QUANTUM SEMINAR: Production of spin-squeezed atomic crystal

EMILIA WITKOWSKA

February 21, 2023
15:00 to 16:00
Blue Lecture Room and Online (Zoom)

The second Quantum Revolution's main objective lies in multipartite entangled states: their production, storage, certification, and application. Such states, i.e., many-body entangled and many-body Bell correlated states, are essential resources for quantum-based technologies and quantum-enhancement metrology. As such, a general protocol allowing the controlled generation of such states is an extensive research direction in modern quantum science. Spin squeezing represents such a protocol paving the way for high-precision measurements.
I will discuss two methods to obtain a regular arrangement of atoms in an optical lattice where all the atoms share metrologically useful quantum correlations in the form of spin squeezing. Such a spin-squeezed atomic crystal is obtained using bosonic or fermionic atoms. In the first case, the spin-squeezed atomic crystal is produced by adiabatically raising an optical lattice in an interacting two-component Bose-Einstein condensate. For fermions, however, it is necessary to add the atom-light coupling to induce effective interactions among atoms. The schemes could be directly implemented experimentally with state-of-the-art techniques.

Abstract:
The second Quantum Revolution's main objective lies in multipartite entangled states: their production, storage, certification, and application. Such states, i.e., many-body entangled and many-body Bell correlated states, are essential resources for quantum-based technologies and quantum-enhancement metrology. As such, a general protocol allowing the controlled generation of such states is an extensive research direction in modern quantum science. Spin squeezing represents such a protocol paving the way for high-precision measurements.
I will discuss two methods to obtain a regular arrangement of atoms in an optical lattice where all the atoms share metrologically useful quantum correlations in the form of spin squeezing. Such a spin-squeezed atomic crystal is obtained using bosonic or fermionic atoms. In the first case, the spin-squeezed atomic crystal is produced by adiabatically raising an optical lattice in an interacting two-component Bose-Einstein condensate. For fermions, however, it is necessary to add the atom-light coupling to induce effective interactions

among atoms. The schemes could be directly implemented experimentally with state-of-the-art techniques.

Meeting ID: 276 878 5000

Passcode: 27687

Hosted by: Prof. Dr. Maciej Lewenstein