Experimental Investigations on disordered and low dimensional superconductors

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In my presentation, I shall be talking about two different systems in which phase fluctuations play a dominant role on the superconducting transition. The first part involves investigation on a 2-dimensional (2d) NbN film across the famous Berezinskii-Kosterlitz-Thouless (BKT) transition [1]. Study of the elctrodynamic response of our film in two widely separated frequency regime, namely kHz and GHz, are carried out using two coil mutual inductance technique and broadband microwave spectroscopy respectively. Our results indicate that the inhomogeneity induced by the intrinsic disorder of our system modifies the vortex motion to a large extent compared to the standard prediction of Bardeen-Stephen theory. The effect becomes severe as we move to lower frequency giving rise to substantially enhanced dissipation. The second part of our work consists of the study of a weakly disordered superconducting state in increasing magnetic field [2]. Scanning tunneling spectroscopy on NbN film reveals that the superconducting state becomes progressively inhomogeneous when the field is increased even though we start with a fairly conventional homogeneous film. Instead of Abrikosov vortex lattice, chains of vortices thread the area. Appearance of pseudogap state with application of magnetic field and the vortex cores with suppressed superconducting order but finite gap suggest the increased importance of phase fluctuation in presence of magnetic field in our system.

[1] R.Ganguly, D.Chaudhuri, P.Raychaudhuri, L.Benfatto, Slowing down of vortex motion at the Berezinskii-Kosterlitz-Thouless transition in ultrathin NbN films,Phys. Rev. B 91, 054514 (2015).
[2] Rini Ganguly, Indranil Roy, Anurag Banerjee, Harkirat Singh, Amit Ghosal, and Pratap Raychaudhuri, Magnetic field induced emergent inhomogeneity in a superconducting film with weak and homogeneous disorder,,Phys. Rev. B 96, 054509 (2017).

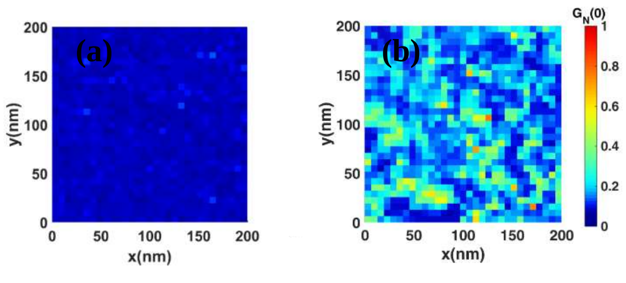

Figure 1 : Zero bias conducance map $G_N(0)$ over 200 nm X 200 nm area of NbN at 350mK for 0 (panel a) and 40 kG (panel b) of magnetic field. Field introduces granularity in the superconducting property.