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Neutron diffraction in MnSb2O6: Coupled chiralities in a polar magnet

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Multiferroic materials have been intensively studied these last decades for their interesting physics and their promising magnetoelectric applications [1]. Materials having a crystallographic chirality are particularly interesting in the sense that their structure couples to magnetism and can display novel magnetoelectric coupling. This is the case of $MnSb_2O_6$ which crystallizes in P 321 space-group. The Mn atoms form a triangle in the unit cell, where the magnetic moments are dephased by 120° and follow a cycloidal modulation along the c-axis [2]. The sense of rotation of the spins are so-called magnetic chiralities and directly linked through Heisenberg interactions to the structural chirality, defined as the helical winding of super-super-exchange pathways along the c-axis. Due to the presence of 3-fold magnetic domains below T_N=12 K, this compound was predicted to have a unique switching mechanism, which was explained by an ambiguous magnetic ground state [3]. By a combination of unpolarized and polarized neutron diffraction techniques, we have extensively studied both the nuclear and magnetic structure of $MnSb_2O_6$ where we found a mixture of chiral structural and magnetic domains. We subsequently propose a mechanism leading to electric polarization based on coupled structural and magnetic chiralities.
[1] S. W. Cheong et al. Nature Mater 6, 13 (2007)
[2] R. D. Johnson et al. Phys. Rev. Lett. 111, 017202 (2013)
[3] M. Kinoshita et al. Phys. Rev. Lett. 117, 047201 (2016)

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