Hidden order in the kagome magnet Co3Sn2S2 probed by RIXS

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Kagome motifs can host flat bands as well as quantum spin liquids due to geometric frustration from the triangular lattice. $Co_3Sn_2S_2$ is a kagome lattice based on magnetic Co atoms. It is ferromagnetically ordered below Tc ∼177 K with a small moment of 0.3 μ_B per Co. It has a large anomalous Hall effect regarding both Hall resistivity and Hall angle [1], with surface Fermi Arcs and Weyl points reported by ARPES, suggesting it is a time-reversal symmetry breaking magnetic Weyl semimetal [2]. Despite the large interest in the material, its magnetic structure and magnetic Hamiltonian are still not unravelled due to the small magnetic moment limiting the effectiveness of traditional neutron scattering methods [3]. Using magnetic circular dichroism RIXS, we discover time reversal symmetry breaking excitations of 0.3 eV, whose temperature dependence follows the static magnetic order, showing that the system has a hidden dynamic order in addition to the static order. With further RIXS cross-section analysis based on the polarization factors, we find that not only the spin degree of freedom, but the orbital degree of freedom also contributes to such excitations, and discover a possible explanation of the small moment in the FM order.

[1] E. Liu, et al. Nat. Phys. 14 (2018), 1125—1131.
[2] D. F. Liu, et al. Science, 365 (2019), 1282—1285.
[3] Qiang Zhang, et al. Phys. Rev. Lett 127 (2021), 117201.