LINDAU NOBEL LAUREATE MEETINGS

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Topics 69th Lindau Nobel Laureate Meeting (#LINO19)

Gravitational Waves

Predicted by Einstein in the early 20th century, gravitational waves are ripples in space, which open an additional observational window to the universe. These waves allow scientists to study phenomena which could not, or solely indirectly, be observed before. The first gravitational wave detection originated from two merging black holes and was observed by **Rainer Weiss** and his colleagues of the LIGO experiment. According to the current model of our universe, gravitational waves could lead to observations beyond the Cosmic Microwave Background (CMB). The CMB marks our observational frontier towards the Big Bang. Gravitational waves could be the tool to solve the riddle about how the universe came into existence and allow a glimpse into a time before the CMB. Important questions in the future of this research field include:
How do the current detectors need to be adapted to make it possible to glimpse beyond the CMB? Will gravitational waves be a tool to observe gravitational fluctuation in empty space? Which steps have to be taken to realise a space mission dedicated to the measurement of gravitational waves?

- Lecture by Joseph Taylor and Rainer Weiss: Tuesday, 2 July, 12:00-13:00 hrs

The Dark Side of the Universe

One of the largest remaining mysteries in physics and astronomy is the composition of the universe. According to present knowledge, the universe is composed of 5 % ordinary matter, 25 % dark matter and 70 % dark energy, which causes the expansion of the universe to accelerate. The mapping of the Cosmic Microwave Background by **John Mather, George Smoot** and the COBE team as well as the discovery of the accelerated expansion of the universe by **Adam Riess, Brian Schmidt** and Saul Perlmutter contributed important cornerstones for understanding the evolution of the universe.
Highly debated questions in this field include among others:
Which innovative research methods can be used to determine the nature of dark matter? What are the current hypotheses that explain the expansion of the universe? And what role can artificial intelligence play to scientifically illuminate the dark side of the universe?

- Lecture by Arthur B. McDonald: Tuesday, 2 July, 9:30-10:00 hrs
- Agora Talk by John C. Mather & George F. Smoot: Tuesday, 2 July, 11:05-11:45 hrs
- Lecture by Adam G. Riess: Tuesday, 2 July, 13:00-13:30 hrs
- Panel Discussion: “The Dark Side of the Universe”, Tuesday, 2 July, 15:30-17:00 hrs

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Laser Physics/Optical Manipulation

Optical manipulation of (small) systems by lasers and ground-breaking inventions in laser physics are the bases for many state of the art technologies in today's medicine (e.g. corrective eye surgery), biology (e.g. optical tweezers), and fundamental research. However, these achievements were only possible in the light of the ground-breaking works of Arthur Ashkin, **Gérard Mourou** and **Donna Strickland.**
By inventing the method of chirped pulse amplification (CPA), **Gérard Mourou** and **Donna Strickland** could produce high intensity, ultra-short laser pulses which led to many advances in high-precision machining as well as laser medicine. Also, the ultra-short laser light pulses, enabled by CPA, allow us to study how molecules and atoms behave as now ultrafast images of split-second processes are possible. Even astrophysical phenomena, like the hot plasma inside of stars, can now be created and studied in laboratories.
Questions prompted by this research are: Which new applications will be available to science and industry with even faster and higher energy laser pulses? How can the communication between the various fields, in which the above-mentioned techniques are used be increased and encouraged?

- Lectures by Gérard Mourou and Donna Strickland:
  Monday, 1 July, 9:00-10:00 hrs
- Press conference with Mourou and Strickland: Tuesday, 2 July, 14:15-15 hrs

Graphene/Materials Physics

Using perfectly normal Scotch Tape on a pencil can lead to ground-breaking discoveries in fundamental research. The one atom thick layer of carbon, named graphene, was prepared by **Konstantin Novoselov** and Andre Geim in roughly this manner. The intense study of the two-dimensional carbon lattice leads to various applications in electronics and the semiconductor industry. Also, this two-dimensional material allows for the study of exotic quantum effects.
Questions to discuss in connection to graphene and the advances in material physics are: How can the latest insight in this system further our endeavours in nanotechnologies? How does our knowledge as well as current and future research on graphene influence and direct the research on other two-dimensional materials?

- Lecture by Konstantin Novoselov: Monday, 1 July, 12:00-12:30 hrs
- Science Breakfast: Wednesday, 3 July, 7:00-8:30 hrs

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Student, Postdoc, and Then…? – Aiming for a Career in Science

A career in science, possibly in an academic position, is the dream of almost every young scientist. Along the way, young researchers naturally encounter questions concerning how scientific excellence is achieved and evaluated by peers. Being at an age when starting a family, pursuing a career in science and striving for a healthy work-life balance, this is often experienced as stressful, if not frustrating. Moreover, in academic positions, one is often additionally burdened with funding problems, teaching duties and heavy administrative tasks, which make a successful career in academic science a complex and often wearing process. Also, being too focused on an academic career, young scientists sometimes miss opportunities outside the academic world.
A healthy professional and/or academic environment with enthusiastic, appreciative colleagues and a mentor are a good start when facing these issues. The benefits of networks between young scientists and their students and mentors, as well as among young scientists themselves are often only seen in respect to science but are rarely seen in respect to the life experiences as a scientist. The Lindau Nobel Laureate Meeting offers the perfect platform for this type of exchange.
In the panel discussion with laureates and young scientists, we will address some of the challenges when aiming for a career as a scientist.

- Panel Discussion: "Student, Postdoc, and Then? – Aiming for a Career in Science", Wednesday, 3 July, 15:30-17:00 hrs

The End of International Collaborations in Science? How Nationalism Threatens an Open Scientific World

Today, international collaborations are common and foster advances in fundamental research. Large multinational projects such as CERN, IceCube, ITER, ESO, SKA etc. are good examples of an open society, where collaborations without barriers count as an everyday commodity and not as something extraordinary. To put it in a different perspective: political and social achievements from the last 70 years shaped the scientific world and were then even taken one step further by scientists.
However, the recent rise in nationalist movements in various countries around the world as well as political populism pose a danger to society and science. Most noticeably for Europe, it is still unclear which consequences Brexit will have for various large and small collaborations, exchange and funding programmes.
The questions are: How will nationalism influence the scientific society? Is there a way to keep international projects going if these separative movements continue? Do scientists have the means to counteract these shifts?

- Press Talk: Monday, 1 July, 14:15-15:15 hrs