Quantum mixtures with ultracold atoms

R. Grimm, M. Inguscio, S. Stringari 11-02-2021 http://www.primapagina.sif.it/article/1243

The Course "Quantum Mixtures with Ultracold Atoms" of the Enrico Fermi International School of Physics of the Italian Physical Society will be held in the beautiful venue of Villa Monastero, Varenna, Italy, from 27 July to 1 August 2021.

Ultracold atomic gases, prepared at temperatures in the nanokelvin range, provide a unique platform for research on the behavior of matter governed by the laws of quantum mechanics. The physics of ultracold atoms represents a synergy field, which combines basic concepts from various other fields, such as condensed-matter physics, statistical physics, few-body physics, nuclear physics etc. In addition to many fundamental research activities worldwide, ultracold systems are used in quantum technologies for realizing novel schemes of quantum computation, quantum metrology and quantum-enhanced sensing.

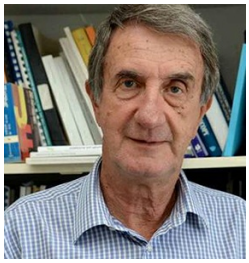
An increasing number of experiments are carried out on *quantum mixtures*: Here systems with new properties can be created when different components (spin mixtures of a single atomic species or mixtures of different species) are mixed together to form compound many-body quantum systems. The great variety of possible combinations and new systems, e.g. combining components of different quantum statistics or largely different masses, allows one to realize few- and many-body systems that challenge our current understanding. New model systems and quantum materials become available in the laboratory and stimulate interaction between theory and experiment. In addition to well-established mixtures serving as the basis for many experiments, new mixtures are currently being prepared in various laboratories for future applications.

The organization of the Course 210 on Quantum Mixtures with Ultracold Atoms represents an ideal continuation of a series of Courses organized in the framework of the Enrico Fermi School in 1998 (Course 140, Bose-Einstein Condensation in Atomic Gases), in 2006 (Course 164, Ultracold Fermi Gases) and in 2014 (Course 191, Quantum Matter at Ultralow Temperatures).

The Course will bring together young scientists (PhD students and post-docs) with leading experts in the field. The lecture series will cover both experimental and theoretical advances in the field of quantum mixtures, with special focus on Bose-Bose, Bose-Fermi, Fermi-Fermi mixtures in bulk systems and in optical lattices, spinor physics, reduced dimensionality, impurity physics, few-body physics, superfluidity and supersolidity. The central aim is to form a strong community of young researchers, excellently trained in the complex physics of multi-component quantum systems. This will foster future international networking activities, including connections between the different branches of research as well as between theory and experiment. The participants will be well prepared to meet the future challenges of a rapidly developing field in fundamental and applied aspects of modern quantum science.

Rudolf Grimm – Professor for Experimental Physics at the University of Innsbruck and Scientific Director at the Institute for Quantum Optics and Quantum Information (IQOQI) of the Austrian Academy of Sciences. He obtained his doctoral degree in 1989 from the ETH Zurich. His present research interests are centered around ultracold quantum gases and mixtures in regimes of strong interactions.

Massimo Inguscio – Professor of Physics of Matter at Campus Biomedico University of Rome and Coordinator of the “Quantum Science and Technology” division of the European Laboratory for Nonlinear Spectroscopy (LENS). He obtained his PhD in 1976 from Scuola Normale Superiore (Pisa). His research activity is focused on experiments with ultracold quantum gases and mixtures.



Sandro Stringari – Professor Emeritus at the University of Trento. After starting his scientific career in nuclear physics, Sandro Stringari moved his research interests towards the theory of quantum liquids and quantum gases in the '80s. In 2002 he founded in Trento the BEC center on Bose-Einstein Condensation. He is a specialist of collective and superfluid phenomena in ultracold atomic gases.