

Novel Facets of Crossover from Surface Superconductivity to Vortex State

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The observation of positive magnetization between $H_{c3}(T)$ and $H_{c2}(T)$ was reported in a spherical crystal of Nb by P Das *et al.* (Phys. Rev. B **78**, 214504 (2008)). Our motivated search for ‘paramagnetic magnetization’ on field cooling in a large variety of weakly pinned single crystals have now not only confirmed its presence in almost all systems, but also revealed many new facets, like, the sign of this ‘positive magnetization’ is independent of the sign of the applied field. The diamagnetic contribution that emerges on reducing the applied field below H_{c2} however respects the sign of the field in the sense that the sign of this contribution is phase reversed to that of the field. Thus, the crossover from compressed flux regime, existing between H_{c3} and H_{c2} to fields below H_{c2} in positive fields leads to a feature usually discussed as an anomalous Paramagnetic Meissner Effect, whereas on cooling in negative fields, the said crossover would pass off as precursor response to superconductivity in an inhomogeneous sample. Highlights of new findings in crystals of $(Ca/Yb)_3Rh_4Sn_{13}$ and Nb shall be presented.