

Seminar

Prof. Francesca Ferlaino

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Supersolids in Magnetic Gases: From Roton Softening to Quantum Vortices

Thursday, November 27, 2025

16:00 h

ESI, Boltzmann Lecture Hall

Abstract:

The exploration of low-temperature physics has captivated scientists for decades, unveiling groundbreaking phenomena such as superfluidity across a variety of states of matter, including solids, liquids, gases, and even light. A central focus of this field has been the emergence of superfluid order in spatially homogeneous systems. However, what occurs when superfluidity emerges alongside periodic density modulations? Can a supersolid state exist, where localization inherent to periodic structures coexist with superfluidity? Is it possible for a solid to exhibit superfluid behavior, or for a superfluid to display crystalline order?

These questions have long intrigued the scientific community. Recent breakthroughs have provided compelling answers with the discovery of “supersolid” quantum states—phases that uniquely combine superfluid and crystalline properties.

This talk will delve into the experimental realization of supersolidity in magnetic quantum gases, enabled by the momentum-dependent, long-range, and anisotropic dipole-dipole interactions. Key topics include the softening of roton excitations as a precursor to the supersolid phase transition, the dynamics of symmetry breakings, and the observation of quantized vortices in rotating supersolid states. These advancements open new avenues for understanding many-body quantum physics and the interplay of order and coherence in complex quantum systems.

This seminar is part of the workshop on “Quantum Many-body Systems and Bose-Einstein Condensation: A Mathematical Physics Perspective” taking place at the Erwin Schrödinger Institute from November 24 - 28, 2025.

R. Seiringer

November 21, 2025