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Quantum Dynamics of a d-wave Josephson Junction

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Ingegneria Meccanica, Energetica e Gestionale, Università di L'Aquila, Località Monteluco, L'Aquila, Italy. We present direct observation
of macroscopic quantum properties in an all high critical temperature superconductor d-wave Josephson junction. Although dissipation
caused by low energy excitations is expected to strongly suppress quantum effects we demonstrate macroscopic quantum tunneling [1]
and energy level quantization [2] in our d-wave Josephson junction. The results clearly indicate that the role of dissipation mechanisms
in high temperature superconductors has to be revised, and may also have consequences for a new class of solid state “quiet” quantum
bit with superior coherence time. We show that the dynamics of the YBCO grain boundary Josephson junctions fabricated on a STO
substrate are strongly affected by their environment. As a first approximation we model the environment by the stray capacitance and
stray inductance of the junction electrodes. The total system consisting of the junction and stray elements has two degrees of freedom
resulting in two characteristic resonance frequencies. Both frequencies have to be considered to describe the quantum mechanical behavior
of the Josephson circuit. [1] T. Bauch et al, Phys. Rev. Lett. 94, 087003 (2005). [2] T. Bauch et al, Science 311, 57 (2006).