Abstract Submitted
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Macroscopic quantum tunneling of a Bose-Einstein condensate through double Gaussian barriers[1] KENJI MAEDA, Department of Physics, Colorado School of Mines, Golden, Colorado, USA, GREGOR URBAN, MATTHIAS WEIDEMÜLLER, Physikalisches Institut, Universität Heidelberg, Heidelberg, Germany, LINCOLN D. CARR, Department of Physics, Colorado School of Mines, Golden, Colorado, USA — Macroscopic quantum tunneling is one of the great manifestations of quantum physics, not only showing passage through a potential barrier but also emerging in a many-body wave function. We study a quasi-1D Bose-Einstein condensate of Lithium, confined by two Gaussian barriers, and show that in an experimentally realistic potential tens of thousands of atoms tunnel on time scales of 10 to 100 ms. Using a combination of variational and WKB approximations based on the Gross-Pitaevskii or nonlinear Schrödinger equation, we show that many unusual tunneling features appear due to the nonlinearity, including the number of trapped atoms exhibiting non-exponential decay, severe distortion of the barriers by the mean field, and even formation of a triple barrier in certain regimes. In the first 10ms, nonlinear many-body effects make the tunneling rates significantly larger than background loss rates, from 10 to 70Hz. Thus we conclude that macroscopic quantum tunneling can be observed on experimental time scales.

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