Novel electronic phases and competing order parameters in the heavy fermion compound URu_2Si_2

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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 HF compound URu_2Si_2 hosts two competing staggered phases: a non-magnetic *Hidden Order* (HO) phase and a *Large Moment Antiferromagnetic* (LMAF) phase. Both phases are principally due to special ordering of the uranium *5f* orbitals. We used polarization resolved Raman spectroscopy to identify the symmetry of low energy excitations above and below the HO transition, to uncover the hidden order parameter, and to study the interrelation between the HO phase and the LMAF phase. From the symmetry analysis of the discovered collective mode we determined that the HO parameter breaks local vertical and diagonal reflection symmetries at the uranium sites, resulting in states with distinct chiral properties:

(1) The HO phase is the *Chirality Density Wave* which breaks local chiral symmetry [1]; and
(2) The LMAF phase is the *Orbital Moment Density Wave* which breaks local time reversal symmetry [2].

The nature of these almost degenerate HO and LMAF phases has been theorized before, but the experimental signature of the direct interrelation between them was lacking. Here we drive and detect dynamic oscillations between HO and LMAF states by using polarized light, and as such provide direct experimental evidence for a unified order parameter describing the competing phases [2].

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References

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[2] H.-H. Kung et al., 2016 *Phys. Rev. Lett.* **115**, 227601.