Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

The size of superposition states in flux qubits BIRGITTA WHALEY, JAN KORSBAKKEN, University of California, Berkeley, USA, FRANK WILHELM, University of Waterloo, Canada — Flux qubits, small superconducting loops interrupted by Josephson junctions, are successful realizations of quantum coherence for macroscopic variables. Superconductivity in these loops is carried by $\sim 10^6$ – 10^{10} electrons, which has been interpreted as suggesting that coherent superpositions of such current states are macroscopic superpositions as exemplified in the extreme case by Schrödinger's 1935 gedanken experiment. We provide a full microscopic analysis of such qubits, from which the macroscopic quantum description can be derived. This reveals that the number of microscopic constituents participating in superposition states for experimentally accessible flux qubits is surprisingly but not trivially small. The combination of this relatively small size with large differences between macroscopic observables in the two branches is seen to result from the Fermi statistics of the electrons and from the large disparity between the values of superfluid and Fermi velocity in these systems.

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Date submitted: 19 Nov 2009 Electronic form version 1.4