

Intra-unit-cell resolved intertwining of multi- Q charge and spin textures in an itinerant skyrmion magnet

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Magnetic skyrmions are topologically stable winding configurations in the lattice of spins in some magnets. Due to their stability, nanometer scale, and movement under low current densities, they have potential applications in spintronic logic and memory technologies. A widely known form of spin-spin interaction that can stabilize magnetic skyrmions is the Dzyaloshinskii-Moriya (DM) interaction, which acts in chiral magnets and other systems in which inversion symmetry is broken. But the smallest known skyrmions have been found in inversion-symmetric crystals where the DM interaction is forbidden, such as the centrosymmetric magnets Gd_2PdSi_3 , GdRu_2Si_2 and GdRu_2Ge_2 . Here the stabilizing mechanisms are not yet understood but probably involve interactions mediated by itinerant electrons, as in the Ruderman-Kittel-Kasuya-Yosida (RKKY) interaction. The behavior of these electrons can be imaged using a scanning tunneling microscope (STM). Here we describe recent spectroscopic-imaging STM experiments on GdRu_2Ge_2 ^[1], which hosts a rich variety of non-coplanar magnetic phases including two distinct skyrmion crystal phases. We see that the electronic local density-of-states exhibits intricate textures that change with external field in concert with the spin textures, helping to elucidate the role that electrons play in the emergence of topological magnetism in centrosymmetric magnets.

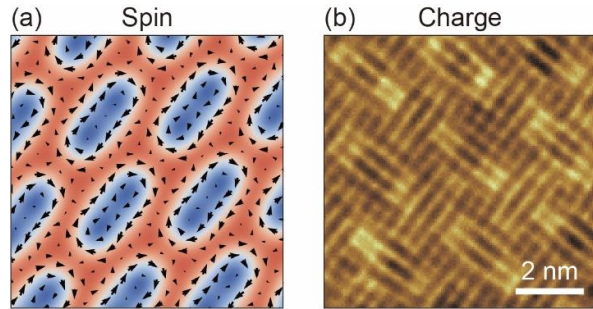


Fig. 1: (a) Spin texture for one of the two distinct skyrmion crystal phases in GdRu_2Ge_2 , and (b) STM conductance image ($E = -100$ meV) of the corresponding local density-of-states texture.

[1] C. J. Butler, K. Nihongi, H. Yoshimochi, N. D. Khanh, R. Takagi, T. Hanaguri, and S. Seki, arXiv: 2608.05528v1 [cond-mat.mtrl-sci] (2026).