Title: Bistability in small quantum systems

Abstract: Bistability occurs in a great variety of nonlinear dynamical systems. The existence of two stable equilibria relies generally on the presence of many microscopic degrees of freedom involved, which lead ultimately to a classical system, or more precisely, a semiclassical type mean-field description of a large quantum system. One of the characteristic examples is optical bistability in which the transmission of a Fabry-Pérot resonator containing a saturable absorber medium can admit two different output intensities depending on the input one. The effect exists if the medium is composed of a large number of atoms which can be described by an intensity-dependent refractive index. On the other hand, this effect is smeared by quantum fluctuations when the system size is reduced to a single atom and to intensities as low as a few photons. In this paper we show that small quantum systems can also produce semiclassical bistability in a generic way. The key to generating a semiclassical state of a quantum system is that the spectrum of a nonlinear quantum system can include a set of equidistant levels. Such a harmonic part of an otherwise substantially anharmonic spectrum can host coherent states.