Probing macroscopic realism via Ramsey correlations measurements

Speaker: Peter Rabl
Affiliation: Institute of Atomic and Subatomic Physics, TU Wien,
Stadionallee 2, 1020 Wien, Austria

The predictions of quantum mechanics differ in a very fundamental way from those of classical physics or more general realistic (hidden variable) theories, which, for example, is manifested in the violation of Bell- or Leggett-Garg type inequalities or quantum contextuality. These predictions are accurately confirmed on a microscopic level with photons and atoms, but similar tests with more massive systems are still outstanding. Here we describe a new and experimentally feasible protocol for performing fundamental tests of quantum mechanics with massive objects. In our approach a single two level system is used to probe the motion of a nanomechanical resonator via multiple Ramsey interference measurements. This scheme enables the measurement of modular variables of macroscopic continuous variable systems and we show that correlations thereof violate a Leggett-Garg inequality and can be applied for tests of quantum contextuality. Our method can be implemented with a variety of different solid state or photonic qubit-resonator systems and provides a clear experimental signature to distinguish the predictions of quantum mechanics from those of other alternative theories at a macroscopic scale.

Reference:
A. Asadian, C. Bruckner, P. Rabl, arXiv: arXiv:1309.2229.