AKjDPG 3: Tutorial Quantum Metrology

Time: Sunday 16:00–18:00 Location: U HS 323

Tutorial AKjDPG 3.1 Sun 16:00 U HS 323

Quantum metrology from a quantum information science perspective — •Geza Toth[1,2,3] and Iagoba Apellaniz[1] — [1]Theoretical Physics, University of the Basque Country UPV/EHU, E-48080 Bilbao, Spain — [2]IKERBASQUE, Basque Foundation for Science, E-48011 Bilbao, Spain — [3]Wigner Research Centre for Physics, H-1525 Budapest, Hungary

We discuss how quantum systems can be used for parameter estimation. We present the central notions of the field such as the quantum Fisher information and the Cramér-Rao bound. We review basic findings on how the precision of the parameter estimation scales with the number of particles in a linear interferometer. The best scaling achievable is quadratic, however, quantum entanglement is needed to surpass the linear or shot-noise scaling. Finally, we explain how uncorrelated noise limits the highest achievable precision in practice. We present the theory of quantum metrology based on concrete setups using highly entangled quantum states, such as Greenberger-Horne-Zeilinger states, spin squeezed states, Dicke states and singlet states.

Tutorial AKjDPG 3.2 Sun 17:00 U HS 323

Quantum metrology with non-classical states of atoms — •Carsten Klempt — Institut für Quantenoptik, Leibniz Universität Hannover, Deutschland

This tutorial will give an introduction to quantum metrology with non-classical states of atoms, with a focus on experimental aspects. The tutorial will start with an introduction to the basic concepts. I will then present the main experimental methods for the creation of entangled many-particle states in neutral atomic ensembles: Quantum non-demolition measurements, cavity interaction, collisional interaction. I will review the classes of entangled states, that have been created experimentally, and describe methods for the quantification of entanglement, including squeezing parameters and entanglement depth. Finally, I will present some highlight applications in the field of metrology.