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Chiral Current Order and C_2 Nematicity in Kagome Metal AV_3Sb_5

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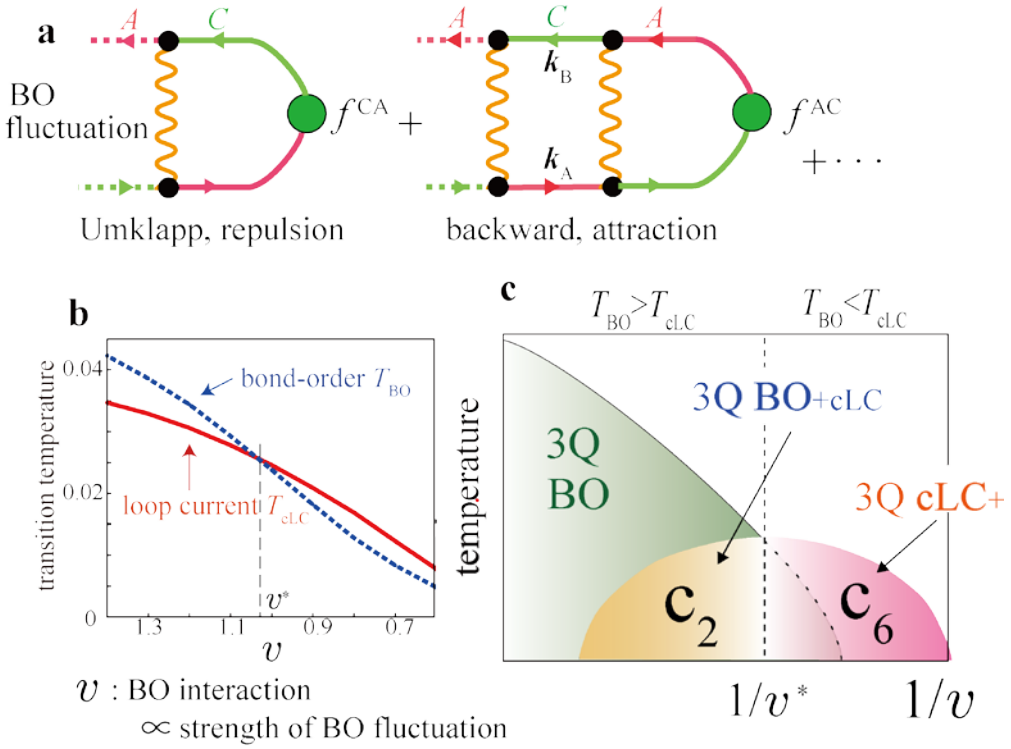
In kagome superconductor AV_3Sb_5, time-reversal-symmetry-breaking (TRSB) phase was reported by μSR study, Kerr rotation analysis, field-tuned chiral transport study and STM measurements. In addition, the emergent nematic (C_2) order, which was detected inside/outside the TRSB phase, attracts great attention. The nematic transition is clearly observed by the elastoresistance, the scanning birefringence, and the STM studies. More recently, magnetic torque measurement reveals the nematic order with TRSB at 130 [K].

However, the microscopic origin of TRSB and C_2-nematicity have been unsolved. In the present study [1], we focus on the important roles of bond-order (BO) fluctuations developed near the quantum-critical point of BO phase. By considering the higher-order many body effects among the d-orbital electrons, we reveal that the chiral loop current phase is mediated by the BO fluctuations in AV_3Sb_5.

In more detail, the sizable off-site Umklapp scattering (Figure a) by the BO fluctuations induces the odd-parity and TRSB current order, which corresponds to the imaginary hopping in Hermite Hamiltonian. This loop current mechanism is universal because it is irrelevant to the origin of the BO. Furthermore, we discover that the coexistence of the BO and the loop current order gives rise to the novel C_2-nematicity along the three lattice directions on kagome lattice. To show this fact, we performed the microscopic calculation of Ginzburg-Landau coefficients and find the stable C_2-nematic state due to the coexisting of BO+loop current state (Figures b,c). The present theory reveals the close relationship between the TRSB, BO[2], C_2-nematicity and superconducting states.

In the presentation, we also showed the recently revealed interesting result that the chiral current order is strongly magnified under the magnetic field along c-axis. This result is consistent with the field-induced enhancement of the loop current observed by μSR studies and field-tuned chiral transport study.

[1] R. Tazai, Y. Yamakawa, and H. Kontani, arXiv:2207.08068 (2022).
[2] R. Tazai, Y. Yamakawa, S. Onari, and H. Kontani, Sci. Adv. 8, eabl4108 (2022).



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