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Complex magnetic orders and the emergent topological Hall effect in the kagome metal ErMn6Sn6

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Following the discovery of a quantum-limit magnetic Chern phase in TbMn6Sn6, and the observation of a large topological Hall effect (THE) related to the field-induced magnetic phases in YMn6Sn6, the magnetic topological metal series RMn6Sn6 (R=Gd-Yb, and Y, Lu), that possess an ideal kagome lattice of Mn, have emerged as a new platform to explore exotic states and novel functionalities. We have recently carried out the growth of high-quality single crystals of the magnetic kagome metal ErMn6Sn6 via the flux method, and the physical properties characterizations via the magnetic susceptibility, heat capacity, and Hall conductivity measurements. We have also undertaken comprehensive neutron diffraction experiments on both single-crystal and powder samples at the WISH diffractometer at ISIS. Several distinct magnetic ordered phases, including the spiral, conical, and k = 0 magnetic orders, have been identified in cooling to low temperatures. Furthermore, we have also observed a range of complex field-induced magnetic phases, including the multi-k non-coplanar magnetic orders, via field-dependent single-crystal neutron diffraction at WISH. We have found that these complex field-induced magnetic phases are directly associated with our observed THE over a wide phase space of field and temperature in this compound. Our study has hinted at a fascinating interplay between topologically non-trivial electronic band structures, magnetism, and electronic correlations in ErMn6Sn6.

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