Vibrating Suspended Carbon Nanotube Josephson Junctions

C.J.H. Keijzers, V. Mourik, C. Padurariu, G.A. Steele, S.M. Frolov, Y.V. Nazarov, and L.P. Kouwenhoven

Kavli Institute of NanoScience, Delft University of Technology, PO Box 5046, 2600 GA, Delft, Netherlands

We study a Josephson junction with an embedded high-frequency and high-quality mechanical resonator, made from a suspended carbon nanotube. Good transparency of the superconductor-nanotube interface allows for the observation of supercurrent through the suspended nanotube, owing to the Josephson effect. The magnitude of the supercurrent is dependent on the charge on the nanotube and can be periodically modulated by a gate electrode, similar to previously reported experiments in unsuspended carbon nanotube Josephson junctions[1][2].
In a such a device we have observed a mechanical resonance frequency which is considerably larger than previously reported[3], and still has a high quality factor. Frequencies of 2.8GHz where achieved. Such type of resonator can in principle be cooled to its ground state at dilution fridge temperatures.
The Josephson junction with embedded a mechanical resonator, allows for the study of the Josephson effect in previously unexplored regimes. Currently we are experimentally and theoretically investigating the interaction of mechanical vibrations with the Josephson effect.

[1]P. Jarillo-Herrero et al., Nature, Vol. 439 (2006)
[2]J.-P. Cleuziou et al., Nature Nanotechnology, Vol. 1 (2006)
[3]G.A.Steele et al., Science, Vol. 325 (2009)