

---

## Press Release of the Lindau Nobel Laureate Meetings

### Inspiring Ignorance

#### **Nobel Laureates and Young Scientists discuss Perspectives of Particle- and Astrophysics in Lindau**

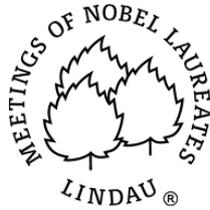
The fabric of the world we're living in was a controversial topic even in 1953 at the first meeting of Nobel Laureates in Physics in Lindau. At the 60<sup>th</sup> Meeting of Nobel Laureates, which will begin on Sunday, it will again play a key role. Since physicists have realized that only 4% of the universe consists of known ingredients, while 96% is made of dark matter and dark energy, the basic construction of this fabric is more mysterious than ever before. Now, the huge particle accelerator, the Large Hadron Collider (LHC) at the European Nuclear Research Centre in Geneva, Switzerland offers the opportunity to shed light on this darkness. Six Nobel Laureates who have made significant contributions to particle physics and cosmology during the last decades will discuss their expectations of the experiments at the LHC at a symposium on Tuesday, June 29.

The Standard Model of particle physics describes the rules by which twelve elementary particles, four forces, and twelve field particles that transmit these forces, work in concert. It has been developed since the mid-1970s, experimentally proven time and again, and could soon be merged with the Big Bang model of cosmology. The latter rests on Einstein's theory of general relativity and includes the assumption that our world originates from the explosion of a tiny dot of highly concentrated energy – an assumption experimentally endorsed by measurements of cosmic background radiation in 1965. Despite its elegance, the Standard Model has gaps; for example, it cannot explain how elementary particles receive their mass or why there are three families of elementary particles when only one seems to be required. Also, gravity cannot yet be integrated into the theoretical connection between elementary particles and the cosmos. That's why David Gross (2002 Nobel Prize in Physics) in his 2008 Lindau lecture "*The Large Hadron Collider and the Super World*," which is available as a video in the online library of the Nobel Laureates Meetings, emphasized: "The most important product of knowledge like the development of the Standard Model is ignorance; by which I

---

#### **Press Contact:**

Christian Rapp (Communications)  
Tel.: +49 (0) 8382 - 277 3115, Fax: +49 (0) 8382 - 277 3113  
E-Mail: christian.rapp@lindau-nobel.org



---

## Press Release of the Lindau Nobel Laureate Meetings

mean...informed ignorance, good questions that can be probed and answered by observation, by experiment and by theory."

### **Detection of new Elementary Particles in the Large Hadron Collider**

Both laureates and young scientists expect good answers to these questions from experiments in the Large Hadron Collider (LHC) in Geneva, as it is "a wonderful instrument to create particles of which you didn't know the existence" according to Martinus Veltman (1999 Nobel Prize in Physics) in his 2008 lecture "*The Development of Particle Physics*." After being accelerated to a speed close to that of light in a subterranean ring with a circumference of 27 kilometres, protons inside the LHC collide with an overall energy of 14.000 billion electron volts. This is comparable to the energy within the universe one trillionth of a second ( $10^{-12}$  sec) after the Big Bang. According to Einstein's equation,  $E = mc^2$ , a part of this collision energy turns into matter. Thus, elementary particles which are characteristic for the very origin of our universe could be detected inside the LHC. This includes the not yet detected Higgs particle which exists theoretically to explain how elementary particles gain their mass and electromagnetically neutral particles, the so-called WIMPS (weakly interacting massive particles), which are suspected to form dark matter.

Almost 80 years ago, astrophysicists first proposed the existence of invisible matter. They had observed that some galaxies rotate faster around their centre than the laws of gravitation and their visible mass allow. On average, their stars have only 10% of the mass that would be necessary to keep them in orbit and prevent them from flying apart. Applying the method of gravitational lensing, the existence of dark matter, which surrounds the stars of a galaxy like a scaffold, could be verified in the 1970s because it bends space and distorts light that reaches the earth. Dark matter accounts for 23% of the entire mass of the universe.

### **A dynamic Interplay in Vacuum**

Dark energy was discovered in 1998. It is a repulsive force, counteracting gravity and accelerating the expansion of the universe. Nobody knows what's hidden

---

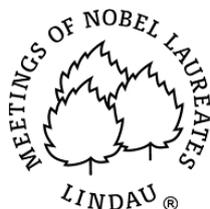
**Press Contact:**

2

Christian Rapp (Communications)

Tel.: +49 (0) 8382 - 277 3115, Fax: +49 (0) 8382 - 277 3113

E-Mail: christian.rapp@lindau-nobel.org



---

## Press Release of the Lindau Nobel Laureate Meetings

behind this energy that makes up nearly 75% of our universe. There are speculations, however, that it could be related to the energy density of the vacuum of space. While matter mutually attracts each other via gravity, parts of the empty space obviously repel each other because the vacuum contains energy. This energy of Nothingness is one of the biggest current mysteries of physics, as David Gross with good humour mentioned in his 2008 lecture: "Our job is to understand nothing, if we understand the vacuum, the rest is trivial."

Werner Heisenberg, who earned his Nobel Prize in Physics in 1932 at the age of 31, explained the origin of the force in the vacuum in his 1968 Lindau lecture "*Kosmologische Probleme in der heutigen Atomphysik*" (Cosmological Problems in Modern Atomic Physics) in 1968. He referred to a discovery of his English colleague Paul Dirac (1933 Nobel Prize in Physics), himself a ten-time participant in the Lindau Meetings. Dirac had discovered that the transformation of energy into matter always leads to the generation of anti-matter. For example, a particle like an electron is always formed together with a positron. Conversely, when a particle and an anti-particle collide, they annihilate each other and turn into energy. "Even pure Nothing," Heisenberg said, could therefore "virtually transform into a number of particle pairs and become a composed system or rather a dynamic problem." Hence, inside the vacuum, a continuous interchange between matter and energy, the so-called vacuum fluctuations, would prevail; matter turns into energy, and energy into matter, at almost infinite speed.

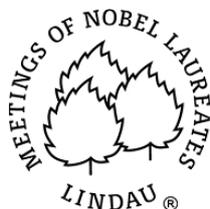
According to the knowledge of current physics, the energy of the Big Bang also created matter and anti-matter. In fact, both would have destroyed each other immediately if a slight asymmetry in favour of matter had not occurred, thus rendering the existence of our world. "I guess that one can now anticipate where the bridge between elementary physics and cosmology must be built," Heisenberg explained, predicting the merger between these two disciplines of physics. At that time, Heisenberg saw this idea as "a dream of the future," yet he did not hesitate to speculate because "in Lindau you occasionally have a licence for such dreams."

---

**Press Contact:**

3

Christian Rapp (Communications)  
Tel.: +49 (0) 8382 - 277 3115, Fax: +49 (0) 8382 - 277 3113  
E-Mail: christian.rapp@lindau-nobel.org



---

## Press Release of the Lindau Nobel Laureate Meetings

### Supplementary Material

At the 60th Nobel Laureates' Meeting there will be – in addition to the symposium - eight lectures and discussions on topics related to elementary particles and cosmology:

John C. Mather (Nobel Prize in Physics 2006): "*The History of the Universe, from the Beginning to the Ultimate End*"

George F. Smoot (Nobel Prize in Physics 2006): "*Mapping the Universe and its History*"

Robert W. Wilson (Nobel Prize in Physics 1978): "*The Discovery of Cosmic Background Radiation and its Role in Cosmology*"

Carlo Rubbia (Nobel Prize in Physics 1984): "*Underground Physics: Neutrino and Dark Matter*"

David Gross (Nobel Prize in Physics 2004): "*Frontiers of Physics*"

Gerardus 't Hooft (Nobel Prize in Physics 1999): "*The Big Challenges*"

Martinus Veltman (Nobel Prize in Physics 1999): "*The Development of Particle Physics*"

James W. Cronin (Nobel Prize in Physics 1980): "*Cosmic Rays: The Most Energetic Particles in the Universe*"

### Original Quotes from the Online Library

The Lindau Media Online Library contains valuable audio and video recordings beginning with lectures from 1952.

#### Quotes from David J. Gross (Nobel Prize in Physics 2004) at Lindau 2008:

<http://www.lindau-nobel.org/MediaContainer.AxCMS?type=lectures&meeting=105&elementID=203>

06:12: "In fact I'd like to say that the most important product of knowledge like the development of the standard model is ignorance, by which of course, I do not mean bad ignorance, the kind that causes wars and bigotry, but rather informed ignorance, good questions that can be probed and answered by observation, by experiment and by theory."

09:22: "Let me tell you a bit about what you might think is a boring subject but underlies our knowledge and our ignorance about the fundamental structure of matter and force, namely the properties of the vacuum. It is the vacuum that theorists like myself study all the time. Our job is to understand Nothing, if we understand the vacuum, the rest is trivial..."

#### Quotes from Martinus Veltman (Nobel Prize in Physics 1999) at Lindau 2008:

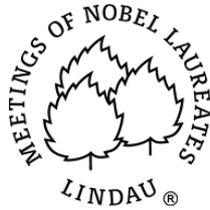
<http://www.lindau-nobel.org/MediaContainer.AxCMS?LaureateID=6968&type=lectures>

00:59: "...so it is a wonderful instrument to create particles of which you didn't know the existence..."

---

#### Press Contact:

Christian Rapp (Communications)  
Tel.: +49 (0) 8382 - 277 3115, Fax: +49 (0) 8382 - 277 3113  
E-Mail: christian.rapp@lindau-nobel.org



---

## Press Release of the Lindau Nobel Laureate Meetings

28:00: "...is this the end? There is some logical end here. It's very hard to make machines bigger than something with a diameter of 8.5 kilometres. You can put it in the Boulevard Peripherique of Paris. What do you do if you want a bigger machine? Make it around France? Make it in the planetary system? I mean that's clearly nonsense. So, I think, as magnitude goes, we are getting to the limit of the possible...I should, of course, say that through all the time that I've been in particle physics, I've had it thought more than once 'We are reaching the end.' I thought so in '63 with the CERN machine. I didn't think of storage rings. So, there are things happening that may make everything I say total nonsense, but for the time being we are reaching as high as we can. The LHC is a miracle of working at the edge of technology..."

**Quotes from Werner Heisenberg (Nobel Prize in Physics 1932) at Lindau 1968:**

**>German version of the presentation<**

<http://www.lindau-nobel.org/MediaContainer.AxCMS?type=lectures&lmeeting=234&elementID=290>

21:17: "...und zwar handelt es sich hier nun wieder um eine entscheidende Konsequenz aus jener Diracschen Entdeckung der Antimaterie. Bis zur Diracschen Entdeckung, also bei der alten Vorstellung der Elementarteilchen, konnte man denken, dass der Grundzustand dieser Physik der Elementarteilchen, einfach das Vakuum, oder sagen wir das Nichts, ist. Der Zustand tiefster Energie war, so hätte man damals gesagt, eben jener Zustand, in dem es überhaupt keine Materie gibt, das reine Nichts, und das reine Nichts hat selbstverständlich die höchste mögliche Symmetrie, das heißt es geht bei jeder beliebigen Transformation wieder in das Nichts über. In dem Moment aber, in dem die Antimaterie entdeckt war, konnte diese Vorstellung nicht mehr aufrechterhalten... Denn auch das reine Nichts kann ja virtuell übergehen in eine Anzahl von Paaren aus Elektron und Positron, oder Proton und Antiproton und so weiter, das heißt, auch dieser Grundzustand wird plötzlich, durch die Entdeckung der Antimaterie, zu einem, wenn Sie wollen, zusammengesetzten System oder, vielleicht besser, zu einem dynamischen Problem."

43:36: "...Ich glaube, dass man eben schon jetzt sieht, wo die Brücke von der Atom- und Elementarteilchenphysik geschlagen werden muss zur Kosmologie und ich glaube, dass die Entwicklung in den nächsten Jahren, vielleicht schon in einer nahen Zukunft eben so aussehen wird, dass die Kosmologie in ähnlicher Weise ein Teil der Elementarteilchenphysik wird so wie sie früher von Einstein als ein Teil seiner einheitlichen Feldtheorie erhofft worden ist. Aber das ist, wie ich eben schon sagte, zu einem erheblichen Teil noch Zukunftsmusik, aber ich glaubte doch, dass man hier in Lindau auch gelegentlich über Zukunftsmusik sprechen darf..."

The Lindau Media Online Library also contains the interesting lectures "*The Beginning and the Development of the Universe*" by George F. Smoot from 2008 and Paul Dirac's "*Does the Gravitational Constant Vary?*" from 1979.

---

**Press Contact:**

5

Christian Rapp (Communications)

Tel.: +49 (0) 8382 - 277 3115, Fax: +49 (0) 8382 - 277 3113

E-Mail: christian.rapp@lindau-nobel.org