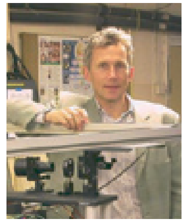
3rd) **Christopher Foot,** Clarendon Laboratory, University of Oxford, UK



Biography:

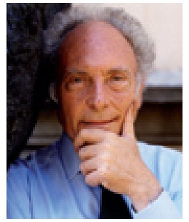
After having begun his physics career with a first-class honours degree and doctorate from the University of Oxford, Christopher Foot spent several years working at Stanford University, supported for part of that time by a Lindemann Trust Fellowship. He returned to the Oxford Physics Department and started research on laser cooling and trapping of atoms. Since 1991 he has been a tutorial fellow at St. Peter's College, Oxford. His current research interests include the study of the superfluid properties of ultra-cold atomic gases (Bose-Einstein condensates), and experiments on ultra-cold atoms held in arrays of optical traps formed by laser light to study the quantum properties of many-particle systems. Such atomic physics techniques give very precise control over the cold-atom systems so that they can be used to simulate phenomena that occur in condensed matter physics and, in the future, for quantum information processing.

The extraordinary behaviour of quantum systems

Small particles such as atoms and electrons behave in strange ways that often seem very weird when compared to our everyday experience of large 'ordinary' objects such as a tennis ball or football. For very small objects the effects of quantum mechanics are manifested in striking ways that are briefly described in this presentation. Firstly, a single quantum object can exist in two places at once, but this is not really as strange as it first appears when considered in terms of waves. However, there is a second property of quantum systems of two or more particles that is truly difficult to understand. Indeed Einstein pointed out a consequence of this property (called entanglement) which is so bizarre that he thought there must be something wrong. Experiments have shown that the quantum world really behaves in this peculiar way. By understanding it we can do new things such as build quantum computers that, in the future, may outperform 'ordinary computers' in certain applications, e.g. cracking the encryption commonly used to transmit information electronically. With current technology we are able to make quantum systems of many atoms at temperatures less than one millionth of a degree above absolute zero, and control these systems in such a way that they act like small quantum calculating machines, or 'quantum simulators', with which we can study the quantum properties of a wide range of other interesting physical systems. This fulfils the vision of the famous physicist Richard Feynman who pointed out many years ago that using one quantum system to study other quantum systems is much more efficient than using an 'ordinary' computer. An example will be given of this type of experiment which we are carrying out in a European Science Foundation programme.

Moderator:

Eduardo Punset



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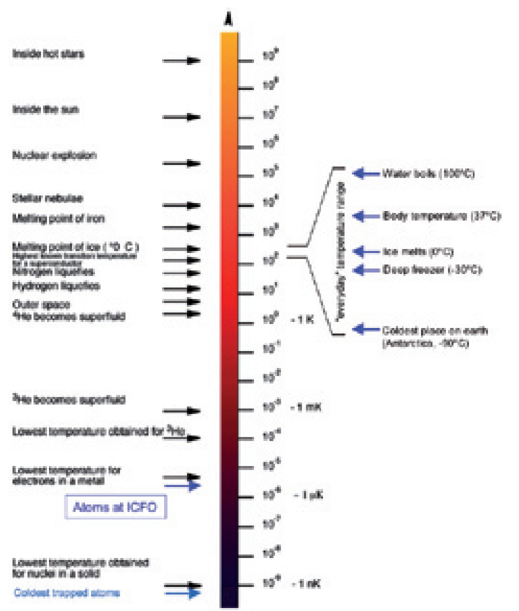
Biography:

Eduardo Punset was born in Barcelona, Spain. After having graduated from North Hollywood High School in Los Angeles, he received a law degree from Madrid University. This was followed by a master's of science in economics at the London School of Economics. For ten years he worked for the BBC and *The Economist* in London. He worked in the International Monetary Fund in Washington and was Minister of European Relations in the Spanish Government, Minister of Finance of the Catalan home government, and President of the delegation of the European Parliament in Poland. He has been professor at the Bull Technological Institute and at the the Instituto de Empresa in Madrid, and currently at the Ramón Llull University. He is the director of the TV program Redes, and has written several books. Among them *Life, Mind and the Universe* –coedited with Lynn Margulis – and *The Happiness Trip*. *A Scientific Journey*. Some of the research done as advisor to Coca Cola's project on the dimensions of happiness appears in his book *El Viaje al Amor*. *Las claves científicas*.



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SETTING SCIENCE AGENDAS FOR EUROPE

1 quai Lezay-Marnésia I BP 90015
67080 Strasbourg Cedex I France
Tel: +33 (0)3 88 76 71 00
Fax: +33 (0)3 88 37 05 32
www.esf.org

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EUROCORES Programme
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EuroQUAM - Cold Quantum Matter

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"The Amazing Quantum World of Ultra Cold Matter"

A Scientific Session at ESOF 2008

21 July • 16.30-18.00

Meet the Scientist at the ESF booth (no 111 & 124)

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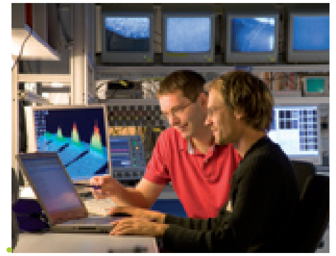
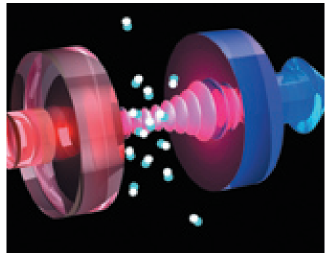
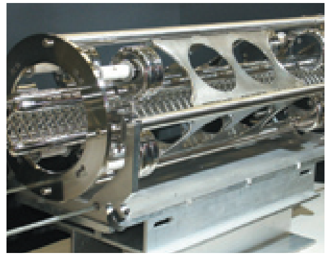
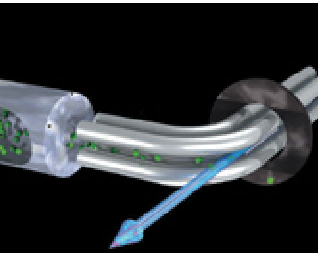
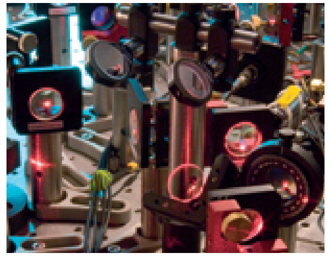
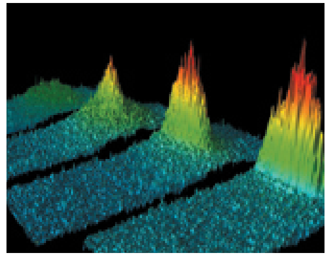




Many of us have been fascinated by the concept of absolute zero, the temperature at which everything comes to a complete stop. But physics tells us otherwise: absolute zero cannot be reached but only approached, and the closer you get, the more interesting phenomena you find! Nowadays, temperatures of less than a millionth of a degree above absolute zero can be produced in the laboratories. Quantum mechanics rules at such temperatures and predicts, for example, that particles may combine into a new state of matter called Bose-Einstein condensate or BEC. Since the first production of a BEC of atoms in 1995, there have been enormous advances in producing and manipulating quantum matter, and exciting applications have been proposed in diverse areas ranging from ultra-high precision metrology to quantum information technology. This session is co-organised by the European Science Foundation (ESF) and The Institute of Photonic Sciences (ICFO) within the ESF’s collaborative research programme *“Cold Quantum Matter (EuroQUAM)”*. It is sponsored under the networking and dissemination supports of the European Collaborative Research (EUROCORES) Scheme.

Organiser:

Jürgen Eschner, The Institute of Photonic Sciences (ICFO), Spain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Biography:
J.Eschner was born in the north of Germany and received his physics education and PhD in Hamburg. He worked at the University of Hamburg, at the Australian National University in Canberra, and at the University of Innsbruck, Austria, before he joined ICFO – The Institute of Photonic Sciences in Barcelona in 2003. He is an experimentalist with research experience in laser physics, laser spectroscopy, quantum optics, laser cooling, atom trapping, and quantum information. He also enjoys collaborating with theorists. At ICFO he leads a group of 10 young researchers working on quantum optical information technology with single atoms and single photons. His group obtained the first cold atoms (below 50 μKelvin) and the first single trapped atoms in Spain.

Speakers:

1st) **Maciej Lewenstein,** The Institute of Photonic Sciences (ICFO), Spain


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Biography:
Maciej Lewenstein was born in Poland. He graduated at Warsaw University and obtained his PhD at Essen University, under the supervision of K. Rzazewski and F. Haake. He has been research associate of the Nobel laureate Roy J. Glauber at Harvard University. He collaborated with A. L’Huillier at the Commissariat à l’Énergie Atomique. At the Joint Institute for Laboratory Astrophysics in Boulder, he ran a joint Bose-Einstein Condensation seminar together with P. Zoller and E. Cornell (Nobel 2001). Later on, he spent a period at Harvard-Smithonian. He has been full professor at the Leibniz University Hannover. In 2005, he moved to Spain as ICREA professor to lead the quantum optics theory group at ICFO-The Institute of Photonic Sciencess in Barcelona. His research interests include Physics of Ultracold Gases, Quantum Information, Statistical Physics, Mathematical Physics, Atomic and Laser Physics, and Quantum Optics. In the last 30 years he has conducted successful research in these areas and is an author of over 300 publications, among them papers in *Nature, Science, Nature Physics and Physical Review Letters.* He is fellow of the American Physical Society and has obtained the Alexander von Humboldt Research Prize.

Toward absolute zero
In my short presentation I will present recent developments in atomic, molecular and optical physics and quantum optics, toward reaching temperatures close to absolute zero. I will argue that while in classical physics absolute zero is in certain sense “boring”, in the quantum world new, fascinating states of matter such as Bose-Einstein condensates arise at ultralow temperatures. The lecture will describe the tremendous advances in physics that have made such experiments possible, and which led to the Nobel prizes in physics for the “development of methods to cool and trap atoms with laser light” in 1997, and for the “achievement of Bose-Einstein condensation in dilute gases of alkali atoms” in 2001. It seems counterintuitive that shining laser light on atoms cools them and this will be explained, together with the way that laser beams are used to hold the cold atoms at fixed positions in space and arrange them into regular patterns to construct ultra-cold quantum matter. The concepts will be explained without mathematics in a manner suitable for a general audience.

2nd) **Christophe Salomon,** Laboratoire Kastler Brossel, Ecole Normale Superieure, France


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Biography:
Christophe Salomon got his PhD in 1984 at Paris 13 University (France) and moved for his post-doc to JILA (USA), where he worked with J. Hall on ultra-stable lasers and laser cooling of atoms. He currently works in Laboratoire Kastler Brossel. Now, as a Research Director at CNRS, he is Head of the cold Fermi gas group at Ecole Normale Supérieure and Principal Investigator for the ACES/PHARAO Space Clock Mission. He has 180 publications. He has obtained the “Three Physicists” prize (FR), the Mergier-Bourdeix Grand Prize of the French Academy of Sciences, the European Time and Frequency Prize, and the Philip-Morris Prize.

Precision Time with Cold Atoms
We will describe an important application of cold atoms, the realization of ultra precise clocks. Using atomic fountains and microwave radiation, the SI unit of time, the second, is realized with an error of less than one second over 100 million years. Clocks operating in the optical domain show even better performances and cycles of light can now be easily counted with a femtosecond laser. Improved tests of General Relativity and fundamental physics can be performed with clocks on Earth and in Space. In a few years clocks will be able to monitor local changes of the Earth gravitational potential due for instance to ocean tides, earthquakes, or global climate warming.