Participating Nobel Laureates – 65th Lindau Nobel Laureate Meeting

Number	Name	First Name	Discipline	Year
1	Agre	Peter	Chemistry	2003

Prize motivation	Co-recipients	Attending co-recipients
For discoveries concerning channels in cell membranes	Roderick MacKinnon	-

Keywords	Tag	Links to other laureates	Links to profiles
Protein, structure, membrane, disease	Aquaporins	Robert Huber, Hartmut Michel (membrane proteins), Ada Yonath, Venkatraman Ramakrishnan (structural biologists)	32, 41, 51, 70

Lecture title
Aquaporin Water Channels – From Atomic Structure to Malaria

Profile text
Aquaporins are membrane proteins that allow the passage of water molecules. They are described as the “body’s piping system”. Aquaporins are selective for water molecules, and prevent charged ions from passing through the membrane. There are several classes of aquaporins that occur, for example, in mammals, bacteria and plants. Mutations in aquaporin genes can lead to severe metabolic and organ disorders. From Agre’s lectures in Lindau: The vector of malaria, the *Anopheles gambiae* mosquito, has several AQP genes. Agre’s data show that AQP1 plays a role in water homeostasis during the absorption of blood by the insect. AQP1 could therefore act as an important modulator in the mosquito’s adaptation to changing moisture conditions and influence the prevalence of malaria in sub-Saharan Africa. Agre is a regular visitor to Lindau.

Number	Name	First Name	Discipline	Year
2	Alferov	Zhores	Physics	2000

Prize motivation	Co-recipients	Attending co-recipients
For developing semiconductor heterostructures used in high-speed- and optoelectronics	Jack S. Kilby, Herbert Kroemer	-

Keywords	Tag	Links to other laureates	Links to profiles
Semiconductors, optics, lasers	Heterotransistor	Gerhard Ertl (surface chemistry), Klaus von Klitzing (solid-state physics)	17, 35

Lecture title
tba

Profile text
Alferov invented the heterotransistor, and he is regarded as one of the fathers of heterostructure physics. Heterostructure semiconductors are based on a sandwich construction in which multiple semiconductor materials with different doping characteristics are stacked on top of each other. The interface layer is referred to as the heterojunction. One application of these devices is in solid-state lasers (laser diodes), which are used in CD and DVD drives, cash register scanners and barcode readers, as well as for data transmission through optical fibre cables. Alferov is an MP for the Communist Party in the Russian Duma and is currently the oldest member of that body. After his first visit in 2001, he is attending his second Lindau Nobel Laureate Meeting this year.

Number	Name	First Name	Discipline	Year
3	Arber	Werner	Physiology or Medicine	1978

Prize motivation	Co-recipients	Attending Co-laureate
For the discovery of restriction enzymes and their application to problems of molecular genetics	Daniel Nathans, Hamilton Smith	Hamilton Smith

Keywords	Tag	Links to other laureates	Links to profiles
DNA, recombinant DNA technology, evolution, bacteria	Restriction enzymes	Hamilton Smith (co-laureate), Richard Roberts	52, 57

Lecture title
Insight into the Laws of Nature for Biological Evolution

Profile text
Arber discovered that bacteria selectively break down foreign genetic material, whereas their own methylated DNA remains intact. He described a class of enzymes, known as restriction endonucleases, which cut DNA at specific sites. Restriction endonucleases are important tools in recombinant DNA technology and are used in molecular biological laboratories around the world. More than 3000 of these enzymes have since been discovered and characterised. Arber has dedicated most of his career to research into molecular evolution. In Lindau, he does not usually speak about the work for which his Nobel Prize was awarded but about Darwinian evolution and the cultural value of scientific evidence. Arber is a regular guest in Lindau.

Number	Name	First Name	Discipline	Year
4	Barré-Sinoussi	Françoise	Physiology or Medicine	2008

Prize motivation	Co-recipients	Attending co-recipients
For their discovery of human immunodeficiency virus	Luc Montagnier, Harald zur Hausen	Luc Montagnier, Harald zur Hausen

Keywords	Tag	Links to other laureates	Links to profiles
Disease, immune system, viruses, healthcare system	HIV	Luc Montagnier, Harald zur Hausen (Co-recipients)	28, 44

Lecture title
Translational Science on Viral Infectious Diseases: From Louis Pasteur to Today

Profile text
Barré-Sinoussi received the 2008 Nobel Prize for discovering the HI virus in 1983. Together with Luc Montagnier, she isolated and cultivated lymph cells from infected patients and was able to characterise the viruses morphologically in cell extracts and demonstrate the activity of reverse transcriptase, thus classifying HIV as a retrovirus. Her more recent work focuses on the transmission of HIV from mother to child and the role of the maternal innate immune system in this context and the adaptive immune response to viral infections. Today, she is active in AIDS-related policymaking, especially in Africa. She is the President of the International AIDS Society. Barré-Sinoussi attended a Lindau Nobel Laureate Meeting for the first time in 2010 and spoke about the eradication of diseases by science and the global benefits of applied research. She is visiting Lindau for the third time following her visits in 2010 and 2014.

Number	Name	First Name	Discipline	Year
5	Betzig	Eric	Chemistry	2014

Prize motivation	Co-recipients	Attending co-recipients
For the development of super-resolved fluorescence microscopy	Stefan Hell, William Moerner	Stefan Hell, William Moerner

Keywords	Tag	Links to other laureates	Links to profiles
Optics, diffraction limit, microscopy	Super-resolved microscopy	Stefan Hell, William Moerner (Co-recipients), Susumu Tonegawa (interest in neurobiology)	29, 42, 61

Lecture title
Working Where Others Aren't (tentative title)

Profile text
The properties of light waves impose a natural limit on the resolution of optical microscopy, known as the diffraction, or Abbe, limit. Objects smaller than around 250 nm can no longer be sharply imaged for physical reasons. Any method that allows objects to be resolved beyond the diffraction limit is referred to as super-resolved microscopy. Betzig developed a method which uses photoactivated fluorescent proteins that are repeatedly exposed to light. Photon emission or bleaching of the proteins is then measured. Calculations based on the observed emission patterns make it possible to resolve biological structures beyond the diffraction limit. Betzig is now working at the Janelia Research Campus in the USA on improving microscopic techniques and their applications in neurobiology. As a 2014 Laureate, Betzig is taking part in a Lindau Nobel Laureate Meeting for the first time.

Number	Name	First Name	Discipline	Year
6	Beutler	Bruce	Physiology or Medicine	2011

Prize motivation	Co-recipients	Attending co-recipients
For their discoveries concerning the activation of innate immunity (Beutler und Hoffmann), for his discovery of the dendritic cell and its role in adaptive immunity (Steinman)	Jules Hoffmann, Ralph Steinman	Jules Hoffmann

Keywords	Tag	Links to other laureates	Links to profiles
Protein, immune system, disease, membrane	Immune system	Jules Hoffmann (co-laureate), Peter Doherty, Susumu Tonegawa, (immunology)	31, 14, 61

Lecture title

Finding Mutations that Affect Immunity

Profile text

Broadly speaking, the immune system consists of two parts: the innate, or non-specific, branch and the acquired, or specific, branch. The innate branch forms the body's first line of defence, while the acquired branch is responsible for the production of antibodies. Beutler discovered that mice require proteins of the toll-like receptor family to respond to bacterial infections. He then identified the sensors for innate immunity. Interestingly, the receptor proteins in flies and mammals are very similar. Ralph Steinmann, the 2011 Co-Laureate, died 3 days before the Prize was announced. He worked on the role of dendritic cells in acquired immunity. Beutler visited Lindau for the first time in 2014.

Number	Name	First Name	Discipline	Year
7	Bishop	J. Michael	Physiology or Medicine	1989

Prize motivation	Co-recipients	Attending co-recipients
For their discovery of the cellular origin of retroviral oncogenes	Harold Varmus	Harold Varmus

Keywords	Tag	Links to other laureates	Links to profiles
DNA, protein, cancer, viruses	Oncogenes	Harold Varmus (co-laureate), Tim Hunt (cancer), Harald zur Hausen (viruses and cancer)	63, 28, 33

Lecture title
A Virus, a Gene and Cancer: An Anatomy of Discovery

Profile text
Oncogenes control the normal growth and division of cells. Mutations in these genes can lead to uncontrolled cell division and therefore cancer. Together with Harold Varmus, J. Michael Bishop described the mechanism of action of the first known oncogene, called src (pronounced “sarc”). Src is a retroviral protein kinase. Varmus and Bishop then succeeded in applying their findings to retroviral transduction in general and to other retroviral oncogenes. Bishop helped to identify mutations that damage normal cellular genes, resulting in cancer. He investigated the contribution of proto-oncogenes to the development of cancer in humans. Following a visit in 2014, this is Bishop’s second Lindau Nobel Laureate Meeting. Before his pioneering work in San Francisco, he lived for a year in Hamburg.

Number	Name	First Name	Discipline	Year
8	Blackburn	Elizabeth	Physiology or Medicine	2009

Prize motivation	Co-recipients	Attending co-recipients
For the discovery of how chromosomes are protected by telomeres and the enzyme telomerase	Jack Szostak, Carol Greider	Jack Szostak

Keywords	Tag	Links to other laureates	Links to profiles
DNA, ageing, cancer	Telomeres	Jack Szostak (co-laureate)	60

Lecture title
Telomeres: Telling Tails

Profile text
The caps at the ends of chromosomes are known as telomeres. They consist of repeating DNA sequences, and they progressively shrink during the ageing process. This is associated with certain diseases. The enzyme telomerase compensates for this process. However, excessive activity of telomerase is a sign of proliferating cancer cells. Therapeutic regulation of telomerase activity is therefore a promising approach to counteract ageing. Blackburn is involved in a company that is researching age-related diseases. She should be in a position to comment on the likelihood of an actual therapeutic application for the modification of telomerase activity. Blackburn attended the Lindau Nobel Laureate Meetings already in 2011 and 2014.

Number	Name	First Name	Discipline	Year
9	Capecchi	Mario	Physiology or Medicine	2007

Prize motivation	Co-recipients	Attending co-recipients
For their discoveries of principles for introducing specific gene modifications in mice by the use of embryonic stem cells	Martin Evans, Oliver Smithies	Martin Evans, Oliver Smithies

Keywords	Tag	Links to other laureates	Links to profiles
Stem cells, cancer, cell biology, recombinant DNA technology	Knockout mouse	Martin Evans, Oliver Smithies (co-laureaten)	18, 58

Lecture title

PLEASE NOTE: Capecchi cancelled his participation

Profile text

Capecchi developed a method that enables scientists to breed mice with mutations in any desired genes. The resulting genetically modified mice are known as knockout mice. To breed knockout mice, target DNA is introduced into isolated embryonic stem cells of the mice. The DNA integrates into the mouse chromosome via a process known as homologous recombination. A marker introduced along with the DNA aids identification of the transgenic mice bred in this manner. Capecchi is currently a Professor in the Genetics Department of the University of Utah, where he is investigating phylogenetic topics in a mouse model. He has not previously attended a Lindau Nobel Laureate Meeting.

Number	Name	First Name	Discipline	Year
10	Chalfie	Martin	Chemistry	2008

Prize motivation	Co-recipients	Attending co-recipients
For the discovery and development of the green fluorescent protein, GFP	Osamu Shimomura, Roger Y. Tsien	Roger Y. Tsien

Keywords	Tag	Links to other laureates	Links to profiles
Protein, cell biology, tools	GFP	Roger Tsien (Co-Laureate)	62

Lecture title

Tickling Worms: Suprises from Basic Research

Profile text

Green-fluorescing protein (GFP), which was originally discovered by Shimomura in a jellyfish species, has developed into a powerful tool in the fields of molecular and cell biology. Much of the credit for this goes to Martin Chalfie. He was the first to discover that GFP is an excellent marker for measuring gene expression. If GFP DNA is coupled to the DNA of a cellular protein being studied, the target protein can be visualised under a fluorescence microscope. The observed luminosity correlates with the strength of expression of that protein. Chalfie is actively studying haptic cells of the nematode *C. elegans*. This marks his fifth visit to Lindau.

Number	Name	First Name	Discipline	Year
11	Chu	Steven	Physics	1997

Prize motivation	Co-recipients	Attending co-recipients
For development of methods to cool and trap atoms with laser light	Claude Cohen-Tannoudji, William Phillips	Claude Cohen-Tannoudji, William Phillips

Keywords	Tag	Links to other laureates	Links to profiles
Optics, lasers, atoms	Trapping atoms	Claude Cohen-Tannoudji, William Phillips (Co-recipients), Serge Haroche (atom traps)	13, 50, 27

Lecture title
tba

Profile text
Atoms in gases (e.g. air) move at around 4000 kph – too fast to be studied individually. Rapid cooling slows atoms in gases, but normally also causes the gases to condense and crystallise. However, crystallisation can be prevented by cooling highly rarefied gases (in a vacuum) to temperatures near absolute zero (-273 degrees Celsius), and the slowed gas molecules can then be individually analysed. Chu used laser light of specific frequencies to draw energy from atoms, thus slowing them step by step and bringing their temperature down to near absolute zero. He also used lasers to build atom traps, allowing him to capture and analyse single atoms that have been slowed down in this manner. He is participating in a Lindau Nobel Laureate Meeting for the fifth time.

Number	Name	First Name	Discipline	Year
12	Ciechanover	Aaron	Chemistry	2004

Prize motivation	Co-recipients	Attending co-recipients
For the discovery of ubiquitin-mediated protein degradation	Avram Hershko, Irwin Rose	Avram Hershko

Keywords	Tag	Links to other laureates	Links to profiles
Protein, cell biology, protein degradation	Ubiquitin	Avram Hershko (Co-Laureate), Tim Hunt, (cyclin degradation in the cellular cycle), Edmond Fischer (regulation of protein activity)	30, 33, 20

Lecture title

The Revolution of Personalized Medicine: Are we going to Cure all Diseases and at What Price?

Profile text

The ubiquitin-proteasome system is an integral part of cellular protein homeostasis. Just as the ribosome is associated with the start of the life of proteins, ubiquitin, a 76-amino-acid protein, is associated with their final demise. When ubiquitin adheres to target proteins, it marks them for degradation by proteasome, which is also a protein complex. Ubiquitin also plays a key role in the regulation of vital cellular functions. For example, timely ubiquitin-induced degradation of cyclins ensures that the cell cycle proceeds correctly. Ubiquitin-dependent protein degradation plays a role in immune responses and in the cellular response to inflammation, programmed cell death and generally in the quality control of proteins. Ciechanover published the landmark experiment that led to the discovery of ubiquitin in an obscure scientific journal (*Biochemical and Biophysical Research Communications*) and not in one of the established journals. He has attended every Lindau Nobel Laureate Meeting since winning the Prize in 2004.

Number	Name	First Name	Discipline	Year
13	Cohen-Tannoudji	Claude	Physics	1997

Prize motivation	Co-recipients	Attending co-recipients
For development of methods to cool and trap atoms with laser light	Steven Chu, William Phillips	Steven Chu, William Phillips

Keywords	Tag	Links to other laureates	Links to profiles
Optics, lasers, atoms	Trapping atoms	Steven Chu, William Phillips (Co-recipients), Serge Haroche (atom traps)	11, 50, 27

Lecture title

The Adventure of Cold Atoms. From Optical Pumping to Quantum Gases

Profile text

Atoms in gases (e.g. air) move at around 4000 kph – too fast to be analysed individually. Rapid cooling slows atoms in gases, but normally also causes the gases to condense and crystallise. However, crystallisation can be prevented by cooling highly rarefied gases (in a vacuum) to temperatures near absolute zero (-273 degrees Celsius), and the slowed gas molecules can then be individually analysed. Cohen-Tannoudji developed the theoretical underpinnings for cooling atoms in gases below what is known as the Doppler limit. He then developed a method that made it possible to cool helium atoms to 0.18 microkelvins using six oppositely aligned laser beams. Under these conditions, helium atoms still have a residual speed of 2 cm per second or 70 mph. Cohen-Tannoudji attended the Lindau Nobel Laureate Meetings in 1998 and 2000.

Number	Name	First Name	Discipline	Year
14	Doherty	Peter	Physiology or Medicine	1996

Prize motivation	Co-Laureate	Attending co-recipients
For their discoveries concerning the specificity of the cell mediated immune defence	Rolf Zinkernagel	-

Keywords	Tag	Links to other laureates	Links to profiles
Protein, immune system, viruses, disease	Immune system	Bruce Beutler, Susumu Tonegawa, Jules Hoffmann (immunology)	6, 61, 31

Lecture title
The Killer Defence

Profile text
Doherty received the Nobel Prize for his contribution to understanding the acquired immune response. Viruses invade host cells, in which their viral DNA or RNA and their proteins are then replicated. Killer T cells destroy infected cells, thus preventing the virus from replicating. Together with Rolf Zinkernagel, Doherty discovered the mechanism by which killer T cells recognise virus-infected cells, i.e. with the help of viral proteins presented at the cell surface and a molecule of the major histocompatibility complex (MHC complex). Doherty is still actively publishing, particularly on the subject of T cell-antigen mechanisms and influenza viruses. He attended the Lindau Nobel Laureate Meetings in 1999 and 2014.

Number	Name	First Name	Discipline	Year
15	Englert	François	Physics	2013

Prize motivation	Co-Laureate	Attending co-recipients
For the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider	Peter W. Higgs	-

Keywords	Tag	Links to other laureates	Links to profiles
Particle physics, collision experiments, atomic nucleus	CERN	Carlo Rubbia, Martinus Veltman (CERN experiments), David Gross (particle physics)	53, 64, 24

Lecture title
The Origin of Mass and the Emergence of the Universe
Profile text
Around half a dozen scientists made key contributions to the discovery and development of the Higgs mechanism, including François Englert. The Higgs mechanism describes the origin of mass on the scale of elementary particles. In the standard model of elementary particle physics, the Higgs field confers mass to the three weakly interacting bosons, W+, W- and Z. The Higgs field itself cannot be experimentally detected. However, experiments at CERN have demonstrated the existence of the Higgs boson, which could not exist without the Higgs field. The work by Englert and Higgs built on the discovery of weak interaction bosons by Rubbia and Van der Meer.

Number	Name	First Name	Discipline	Year
16	Ernst	Richard	Chemistry	1991

Prize motivation	Co-Laureate	Attending co-recipients
For his contributions to the development of the methodology of high-resolution nuclear magnetic resonance (NMR) spectroscopy	Sole laureate	-

Keywords	Tag	Links to other laureates	Links to profiles
Nuclear magnetic resonance, electromagnetism	NMR	Kurt Wüthrich (NMR), Robert Huber, Hartmut Michel (structural biology)	32, 41, 69

Lecture title

What can we Learn from the Extraordinary Success of Magnetic Resonance? Nobel Prizes and other Recognitions.

Profile text

Measurements of nuclear magnetic resonance take advantage of the property that atomic nuclei exposed to electromagnetic fields absorb energy, causing them to emit electromagnetic signals. NMR can be used to investigate the structure of molecules, for example proteins or metabolites, directly in solution. The most familiar use of NMR technology is in the field of medical diagnostics. Thanks to Ernst's research, it was possible to greatly enhance the sensitivity and resolution of NMR spectroscopy, making the technique suitable for larger macromolecules, like proteins, for example. For many years, NMR spectroscopy was regarded as the most important instrumental measuring technique in chemistry. Ernst is a regular visitor to Lindau.

Number	Name	First Name	Discipline	Year
17	Ertl	Gerhard	Chemistry	2007

Prize motivation	Co-Laureate	Attending co-recipients
For his studies of chemical processes on solid surfaces	Sole laureate	-

Keywords	Tag	Links to other laureates	Links to profiles
Chemical catalysis, electrochemistry, materials science	Surface chemistry	Ryoji Noyori, Ei-Ichi Negishi (reaction mechanisms), Zhores Alferov, Klaus von Klitzing (solid-state physics)	48, 46, 2, 35

Lecture title

Reactions at Surfaces: From Atoms to Complexity

Profile text

Gerhard Ertl developed a theoretical model and a portfolio of methods for studying chemical reactions on the surfaces of solids. His approach is based on a consideration of what precisely happens, for example, when atom-thick layers of a dissimilar material are deposited on the highly purified surface of metals in a vacuum. Ertl's research is application-oriented. Surface chemistry explains, for example, the mechanism of the Haber-Bosch process for fixing nitrogen from air to manufacture agricultural fertilisers, and the reactions that occur in catalytic converters to remove pollutants from automotive exhaust gases. Surface chemistry is important in the manufacture of semiconductor materials for transistors, as well as in the development of fuel cells. Ertl has previously visited Lindau on five occasions.

Number	Name	First Name	Discipline	Year
18	Evans	Martin	Physiology or Medicine	2007

Prize motivation	Co-recipients	Attending co-recipients
For research on embryonic stem cells and the switching off of individual genetic information in mammals	Mario Capecchi, Oliver Smithies	Mario Capecchi, Oliver Smithies

Keywords	Tag	Links to other laureates	Links to profiles
Stem cells, cancer, cell biology	Stem cells	Mario Capecchi, Oliver Smithies (Co-recipients)	9, 58

Lecture title

PLEASE NOTE: Evans cancelled his participation

Profile text

Embryonic stem cells (ES cells) are unique in their ability not only to undergo division but also to differentiate into all kinds of somatic (body) cells. Evans isolated ES cells from early mouse embryos and cultivated them *in vitro*, where they could be genetically modified. Re-implanting those cells into the uteri of female mice resulted in the birth of transgenic animals. Evans will be visiting Lindau for the fourth time in 2015. In 2004 he spoke about teratomas, i.e. tumours arising from stem cells that may contain various tissue types (hair, teeth, etc.). His hobby is painting with acrylic paint.

Number	Name	First Name	Discipline	Year
19	Fert	Albert	Physics	2007

Prize motivation	Co-Laureate	Attending co-recipients
For the discovery of Giant Magnetoresistance	Peter Grünberg	-

Keywords	Tag	Links to other laureates	Links to profiles
Hard discs, quantum mechanics, materials science	GMR effect	Gerhard Ertl (materials science), possibly Zhores Alferov (semiconductor technology)	17, 2

Lecture title
Master Class: Spintronics, Nanomagnetism and Magnetic Skyrmions

Profile text
Albert Fert discovered the GMR (giant magneto-resistance) effect independently of, but at around the same time as Peter Grünberg. In the GMR effect, the electrical resistance of materials consisting of alternating nanometre-thin magnetic and non-magnetic layers changes with the nature of the magnetisation: a quantum mechanical effect. As abstract as this explanation may sound, the main application of the GMR effect is ubiquitous: nearly all modern hard discs use reading heads whose technology is based on the GMR effect, which has made it possible to increase the storage density of data medium in recent decades tremendously. Albert Fert is visiting Lindau for the third time.

Number	Name	First Name	Discipline	Year
20	Fischer	Edmond	Physiology or Medicine	1992

Prize motivation	Co-Laureate	Attending co-recipients
For their discoveries concerning reversible protein phosphorylation as a biological regulatory mechanism	Edwin Krebs	-

Keywords	Tag	Links to other laureates	Links to profiles
Protein, phosphorylation, signalling, cell cycle	Phosphorylation	Tim Hunt (cyclin degradation in the cell cycle), Aaron Ciechanover, Avram Hershko (regulation of protein activity)	33, 12, 30

Lecture title
The Origin of Reversible Protein Phosphorylation as a Regulatory Mechanism
Profile text
Fischer discovered an essential mechanism by which information is transmitted in cells and by which cellular processes are regulated: reversible protein phosphorylation. Protein kinases attach phosphate residues to specific amino acids in target proteins, and protein phosphatases are able to remove them again. In this way, the target proteins are activated and deactivated. Such post-translational modifications play a role in many important regulatory processes in cells. Fischer, who regularly visits Lindau, will probably give a historic overview of his discovery and its generalised application to practical research.

Number	Name	First Name	Discipline	Year
21	Giaever	Ivar	Physics	1973

Prize motivation	Co-recipients	Attending co-recipients
For their experimental discoveries regarding tunnelling phenomena in semiconductors and superconductors, respectively	Leo Esaki, Brian David Josephson	Brian David Josephson

Keywords	Tag	Links to other laureates	Links to profiles
Quantum mechanics, superconductors, semiconductors	Tunnel effect	Brian David Josephson (Co-Laureate)	34

Lecture title
Global Warming Revisited

Profile text
The tunnel effect states that atomic particles are able to overcome a high-energy potential threshold despite having a lower intrinsic energy. This effect, which should not occur according to the classical laws of physics, is explained in terms of quantum mechanics. Giaever was also able to observe the tunnel effect in superconducting materials. In so doing, he proved the existence of a band gap in superconductors that had been theoretically predicted but not yet experimentally confirmed. Giaever developed his tunnel experiments into a spectroscopic method for studying superconductors. The tunnel effect is exploited, for example, in the scanning tunnelling electron microscope and in flash storage devices such as USB sticks and memory cards. Giaever is a regular guest in Lindau and has already attended 17 Lindau Nobel Laureate Meetings.

Number	Name	First Name	Discipline	Year
22	Gilbert	Walter	Chemistry	1980

Prize motivation	Co-recipients	Attending co-recipients
For their contributions concerning the determination of base sequences in nucleic acids	Frederick Sanger, Paul Berg	-

Keywords	Tag	Links to other laureates	Links to profiles
DNA, sequencing, RNA, tools	DNA sequencing	Richard Roberts (splicing), Hamilton Smith, Werner Arber (restriction enzymes)	52, 57, 3

Lecture title
NO LECTURE

Profile text
Gilbert has been involved in many discoveries relating to DNA sequencing, the processing of genetic information and the regulation of gene expression. Although he received his Nobel Prize for a DNA sequencing method (Maxam-Gilbert sequencing), Gilbert is something of an all-round genius. He was the first to suggest that genes in eukaryotic organisms consist of introns and exons. He was the first to propose the “RNA world hypothesis”, which states that self-replicating RNA molecules formed the precursors of life on Earth. The DNA sequencing technique he developed has meanwhile been superseded by next-generation sequencing based on the Sanger method. Gilbert has so far attended four Lindau Nobel Laureate Meetings, most recently in 2013.

Number	Name	First Name	Discipline	Year
23	Glauber	Roy	Physics	2005

Prize motivation	Co-recipients	Attending co-recipients
For his contribution to the quantum theory of optical coherence	John L. Hall, Theodor W. Hänsch	John L. Hall, Theodor W. Hänsch

Key Words	Tag	Links to other laureates	Links to profiles
Optics, quantum physics	Quantum optics	John L. Hall, Theodor W. Hänsch (Co-recipients), Serge Haroche	25, 26, 27

Lecture title
Atomtronics: Atomic Analogs to Electronic Devices

Profile text
The fact that light has the characteristics of both waves and particles is now general knowledge. Glauber made pioneering contributions to this realisation. He was instrumental in establishing the field of quantum optics in physics in the 1960s by applying known quantum mechanical effects to optical phenomena. Quantum optics is concerned with the interaction of light and material. Glauber's investigations made it possible to explain the differences between non-coherent light sources, such as incandescent light bulbs, and coherent lasers on the basis of quantum mechanics. He is visiting Lindau for the sixth time this year.

Number	Name	First Name	Discipline	Year
24	Gross	David	Physics	2004

Prize motivation	Co-recipients	Attending co-recipients
For the discovery of asymptotic freedom in the theory of the strong interaction	Hugh David Politzer, Frank Wilczek	-

Keywords	Tag	Links to other laureates	Links to profiles
Particle physics, atomic nucleus	Strong interaction	Carlo Rubbia, François Englert, Martinus Veltman (particle physics)	53, 15, 64

Lecture title
The Future of Particle Physics
Profile text
The strong interaction is the force that hold quarks together in protons and neutrons in the atomic nucleus. Together with his doctoral supervisor, Frank Wilczek, Gross observed how the strong interaction between quarks becomes weaker the closer the quarks are to each other, and the stronger it becomes the farther away they are from each other. Quarks act almost like free particles when they are close together. In popular science, this behaviour is often compared to the effect of rubber bands stretched between quarks. They exert a progressively stronger force as the quarks move away from each other. Gross is a signatory of the Humanist Manifesto, as are his fellow Laureates Kroto, Molina, Neher and Roberts, who are also attending this year's Meeting. Gross is visiting Lindau for the fifth time.

Number	Name	First Name	Discipline	Year
25	Hall	John	Physics	2005

Prize motivation	Co-recipients	Attending co-recipients
For their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique	Roy J. Glauber, Theodor W. Hänsch	Roy J. Glauber, Theodor W. Hänsch

Keywords	Tag	Links to other laureates	Links to profiles
Quantum optics, measuring methods, lasers	Frequency comb	Roy Glauber, Theodor W. Hänsch (Co-recipients)	23, 26

Lecture title
What about Redefining Time using a Stable Laser?

Profile text
John Hall and Theodor W. Hänsch developed methods and devices for very precise measurements of distances and time. Their developments are based on extremely frequency-stable laser systems, among other things. Their work made it possible to define the second and the metre precisely at the atomic level. They were instrumental in the development of a frequency comb. A frequency comb is a light source whose spectrum consists of clearly defined frequencies. Frequency comb generators are used in many laboratories around the world for optical frequency measurements. Hall and Hänsch received the Nobel Prize for the development of ultra-precise measuring instruments. Hall is visiting Lindau for the fourth time.

Number	Name	First Name	Discipline	Year
26	Hänsch	Theodor	Physics	2005

Prize motivation	Co-recipients	Attending co-recipients
For their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique	Roy J. Glauber, John L. Hall	Roy J. Glauber, John L. Hall

Keywords	Tag	Links to other laureates	Links to profiles
Quantum optics, metrology, lasers	Frequency comb	John L. Hall, Roy Glauber (Co-recipients)	25, 23

Lecture title
Science with Combs of Light

Profile text
John Hall and Theodor W. Hänsch developed methods and equipment for very precise measurements of distances and time. Their developments are based on extremely frequency-stable laser systems, among other things. Their work made it possible to define the second and the metre precisely at the atomic level. They were instrumental in the development of a frequency comb. A frequency comb is a light source whose spectrum consists of clearly defined frequencies. Frequency comb generators are used in many laboratories around the world for optical frequency measurements. Hall and Hänsch received the Nobel Prize for the development of ultra-precision measuring instruments. This year marks Theodor Hänsch's seventh Lindau Nobel Laureate Meeting.

Number	Name	First Name	Discipline	Year
27	Haroche	Serge	Physics	2012

Prize motivation	Co-Laureate	Attending co-recipients
For ground-breaking experimental methods that enable measuring and manipulation of individual quantum systems	David J. Wineland	

Keywords	Tag	Links to other laureates	Links to profiles
Quantum optics, particle physics	Photon traps	Steven Chu, Claude Cohen-Tannoudji, William Phillips (atom traps)	11, 13, 50

Lecture title

Fifty Years of Revolution in Atomic Physics and Quantum Optics

Profile text

Quantum mechanical phenomena are notoriously difficult to measure, as they are based on the behaviour of individual, isolated particles. Moreover, the technical means are not always available to isolate particles and then study them in experiments without destroying them. Haroche works in the field of quantum optics. He succeeded in capturing single photons between two superconducting reflectors for a fraction of a second. The brief period was long enough to detect the trapped photon and to measure it with the help of so-called Rydberg atoms. He visited Lindau once before in 2013.

Number	Name	First Name	Discipline	Year
28	zur Hausen	Harald	Physiology or Medicine	2008

Prize motivation	Co-recipients	Attending co-recipients
For his discovery of human papillomaviruses causing cervical cancer	Luc Montagnier, Françoise Barré-Sinoussi	Luc Montagnier, Françoise Barré-Sinoussi

Keywords	Tag	Links to other laureates	Links to profiles
Disease, viruses, healthcare, cancer	Viruses and cancer	J. Michael Bishop, Harold Varmus (viruses as causative agents of cancer), Luc Montagnier, Françoise Barré-Sinoussi (Co-recipients)	7, 63, 44, 4

Lecture title

Cancer and Neurological Disorders as Zoonoses?

Profile text

Infections due to human papillomaviruses (HPV) are responsible for the vast majority of cases of uterine cancer. Cervical cancer is the third most common type of cancer in women. Zur Hausen not only discovered this causal relationship but also developed a vaccine to prevent HPV infection, which is now routinely used to immunise girls before they become sexually active. Zur Hausen's work relates to cancer research as well as to public health and immunisation policies. He is in a position to comment on a wide range of issues, such as: How do viruses cause cancer in humans? How can viral infections that potentially cause cancer be prevented? How successful are ongoing HPV immunisation campaigns? Are opponents of immunisation jeopardising the success of HPV immunisation? Zur Hausen has attended all the Meetings in Lindau since 2010. In his lecture, he propounds the hypothesis that viruses are involved in many other types of cancer – a relationship that has not been sufficiently investigated to date.

Number	Name	First Name	Discipline	Year
29	Hell	Stefan	Chemistry	2014

Prize motivation	Co-recipients	Attending co-recipients
For the development of super-resolved fluorescence microscopy	Eric Betzig, William Moerner	Eric Betzig, William Moerner

Keywords	Tag	Links to other laureates	Links to profiles
Optics, diffraction limit, microscopy, lasers	STED microscope	Eric Betzig, William Moerner (Co-recipients), Roger Tsien (GFP in microscopy)	5, 42, 62

Lecture title

Optical Microscopy: the Resolution Revolution

Profile text

The properties of light waves impose a natural limit on the resolution of optical microscopy, known as the diffraction, or Abbe, limit. Objects smaller than around 250 nm can no longer be sharply imaged for physical reasons. All methods that allows objects to be resolved beyond the diffraction limit is referred to as super-resolved microscopy. Hell developed the STED microscope (stimulated emission depletion microscope), in which the objects being studied are scanned by two lasers, one with an activating focus and the other with a deactivating focus. The areas excited to fluoresce in this way are very small and focussed thanks to the combination of the two lasers (one point-like and one ring-shaped), making it possible to resolve structures down to around 2.5 nm, well below the Abbe limit. Hell is the Director of the Max Planck Institute for Biophysical Chemistry in Göttingen, where he heads the NanoBiophotonics Department. As a 2014 Nobel Laureate, he is attending a Lindau Nobel Laureate Meeting for the first time.

Number	Name	First Name	Discipline	Year
30	Hershko	Avram	Chemistry	2004

Prize motivation	Co-recipients	Attending co-recipients
For the discovery of ubiquitin-mediated protein degradation	Aaron Ciechanover, Irwin Rose	Aaron Ciechanover

Keywords	Tag	Links to other laureates	Links to profiles
Protein, cell biology, protein degradation	Ubiquitin	Aaron Ciechanover (Co-Laureate), Tim Hunt (regulation of the cell cycle)	12, 33

Lecture title
Roles of the Ubiquitin System in Health and Disease
Profile text
Ubiquitin is a small protein consisting of 76 amino acids which binds covalently to substrate proteins, thus marking them for degradation. The marking mechanism involves a three-stage enzymatic cascade with E1-ubiquitin-activating enzymes, several E2-ubiquitin-conjugating enzymes and many E3 ubiquitin ligases that attach ubiquitin molecules to the target proteins. The number of ubiquitins and the manner by which they are attached determine the fate of the target proteins. Together with his doctoral supervisor and Co-Laureate, Aaron Ciechanover, Avram Hershko discovered the role of ubiquitin in protein degradation through classical biochemical experiments. Hershko is visiting Lindau this year for the fifth time.

Number	Name	First Name	Discipline	Year
31	Hoffmann	Jules	Physiology or Medicine	2011

Prize motivation	Co-recipients	Attending co-recipients
For their discoveries concerning the activation of innate immunity (Beutler und Hoffmann), for his discovery of the dendritic cell and its role in adaptive immunity (Steinman)	Ralph Steinman, Bruce Beutler	Bruce Beutler

Keywords	Tag	Links to other laureates	Links to profiles
Protein, membrane, immune system	Immune system	Bruce Beutler, Peter Doherty, Susumu Tonegawa (immunology)	6, 14, 61

Lecture title
Master Class: Antimicrobial Defenses

Profile text
How does the body discover an infection? Hoffmann experimented with fruit flies and discovered that toll-like receptors play an essential role in the detection of infections. Toll-like receptors are also found in humans. They are sensors of the innate immune system, the first line of defence of the immune response. Hoffmann's work with *Drosophila* therefore allows direct conclusions to be drawn about the function of the immune system in humans. Hoffman is attending a Lindau Nobel Laureate Meeting for the second time this year. The author of several books, his most recent, "Sentinel Chicken", discusses what birds can teach us about our health and the world.

Number	Name	First Name	Discipline	Year
32	Huber	Robert	Chemistry	1988

Prize motivation	Co-recipients	Attending co-recipients
For the determination of the three-dimensional structure of a photosynthetic reaction centre	Johann Deisenhofer, Hartmut Michel	Hartmut Michel

Keywords	Tag	Links to other laureates	Links to profiles
Protein, structural biology, membrane	Crystallography	Hartmut Michel (Co-Laureate), Ada Yonath, Venkatraman Ramakrishnan (structure of the ribosome)	41, 70, 51

Lecture title

Structural Aspects of Protease Control in Health and Disease

Profile text

The elucidation of protein structures provides more than pretty images. Structural biology can help to investigate and understand biochemical reactions and molecular processes at the atomic level. To determine the structure of a protein, the protein is crystallised and then studied, for example through X-ray analysis. Huber won the Nobel Prize for resolving the structure of a membrane protein involved in photosynthesis. Membrane proteins are notoriously difficult to crystallise. Huber has served as Director of the MPI of Biochemistry in Martinsried since 1971, where he created a “protein structure factory”. Several hundred protein structures have been identified in his laboratory and subsequently published. He is a regular guest in Lindau, having already visited 19 times, and is therefore a good candidate for answering general questions about the Lindau Nobel Laureate Meetings and their ongoing development. Apart from science itself, he is also concerned with science policy issues.

Number	Name	First Name	Discipline	Year
33	Hunt	Tim	Physiology or Medicine	2001

Prize motivation	Co-recipients	Attending co-recipients
For their discoveries of key regulators of the cell cycle	Paul Nurse, Leland Hartwell	-

Keywords	Tag	Links to other laureates	Links to profiles
Protein, phosphorylation, cell cycle	Cell cycle	Edmond Fischer (phosphorylation), Aaron Ciechanover, Avram Hershko (regulation)	20, 12, 30

Lecture title
The Cell Cycle and Cancer

Profile text
Cell division is a complex cyclical process in which a number of steps must be orchestrated in sequence. The cell must increase in volume, the DNA must duplicate and ultimately be divided equally between the two daughter cells, and then a new cell membrane must be synthesised. The cell cycle is controlled by gatekeeper proteins. These proteins, known as cyclin-dependent kinases, are activated by cyclins, which are synthesised briefly during the cell cycle and are then degraded again. Cyclin activation initiates intracellular phosphorylation cascades, which ultimately drive the cell to the next stage of the cell cycle. Hunt discovered cyclins and, with the help of molecular biological methods in synchronised cells, showed that they are periodically synthesised and degraded in the course of the cell cycle. He is visiting Lindau for the fourth time.

Number	Name	First Name	Discipline	Year
34	Josephson	Brian	Physics	1973

Prize motivation	Co-recipients	Attending co-recipients
For his theoretical predictions of the properties of a supercurrent through a tunnel barrier, in particular those phenomena which are generally known as the Josephson effect	Leo Esaki, Ivar Giaever	Ivar Giaever

Keywords	Tag	Links to other laureates	Links to profiles
Tunnel effect, superconductors, quantum mechanics	Josephson effect	Ivar Giaever (Co-Laureate)	21

Lecture title
NO LECTURE

Profile text
The tunnel effect states that atomic particles are able to overcome a high-energy potential threshold despite having a lower intrinsic energy. This effect, which should not occur according to the classical laws of physics, is explained in terms of quantum mechanics. Josephson's research built upon Giaever's findings on the tunnel effect in superconducting materials. He made several theoretical predictions, all of which have been experimentally confirmed. The Josephson effect, named after him, describes a tunnelling current between two superconductors that flows perpetually without any voltage being applied. Josephson is a regular guest in Lindau, 2015 marking his 13th Lindau Nobel Laureate Meeting.

Number	Name	First Name	Discipline	Year
35	von Klitzing	Klaus	Physics	1985

Prize motivation	Co-Laureate	Attending co-recipients
For the discovery of the quantized Hall effect	Sole laureate	-

Keywords	Tag	Links to other laureates	Links to profiles
Quantum mechanics, Hall effect, electromagnetism	Quantum Hall effect	Robert Laughlin (quantum Hall effect)	37

Lecture title
A New Kilogram in 2018: The Biggest Revolution in Metrology since the French Revolution

Profile text
The Hall effect describes the production of a voltage difference across an electrical conductor in a magnetic field through which an electrical current flows. The voltage is perpendicular to the direction of current and changes with the magnetic field. The quantum Hall effect states that the observed voltage does not change linearly with the magnetic field but in discrete steps. Von Klitzing demonstrated and measured these steps in two-dimensional electron systems at the Max Planck Institute for Solid State Research in Stuttgart. Von Klitzing's work forms the basis of research by Horst Ludwig Störmer, Daniel C. Tsui and Robert Laughlin, who jointly won the 1998 Nobel Prize for describing the fractional quantum Hall effect. Laughlin is also in Lindau this year; Von Klitzing is a regular guest.

Number	Name	First Name	Discipline	Year
36	Kroto	Harold	Chemistry	1996

Prize motivation	Co-recipients	Attending co-recipients
For their discovery of fullerenes	Robert F. Curl Jr., Richard Smalley	-

Keywords	Tag	Links to other laureates	Links to profiles
Nanotechnology, carbon research, scientific communication	Fullerenes	William Moerner (analysis of single molecules)	42

Lecture title
The Enlightenment Under Threat

Profile text
Fullerenes resemble footballs. They are stable carbon bodies on the nanometre scale. Fullerenes, along with diamond, graphite, shale and amorphous carbon, are carbon allotropes. Like carbon nanotubes and graphene, they are currently attracting considerable attention in materials research and nanotechnology. Harry Kroto was one of the co-discoverers of the original C60 fullerene (comprising 60 carbon atoms). Kroto is an engaging, entertaining speaker who is strongly committed to scientific public-relations work. He has also founded and supports several foundations and initiatives. Kroto is a regular visitor to Lindau.

Number	Name	First Name	Discipline	Year
37	Laughlin	Robert	Physics	1998

Prize motivation	Co-recipients	Attending co-recipients
For their discovery of a new form of quantum fluid with fractionally charged excitations	Horst Ludwig Störmer, Daniel C. Tsui	-

Keywords	Tag	Links to other laureates	Links to profiles
Quantum mechanics, Hall effect, electromagnetism	Quantum liquid	Klaus von Klitzing (Quantum Hall effect)	35

Lecture title
tba

Profile text
The Hall effect describes the production of a voltage difference across an electrical conductor in a magnetic field through which an electrical current flows. The voltage is perpendicular to the direction of current and changes with the magnetic field. The quantum Hall effect states that, at low temperatures and in strong magnetic fields, the observed voltage does not change linearly with the magnetic field but in discrete quantum steps. The fractional quantum Hall effect states that these stages do not necessarily have to take on whole number factors in the equations that describe the quantum Hall effect and that intermediate stages with fractional numbers exist. Störmer and Tsui observed this effect, while Laughlin developed the related mathematical formulas. Laughlin, visiting Lindau for the fifth time, explained this observation in terms of the existence of a quantum fluid that cannot be described by the laws of classical physics.

Number	Name	First Name	Discipline	Year
38	Lefkowitz	Robert	Chemistry	2012

Prize motivation	Co-Laureate	Attending co-recipients
For studies of G protein-coupled receptors	Brian K. Kobilka	-

Keywords	Tag	Links to other laureates	Links to profiles
Protein, GPCRs, membrane proteins	Receptor proteins	Edmond Fischer, Tim Hunt (phosphorylation)	20, 33

Lecture title

Seven Transmembrane Receptors

Profile text

G-protein-coupled receptors (GPCRs) are transmembrane proteins that detect extracellular molecules such as hormones, odours and neurotransmitters, and trigger a reaction within cells. The detected signals are transmitted intracellularly along two signal transduction pathways, partly via phosphorylation cascades. In tracer experiments, Lefkowitz demonstrated the existence and location of the receptor proteins, cloned a beta-adrenoreceptor and, by comparing sequences, postulated the existence of a family of G-protein-coupled receptors. He is taking part in a Lindau Nobel Laureate Meeting for the first time this year.

Number	Name	First Name	Discipline	Year
39	Lehn	Jean-Marie	Chemistry	1987

Prize motivation	Co-recipients	Attending co-recipients
For their development and use of molecules with structure-specific interactions of high selectivity	Donald Cram, Charles Pedersen	-

Key words	Tag	Links to other laureates	Links to profiles
Cryptands, reaction mechanisms	Supramolecular chemistry	Rudolph Marcus, Gerhard Ertl (fundamental chemical reaction mechanisms)	40, 17

Lecture title
Towards Adaptive Chemistry

Profile text
Lehn received the Nobel Prize for the discovery of cryptands, derivatives of crown ethers. Based on this discovery, and arguably his greatest contribution to science, he established supramolecular chemistry as an independent field of chemistry. Supramolecular chemistry deals with weak (non-covalent) interactions between molecules and with emergent properties, such as the self-organisation of material. It is entirely conceivable to link Lehn's research field to molecular biology, namely via interactions between receptors and ligands, the self-organisation of helices and possibly also the problem of protein folding. Lehn is attending his eighth Lindau Nobel Laureate Meeting this year.

Number	Name	First Name	Discipline	Year
40	Marcus	Rudolph	Chemistry	1992

Prize motivation	Co-Laureate	Attending co-recipients
For his contributions to the theory of electron transfer reactions in chemical systems	Sole laureate	-

Keywords	Tag	Links to other laureates	Links to profiles
Energetics, reaction mechanisms	Electron transfer reactions	Jean-Marie Lehn, Gerhard Ertl (fundamental chemical reaction mechanisms)	17, 39

Lecture title
Electron Transfer Kinetics in Photovoltaic Systems

Profile text
Marcus described one of the most fundamental chemical reaction mechanisms: electron transfer reactions, in which a reactant donates one or more electrons and the other accepts them. This is a redox reaction, in which, however, no (covalent) chemical bonds are broken or made. Marcus developed a simple mathematical model intended to describe the energetics of such reactions and explained why these chemical reactions proceed relatively slowly. Examples of such reactions are the rusting of metal, light fixation by photosynthesis and protein chemiluminescence. Marcus is a regular participant in Lindau.

Number	Name	First Name	Discipline	Year
41	Michel	Hartmut	Chemistry	1988

Prize motivation	Co-recipients	Attending co-recipients
For the determination of the three-dimensional structure of a photosynthetic reaction centre	Robert Huber, Johann Deisenhofer	Robert Huber, Johann Deisenhofer

Keywords	Tag	Links to other laureates	Links to profiles
Protein, structure, membrane, energy	Cytochrome c oxidase	Robert Huber, Hartmut Michel (Co-recipients), Arieh Warshel (modelling of cellular respiration)	32, 41, 66

Lecture title

Membrane Proteins: Importance, Functions, Mechanisms

Profile text

Hartmut Michel received his Nobel Prize as a young scientist for crystallising the photosynthetic reaction centre (a membrane protein complex) of a cyanobacterium. He then devoted most of his scientific career to the structure and mechanism of cytochrome c oxidase, and will be speaking on this topic at Lindau. Cytochrome c oxidase, an essential membrane protein in the cellular respiratory chain, is involved in energy metabolism in humans. The oxygen we breathe is oxidised to water on cytochrome c oxidase. In this process, protons are pumped across a mitochondrial membrane, the ultimate purpose being to synthesise ATP to supply the cell with energy. Michel is a regular guest in Lindau.

Number	Name	First Name	Discipline	Year
42	Moerner	William	Chemistry	2014

Prize motivation	Co-recipients	Attending co-recipients
For the development of super-resolved fluorescence microscopy	Eric Betzig, Stefan Hell	Eric Betzig, Stefan Hell

Keywords	Tag	Links to other laureates	Links to profiles
Optics, diffraction limit, microscopy	Fluorescence microscopy	Eric Betzig, Stefan Hell (Co-recipients), Dan Shechtman (private relationship)	5, 29, 56

Lecture title
Fun with Light and Single Molecules

Profile text
The focus of Moerner's research is on single molecules. He is credited with being the first researcher ever to succeed in visualising a single molecule (pentacene). Later, Moerner developed and used fluorescence spectroscopy to visualise single molecules, notably proteins, in the cellular milieu. Moerner is currently at Stanford, where he is working on imaging techniques to visualise single biological macromolecules. As a 2014 Nobel Laureate, he is taking part in his first Lindau Nobel Laureate Meeting this year. The son of another attending Nobel Laureate, Dan Shechtman, works in Moerner's lab.

Number	Name	First Name	Discipline	Year
43	Molina	Mario	Chemistry	1995

Prize motivation	Co-recipients	Attending co-recipients
For their work in atmospheric chemistry, particularly concerning the formation and decomposition of ozone	Paul J. Crutzen, Frank Sherwood Rowland	-

Keywords	Tag	Links to other laureates	Links to profiles
Ozone, CFCs, atmospheric chemistry	Ozone hole	-	-

Lecture title

PLEASE NOTE: Molina cancelled his participation

Profile text

Ozone (O_3) is present in traces primarily in the upper strata of the atmosphere, most of it 10 to 40 km above ground level. It is formed from oxygen, with energy being supplied by UV light from the sun. Ozone blocks a large proportion of the UV light emitted by the sun, which is mutagenic and damages skin. Especially in the 20th century, the ozone layer was damaged by gases released from pressurised spray cans and refrigerators (chlorofluorocarbons). Molina recognised this relationship during his time as a postdoc with his Co-Laureate Frank Rowland and, through his publications, sparked a global debate that ultimately led to a ban on CFCs. In the meantime, the ozone layer has recovered somewhat. This is Molina's fifth visit to Lindau.

Number	Name	First Name	Discipline	Year
44	Montagnier	Luc	Physiology or Medicine	2008

Prize motivation	Co-recipients	Attending co-recipients
For their discovery of human immunodeficiency virus	Harald zur Hausen, Françoise Barré-Sinoussi	Harald zur Hausen, Françoise Barré-Sinoussi

Keywords	Tag	Links to other laureates	Links to profiles
Disease, immune system, viruses	HIV	Harald zur Hausen, Françoise Barré-Sinoussi (Co-recipients)	28, 4

Lecture title
NO LECTURE

Profile text
Montagnier discovered the HI virus together with Barré-Sinoussi. They isolated and cultivated lymph cells from infected patients in the lab. They were then able to characterise the viruses morphologically in cell extracts and demonstrate the activity of reverse transcriptase, thus classifying the virus as a retrovirus. Infection with HI virus leads to immunodeficiency, as the virus attacks specific cells of the immune system. In recent years, Montagnier has come under increased criticism. In the documentary *House of Numbers*, for example, he claims that a healthy immune system and adequate hygiene are sufficient to fight off an HIV infection. Recently, he argued that DNA and RNA (including RNA from the HI virus) in homeopathic doses induces electromagnetic waves – a claim that has attracted strong public criticism. Montagnier is attending his second Lindau Nobel Laureate Meeting this year.

Number	Name	First Name	Discipline	Year
45	Murad	Ferid	Physiology or Medicine	1998

Prize motivation	Co-recipients	Attending co-recipients
For their discoveries concerning nitric oxide as a signalling molecule in the cardiovascular system	Louis Ignarro, Robert Furchgott	-

Keywords	Tag	Links to other laureates	Links to profiles
Medicine, disease, signalling	NO muscle relaxation	-	-

Lecture title
Role of Nitric Oxide and Cyclic GMP in Cell Signaling and Drug Development

Profile text
Nitric oxide (NO) is an important signalling molecule in the human body. Murad showed that established drugs such as nitroglycerin act by releasing NO. NO relaxes smooth muscles by increasing intracellular levels of cGMP. NO is used medically for treating pulmonary hypertension in newborn infants. Murad is attending his fifth Lindau Nobel Laureate Meeting this year. He will most likely speak about the role of nitric oxide and cGMP in cellular signalling and about pharmaceutical developments. Murad is regarded as a dynamic and humorous speaker.

Number	Name	First Name	Discipline	Year
46	Negishi	Ei-ichi	Chemistry	2010

Prize motivation	Co-recipients	Attending co-recipients
For palladium-catalyzed cross couplings in organic synthesis	Richard F. Heck, Akira Suzuki	-

Keywords	Tag	Links to other laureates	Links to profiles
Organic chemistry, reaction mechanisms, catalysts	Cross-coupling reaction	Ryoji Noyori, Gerhard Ertl (reaction mechanisms)	48, 17

Lecture title

How to Synthesize a Wide Variety of Optically Active Organic and Bioorganic Compounds of >99% Optical Purity

Profile text

Negishi developed a chemical reaction that makes it possible to synthesise complex organic substances with the help of palladium or nickel catalysts. In the first step of a cross-coupling reaction (Negishi coupling), the substrate (e.g. an aryl halogenide) undergoes oxidative addition to the metal catalyst. In the second step, transmetallisation occurs. Finally, the product undergoes reductive elimination to regenerate the catalyst. Such cross-coupling reactions are used globally in research and, for example, in the synthesis of pharmaceutical substances. He is visiting Lindau for the second time.

Number	Name	First Name	Discipline	Year
47	Neher	Erwin	Physiology or Medicine	1991

Prize motivation	Co-Laureate	Attending co-recipients
For their discoveries concerning the function of single ion channels in cells	Bert Sakmann	Bert Sakmann

Keywords	Tag	Links to other laureates	Links to profiles
Protein, ion channels, neurobiology	Ion channels	Bert Sakmann (Co-Laureate), Torsten Wiesel (neurobiology)	54, 67

Lecture title
Ion Channels: Their Discovery, their Function and their Role in Diseases

Profile text
Neher and Sakmann demonstrated ion channels in cell membranes and showed how they function. They developed a technique (patch clamp) to investigate ion streams in individual ion channels in living cells. Ion channels are present in nearly all cell types. They play a particularly important role as components of the nervous system, where they are responsible for transmitting nerve impulses. Neher is taking part in his 14th Lindau Nobel Laureate Meeting this year and will most likely talk about the release of neurotransmitters in connection with ion channels.

Number	Name	First Name	Discipline	Year
48	Noyori	Ryoji	Chemistry	2001

Prize motivation	Co-recipients	Attending co-recipients
For their work on chirally catalysed hydrogenation reactions	William Standish Knowles, Karl Barry Sharpless	-

Keywords	Tag	Links to other laureates	Links to profiles
Organic chemistry, catalysts, reaction mechanisms	Chirality	Ei-ichi Negishi, Gerhard Ertl (reaction mechanisms)	46, 17

Lecture title

Where am I From? Where Are You Going?

Profile text

Most chemical substances can occur in two chiral forms that are mirror images of each other. Designated D and L, these forms are known as enantiomers. Despite having the same molecular formula, the molecules are not identical. Most chemical synthesis reactions give rise to both chiral enantiomers. However, often just one enantiomer is desired. For example, amino acids occur in proteins only in their L form. Noyori and Knowles, working independently of each other, discovered methods to carry out asymmetric hydrogenation. They used specific catalysts to preferentially synthesise one enantiomer. Noyori's research also focussed on asymmetric hydrogenation, in which chiral ruthenium catalysts are used for the enantiospecific hydrogenation of ketones, aldehydes and imines. Noyori is attending his fourth Lindau Nobel Laureate Meeting this year.

Number	Name	First Name	Discipline	Year
49	Perlmutter	Saul	Physics	2011

Prize motivation	Co-recipients	Attending co-recipients
For the discovery of the accelerating expansion of the Universe through observations of distant supernovae	Brian P. Schmidt, Adam G. Riess	Brian P. Schmidt

Keywords	Tag	Links to other laureates	Links to profiles
Supernovae, astronomy, cosmology	Supernovae	Brian P. Schmidt (Co-Laureate), Robert Wilson, George Smoot (cosmology)	55, 68, 59

Lecture title
What We Learn When We Learn that the Universe is Accelerating

Profile text
Perlmutter shared the 2011 Nobel Prize for his observations of distant supernovae. He observed that these supernovae are less bright than expected. In parallel with a team headed by his Co-recipients Brian P. Schmidt und Adam G. Riess, he concluded that the universe is not only expanding, as described by the Big Bang theory, but that the rate of expansion is continuously increasing. A prediction derived from this observation is that the universe is becoming increasingly cold and at some point will end in ice. The expansion is driven by dark matter, which makes up around three-quarters of the mass of the universe and currently poses the greatest enigma in physics. Perlmutter began to study distant supernovae a good five years before his Co-recipients. Both teams benefited greatly from the technical development and improvement of CCD sensors, which are used in digital cameras. The 2009 Nobel Prize was awarded for the development of CCD sensors.

Number	Name	First Name	Discipline	Year
50	Phillips	William	Physics	1997

Prize motivation	Co-recipients	Attending co-recipients
For development of methods to cool and trap atoms with laser light	Steven Chu, Claude Cohen-Tannoudji	Steven Chu, Claude Cohen-Tannoudji

Keywords	Tag	Links to other laureates	Links to profiles
Optics, lasers, atoms	Trapping atoms	Steven Chu, Claude Cohen-Tannoudji (Co-recipients), Serge Haroche (single particle physics)	11, 13, 27

Lecture title

Atomtronics: Atomic Analogs to Electronic Devices

Profile text

Atoms in gases (e.g. air) move at around 4000 kph – too fast to be studied individually. Rapid cooling slows atoms in gases, but normally also causes the gases to condense and ultimately crystallise. However, crystallisation can be prevented by cooling highly rarefied gases (in a vacuum) to temperatures near absolute zero (-273 degrees Celsius), and the slowed gas molecules can then be individually analysed. Phillips developed an apparatus based on magnetic fields of varying intensity and a laser to slow down atoms radically. In this way, he succeeded in trapping single sodium atoms in a magnetic particle trap. Phillips borrowed methods from Co-Laureate Steven Chu and refined them to achieve temperatures of 40 microkelvins. Later, in collaboration with his second Co-Laureate, Cohen-Tannoudji, he reached temperatures as low as 2 microkelvins. This is Phillips' fifth visit to Lindau.

Number	Name	First Name	Discipline	Year
51	Ramakrishnan	Venkatraman	Chemistry	2009

Prize motivation	Co-recipients	Attending co-recipients
For studies of the structure and function of the ribosome	Thomas A. Steitz, Ada Yonath	Ada Yonath

Keywords	Tag	Links to other laureates	Links to profiles
Protein, structural biology, antibiotics	Ribosomes	Ada Yonath (Co-Laureate), Robert Huber (crystallography), Richard Ernst (structural biology)	70, 32, 16

Lecture title
Seeing is Believing - A Hundred Years of Visualizing Molecules

Profile text
Ribosomes are large macromolecular machines within cells on which mRNA is translated into amino acid sequences to produce proteins. Ramakrishnan is a structural biologist who first crystallised sections and then entire subunits of the ribosome. Subsequently, he crystallised the entire ribosome and elucidated its structure. In his later research, he investigated structure-function relationships of ribosomes, for example during individual stages of protein synthesis and during interactions between antibiotics and ribosomes. Ramakrishnan is attending his first Lindau Nobel Laureate Meeting this year.

Number	Name	First Name	Discipline	Year
52	Roberts	Richard	Physiology or Medicine	1993

Prize motivation	Co-Laureate	Attending co-recipients
For their discoveries of split genes	Phillip Sharp	-

Keywords	Tag	Links to other laureates	Links to profiles
DNA, recombinant DNA technology, evolution	Introns and splices	Walter Gilbert (discovery of exons and introns), Hamilton Smith (DNA restriction)	22, 57

Lecture title

Why You Should Love Bacteria

Profile text

Genes in eukaryotic cells, including the cells of our bodies, consist of coded and non-coded sections, called introns and exons. Roberts and Sharp discovered that genes in adenoviruses are cut into a number of segments, which are then recombined during RNA processing. Later, it was found that this discovery applies to all chromosomal eukaryotic genes. The topic of Roberts' Novel Prize Lecture was methyl transferases and their role in DNA restriction. This year marks his fifth visit to Lindau. At past Meetings, he spoke about bacterial biodiversity and about DNA restriction and DNA modification mechanisms that occur in nature. Roberts is a signatory of the Humanist Manifesto (Good without a god), as are his fellow Laureates Kroto, Molina, Neher and Gross, who are also attending this year's Meeting.

Number	Name	First Name	Discipline	Year
53	Rubbia	Carlo	Physics	1984

Prize motivation	Co-Laureate	Attending co-recipients
For their decisive contributions to the large project, which led to the discovery of the field particles W and Z, communicators of weak interaction	Simon van der Meer	-

Keywords	Tag	Links to other laureates	Links to profiles
Particle physics, collision experiments, atomic nuclei	CERN	François Englert, Martinus Veltman (CERN experiments), David Gross (particle physics)	15, 64, 24

Lecture title
Future Accelerators for Astro-Particle Physics

Profile text
There are four fundamental forces in physics: gravitation, electromagnetism, the strong interaction and the weak interaction. Carlo Rubbia headed particle collision experiments at CERN, which at the time had only recently opened, with the aim of studying the weak interaction. The weak interaction is the predominant force in atomic nuclei and plays a role in radioactive beta decay. The experiments led by Rubbia discovered the neutral Z boson and the two positively and negatively charged W bosons, i.e. the mediators of the weak interaction. Another finding from the experiments at CERN was that these bosons carry mass. The explanation for this was first made possible by experiments recently performed at CERN, for which Higgs and Englert received the 2013 Nobel Prize. Englert is also attending this year's Meeting. This year marks Rubbia's fourth visit to Lindau.

Number	Name	First Name	Discipline	Year
54	Sakmann	Bert	Physiology or Medicine	1991

Prize motivation	Co-Laureate	Attending co-recipients
For their discoveries concerning the function of single ion channels in cells	Erwin Neher	Erwin Neher

Keywords	Tag	Links to other laureates	Links to profiles
Protein, neurobiology, brain	Ion channels	Erwin Neher (Co-Laureate), Torsten Wiesel (brain research)	47, 67

Lecture title
NO LECTURE

Profile text
Neher and Sakmann demonstrated ion channels in cell membranes and showed how they function. They developed a technique (patch clamp) to investigate ion streams in individual ion channels in living cells. Ion channels are present in nearly all cell types. They play a particularly important role as components of the nervous system, in which they are responsible for transmitting nerve impulses. At past meetings in Lindau, Sakmann spoke about his own research: cortical columns in the rat brain and his method for characterising the morphology of the brain in three dimensions by developing circuit diagrams of neuron groups. Sakmann is a regular visitor to Lindau.

Number	Name	First Name	Discipline	Year
55	Schmidt	Brian	Physics	2011

Prize motivation	Co-recipients	Attending co-recipients
For the discovery of the accelerating expansion of the Universe through observations of distant supernovae	Saul Perlmutter, Adam Riess	Saul Perlmutter

Keywords	Tag	Links to other laureates	Links to profiles
Supernovae, astronomy, cosmology	Supernovae	Saul Perlmutter (Co-Laureate), Robert Wilson, George Smoot (cosmology)	49, 68, 59

Lecture title
The State of Cosmology in 2015
Profile text
Schmidt received the Nobel Prize for his observations of very distant supernovae. He determined that the supernovae are less bright than expected. In parallel with a team headed by his Co-Laureate Saul Perlmutter, he concluded that the universe is not only expanding, as described by the big bang theory, but that the rate of expansion is continuously increasing. His lecture will likely deal with the standard model of cosmology and thereby explain supportive observations, as well as the corresponding scientific challenges that lie ahead. This is his third visit to Lindau.

Number	Name	First Name	Discipline	Year
56	Shechtman	Dan	Chemistry	2011

Prize motivation	Co-Laureate	Attending co-recipients
For the discovery of quasicrystals	Sole laureate	-

Keywords	Tag	Links to other laureates	Links to profiles
Solids, structure	Quasicrystals	-	-

Lecture title
tba

Profile text
Shechtman's research disproved a dogma: Until quasicrystals were discovered by Shechtman, it was assumed that the atoms in chemical solids are always arranged in regular, repeating patterns. However, Shechtman also observed quasicrystalline arrangements under the microscope. It proved a laborious task to convince the research community of the existence of quasicrystals. He was aided by the fact that, despite the absence of regularity, there are mathematical approaches to describe the observed arrangements, and by the discovery that some mosaics, for example in the Alhambra in Granada, also follow quasicrystalline arrangements. This is Shechtman's third visit to Lindau. His son Yoav conducts research in the lab of William Moerner (2014 Nobel Prize Laureate).

Number	Name	First Name	Discipline	Year
57	Smith	Hamilton	Physiology or Medicine	1978

Prize motivation	Co-recipients	Attending co-recipients
For the discovery of restriction enzymes and their application to problems of molecular genetics	Werner Arber, Daniel Nathans	Werner Arber

Keywords	Tag	Links to other laureates	Links to profiles
DNA, synthetic biology, recombinant DNA technology	Restriction enzymes	Werner Arber (Co-Laureate), Jack Szostak (artificial chromosomes), Richard Roberts (DNA restriction)	3, 60, 52

Lecture title

Minimizing a Bacterial Genome by Global Design and Synthesis

Profile text

Restriction endonucleases are tools of recombinant DNA technology. These enzymes are used in all molecular biology labs throughout the world. Smith received the Nobel Prize for their discovery. He also discovered DNA methylases, whose existence was predicted by his Co-Laureate Werner Arber. Smith is presently working with Craig Venter, using tools to modify gene and genome sequences. Recombinant DNA technology is currently being revolutionised by a method called genome editing, which uses various classes of enzymes (CRISPR/CAS, TALENs and ZFNs) to cut DNA at desired sites. Together with Craig Venter, Smith is working on *Mycoplasma laboratorium*, the first living organisms with a synthetic genome. He may speak about Craig Venter's work, artificial life and the in vitro synthesis of complete chromosomes. He may also delve into the opportunities and the philosophical aspects of synthetic biology. Smith is a regular guest in Lindau, this year marking his 14th Lindau Nobel Laureate Meeting.

Number	Name	First Name	Discipline	Year
58	Smithies	Oliver	Physiology or Medicine	2007

Prize motivation	Co-recipients	Attending co-recipients
For their discoveries of principles for introducing specific gene modifications in mice by the use of embryonic stem cells	Mario Capecchi, Martin Evans	Mario Capecchi, Martin Evans

Keywords	Tag	Links to other laureates	Links to profiles
DNA, recombination, recombinant DNA technology	Gene targeting	Mario Capecchi, Martin Evans (Co-recipients), Werner Arber, Hamilton Smith (fundamental DNA methods)	9, 18, 3, 57

Lecture title
Ideas Come from Many Places

Profile text
Smithies developed a technology called gene targeting that can remove genetic material from target cells (e.g. embryonic stem cells of mice) or replace it with laboratory-produced DNA. The new DNA is inserted into the cell and is integrated into the genome by homologous recombination. Gene targeting is used, for example, to study disease models in mice. Smithies is a 90-year-old molecular biology veteran who is also credited with inventing, among other things, agarose gel electrophoresis and who has contributed to many other trailblazing developments in modern molecular biology. Smithies has attended three past Lindau Nobel Laureate Meetings, at which he did not speak specifically about his research but about science at a meta level: What are the motivations for science? What factors influence the scientific discovery process? Inspiring lectures that have traditionally been very favourably received.

Number	Name	First Name	Discipline	Year
59	Smoot	George	Physics	2006

Prize motivation	Co-Laureate	Attending co-recipients
For their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation	John C. Mather	-

Keywords	Tag	Links to other laureates	Links to profiles
Big Bang, cosmology, astronomy	Background radiation	Robert Wilson, Saul Perlmutter, Brian Schmidt (cosmology)	68, 49, 55

Lecture title
Mapping the Universe / Probing the Early Universe (tentative title)
Profile text
In a manner of speaking, the cosmic background radiation is the echo of the Big Bang. It can be heard throughout the universe and was detected for the first time by Laureates Robert Wilson and Arno Penzias with an antenna in New Jersey. The former is also in Lindau this year. Smoot and Mather, working with the COBE satellite, had much finer “ears” than Wilson and Penzias. Their measurements reconfirmed the Big Bang theory. In addition, Smoot interpreted small deviations in the spectra of the background radiation as evidence of the formation of cosmic clumps of mass, the precursors of today’s galaxies. This is Smooth’s fourth Lindau Meeting.

Number	Name	First Name	Discipline	Year
60	Szostak	Jack	Physiology or Medicine	2009

Prize motivation	Co-recipients	Attending co-recipients
For the discovery of how chromosomes are protected by telomeres and the enzyme telomerase	Elizabeth Blackburn, Carol W. Greider	Elizabeth Blackburn

Keywords	Tag	Links to other laureates	Links to profiles
DNA, ageing, chromosomes	Telomeres	Elizabeth Blackburn (Co-Laureate), Hamilton Smith (artificial chromosomes)	8, 57

Lecture title
The Origins of Cellular Life

Profile text
The ends of chromosomes are known as telomeres. They consist of repeating DNA sequences, and they progressively shrink during the ageing process. Szostak observed the rapid degradation of linear, chromosome-like DNA molecules in yeast cells. Together with Elizabeth Blackburn, who is also here in Lindau this year, he attached telomere DNA sequences (CCCCAA) to linear DNA fragments and was able to show that this protected the DNA from degradation. Later, yeast mutations were identified by Szostak's lab in which the telomere DNA shortened with each cell division, providing indirect evidence of the existence of telomerase, an enzyme that actively lengthens telomeres. Szostak is visiting Lindau for the second time.

Number	Name	First Name	Discipline	Year
61	Tonegawa	Susumu	Physiology or Medicine	1987

Prize motivation	Co-Laureate	Attending co-recipients
For his discovery of the genetic principle for generation of antibody diversity	Sole laureate	-

Keywords	Tag	Links to other laureates	Links to profiles
Immune system, antibodies, recombination	Antibodies	Bruce Beutler, Peter Doherty, Jules Hoffmann (immunology); Eric Betzig (due to current research into neurobiological topics)	6, 14, 31, 5

Lecture title

Memory Engram Cells Have Come of Age

Profile text

How does the immune system manage to produce the right antibodies against each pathogenic invader – whether bacterial, viral or fungal? Tonegawa discovered that genes responsible for the synthesis of antibodies are not translated directly into proteins but recombine to form B-lymphocytes in the course of the development of stem cells. This recombination makes it possible to synthesise billions of different antibodies from just a few original genes. Tonegawa is currently at MIT, where he is using cell biological and neurobiological methods to study the molecular mechanisms of learning and memory. After 1990, this is Tonegawa's second Lindau Nobel Laureate Meeting.

Number	Name	First Name	Discipline	Year
62	Tsien	Roger	Chemistry	2008

Prize motivation	Co-recipients	Attending co-recipients
For the discovery and development of the green fluorescent protein, GFP	Osamu Shimomura, Martin Chalfie	Martin Chalfie

Keywords	Tag	Links to other laureates	Links to profiles
Protein, cell biology, fluorescence microscopy	GFP	Martin Chalfie (Co-Laureate)	10

Lecture title

Molecules Against Cancer or for Long-Term Memory Storage

Profile text

Green-fluorescing protein (GFP) is a bioluminescent molecule, meaning that it lights up. After being coupled to target proteins, GFP serves as a molecular marker in cell biology. GFP helps to determine the level of intracellular protein expression and to locate intracellular proteins. It is an important tool in light microscopy and in the investigation of protein-protein interactions. Tsien modified the original GFP genetically, creating several derived versions that glow in every colour of the rainbow. New applications for GFP and related bioluminescent molecules include transgenic pets (luminescent fish, cats, rabbits, mice and flies have all been successfully bred) and more meaningful methods for monitoring different classes of neurons in the brain and improving the contrast between dissimilar tissue types during surgical interventions. The potential applications appear endless, and Tsien is in the position talk about them at length. This is his fifth appearance at a Lindau Nobel Laureate Meeting.

Number	Name	First Name	Discipline	Year
63	Varmus	Harold	Physiology or Medicine	1989

Prize motivation	Co-Laureate	Attending co-recipients
For their discovery of the cellular origin of retroviral oncogenes	J. Michael Bishop	J. Michael Bishop

Keywords	Tag	Links to other laureates	Links to profiles
Cancer, DNA, mutations, viruses	Oncogenes	J. Michael Bishop (Co-Laureate), Harald zur Hausen (viruses as a cause of cancer), Tim Hunt (cancer)	7, 28, 33

Lecture title
How Discovery of Cancer Genes is Affecting the Treatment and Prevention of Cancer (tentative title)
Profile text
Oncogenes control the normal growth and division of cells. Mutations in these genes can lead to uncontrolled cell division and therefore cancer. Harold Varmus, together with J. Michael Bishop, described the mechanism of action of the first oncogene, called src (pronounced “sarc”), a protein kinase of a retrovirus. Varmus and Bishop then succeeded in applying their findings to retroviral transduction in general and to other retroviral oncogenes, thus providing an explanation for the emergence of cancer. This is Varmus’s first Lindau Nobel Laureate Meeting.

Number	Name	First Name	Discipline	Year
64	Veltman	Martinus	Physics	1999

Prize motivation	Co-Laureate	Attending co-recipients
For elucidating the quantum structure of electroweak interactions in physics	Gerardus 't Hooft	-

Keywords	Tag	Links to other laureates	Links to profiles
Quantum mechanics, particle physics, mathematics	Electroweak interaction	Carlo Rubbia, François Englert (CERN experiments), David Gross (particle physics)	53, 15, 24

Lecture title
Discovery of the Higgs Particle

Profile text
Physics comprises experimentation on the one hand and a mathematical description of observed phenomena on the other, including the possibility of making predictions on the basis of derived mathematical formulas, thus prompting further experiments. Martinus Veltman received his Nobel Prize (together with his doctoral supervisor Gerard t'Hooft) for the mathematical description of the electroweak interaction from the point of view of particle physics. Together with t'Hooft, he renormalised non-Abelian gauge theories and created a mathematical foundation for explaining the W+, W- and Z bosons discovered at CERN in 1983. This is Veltman's seventh visit to Lindau.

Number	Name	First Name	Discipline	Year
65	Warren	J. Robin	Physiology or Medicine	2005

Prize motivation	Co-Laureate	Attending co-recipients
For their discovery of the bacterium *Helicobacter pylori* and its role in gastritis and peptic ulcer disease	Barry Marshall	-

Keywords	Tag	Links to other laureates	Links to profiles
Bacteria, disease, antibiotics	*Helicobacter pylori*	Ada Yonath, Venkatraman Ramakrishnan (antibiotics)	70, 51

Lecture title
The Discovery of Helicobacter

Profile text
Together with Marshall, Warren discovered that infection with the bacterium *Helicobacter pylori* is responsible for most peptic ulcers. It had previously been believed that stress, excess acid production and poor nutrition were causative factors. Thanks to his discovery, it was recognized that gastritis and peptic ulcers can be treated with antibiotics. Warren was also involved in the development of a simple diagnostic method that can detect *H. pylori* infection in patients with peptic ulcers by analysing their breath. This is Warren's first Lindau Nobel Laureate Meeting.

Number	Name	First Name	Discipline	Year
66	Warshel	Arieh	Chemistry	2013

Prize motivation	Co-Laureate	Attending co-recipients
For the development of multiscale models for complex chemical systems	Martin Karplus, Michel Levitt	-

Keywords	Tag	Links to other laureates	Links to profiles
Models, simulations,	Models and simulations	-	-

Lecture title
How to Model the Action of Complex Biological Systems on a Molecular Level

Profile text
Warshel received the Nobel Prize for the development of various calculation methods and tools to study structure-function relationships in biological molecules and computer simulations of biological processes. For instance, he simulates dynamic chemical reaction at the atomic level, develops energy models for protein folding and researches the energetics of chemical reactions. Warshel's work explains biochemical processes at the atomic level. He therefore has links to many structural biologists who are studying molecular mechanisms. This is his second visit to Lindau.

Number	Name	First Name	Discipline	Year
67	Wiesel	Torsten	Physiology or Medicine	1981

Prize motivation	Co-Laureate	Attending co-recipients
For their discoveries concerning information processing in the visual system	Roger Sperry, David Hubel	-

Keywords	Tag	Links to other laureates	Links to profiles
Neurobiology, brain, eye	Information processing	Bert Sakman (brain research), Eric Betzig, Susumu Tonegawa (interest in neurobiology)	54, 5, 61

Lecture title
NO LECTURE

Profile text
How are visual signals in the brain processed? Wiesel and Hubel studied the brains of anaesthetised cats with implanted microelectrodes to measure reactions to visual signals. They identified what are known as ocular dominance columns, i.e. strips of neurons in the visual cortex that selectively respond to light stimulus in only one eye. Their work is directly related to research into neuroplasticity. Wiesel is no longer active in research but acts as a scientific representative in various organisations and is active in human rights initiatives. He has previously attended five Lindau Nobel Laureate Meetings.

Number	Name	First Name	Discipline	Year
68	Wilson	Robert	Physics	1978

Prize motivation	Co-Laureate	Attending co-recipients
For their discovery of cosmic microwave background radiation	Pyotr Kapitsa, Arno Allan Penzias	-

Keywords	Tag	Links to other laureates	Links to profiles
Big Bang, cosmology, astronomy	Background radiation	George Smoot, Saul Perlmutter, Brian Schmidt (cosmology)	59, 49, 55

Lecture title
tba

Profile text
In their attempt to detect microwave signals from our solar system, Robert Wilson and his colleague Arno Penzias were plagued by constant background static that affected their measurements. Having ruled out all terrestrial sources of the background noise (including pigeon droppings on their antenna), they concluded that the noise must permeate the entire universe. In this way, they discovered cosmic microwave background radiation, missing proof of the Big Bang theory, which – thanks to Wilson's and Penzias' observations – became the standard model of cosmology. This is Wilson's third visit to Lindau.

Number	Name	First Name	Discipline	Year
69	Wüthrich	Kurt	Chemistry	2002

Prize motivation	Co-recipients	Attending co-recipients
For his development of nuclear magnetic resonance spectroscopy for determining the three-dimensional structure of biological macromolecules in solution	John Fenn, Koichi Tanaka	-

Keywords	Tag	Links to other laureates	Links to profiles
Structure, tools, NMR	Nuclear Overhauser effect	Richard Ernst (NMR)	16

Lecture title

NMR in Biology, Chemistry and Medicine

Profile text

Nuclear magnetic resonance (NMR), like X-ray analysis, is a method for investigating the structure of biological molecules such as proteins and metabolites. The major advantage of NMR is that investigations can be carried out in solution, so no crystallisation is required. Wüthrich was involved in the establishment of the nuclear Overhauser effect (NOE), which made it possible to measure distances between atoms within proteins. Perhaps the most familiar use of NMR technology is magnetic resonance imaging in medical diagnostics. Wüthrich is a regular visitor to Lindau.

Number	Name	First Name	Discipline	Year
70	Yonath	Ada	Chemistry	2009

Prize motivation	Co-recipients	Attending co-recipients
For studies of the structure and function of the ribosome	Thomas Steitz, Venkatraman Ramakrishnan	Venkatraman Ramakrishnan

Keywords	Tag	Links to other laureates	Links to profiles
Protein, structure, antibiotics	Ribosomes	Venkatraman Ramakrishnan (Co-Laureate), Robert Huber, Hartmut Michel (structural biology), Aaron Ciechanover (intelligent materials research)	51, 32, 41, 12

Lecture title

The Amazing Ribosome and Its Tiny Enemies

Profile text

Ribosomes are large macromolecular machines within cells on which mRNA is translated into amino acid sequences to produce proteins. Yonath elucidated the complete highly resolved structure of both ribosomal subunits and explained how polypeptide binding functions in the active centre of the ribosome. She visualised the ribosomal tunnel, the site from which the growing polypeptide chain, i.e. the new protein, emerges. Although ribosomes of bacteria and eukaryotic cells are functionally similar, they differ in the number of structural features. Because of these differences, bacterial ribosomes are good targets for antibiotics that specifically disrupt bacterial protein biosynthesis. Yonath is investigating the mechanisms of action of various antibiotics and related resistance mechanisms. Her work has facilitated the structure-based development of new antibiotics. Yonath is visiting Lindau for the fifth time this year.