Abstract Submitted
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Spontaneous emission from a tunneling atom DANIEL BRAUN, JOHN MARTIN, University Paul Sabatier Toulouse — We study the tunneling of a two-level atom in a double well potential in while the atom couples either to a single electromagnetic field mode of a cavity to the full continuum of electromagnetic modes in three dimensions. Both studies are within the Lamb-Dicke regime concerning transitions to higher vibrational states, but beyond the Lamb-Dicke regime concerning the tunneling split groundstate. The first case leads to an extended Jaynes-Cummings model which can be solved exactly. We show that the coupling between internal and external degrees of freedom of the atom induced by the cavity mode can dramatically change the tunneling behavior. In general the tunneling process becomes quasiperiodic. If the cavity is fed with a coherent state, a collapse and revival of the tunneling can occur. Accessing the internal degrees of freedom of the atom with a laser allows to coherently manipulate the atom position, and in particular to prepare the atom in one of the two wells. In the second case, the tunneling process may decohere, depending on the wavelength corresponding to the internal transition and on the spontaneous emission rate. Interference fringes appear in the emitted light from a tunneling atom, or an atom in a stationary coherent superposition of its center–of–mass motion, if the wavelength is comparable to the well separation and if the external state of the atom is post-selected.
[1] J. Martin and D. Braun, arXiv:0704.0763 and arXiv:0707.4158.

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