Microwave cooling of Josephson plasma oscillations

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Macroscopic Josephson junctions allow strong coupling between the superconducting phase difference across the junction (the Josephson phase) and transverse microwave cavity modes in the junction itself. When the cavity bandwidth is much smaller than the Josephson plasma frequency the coupled phase and photon dynamics generate sideband resonances for each of the cavity modes. This makes it possible to use inelastic photon scattering to dampen or to enhance the Brownian motion of the Josephson phase. In particular, by measuring the histograms of the junction's switching current, we have observed that Stokes (anti-Stokes) scattering effectively heats (cools) the Josephson phase [1] . Both these effects increase with microwave power. These out-of-equilibrium phase dynamics results from a large phase relaxation time. We have measured this time directely using a pump-probe like technique [2] . Finally I shall discuss analogies and differences with similar experiments on the cooling of optomechanical devices.

[1]J. Hammer, M. Aprili and I. Petković to appear in Phys. Rev. Lett.
[2]I. Petković and M. Aprili, Phys. Rev. Lett. **102**, 157003 (2009).

INVITED PAPER