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Nano-mechanical-resonator induced synchronization in Josephson junction arrays[1] BRAD TREES, Ohio Wesleyan University, STEFAN NATU, Ohio Wesleyan University, DAVID STROUD, The Ohio State University — We show that a serial array of N critical-current disordered, underdamped, Josephson junctions coupled piezoelectrically to a nanomechanical (NEM) oscillator results in phase locking (synchronization) of the junctions. We find a semi-classical solution to the coupled differential equations generated by Heisenberg operator equations, based on a Hamiltonian including the following effects: charging and Josephson energies of the junctions, junction dissipation, effect of a dc bias current, and an undamped simple harmonic oscillator representing the NEM. Synchronization of the array is signaled by a step in the current- voltage (I-V) curve. Stability analysis reveals that the phase-locked junctions are neutrally stable at the bottom and top of the step. We calculate an analytic expression for the location of the resonance step in the I-V curve. We also find it is possible to set a desired number $N_a \leq N$ of junctions on the resonance step, with N_a –Njunctions in zero-voltage state.

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