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From π -CSL to fan: a topological phase transition in one dimension

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: In the centre of our here presented work was the Heusler compound $\text{Mn}_{1.4}\text{PtSn}$ characterized by anisotropic DMI and known to host various chiral spin textures. In this study, we employed a combination of REXS and micromagnetic simulations to reveal distinct features consistent with a fan-like [1] spin structure and its field driven evolution under increasing in-plane magnetic fields. Starting from the chiral ground state (π -CSL [2]) of $\text{Mn}_{1.4}\text{PtSn}$, this field-induced transition is accompanied by a change in the quasi-one-dimensional magnetic topology via symmetry breaking. The resulting fan state exhibits oscillatory spin arrangements confined to a finite angular range about the field direction and lacks topological winding.

Fan structures are traditionally observed in non-chiral systems such as Yoshimori-type helimagnets, where competing nearest- and next-nearest-neighbor exchange interactions stabilize helices of both chiralities [2]. These can smoothly transform into fan phases under transverse magnetic fields without an energy penalty [1,4]. In contrast, the emergence of a fan-like spin texture in chiral magnets such as $\text{Mn}_{1.4}\text{PtSn}$ is unusual. Here, DMI enforces a fixed chirality, making the fan energetically unfavorable by the DMI [1]. Historically, this has excluded fan states from consideration in DMI-active systems.

Only recently, LTEM studies on the monoaxial helimagnet MnNb_3S_6 have reported domain-like patterns reminiscent of fan structures [6,7]. However, due to limited spatial resolution and similarities with stripe phases, these observations remain inconclusive [8]. Building on these findings, we present the first unambiguous experimental identification of fan-like magnetic textures in a chiral magnet, resolving ambiguities that have limited previous observations.

References:

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