Quantum Criticality

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We investigate the theory of quantum fluctuations in non-equilibrium systems having large critical fluctuations. This allows us to treat the limits imposed by nonlinearities to quantum squeezing and noise reduction, and also to envisage future tests of quantum theory in regions of macroscopic quantum fluctuations. A long-term objective of this research is to identify suitable physical systems in which macroscopic 'Schrödinger cat'-like behaviour may be observed. We investigate two systems in particular of much current experimental interest, namely the degenerate parametric oscillator near threshold, and the evaporatively cooled (BEC). We compare the results obtained in the positive-*P* representation, as a fully quantum mechanical calculation, with the truncated Wigner phase space equation, also known as semi-classical theory. We show when these results agree and differ in calculations taken beyond the linearized approximation. In the region where the largest quantum fluctuations and Schrödinger cat-like behaviour might be expected, we find that the quantum predictions correspond very closely to the semi-classical theory. *Nature abhors observing a Schrödinger cat.* – Pacs: 03.65.Bz

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