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Observation of Fractional Fluxoid States in Mesoscopic Rings of Sr_2RuO_4 by Ultrasensitive Cantilever Magnetometry[1]

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In the past decade, there has emerged strong evidence to support spin-triplet superconductivity in the layered-perovskite Sr_2RuO_4, whose ground state is thought to be analogous to the A-phase of ^{3}He. It is believed that the spin and orbital degrees of freedom of the superconducting order parameter can give rise to states with remarkable properties, such as chiral domains and half-quantum vortices (HQV) that may obey non-Abelian statistics. With regards to the latter, recent theoretical work suggests that the HQV state could be made energetically favorable in mesoscopic samples [1]. In this talk, I will present a new method for ultrasensitive cantilever magnetometry that allows us to probe the magnetic response of mesoscopic samples of Sr_2RuO_4. Using this technique, we have detected the entry of individual vortices into micron-size rings of Sr_2RuO_4. Our most intriguing observation is the appearance of fractional fluxoid states that have half the magnetic moment of the full (integer) fluxoid. We find that the stability region of the fractional fluxoid state grows linearly with the magnitude of the in-plane magnetic field applied to the crystal. While the physical origin of the fractional state is yet unknown, I will present a recent theoretical proposal that predicts spontaneous spin polarization in the HQV state [2] which could explain the observed field dependence.

[1] S. B. Chung, H. Bluhm, and E. A. Kim, Phys. Rev. Lett. **99**, 197002 (2007).
[2] V. Vakaryuk, and A. J. Leggett, Phys. Rev. Lett. **103**, 057003 (2009).

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