Abstract Submitted
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Testing macroscopic realism with nonlinear beam splitters and Bell inequalities in time[1] MARGARET REID, Swinburne University of Technology, Melbourne 3122, Australia, LAURA ROSALES-ZARATE, Centro de Investigaciones en Optica A.C., Leon, Guanajuato 37150, Mexico, LISA DRUMMOND, MANUSHAN THENABADU, Swinburne University of Technology, Melbourne 3122, Australia — It remains a challenge to falsify macroscopic realism in the sense identified by Leggett and Garg. A difficulty has been justifying a second premise, called macroscopic noninvasive measurability. Here, we consider two dynamically evolving entangled cat-systems prepared at spatially separated locations. A measurement can be made on each cat-system that at any time will give one of two mesoscopically (or macroscopically) distinct outcomes. We show how such an evolution is realisable from a nonlinear beam splitter, using a well-known two-mode Josephson nonlinear Hamiltonian. Importantly, we then show how a rigorous test of mesoscopic (macroscopic) realism can be carried out, with the additional assumption of macroscopic locality. This circumvents difficulties associated with traditional Leggett-Garg tests of macroscopic reality, based on the noninvasive measurement assumption. In our gedanken experiment, there are two measurement choices at each location corresponding to different times, contrasting with the choice of two spin angles in a traditional Bell experiment. We discuss how the proposal gives the opportunity for intriguing tests of quantum mechanics involving nonlocality and time. The experiment might be realised using matter waves or Bose-Einstein condensates.

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