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Microwave characterization of Josephson junction arrays in superconducting regime for Coulomb blockade and quantum metrology VLADIMIR MANUCHARYAN, Yale Applied Physics, MICHAEL METCALFE, JENS KOCH, Yale Applied Physics, LUIGI FRUNZIO, MARKUS BRINK, NICOLAS BERGEAL, LEONID GLAZMAN, MICHEL DEVORET, Yale Applied Physics
— Although the phenomenon of Bloch Oscillations could in principle lead to a primary standard of electrical current, it requires in practice the embedding of a Josephson junction in an electrodynamic environment with microwave impedance much greater than resistance quantum for Cooper pairs. A promising candidate for such environment is an array of Josephson tunnel junctions in the superconducting (non-insulating) regime. We have developed a new technique to dispersively probe the electromagnetic properties of such arrays. We access the RF impedance of the array by placing it as a "mirror" in a high-Q planar superconducting microwave resonator, whose phase and magnitude response are measured. The advantage of this configuration is that, while measuring the RF property of the array, we can pass DC current through it. This serves three purposes: i) emulating the situation of a current standard experiment with arrays, ii) providing a knob for control experiments on the RF dissipation in arrays, iii) exploring a novel out-of-equilibrium non-linear collective system. Our experiment also contributes to the physics of superconducting qubits and nano-wires.

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