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Quantum Indian Rope Tricks: Fluctuation driven magnetic hard-axis ordering in metallic ferromagnets FRANK KRUGER, CHRIS PEDDER, ANDREW GREEN, London Centre for Nanotechnology, UCL — We demonstrate that the interplay between soft electronic particle-hole fluctuations and magnetic anisotropies can drive ferromagnetic moments to point along a magnetic hard axis. As a proof of concept, we show this behavior explicitly for a generic two-band model with local Coulomb and Hund's interactions, and a spin-orbit-induced easy plane anisotropy. The phase diagram is calculated within the fermionic quantum order-by-disorder approach, which is based on a self consistent free-energy expansion around a magnetically ordered state with unspecified orientation. Quantum fluctuations render the transition of the easy-plane ferromagnet first-order below a tricritical point. At even lower temperatures, directionally dependent transverse fluctuations dominate the magnetic anisotropy and the moments flip to lie along the magnetic hard axis. We discuss our findings in the context of recent experiments that show this unusual ordering along the magnetic hard direction.
F. Krüger, C. J. Pedder, and A. G. Green, Phys. Rev. Lett. **113**, 147001 (2014)

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