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### **Quantum Dynamics of a d-wave Josephson Junction**

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<sup>1</sup> Quantum Device Physics Laboratory, Department of Microtechnology and Nanoscience, MC2, Chalmers University of Technology, S-412 96 Göteborg, Sweden. <sup>2</sup> National Physical Laboratory, Queens Road, Teddington, Middlesex TW11 0LW, UK. <sup>3</sup> Istituto Nazionale per la Fisica della Materia-Dipartimento Ingegneria dell'Informazione, Seconda Università di Napoli, Aversa (CE), Italy. <sup>4</sup> Dipartimento di Ingegneria Meccanica, Energetica e Gestionale, Università of 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).