of UBS Verbier Festival Chamber Orchestra on Wednesday	186



“ My participation in the 58th Meeting of Nobel Laureates in Lindau has been very fruitful, especially at the social and political level. At first, I would like to emphasise the exchange between young researchers. Needless to say that research especially in physics is international. Nevertheless, I must admit that I meet with young scientist from India and China quite rarely. In this sense the Lindau Meeting was a real opportunity for me to open my mind to this culture and people. Secondly, according to me the environmental panel was the main event of the meeting. It reminds me, that as a scientist we need to /must have an active political role. Indeed we can simplify and clarify complex problems without perverting the facts, this is extremely valuable in this context. Consequently, the improvement of our communication system will be our real challenge. The inclusion of the latter new dimension will certainly change my way of doing science.

Cyril Petitjean, France/FELLOW OF ALEXANDER VON HUMBOLDT FOUNDATION ”

III. ORGANISATION OF THE MEETING

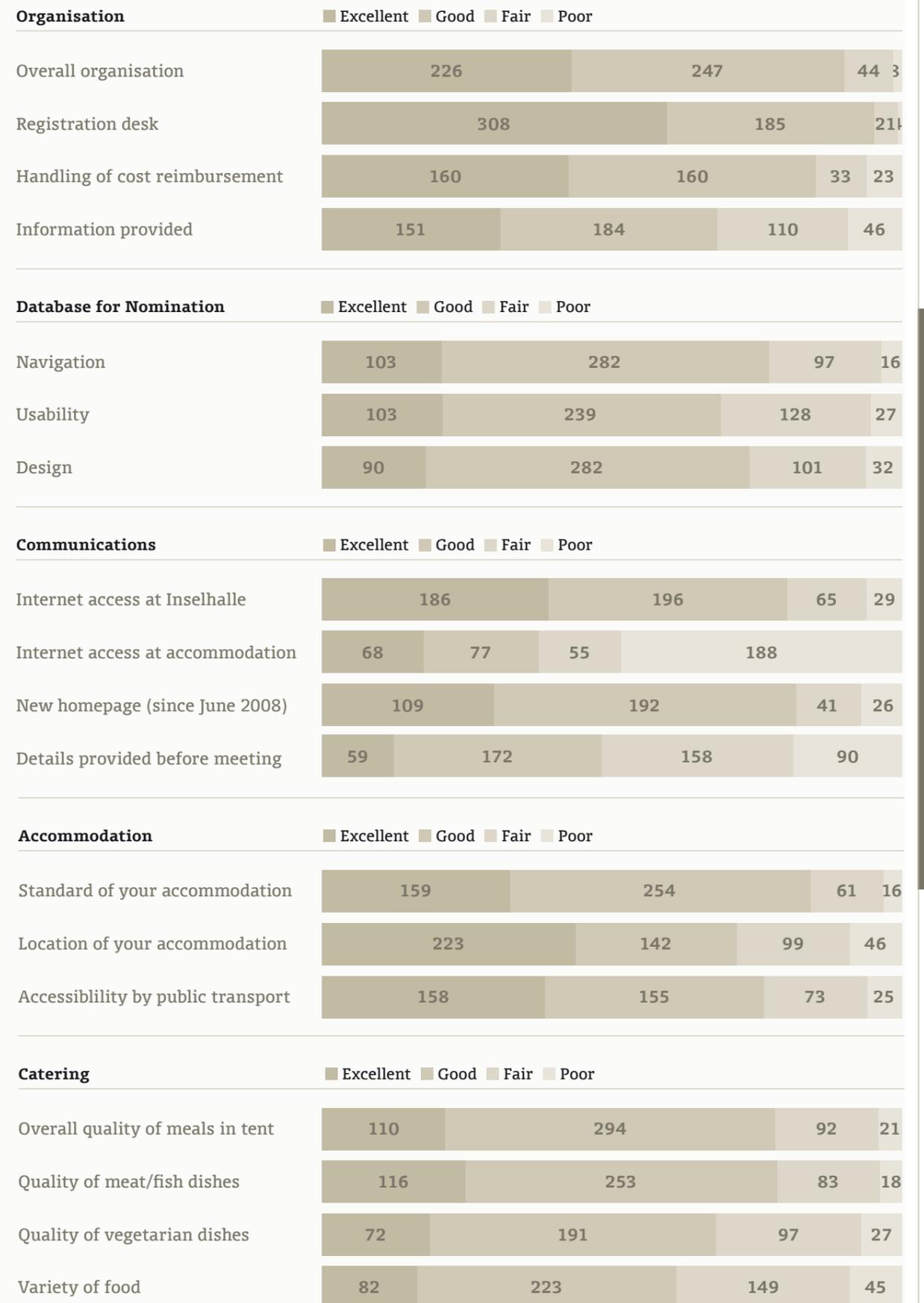
90% of the participants rated the overall organisation of the 58th Meeting of Nobel Laureates as Very Good (43%) or Good (47%). In comparison to 2007, this – still very positive – rating dropped by a few percentage points. Once again, the Registration Desk received extremely positive feedback – the quick, competent assistance provided by Nadine Gärber, Sabine Harder, and Elisa Mussack played a significant role in creating a very positive overall impression.

For the first time, the participants were surveyed on their opinion of the applicant database. The entire selection process is organised using the Internet-based database, which had been tailored to the needs of the international multistage process. The majority of participants rated Navigation and Usability positively, yet the numbers show that further improvements are needed. This was also made evident at the meeting of honorary instructors during this year's meeting. Improvements began immediately following the meeting.

Spending a week at Lake Constance with scientists from all over the world requires a well-functioning communications network in order to keep all of the participants connected to their colleagues and their families at home. The Internet café provided by the Deutsche Telekom and its provision of a WLAN connection in the Inselhalle received rave reviews by the participants. In contrast, the provision of Internet access in Hotel Lindau received the worst ratings of the entire survey. The quality of the hotel's lodging received better marks, although there is still room for improvement.

Last year, the catering facilities in the tent next to the Inselhalle, where the young scientists took their meals, received very poor ratings in the survey (35% Fair, 17% Poor). In response, organisers took special care prior to the 2008 Lindau Meeting to accommodate the various eating habits of participants from all over the world. The results of the survey show that the quality of the food improved, yet there is still significant room for improvement concerning variety (Variety of food: 16% Excellent, 44% Good, 30% Fair, 9% Poor).

• Please rate the following aspects



IV. BEYOND LINDAU

• **Would you be interested in receiving information about German academic institutions and research facilities following your stay in Lindau?** [TOTAL: 505]

I am highly interested in it.	43 %	218	
It would be an option for me.	34 %	173	
I am not interested in it.	12 %	61	
Does not apply.	11 %	53	

• **Would you be interested in receiving information about European academic institutions and research facilities following your stay in Lindau?** [TOTAL: 498]

I am highly interested in it.	51 %	252	
It would be an option for me.	38 %	189	
I am not interested in it.	7 %	34	
Does not apply.	4 %	23	

• **Would you be interested in receiving more information about the Lindau Meeting's Donors and Benefactors and in an interaction with them?** [TOTAL: 517]

I am highly interested in it.	27 %	138	
It would be an option for me.	40 %	207	
I am not interested in it.	33 %	172	
Does not apply.	-	-	

V. THE ALUMNI NETWORK

The results of this portion of the survey made it clear that participants would very much welcome the continuation of the dialogue they began at Lake Constance. 63% said they would definitely create their own profile on an alumni platform. They not only wish to use such a profile in order to stay in contact with the young researchers they met at the Lindau Meeting, but also to form networks with alumni from past and present meetings. The alumni platform, therefore, could make an important contribution to the establishment of sustainable networks for highly talented, up-and-coming scientists.

• **Will you create your own profile at the Alumni Network of the Lindau Meetings:** [TOTAL: 515]

I definitely will create my own profile.	63 %	324
I will decide later.	36 %	185
I will not create a profile because I'm already member of other web-based networks.	1 %	4

• **Please tell us what you expect from an Alumni Network of the Lindau Nobel Laureate Meeting (choose up to three items):** [TOTAL: 515]

Keep in touch with other participants from this year's meeting.	404
Start a dialogue with participants from past meetings.	117
Get news about future Lindau Meetings (e.g. online lectures).	242
Open forum for discussions between former participants.	215
I do not have any expectations.	8

MAECENATES, PATRONS, DONORS

The Lindau Nobel Laureate Meetings would like to thank all maecenates, patrons and donors for their contribution to the endowment of the Foundation.

MAECENATES

Audi AG	RWE AG
Deutsche Bank AG	SAP AG
Ecoscientia Stiftung	Verband der Bayerischen Metall- u. Elektroindustrie
EnBW Energie Baden-Württemberg AG	
Dr. Ing. h.c. F. Porsche AG	

PRINCIPAL PATRONS

Bertarelli Foundation	Siemens AG
Lonza AG	Südwestmetall Baden Württemberg
Mars, Incorporated	Verein der Bayerischen Chemischen Industrie
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* Became member of the founders' assembly during the 58th Meeting of Nobel Laureates.



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Amount 774.800,00 EUR

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Amount 365.000,00 EUR

TOTAL SUM OF REVENUES

Amount 1.139.800,00 EUR

Any deficit which may arise upon presentation of all costs as of December 31st 2008, will be balanced by an existing letter of indemnity provided by the Foundation Lindau Nobelprizewinners Meetings at Lake Constance.

EXPENDITURES

Printing costs and printed materials	46.743,17 EUR
Translation and interpreting costs	5.268,52 EUR
Rent conference venue, tent and office, as well as technical facilities	23.622,13 EUR
External services	104.434,79 EUR
PR (including outreach initiatives)	66.640,55 EUR
Selection process for participants	14.380,00 EUR
General travel expenses	12.784,60 EUR
Travel expenses Nobel Laureates	69.243,80 EUR
Travel expenses participants	19.201,52 EUR
Travel expenses scientific chairmen and Council	2.795,59 EUR
General boarding costs	3.987,26 EUR
Boarding Nobel Laureates	20.314,21 EUR
Boarding participants	104.033,09 EUR
Boarding Council	1.495,75 EUR
General lodging costs	4.601,00 EUR
Lodging Nobel Laureates	35.247,25 EUR
Lodging participants	163.373,02 EUR
Lodging Council	10.536,00 EUR
Expenses for Nobel Laureates	4.627,60 EUR
Postage	14.965,02 EUR
Newspapers, books	346,36 EUR
Telephone	2.974,01 EUR
Internet (Website and global broadcasting)	178.193,59 EUR
Office equipment	2.851,88 EUR
Operating costs (electricity, water etc.)	11.407,95 EUR
Consulting fees	
Insurances and taxes	1.525,00 EUR
Overheads for financial transactions	412,19 EUR
Staffing, wages and salaries incl. Payroll taxes	247.565,55 EUR
Accounting costs	9.912,19 EUR

Total sum of expenditures (until 10/2009) 1.183.483,59 EUR

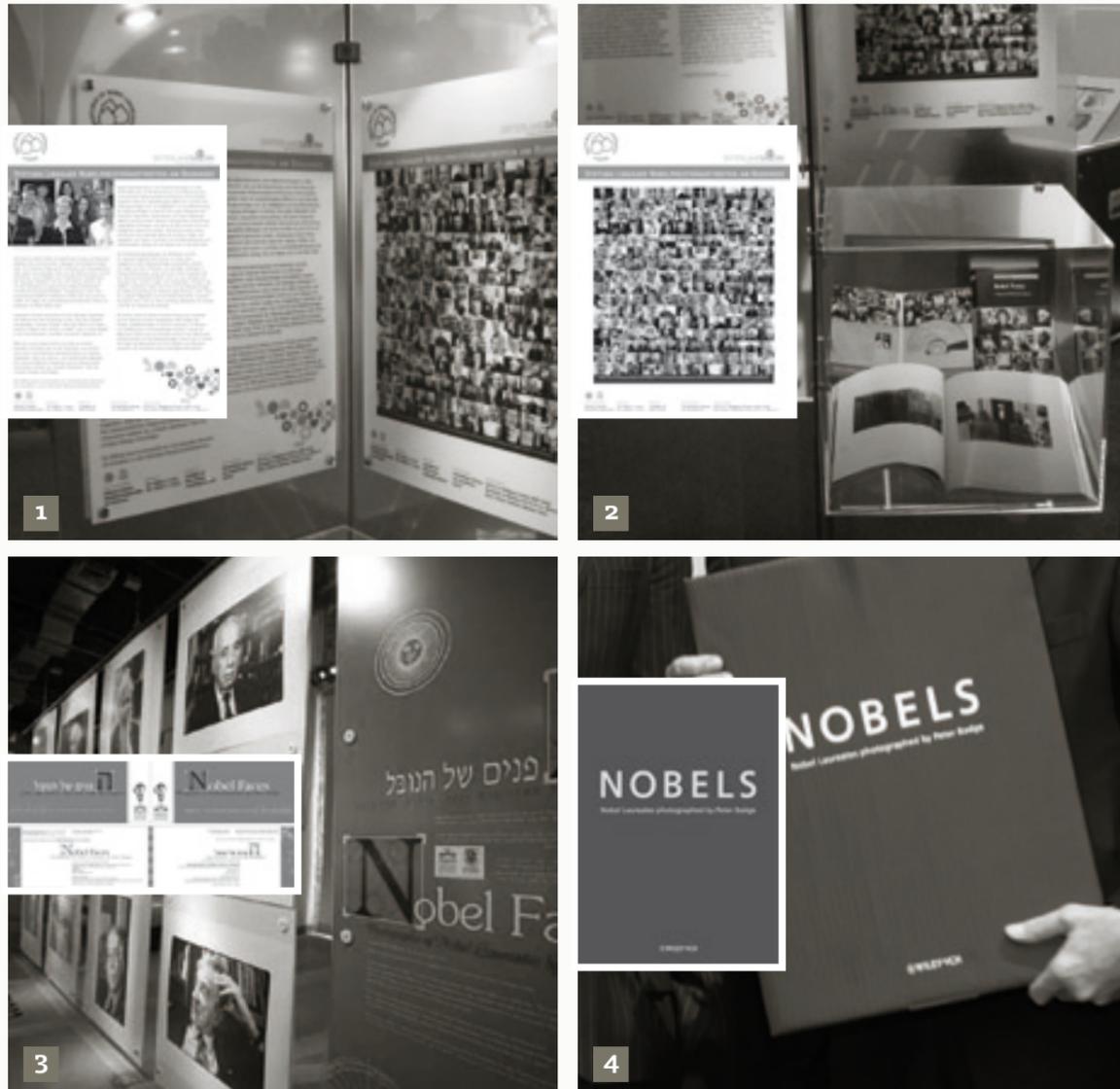
Expected expenditures 11/2008 – 12/2008 60.000,00 EUR

TOTAL

Amount 1.243.483,59 EUR

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EDUCATING AND INSPIRING SCIENTIFIC GENERATIONS: OUTREACH ACTIVITIES OF THE LINDAU MEETINGS.



1 2 Impressions from the “Stifterland Bayern” exhibition: The Lindau Meetings of Nobel Laureates are demonstrating just how well public-private partnerships can function. **3** The exhibition at Israel features Peter Badge’s portraits of Nobel Laureates. **4** The new coffee table book “Nobels” presents 300 large scale black and white images of all living Nobel Laureates accompanied by a short biography of each prize recipient.

Stifterland Bayern

From March 2008 until June 2009, the Association of German Foundations is staging the STIFTERLAND BAYERN (“Bavaria – The donor state”) initiative. With an exhibition, catalogue, symposia and events in all administrative districts of the Free State of Bavaria, it is demonstrating the diversity of foundations active in the region and the indispensable non-profit-making commitment of its sponsors, and aims to reinforce the concept of philanthropy. With almost 2,800 foundations under public law, Bavaria is one of the states in Germany with the largest number of foundations. The Foundation Lindau Nobelprizewinners Meetings at Lake Constance is actively involved in the initiative, and is presenting the Nobel Laureates Meeting both as part of the exhibition as well as in the catalogue.

Exhibition at Israel

A collection of 77 portraits of Nobel Laureates by Peter Badge was on display at Madatech-Israel National Museum of Science, Technology and Space in Spring 2008. Beyond its artistic and documentary merit, the exhibition allows visitors to “meet” Nobel Laureates and discuss scientific novelties and their effects on human life. The exhibition – a joint venture of Technion, Madatech and the Lindau Foundation – was initiated by Professor Aaron Ciechanover, Nobel Laureate in Chemistry 2004, who chose the portraits together with Technion President, Professor Yitzhak Apeloig, and Physics Professor Moti Segev.

“Nobels” – Portraits by Peter Badge

The Nobel prizes were first awarded in 1901, after Alfred Nobel decided to devote his enormous fortune to the betterment of mankind. In his will, he established annual awards in the fields of physical science, chemistry, medical science or physiology, literature and peace (an associated prize was later created in economics). Since then, nearly 600 amazingly accomplished individuals have received a Nobel prize. But most of the recipients have spent their lives in research labs and behind desks, pushing for breakthrough discoveries or creating masterful works of art. In “NOBELS – Nobel Laureates” photographed by Peter Badge, a talented German photographer presents the results of an ambitious project he began in 2000. He has photographed every single living Nobel Laureate.

He presents his work in an impressive coffee table book filled with more than 300 large scale and haunting black-and-white images accompanied by a short biography of each prize recipient. Badge tracked them to all corners of the earth in order to capture a unique image of each and every one. He then teamed up with writer Chris Richmond to create a stunning word/image tableau. “NOBELS” was published in summer 2008. The portraits of Nobel Laureates used in this report (see p. 4/5) are part of a project set up by the Foundation Lindau Nobelprizewinners Meetings at Lake Constance and supported by the Klaus Tschira Stiftung gGmbH. The encouragement by Nobel Laureates of scientific excellence in subsequent generations of scientists marks the spirit of the Lindau Nobel Laureate Meetings where many of the portraits were taken.



UPCOMING LINDAU MEETINGS

59TH MEETING OF NOBEL LAUREATES

(dedicated to Chemistry) from 28 June–3 July, 2009

60TH MEETING OF NOBEL LAUREATES

(3rd interdisciplinary meeting with Nobel Laureates from the fields of Physics, Medicine or Physiology, Chemistry) from 27 June–2 July, 2010

61ST MEETING OF NOBEL LAUREATES

(dedicated to Medicine or Physiology) from 26 June–1 July, 2011

4TH MEETING IN ECONOMIC SCIENCES

from 23–27 August, 2011

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