Abstract Submitted
for the OSF05 Meeting of
The American Physical Society

Nano-mechanical-resonator induced synchronization in Josephson junction arrays STEFAN NATU, BRAD TREES, Ohio Wesleyan University — We show that a serial array of N disordered, underdamped, Josephson junctions coupled piezoelectrically to a nanomechanical (NEM) oscillator results in phase locking (synchronization) of the junctions. Our approach is based on a semiclassical solution to a set of coupled differential equations generated by the Heisenberg operator equations, which in turn are based on a model Hamiltonian that includes the following effects: the charging and Josephson energies of the junctions, dissipation in the junctions, the effect of a dc bias current, and an underdamped simple harmonic oscillator representing the NEM. Resonance between the array and NEM is signaled by a step in the voltage-current curve. Synchronization is also measured by the value of the phase and frequency order parameters on the step. The stability analysis of the synchronized junctions reveals that the phase-locked junctions are neutrally stable at the bottom and top of the step but not for bias currents in the middle of the step. Using harmonic balance, we are able to calculate an analytic expression for the voltage locating the resonance step in the I-V curve.

Brad Trees
Ohio Wesleyan University

Date submitted: 23 Sep 2005 Electronic form version 1.4