Plenary Sessions

Wednesday, 2. Sept. 2009, Room A

Time	ID	Plenary Session I
09:00	**1**	**Future Perspectives for Ground-based Telescopes** *Tim de Zeeuw, ESO* Technological developments now make it possible to observe planets orbiting other stars, peer deeper than ever into the Universe, use particles and gravitational waves to study celestial sources, and to carry out in situ exploration of Solar System objects. This promises tremendous progress towards answering key astronomical questions such as the nature of dark matter and dark energy; physics under extreme conditions including black holes, supernovae and gamma-ray bursts; the formation and evolution of galaxies from first light to the present, and the formation of stars and planets including the origin of our own Solar system and the beginning of life. These are amongst the most fundamental scientific questions and are of enormous interest to the general public. A wide range of general purpose and dedicated observatories, on the ground and in space, is presently in operation or under development. Plans are being drawn up for a next generation of facilities, including extremely large telescopes for the optical and infrared, a radio telescope with very large collecting area, survey telescopes which would provide deep imaging of the sky every few nights, an advanced technology Solar telescope, wide-field imagers in space, advanced planetary and Solar missions, experiments to detect particles and gravitational waves, large X-ray telescopes, and space missions devoted to characterizing extra-solar planets. Construction of these facilities will require substantial investment by national funding agencies over the next decades. At their request, an integrated science vision was developed which identifies the most promising techniques and facilities needed to make substantial progress, followed by a road map for the development of the required infrastructure. The talk will discuss future ground-based facilities and highlight the role of ESO.
09:40	**2**	**The energetic universe seen through the eyes of Fermi and H.E.S.S.** *Olaf Reimer, Institut für Astro- und Teilchenphysik, Leopold-Franzens-Universität Innsbruck, Technikerstraße 25/8, 6020 Innsbruck, Austria* Fermi Gamma-ray Space Telescope is an international satellite mission with a physics program spanning from gamma-ray astronomy to particle astrophysics. Fermi was launched in 2008, and is successfully conducting science observations of the gamma-ray sky. A variety of discoveries have been made already, e.g. finding radio-quiet PSRs as major constituents among the Galactic gamma-ray sources, and disproving a universal "GeV excess" in the diffuse emission spectrum. Complementary in many aspects, the ground-based High Energy Stereoscopy System (H.E.S.S.) reveals even more extreme particle accelerators. With both techniques deployed a Golden Age for particle astrophysics using the photon messenger has just begun.

10:20		*Coffee Break*
10:50	**3**	**LHC: Entering a new era in Particle Physics** *Günther Dissertori* *Institute for Particle Physics, ETH Zürich, Schafmattstr. 20, 8093 Zürich, Switzerland* The Large Hadron Collider (LHC) at CERN will collide protons at unprecedented centre-of-mass energies and luminosities. It is expected that this will allow to explore new physics concepts beyond the so successful Standard Model, ranging from supersymmetric extensions to new large extra spatial dimensions. Furthermore, it should shed light on the mechanism behind electro-weak symmetry breaking. In this presentation I will highlight the challenges of the construction and commissioning of both the machine and the detectors, and report on the current status of preparations. Furthermore, I will outline the early physics reach of the experiments.
11:30	**4**	**Climate Change - What are the main issues with regard to human activities, climate modeling and land-climate interactions?** *Sonia Seneviratne* *Institute for Atmospheric and Climate Science, ETH Zürich, Switzerland* Climate change projections are computed with global and regional climate models (GCMs, RCMs) as part of international and national research efforts (IPCC, EU-projects ENSEMBLES, PRUDENCE, CECILIA; e.g. [1, 2]). These model projections are used to assess future impacts of climate change, in terms of changes in mean climate and of changes in intra- and interannual variability (e.g. higher occurrence of extreme events), as well as for more concrete assessments using impact models (e.g. hydrological models, crop models). An important issue with regard to climate-change projections is the assessment of their inherent uncertainty. Beside uncertainties linked with emission scenarios, there are also significant uncertainties linked with model parameterizations and process understanding. A subject of on-going research is the development of new techniques for the estimation of probability distributions for projected climate changes. Another issue is the identification of sensitive climate feedbacks (e.g. land-atmosphere coupling), which induce non-linear (and thus less predictable) modifications of the climate system (e.g. [3, 4]). This is also relevant for the assessment of possible mitigation and adaptation options. In Europe, present climate models predict significant changes both in mean climate and in climate variability. In particular, it is projected that extremes such as heavy precipitation events, droughts and heatwaves will be enhanced. This is linked with a significant shift in climatic regimes, involving modifications in the land-atmosphere coupling characteristics of this region [3]. Remaining uncertainties associated with these projections as well as relevant impacts for the economy and society will be discussed. In particular, current needs regarding the development of monitoring programs and modeling applications will be addressed.

		References: [1] J. H. Christensen, et al., 2007. Regional Climate Projections. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. [2] G. A. Meehl et. al. 2007. Global Climate Projections. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S. et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. [3] S. I. Seneviratne, D. Lüthi, M. Litschi, and C. Schär, 2006: Land-atmosphere coupling and climate change in Europe. Nature, 443, 205-209. [4] S. I. Seneviratne, T. Corti, E. L. Davin, M. Hirschi, I. Lehner, and A. J. Teuling, 2009: Investigating soil moisture-climate interactions in a changing climate: A review. Submitted to Earth-Science Reviews.
12:10	**31**	***Winner of the ÖPG "Ludwig-Boltzmann" Award***
12:40		***Postersession, Lunchbuffet***
14:00		***TOPICAL SESSIONS***

Thursday, 3. Sept. 2009, Room A

Time	ID	Plenary Session II
09:00	5	**Materials challenges for future nanoscale electronics** *Walter Riess, IBM Research, Säumerstrasse 4, 8803 Rüschlikon, Switzerland* Scaling of semiconductor technology (CMOS) has been the driving force for the success of information technology. However, as device dimensions continue to shrink into the nanometer length-scale regime, conventional semiconductor technology will be approaching fundamental physical limits. New strategies, including the use of novel materials and 1D-device concepts, innovative device architectures, and smart integration schemes need to be explored and assessed. They are crucial to extend current capabilities and maintain momentum beyond the end of the technology roadmap time frame (post-CMOS era).
09:40	6	**THz Science: Exploring the secrets of nanostructures** *Karl Unterrainer, TU Wien, Photonik Institut und Zentrum für Mikro & Nanostrukturen, Gusshaustr. 27-29, 1040 Wien, Austria* Since scientists realized that radio waves and light are the same phenomenon - electromagnetic radiation, at different frequencies - they have naturally been interested in the area where one shades into the other. That is "the terahertz gap". To radio engineers it's the "sub-millimeter band", and from an optics point of view it's the "far infrared". Nature, however doesn't have a gap: it is full of natural radiation in this range. But until very recently there were no readily controllable sources and detection was difficult. It became only possible to solve this problem with the advent of modern nano structures with fascinating new functionalities like THz optical transitions. These transitions occur due to the quantum confinement and are entirely determined by the geometry on the nano scale. These quantized transitions help to provide sources like the THz quantum cascade lasers which can cover the full THz range with electrical control and on-chip integration. Few-cycle THz pulses generated by ultrafast laser pulses provide a perfect tool to explore the properties of quantized transitions providing direct insight to the dynamics and coherence of quantum wells and quantum dots. The study of THz quantum cascade lasers with few-cycle THz allows even phase-resolved measurements of stimulated emission.
10:20		***Coffee Break***
10:50	7	**Molecules in Cold Helium Nanodroplets: Formation of High-Spin States and Magnetic Resonance Spectroscopy** *Wolfgang E. Ernst, Institute of Experimental Physics, Graz University of Technology, Petersgasse 16, 8010 Graz, Austria* Droplets of about 10^4 helium atoms generated in a supersonic expansion, represent a nanometer-sized superfluid medium of 0.4 K temperature and can be doped with one or several atoms or molecules that may form complexes in this cold

		environment. Using two-laser excitation schemes, we were able to identify the alkali trimers K_3, Rb_3, K_2Rb and KRb_2 in their lowest quartet states formed on droplets loaded with potassium and rubidium atoms and assign several excited states that underlie both Jahn-Teller and spin-orbit coupling. By measuring the circular dichroism spectra in the presence of a magnetic field, we obtained information about the electronic spin relaxation in alkali atoms and molecules on helium droplets. Optical detection of spin resonance has been achieved in an optical pump-probe experiment with the electron spin transition induced in a microwave cavity in a magnetic field between the pump and probe regions. With a circularly polarized pump laser depleting a particular spin state, the probe laser detects the successful spin flip induced by the microwave field.
11:30	**8**	**Phase-Contrast and Dark-Field Imaging for Improved Contrast in Medical X-Ray Diagnostics** *Franz Pfeiffer, Technical University Munich, Physik-Department (E17), 85748 Garching b. München, Germany* The basic principles of x-ray image formation in radiography have remained essentially unchanged since Röntgen first discovered x-rays over a hundred years ago. The conventional approach relies on x-ray absorption as the sole source of contrast and draws exclusively on ray or geometrical optics to describe and interpret image formation. This approach ignores another, potentially more useful source of contrast, namely the phase information. Phase-contrast imaging techniques, which can be understood using wave optics rather than ray optics, offer ways to augment or complement standard absorption contrast by incorporating phase information. This presentation will focus on our recent contributions to this field and will discuss particularly the development of novel grating-based x-ray phase-contrast and dark-field imaging methods for use with conventional, lab-based x-ray sources. A variety of experimental results will be shown that highlight the potential of this novel method for biomedical, clinical, and industrial applications. The presentation concludes with an outlook concerning the use of these advanced radiology methods for future human diagnostics in clinical practice. References (selected): • F. Pfeiffer et al., Nature Materials 7, 134-137 (2008). • F. Pfeiffer et al., Physical Review Letters 101, 16810 (2008). • F. Pfeiffer et al., Physics in Medicine and Biology 52, 6923-6930 (2007). • F. Pfeiffer et al., Nature Physics 2, 258-261 (2006). • T. Weitkamp et al., Optics Express 13, 6296-6304 (2005).
12:10	**41**	***Winner of the SPS Award in General Physics, sponsored by ABB***
12:40		***Postersession, Lunchbuffet***
14:00		***TOPICAL SESSIONS***

Time	ID	Plenary Session III, Award Ceremony and General Assemblies of ÖPG, SPS and ÖGAA
09:00	9	**Experimental Methods for Matter Waves With Clusters and Molecules** *Markus Arndt, Universität Wien* Matter wave interferometry with large things poses many technological as well as fundamental challenges. The talk will focus on experimental explorations of molecular beam methods with regard to their use in quantum optics experiments. This includes a comprehensive assessment of different particle sources, molecular detection schemes and a range of ideas on how to create and maintain coherence for supermassive neutral particles. The talk underlines the importance of cluster physics for the future of quantum optics but also shows the experimental benefits of quantum interferometry for physical chemistry. [1] Hackermüller et al., Nature, 427, 711 (2004). [2] Stibor et al., New J. Phys. 7, 1-10 (2005). [3] Reiger et al., Opt. Comm. 264, 326 (2006). [4] Gerlich et al., Nature Physics 3, 711 (2007). [5] Gerlich et al., Angew. Chem. Int. Ed. 47, 6195 (2008). [6] Marksteiner et al., J. Am. Soc. Mass. Spectrom., 19, 1021 (2008). [7] Hornberger et al., New J. Phys. 11, 043032 (2009).
09:40		***AWARD CEREMONY (see page 14)***
10:50		***Coffee Break***
11:20	10	**Reflections on a bubble: Physics, history and art** *Denis Weaire, School of physics,Trinity College Dublin, Ireland* A single bubble may be an icon of of perfection and symmetry in nature, as well as a poetic reminder of mortality, but the mass of bubbles that we call a foam represents much more. It is a "complex system" whose simple components interact to produce a rich variety of physical properties. When looked at in detail its structure also has a certain aesthetic appeal: it formed the basis of the Water Cube at the 2008 Beijing Olympics. This particular structure has a fascinating history, involving the blind Belgian scientist Joseph Plateau, the great Irish physicist Lord Kelvin and others. This is a "dry" foam. "Wet" foam, made up of small spherical bubbles, also has an interesting history, beginning when Lawrence Bragg was attending to his Cambridge garden... So foams can provide an attractive, familiar and convenient prototype for many physical systems (especially soft matter) in both research and teaching.
12:00		
12:10		***GENERAL ASSEMBLIES*** ***ÖPG: Room C*** ***SPS: Room D***

12:40		***Postersession, Lunchbuffet***
14:00	***TOPICAL SESSIONS***	
14:30 - 16:00	***GENERAL ASSEMBLY ÖGAA: Room F***	
18:45		***END OF TOPICAL SESSIONS***

Friday, 4. Sept. 2009, Aula Hauptgebäude, Innrain 52

Time	ID	Plenarsitzung, Öffentlicher Vortrag
19:30	**21**	**Einsteins Schleier** *Anton Zeilinger, Universität Wien* Wieso verhalten sich Teilchen als Wellen? Und warum verhalten sich Wellen als Teilchen? Wieso ist die Welt überhaupt so - so seltsam? Die Quantenphysik gilt gewöhnlich als dunkel, paradox, rätselhaft, weil sie mit dem gesunden Menschenverstand und unserer natürlichen Wahrnehmung zu kollidieren scheint. Genau dies macht sie aber auch für so viele faszinierend, fesselt Physiker ebenso wie Philosophen, Fachleute ebenso wie Laien. Erwin Schrödinger hatte etwa gemeint, Verschränkung, von Einstein "spukhaft" genannt zwinge uns, von unseren liebgewordenen Vorstellungen wie die Welt beschaffen ist, Abschied zu nehmen. In seinem Vortrag erläutert Anton Zeilinger die zentralen Aussagen der Quantenphysik, wie etwa Zufall und Verschränkung nicht abstrakt, sondern an Hand von ganz einfachern Experimenten, und reflektiert ihre Auswirkungen auf unser Weltbild.
20:30		***END OF CONFERENCE***