All YBCO Transmon for Low Energy Quasiparticle Spectroscopy

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Recent findings of macroscopic quantum properties in high critical temperature superconductor (HTS) Josephson junctions (JJs) point toward the need to revise the role of zero energy quasi-particles in this novel superconductor.[1] A deeper insight into the low energy spectrum of quasi particles is thought to be fundamental for understanding the mechanism leading to high critical temperature superconductivity.
We have engineered high quality $YBa_2Cu_3O_{7-x}$ (YBCO) grain boundary JJs on low dielectric constant substrates. By fabricating submicron junctions, we extract values of capacitance and Josephson critical current densities that satisfy the main transmon design requirements, i.e. an artificial two level system strongly coupled to the quantized electromagnetic field in a resonator. Measurements of the microwave reflection coefficient at 20 mK of a YBCO transmon embedded in a YBCO resonator clearly demonstrate that we reach the strong coupling limit. Moreover we present first relaxation time measurements of our YBCO artificial two level system enabling us to extract information about the low energy quasiparticle spectrum.

[1]T. Bauch, et al., Phys. Rev. Lett. **94**, 087003 (2005).
T. Bauch, et al., Science **311**, 57 (2006).