Transport studies of self-assembled InAs quantum dots contacted with superconducting leads

Tuesday, 3 February 2009, 12:00-13.00

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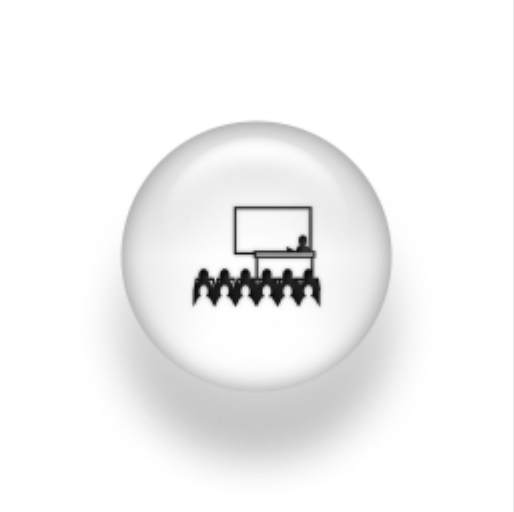

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ABSTRACT:
Self-assembled InAs quantum dots are a promising system for Quantum information processing, possessing excellent and well studied optical properties and strong spin-orbit coupling. Recently the transport properties of single uncapped InAs quantum dots have been accessed using nanogap electrodes[1,2,3] with a back gate used to control the chemical potential of the dot. I will discuss recent transport measurements on single self assembled InAs quantum dots in our lab with a focus on devices with superconducting leads.
I will discuss recent measurements on devices with normal and superconducting leads in which the spectral properties of the QD are probed through electron tunnelling. At temperatures below the transition temperature of the superconducting lead the low bias current is transmitted through Andreev reflections which require pairing of electrons upon the quantum dot and are therefore extremely sensitive to correlation effects such as Coulomb interaction and the many-body Kondo effect. We identify signature of strong Proximity effect in resonant Andreev conductance and observe that the for appropriate device parameters the Kondo singlet state enhances zero bias Andreev conductance. We also study single InAs self-assembled quantum dots contacted with superconducting Aluminium nanogaps. We select devices with high coupling of leads and dot to observe Josephson supercurrent which reveals interplay between proximity effect and electron-electron interaction.
[1] M. Jung et al., App. Phys. Lett., 86, 33106 (2005).
[2] K. Shibata et al., Appl. Phys. Lett., 91, 112102 (2007).
[3] C. Buizert et al., Phys. Rev. Lett., 99, 136806 (2007).