Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Delocalised oxygen as the origin of two-level defects in Josephson junctions JARED COLE, TIMOTHY DUBOIS, Chemical and Quantum Physics, School of Applied Sciences, RMIT University, Melbourne 3001, Australia, MANOLO PER, Virtual Nanoscience Laboratory, CSIRO Materials Science and Engineering, Parkville 3052, Australia, SALVY RUSSO, Chemical and Quantum Physics, School of Applied Sciences, RMIT University, Melbourne 3001, Australia — One of the key problems facing superconducting qubits and other Josephson junction devices is the decohering effects of bi-stable material defects. Although a variety of phenomenological models exist, the true microscopic origin of these defects remains elusive. We show that these defects can arise from delocalisation of the atomic position of the oxygen in the oxide forming the Josephson junction barrier. Using a microscopic model, we compute experimentally observable parameters for phase qubits. Such defects are charge neutral but have non-zero response to both applied electric field and strain. This explains the observed long coherence time of two-level defects in the presence of charge noise, while still coupling to the junction electric field and substrate phonons.

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Date submitted: 17 Oct 2012 Electronic form version 1.4