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Coherent dynamics in a Zeno subspace

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The coherent dynamics of a system, such as an atom evolving in a superposition of two levels, can be protected from leakage and decoherence by decoupling the system from its environment. An opposite strategy is also possible in Quantum Mechanics: the coherent evolution can be protected by strongly coupling the system with neighboring states or measuring devices. This profound and counterintuitive phenomenon, known as Quantum Zeno Dynamics (QZD), has never been observed experimentally. I will show how it is possible to demonstrate QZD with a 87Rb Bose-Einstein condensate (BEC) in a five-level Hilbert space exploiting the back-action of frequent measurements and strong coupling to dynamically disconnect different groups of quantum states and constrain the dynamics of the atoms to a two-level subregion. The demonstration of QZD can be a critical step forward to protect and control the dynamics of quantum bits (qubits) and, broadly speaking, quantum information processing.

[1] P. Facchi and S. Pascazio, Phys. Rev. Lett 89, 080401 (2002).
[2] J. Petrovic, I. Herrera, P. Lombardi, F. Schaefer, F. S. Cataliotti New Journal of Physics 15(4), 043002 (2013)