Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Quantum Zeno dynamics of a Rydberg atom SEBASTIEN GLEYZES, ADRIEN SIGNOLES, ADRIEN FACON, DORIAN GROSSO, IGOR DOTSENKO, SERGE HAROCHE, JEAN MICHEL RAIMOND, MICHEL BRUNE, Laboratoire Kastler Brossel, Collège de France, ENS, UPMC-Paris 6, CNRS, 11, place Marcelin Berthelot, 75231 Paris, France — The back-action of a quantum measurement can completely modify the evolution of a quantum system. A famous example is the quantum Zeno effect. However, if the eigenspace corresponding to the result of the measurement is degenerated, the evolution of system is no longer freezed, but the dynamics is confined inside the eigenspace. This is the Quantum Zeno Dynamics (QZD). We have experimentally implemented QZD in the Stark manifold of a Rydberg atom. Under the effect of a sigma+ radio-frequency field, our atom initially in the circular state behaves as a J=25 spin, which rotates between the north pole and the south pole of a generalized Bloch sphere. By repeatedly asking the system "have you crossed a given latitude?", we can confine the evolution of the spin to the polar cap of the Bloch sphere. We have recorded the population of the different m sublevels as a function of the RF drive duration to see that the dynamics of the atom is confined in the first states of the spin ladder. We have measured the Q function of the spin for different interaction times, and clearly seen the phase space distribution disappearing from one side of the LL and reappearing on the other, while being transiently in a superposition of two spin coherent states with different phases. To demonstrate the quantum coherence of this superposition, we have reconstructed the full density matrix of the atom at this time.

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Date submitted: 31 Jan 2014 Electronic form version 1.4