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Continuous measurement quantum state tomography of atomic spins CARLOS RIOFRIO, IVAN DEUTSCH, Department of Physics and Astronomy, Center for Quantum Information and Control, University of New Mexico, AARON SMITH, BRIAN ANDERSON, HECTOR SOSA, POUL JESSEN, College of Optical Sciences, Center for Quantum Information and Control, University of Arizona — Quantum state tomography is a fundamental tool in quantum information science and technology. It requires estimates of the expectation values of an "informationally complete" set of observables. This is, in general, a very time-consuming process that requires a large number of measurements to gather sufficient statistics. There are, however, systems in which the data acquisition can be done more efficiently. An ensemble of quantum systems can be prepared and driven by external fields while being continuously and collectively probed, producing enough information in the time evolving measurement record to estimate the initial state. Such protocol has the advantage of being fast and robust. In this talk, we present a study of a continuous-measurement quantum-state tomography protocol and its application to controlling large spin ensembles. We perform reconstruction of quantum states prepared in the 16 dimensional ground-electronic hyperfine manifolds of an ensemble of 133Cs atoms, controlled by microwaves and radio-frequency magnetic fields and probed via polarization spectroscopy. We present theoretical and experimental results of its implementation and discuss two estimation methods: constrained maximum likelihood and compressed sensing.

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