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Single-crystal investigation of YBaCuFeO5 by spherical neutron polarimetry

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The low ordering temperatures of most non-collinear spiral magnets critically limits their implementation in devices. The layered perovskites $LnBaCuFeO_5$ are a rare case of frustrated oxide family that has raised great expectation as promising high-temperature spiral magnets and chiral spin-driven multiferroic candidates. Though a novel mechanism ("*Spiral order by disorder*") seems to account for the extraordinary thermal stability of their presumed spiral order, such order was alleged on the basis of neutron data on powder samples. Thus far, it has not the support yet from single-crystal studies able to lift ambiguity. A $YBaCuFeO_5$ single crystal has been grown with enough Cu/Fe disorder to stabilize the incommensurate magnetic phase up to T_S ca. 200 K. Here, we unveil the features of its magnetic structures by spherical neutron polarimetry and single-crystal neutron diffraction, demonstrating the non-collinear chiral nature of the magnetic domains in the singular incommensurate phase. It is thus finally proved that such phase is spiral in our crystal, and therefore also in those compositions of this perovskite family where T_S values well above room temperature have been reported. Yet, this study also illustrates critical features of relevance to the search for high-temperature magnetoelectric response induced by the spiral phase.

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