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Hidden Quantum Phase Transitions Hosted in the "Mixed-Type" Band Electrons in Kagome Metal AV_3Sb_5

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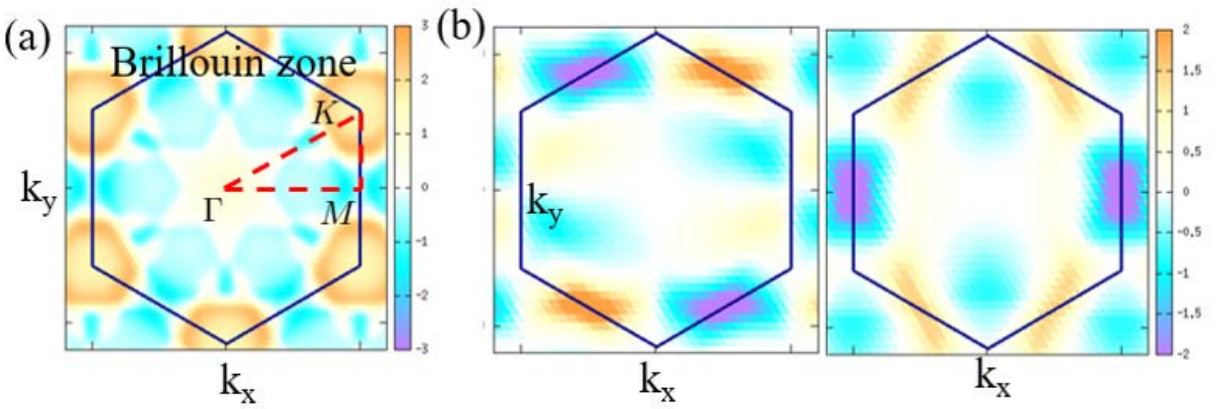
Exotic multiple quantum phase transitions in kagome metal AV_3Sb_5, including the star-of-David bond-order, charge-loop-current and nematicity, attract increasing attention. Previous theoretical studies focused on the "pure-type" band, in which each van-Hove singularity point is composed of single sublattice t_{3g}-orbital[1,2]. However, the impact of the "mixed-type" band, in which each van-Hove singularity point is composed of two of three sublattice t_{2g}-orbtals, has been overlooked.

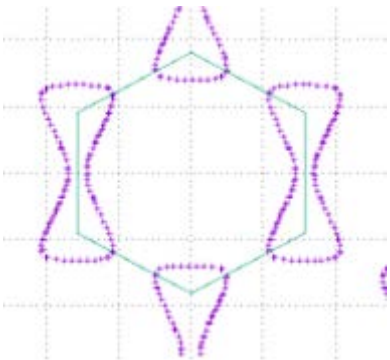
In the present study, we calculate the DW equation in the "mixed-type" band, which takes many-body correlations beyond the mean-field approximation into account. We obtain the A_{1g} (Fig. 1(a)) solution and the E_{2g} (Fig. 1(b)) solution. The former does not break the rotational symmetry, but the latter is a two-dimensional XY-type nematic state and makes the electronic system anistropic as shown in Fig. 2. We discuss that these two solutions may explain several experimental reports, such as the increment of the A_{1g} symmetry susceptibility below T_{CDW} and the nematic transition inside the CDW phase at T～35K[3]. This research may be helpful for unders the cascade phase transitions in Kagome metals.

[1] R.Tazai et al., Sci. Adv. 8, eabl 4108 (2022)

[2] R.Tazai et al., arXiv:2207.08068

[3]Nie, L. et al. Charge-density-wave-driven electronic nematicity in a kagome superconductor. Nature 10.1038





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