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Symmetry Breaking in the Hidden-Order Phase of URu_2Si_2[1]

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In the heavy fermion compound URu_2Si_2, the hidden-order transition occurs at 17.5 K, whose nature has posed a long-standing mystery. A second-order phase transition is characterized by spontaneous symmetry breaking, and thus the nature of the hidden order cannot be determined without understanding which symmetry is being broken. Our magnetic torque measurements in small pure crystals reveal the emergence of an in-plane anisotropy of the magnetic susceptibility below the transition temperature [1], indicating the spontaneous breaking of four-fold rotational symmetry of the tetragonal URu_2Si_2. In addition, our recent observation of cyclotron resonance allows the full determination of the electron-mass structure of the main Fermi-surface sheets, which implies an anomalous in-plane mass anisotropy [2] consistent with the rotational symmetry breaking. These results impose strong constraints on the symmetry of the hidden order parameter.

[1] R. Okazaki *et al.,* Science **331**, 439 (2011).
[2] S. Tonegawa *et al.,* Phys. Rev. Lett. **109**, 036401 (2012).

[1]This work has been done in collaboration with R. Okazaki, S. Tonegawa, K. Hashimoto, K. Ikada, Y. H. Lin, H. Shishido, H. J. Shi, Y. Haga, T. D. Matsuda, E. Yamamoto, Y. Onuki, H. Ikeda, and Y. Matsuda.