Staggered magnetic chirality along zig-zag ladders in β-$CaCr_2O_4$

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The crystal and magnetic structures of the S = 3/2 antiferromagnet β-$CaCr_2O_4$ [1] (Figure 1), an isotype of calcium ferrite $CaFe_2O_4$ [2] have been investigated by means of specific heat, magnetization, muon relaxation and neutron powder diffraction between 300K and 1.5K [3]. In this compound, in which the unusual topology of the Cr^{3+} magnetic lattice can be described as a network of triangular "zig-zag" ladders with legs parallel to c, a complex antiferromagnetic ordering with an incommensurate propagation vector $\mathbf{k}$ = (0, 0, q) (q ~ 0.477 at 1.5K) is evidenced below T_N = 21K. This complex magnetic ordering can be described as a honeycomb-like arrangement of cycloids, running along c, and presenting a unique pattern of staggered chirality (Figure 2). To account for the experimental observation of this staggered chirality, we propose to use antisymmetric Dzyaloshinskii-Moriya terms in the exchange Hamiltonian. Inelastic scattering experiments have also been performed in order to better understand the relevant magnetic couplings stabilising this complex magnetic structure.

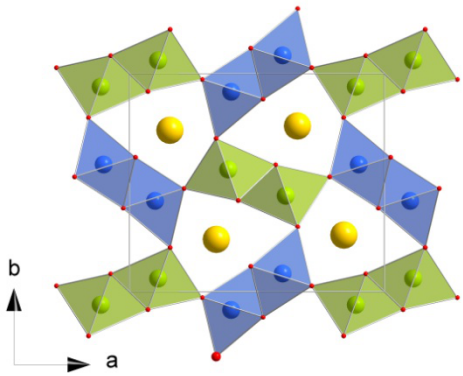

Figure 1 : Crystal structure of ° -$CaCr_2O_4$

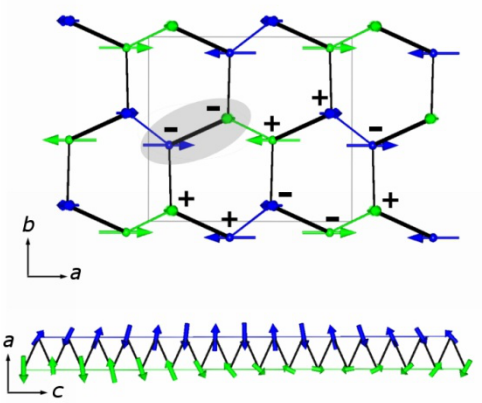

Figure 2 : Distribution of the chirality signs along c within Cr chains in the honeycomb lattice. Two adjacent chains with same chirality are outlined in grey, the corresponding ladder is drawn.

[1] W. Ford and W. J. Rees, *Transactions of the British Ceramic Society* **48**, 291 (1949).
[2] F. Bertaut, P. Blum, and G. Magnano, *Comptes Rendus Hebdomadaires Des Séances De L' Académie Des Sciences* **241**, 757 (1955).
[3] F. DAMAY *et al*, *Phys. Rev. B* 81, 214405 (2010).