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Abstract for an Invited Paper
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Macroscopic quantum tunneling in Bose-Einstein condensates[1]

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I present three studies on macroscopic quantum tunneling of Bose-Einstein condensates. First, I show how even at the simplest mean field level already the problem of escape through a barrier has new features compared to single particle physics: the tunneling time is not the inverse of the rate and interactions allow one to tune from bound to quasi-bound to unbound states freely. Second, I show how tunneling in a double-well system leads to Josephson junction and Schrodinger cat (NOON state) physics. I demonstrate that although a very small bias or tilt in the potential can destroy Cat-like states, by intentional use of bias the many body wavefunction can be used to protect such states from destruction (or internal decoherence). Third, I present a full many-body calculation of entangled quantum dynamics of the escape problem, exploring entanglement, number correlations, and other features not accessible by instanton or other methods. I show that the tunneling process is non-smooth, and actually occurs in bursts. When approximately half the particles have tunneled out of the well, the particles remaining are maximally entangled with the escaped portion.

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