Presence of Chirality in the Kagome System CsV_3Sb_5

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Abstract. Kagome systems have recently attracted interest because of their unique electronic band structure, which exhibits delocalized electrons, Dirac points, flat bands, and multiple van Hove singularities (vHS) near the Fermi level.
Using x-ray photoelectron diffraction (XPD) and angle-resolved photoemission spectroscopy, we study photoemission intensity associated with the changes in the geometric and electronic structure of the kagome metal CsV_3Sb_5 upon transition to an unconventional charge density wave (CDW) state. CsV_3Sb_5 shows a CDW reconstruction below the transition temperature (T_{CDW} = 94 K).
The XPD patterns of CsV_3Sb_5 (measured at a photon energy of 6 keV for 115 K > T_{CDW} and 30 K < T_{CDW}) reveal the presence of a chiral atomic structure in the CDW phase. Experiments in the hard and soft x-ray ranges were performed at the time-of-flight momentum microscopy end stations of the beam lines P22 and P04 at PETRA III.
Using circularly polarized x-rays from beamline I09 at Diamond Light Source, UK, we have found a pronounced non-trivial circular dichroism in the angular distribution (CDAD) of the valence band photoemission in the CDW phase, indicating a chirality of the electronic structure. The angle of incidence for the circularly polarized x-rays was $\theta = 22.5°$ with respect to the sample surface, which was oriented to align the Γ-M-L plane with the incident beam. The total energy resolution was set to 50 meV.
The CDAD asymmetry at the Fermi surface is antisymmetric with respect to the plane of incidence, with the maximum asymmetry $A_{max} \approx 0.5$. The magnetic circular dichroism (MCD) asymmetry shows negative values up to −0.1 near the M point. The sections along M-Γ and M-K suggest that the negative MCD asymmetry is related to the electronlike band with a maximum binding energy of 0.1 eV at the M point, which belongs to the van Hove singularity vHS-2. Bands associated with vHS-1, i.e., the flat band near the Fermi level at the M point and vHS-3 (holelike band) have positive A_{MCD} values. This observation is consistent with the proposed orbital loop current order. The results suggest an antiferromagnetic coupling of the orbital magnetic moments along the *c*-axis. For details, see [1].

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