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Nernst effect, fluctuation diamagnetism and vortices above Tc in cuprates[1]

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Nernst-effect and torque magnetometry experiments have provided evidence that, in the hole-doped cuprates, long-range phase coherence vanishes at the critical temperature T_c, while the pair condensate survives to a much higher "onset" temperature T_{onset}. In the Nernst experiment, the vortex current produced by a gradient generates a Josephson E-field perpendicular to the applied field $\mathbf{H}$. In cuprates, this large Nernst signal e_N persists to $T_{onset} \sim 130$ K. Extensive Nernst experiments in the cuprates LSCO, Bi 2201, and 2212 yield a 3D phase diagram (x, T, H) in fields up to 45 T. This picture has been confirmed by high-resolution torque magnetometry. In a tilted $\mathbf{H}$, local planar supercurrents associated with vortices above T_c produce a torque that deflects a cantilever. At each T, the diamagnetic magnetization inferred matches the field profile of the Nernst e_N. The high-resolution measurement of the diamagnetic susceptibility χ over 5 field decades uncovers an unusual, fragile "London rigidity" that exists in the pseudogap state of Bi 2212 and 2201. The magnetization curves below T_c also provide a reliable determination of the upper critical field H_{c2} which is found to scale linearly with T_{onset}. I will also preview evidence for pairing without phase coherence at 0.35 K in LSCO for $x < x_c$ in fields to 30-45 T.

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