JOHANNES GUTENBERG UNIVERSITÄT MAINZ

iRyd

SPP 1929 – Seminar

07. Juni 2018, 14:00 Uhr c.t.

Johannes Gutenberg Universität Mainz
Lorentz-Raum (05-127)
Staudingerweg 7, 55128 Mainz

Jean-Michel Raimond
(Laboratoire Kastler Brossel, France)

Quantum metrology and quantum simulation with Rydberg atoms

Rydberg atoms, excited states with a high principal quantum number are very sensitive to external fields. Their rich level structure allows one to engineer non-classical states, which can be used for the realization of quantum-enabled sensors. We realized an electrometer based on 'Schrödinger cats', superpositions of states with very different electric dipoles. It measures the electric field and its time correlation function with a 5 MHz bandwidth. Its exquisite sensitivity leads to interesting perspectives for single-charge detection in mesoscopic physics. We also develop a quantum-enabled magnetometer based on a superposition of 'circular' Rydberg states with opposite magnetic moments. The strong dipole-dipole interactions between giant Rydberg atoms can be used to realize quantum simulations of many-body problems. We propose a quantum simulator, based on laser-trapped circular Rydberg atoms, protected from spontaneous emission, with lifetimes in the minute range. The dipole-dipole interaction implements a XXZ nearest-neighbor spin-1/2 Hamiltonian. All its parameters are under control. This flexible simulator of spin ensembles is able to follow their evolution over extremely long times. I will report on progress towards its realization.