The Hebrew University of Jerusalem , Symposium on Quantum Measurement

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"How do we optimally extract precision information from continuous measurement records?"

Quantum systems find use as precision probes, as well as time and frequency standards, and much research has dealt with the sensitivity of measurement schemes based on the preparation, evolution and final detection of different, particular quantum states. In this talk, I shall discuss another common scheme for precision probing, where a fluctuating signal is retrieved continuously in time, while the quantum system that emits the signal follows a stochastic evolution, sometimes referred to as a quantum trajectory. I shall show how the stochastic master equation describing the dynamics of such a quantum system effectively "filters" the likelihood functions for any unknown parameters in the system dynamics. I shall also show that the theoretical sensitivity limit for parameters that govern the system dynamics can be obtained from the (un-observed) system master equation. With detection of atomic fluorescence signals as an example, I shall demonstrate that photon counting and homodyne detection of the signal yield different sensitivity to the atomic and field parameters, while none of them exceed the general sensitivity limit.