Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Non-classical Rydberg states for metrology experiments EVA-KATHARINA DIETSCHE, ADRIEN FACON, DORIAN GROSSO, ADRIEN SIGNOLES, IGOR DOTSENKO, SERGE HAROCHE, JEAN-MICHEL RAIMOND, MICHEL BRUNE, SEBASTIEN GLEYZES, Laboratoire Kastler Brossel, Collège de France, CNRS, ENS-PSL Research University, UPMC-Sorbonne Universités, 11, pl. M. Berthelot, Paris, France — The Stark level structure of a Rydberg atom offers a large Hilbert space in which we can implement novel complex quantum dynamics. Coupled to a well polarized radio-frequency field, the atom behaves like a large angular momentum. We have recently demonstrated that we can use Quantum Zeno dynamics to prepare the atom in a quantum superposition of coherent spin states. The atom, initially in the circular state, is driven by the radio-frequency field while a microwave field selectively addresses a given Stark sub-level. The coupling to the microwave field leads to a restricted evolution in the Hilbert space, in which the atom periodically evolves in a quantum superposition of two spins pointing in different classical directions. Those states show a Wigner function with fast oscillating interference fringes, which are very sensitive to slight changes of the atomic frequency induced by either the Stark or the Zeeman effect. We explore how such Schrodinger cat states can be used to perform metrology experiments that measure small variations of electric or magnetic fields with a sensitivity beyond the standard quantum limit.

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Date submitted: 30 Jan 2015 Electronic form version 1.4