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Chirality density wave of the "hidden order" phase in URu2Si2[1]

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Many novel electronic ground states have been found to emerge from the hybridization between localized $d-$ or $f-$electron states and conduction electron states in correlated electron materials. The heavy fermion compound URu_2Si_2 exhibits the coexistence of two such ground states: so-called "hidden order" (HO) below T_{HO} =17.5 K and superconductivity below T_c =1.5 K. Despite 30 years of research the symmetry of the order parameter associated with HO phase below 17.5 K has remained ambiguous.

Here we report results of polarization resolved Raman spectroscopy study aimed to specify the symmetry of the low energy excitations above and below the HO transition. These excitations involve transitions between interacting heavy uranium *5f* orbitals, responsible for the broken symmetry in the HO phase. From the symmetry analysis of the collective mode, we determine that the HO parameter breaks local vertical and diagonal reflection symmetries at the uranium sites, resulting in crystal field states with distinct chiral properties, which order to a commensurate *chirality density wave* ground state [1]. We further explore the competition between the HO phase and large moment antiferromagnetic (LMAFM) phase [2], and the connection between the HO chirality density wave and the unconventional superconductivity which has recently been proposed to be of a chiral *d*-wave type [3].

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2. K. Haule and G. Kotliar. Complex Landau-Ginzburg theory of the hidden order in URu_2Si_2. Eur. Phys. Lett. **89**, 57006 (2010).
3. T. Yamashita et al. Colossal thermomagnetic response in the exotic superconductor URu_2Si_2. Nature Phys. **11**, 17 (2014).

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