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Evidence for electron fractionalization in a kagome metal

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There are long-standing ideas and experiments concerning the emergence of unconventional quasiparticles in strongly interacting Fermi systems. The most dramatic are the fractional states originally observed for the two-dimensional electron gases in semiconductor heterostructures subjected to perpendicular magnetic fields, and explained shortly thereafter by Laughlin. Others found in zero field are more subtle in the sense that their peculiarity is reflected in their scattering rates which rise linearly together with their energies; these are the "marginal" fermions first conjectured for the layered cuprates also displaying high temperature superconductivity. Here we describe experiments revealing signatures of both types of anomalous quasiparticles in zero applied field. The material is Fe3Sn2, a ferromagnetic "kagome"metal, with numerous Weyl nodes near the Fermi level, and a high Curie temperature of ca. 640K. We investigated the compound using microfocused, laser-based angle-resolved photoemission, together with density functional theory (DFT) and machine learning-based analysis of images. Inelastic X-ray scattering measurements reveal that the correct starting point for understanding this material is not a single kagome layer, but rather a triangular lattice of Fe octahedra.

Refs.

1. S. A. Ekahana et al., Nature 627, 67-72 (2024)
2. S. A. Ekahana et al., Mach. Learn.: Sci. Technol. 4 035021 https://doi.org/10.1088/2632- 2153/aced7d (2023)
3. M. Yao et al. arXiv:1810.01514
4. W. Zhang et al., Nature Comm. 15, Article number: 8905 (2024)

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