Superfluid Density Study of Two-dimensional NbN Films near Superconductor Insulator Transition

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The superfluid densities of two-dimensional (2D) amorphous NbN films with sheet resistances up to 2 $k\Omega$ have been measured, with the goal of obtaining new insights into quantum and thermal fluctuations near the quantum critical point. Evidence for strong thermal phase fluctuations is found in a Kosterlitz-Thouless-Berezinski-like downturn in superfluid density near T_c, although the downturn occurs at a lower temperature than anticipated by KTB theory for the highest sheet resistance films. Evidence for strong quantum fluctuations is found in a suppression of zero-temperature superfluid density below the BCS value, and a large difference between the T_c determined resistively and the T_c where superfluid appears.