Poster

Incommensurate magnetic modulations of the 2D-layered Ho_3Co described by superspace symmetry

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The rich rare-earth (*R*) intermetallic compounds R_3Co exhibit varied physical properties originating from the competition between exchange interactions and crystal field [1,2]. Their complex magnetic behavior, high spin ordering temperatures, magnetocaloric effect, giant magnetoresistance are naturally of fundamental interest, but also of great potential for technological applications such as cryocoolers and magnetoresistive devices [3]. They crystallize in the orthorhombic Fe_3C-type structure (space group *Pnma*). This structure is 2-dimensional, consisting of R_3Co sheets oriented along (001), with the *R* atoms located at two inequivalent positions. Surprisingly, most of the R_3Co magnetic structures are yet poorly described. The Ho_3Co compound remains probably the least studied compound of this isostructural series. It exhibits two antiferromagnetic transitions – one below the Néel temperature T_N (=21 K) and another at T_T (=9 K) previously identified as a spin re-orientation [4-6]. Single crystal magnetization and neutron diffraction performed on Ho_3Co (powder and single crystal) did not provide any clear magnetic model [4,7]. Here we present the description of the incommensurate modulated magnetic structures in terms of magnetic superpace formalism as refined from neutron powder data in Jana2020 [8]. In the temperature range 3 K$\leq T<T_N$, the magnetic structure is described by an incommensurate propagation vector $\mathbf{k}=(\alpha,0,0)$ with $0.1605<\alpha<0.1585$ and a commensurate component $\mathbf{k}_0 = (0,0,0)$. For $T_T<T\leq T_N$ the spin arrangement consists of fan-like (Ho) and cycloidal (Co) modulations. Below T_T, the presence of 3**k** and 5**k** harmonics results in an anharmonic ground state with the squaring of the modulation. The evolution of the magnetic modulations in Ho_3Co for 3 K$\leq T< T_N$, is explained by two active irreducible representations under the *Pnm'a*(α00)000 magnetic superspace group, which allows the change of the structure with no further symmetry breaking. A significant moment contribution was detected in Co. The realized magnetic model will be discussed within the superspace symmetry approach, showing how it describes the complex modulations in a simple and robust form that is fully consistent with the macroscopic properties.

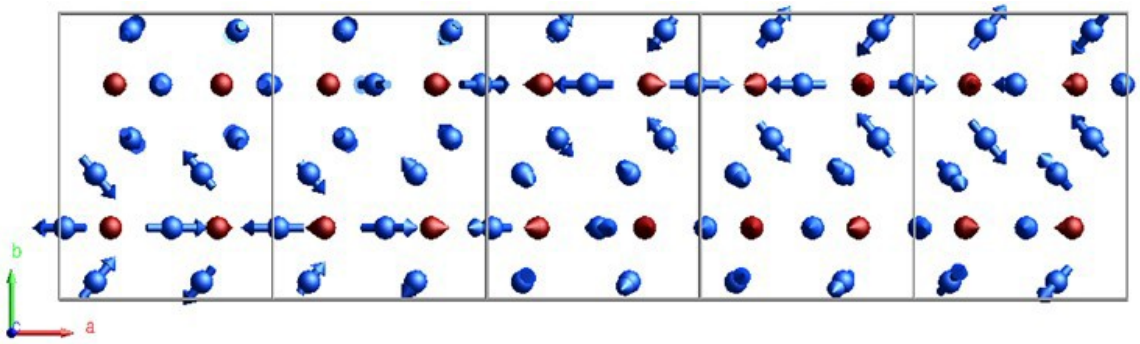

Figure 1. Spin modulation of Ho_3Co at 18 K for Ho (blue) and Co (red) represented in a 5×1×1 supercell of the parent orthorhombic unit cell. The modulation of Ho1 and Ho2 is described as fanlike, with a fan spanning of 100°. The fan plane of Ho1 is parallel to (101), whereas Ho2 spins are at an angle of 57° away from the *a*-axis. The modulation of the Co spins is a circular cycloidal restricted to be parallel to (101).

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