凝縮系物理学ゼミナール

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場所：理学部5号館　413号室

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「Rotational Symmetry Breaking in the Hidden Order Phase of URu_2Si_2 」

A second-order phase transition is characterized by spontaneous symmetry breaking. Below the transition temperature a new state of reduced symmetry thus develops continuously from the disordered high-temperature phase. The nature of the distinct second-order transition at T_h=17.5 K in the heavy fermion compound URu_2Si_2 has posed a long-standing mystery in physics today, because despite 25 years of study no indication of symmetry breaking has been observed in the so-called 'hidden order' phase below T_h. Identifying its broken symmetry is important because it can lead to the discovery of new order parameters in strongly correlated electron systems.

We report the emergence of an in-plane two-fold symmetry of the magnetic susceptibility below the hidden order transition temperature in URu_2Si_2 with tetragonal crystal structure. The difference in the magnetic response under 90-degree rotation is sensitively detected in small pure crystals by the magnetic torque, which is measured in magnetic fields rotating within the ab plane with high alignment precision. The amplitude of the observed in-plane two-fold anisotropy is closely linked to an order parameter that develops just below T_h. This observation uncovers an essential feature of the hidden order, i.e. the low-temperature ordered phase is an electronic nematic state that breaks four-fold rotational symmetry.