



# Leibniz Lecture

## Professor Dr Wolfgang Ertmer

Institute of Quantum Optics,  
Leibniz Universität Hannover

Vice President of the DFG  
Gottfried Wilhelm Leibniz Prize 1997

Date & Time: Tuesday, February 21, 2017, 5.00 pm  
Venue: Faculty of Physics, Lomonosov Moscow State  
University (MSU), Leninskie Gory, 1-2

The lecture will be held in English.



## COLD ATOM BASED QUANTUM METROLOGY

### About the lecture:

Highly sensitive quantum sensors based on ultra-cold atomic ensembles open new horizons in quantum sensing and quantum metrology. For instance, inertial sensing by atom interferometry or optical atomic clocks benefit strongly from new methods of quantum engineering of the atomic ensembles.

Entanglement, one of the most intriguing features of quantum mechanics, is nowadays a valuable resource for the improved sensitivity of quantum metrology beyond the standard quantum noise limit. Most prominently, quadrature-squeezed and spin-squeezed states are and will be new techniques propelling atom interferometry and atomic clocks to sub-shot-noise performance. Eventually, this will pave the way towards “interaction-free” quantum measurements.

This lecture treats – besides introductory examples – innovative applications and research directions based on these developments and recent breakthroughs. This will include relativistic geodesy, pan-European clock comparisons, fundamental tests in weightlessness and on ground.

### About the speaker:

Born in 1949 in Bonn, Wolfgang Ertmer studied Physics at the Rheinische Friedrichs-Wilhelms-Universität Bonn. In 1978 he obtained his doctorate (supervisor Prof. Siegfried Penselin, Bonn) with a thesis about double-resonance hyperfine structure measurement of titanium. From 1982 until 1984 he worked as research fellow resp. visiting scientist at the Joint Institute for Laboratory Astrophysics (JILA), Boulder, Colorado, together with John L. Hall, Nobel Prize laureate 2005. After his return he habilitated in 1985 at the Rheinische Friedrichs-Wilhelms-Universität Bonn. Since 1994 Wolfgang Ertmer is full professor at the Leibniz Universität Hannover. Wolfgang Ertmers main research interests are atomic physics, quantum optics, degenerate quantum gases, quantum metrology, and biophotonics. Since 2007 he is dean of the QUEST-Leibniz Research School (Quantum Engineering and Space-Time Research). Since 2013 Wolfgang Ertmer is Chairman of the Scientific Board of Directors of the Laser Zentrum Hannover e.V.

The **Gottfried Wilhelm Leibniz Prize** has been awarded by the Deutsche Forschungsgemeinschaft (German Research Foundation, DFG) every year since 1986 for outstanding achievements in research. This most prestigious scientific award in German research aims to improve the working conditions of outstanding scientists and academics, expand their research opportunities, relieve them of administrative tasks, and help them employ particularly qualified young researchers.

The Leibniz Lecture is a DFG format to invite Leibniz Prize Laureates for lectures, seminars and visits abroad in order to stimulate the dialogue between the laureates and the research community, as well as the broader public in the host country.

The **Deutsche Forschungsgemeinschaft (DFG)** is the largest independent research funding organisation in Germany. It is an association under German private law. Its member organisations include German universities, non-university research institutions, academies of sciences and humanities, and scientific associations. It serves all branches of science and the humanities by funding research projects and facilitating cooperation among researchers.

The DFG facilitates national and international cooperation among researchers. It provides scientific policy advice and fosters relations with the private sector. It promotes gender equality in the German scientific and academic communities. It encourages the advancement and training of early-career researchers.

The DFG organizes **Leibniz Lectures** in different regions across the world in order to promote German science, especially at locations where it has its own foreign representations like in Brazil, Russia, India, China, Japan and the USA. Germany's scientific relations with Russia are part of a lively, centuries-old tradition. Russia is particularly significant for the German scientific system and is a priority country in the DFG's international activities. The DFG has maintained an intensive scientific dialogue with Russia for decades and, since 2003, has supported the development of bilateral cooperation through its own representative office in Moscow, the **DFG Office Russia/CIS** (<http://www.dfg.de/ru>). As well as being the DFG's liaison office, it functions as a local point of contact for Russian scientists, providing advice and mentoring in cooperation programmes.

In 2012 the DFG Office organized the first Leibniz Lecture in Moscow. Since then once a year the following lectures have been held in the Russian Federation:

- 2012: Matthias Kleiner (DFG-President), "Strategic Research in Engineering – Advanced Light Metal Extrusion for Low Energy Design", Moscow State University, Moscow;
- 2013: Günter Ziegler (Freie Universität Berlin), "Cannons at Sparrows: Cutting Polygons via Configuration Spaces", Library Hall, Hotel Balchug, Moscow;
- 2014: Günter Ziegler (Freie Universität Berlin), "Sugar Cubes, Soap Bubbles, a Revolution and a Star: Some Stellar Images between Mathematics and Physics", Steklov Institute of Mathematics, Saint Petersburg Branch;
- 2015: Hartmut Leppin (Goethe-Universität Frankfurt/Main), "Demut und Macht: Die christlichen Kaiser der Spätantike (Смирение и власть: императоры-христиане позднего Рима)", Russian State University for Humanities, Moscow;
- 2016: Hartmut Leppin (Goethe-Universität Frankfurt/Main), „Antikes Christentum und Religiöse Gewalt“ (Античное христианство и религиозное насилие), Scientific Library of Moscow State University (MSU), Moscow.