Abstract Submitted
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A sensitive electrometer based on a Rydberg atom in a Schrdinger-cat state[1] SEBASTIEN GLEYZES, ADRIEN FACON, EVA-KATHARINA DIETSCHE, ARTHUR LARROUY, DORIAN GROSSO, SERGE HAROCHE, JEAN-MICHEL RAIMOND, MICHEL BRUNE, Laboratoire Kastler Brossel, College de France, CNRS, ENS-PSL Research University, UPMC-Sorbonne Universites, 11, place Marcelin Berthelot, Paris, FR — Metrology experiments based on the measurement of small rotation of a large angular momentum are limited by the projection noise. When the measurement is performed using classical states, the precision cannot exceed the standard quantum limit (SQL), that scales like $1/\sqrt{J}$. To beat the SQL, one needs to make use of non-classical states. Our system is a Rydberg atom with a large quantum principal number $n \sim 50$. In the presence of a small electric field, the degeneracy between levels with the same n is lifted. Then, using a radio frequency field with a well-defined polarization, it is possible to restrict the evolution of the atom to a subspace of the Rydberg manifold where the system behaves like a large spin $J = (n-1)/2$, whose frequency is proportional to the local amplitude of the electric field. We have used this effective spin to perform a quantum-enabled measurement of the static electric field [1]. We prepare a Schrdinger cat state of the Rydberg atom, and observe how the quantum phase of the cat provides a very sensitive signal to measure the variation of the static electric field allowing us to go beyond the SQL.

[1] A. Facon, *et al*, Nature **535**, 262-265 (2016)

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Sebastien Gleyzes
College de France, CNRS, ENS-PSL Res., Univ., UPMC-Sorbonne

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