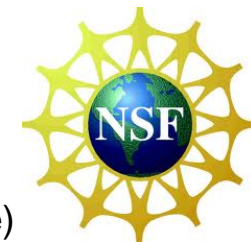




Selecting Magnetic Chirality in Acentric $\text{Ba}_3\text{NbFe}_3\text{Si}_2\text{O}_{14}$

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Generally, spin-orbit coupling has no relevant effect in ordinary magnets, however, on geometrically frustrated spin lattices it may be crucial for selecting the magnetic ground state (GS). $\text{Ba}_3\text{NbFe}_3\text{Si}_2\text{O}_{14}$ (BNFSO) is an intriguing example of the latter (Fig. 1), where a unique double chiral GS is realized. The origin of the mysterious selection of one of the two possible GSs has been unveiled by our electron spin resonance (ESR) study.

In our ESR experiments, we focused on antiferromagnetic resonance (AFMR) collective modes, occurring below the Néel transition at 27 K, because these are intimately related to magnetic anisotropy present in the system. Performing ESR experiments in a broad frequency/field range, which are possible at NHMFL, turned out essential for the success of our study. Theoretical modeling of these modes (Fig. 2) allowed us to distinguish between two possible dominant magnetic anisotropy contributions; Dzyaloshinsky-Moriya (DM) and single-ion (SI) anisotropy.

We discovered that DM is the leading anisotropy in BNFSO. Due to its special symmetry it is responsible for selecting the unique GS and for unique magnetic properties. Our discovery has significantly advanced the understanding of the role of minute terms on geometrically frustrated lattice, terms which are too often neglected in experimental and theoretical studies.

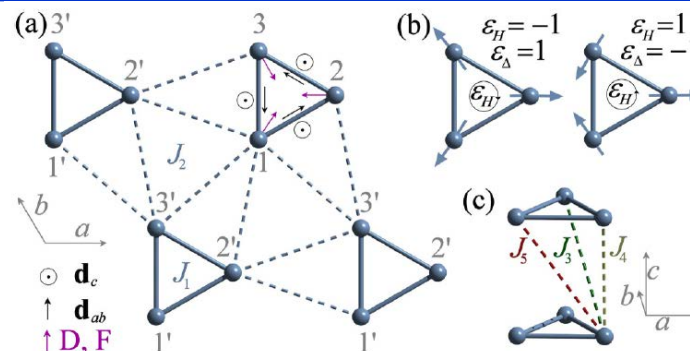


Fig. 1: “Triangular” arrangement of Fe^{3+} in BNFSO with (a) intra-layer and (c) interlayer exchange and DM (d), SI (D, F) magnetic anisotropy. (b) Two possible double chiral ground states.

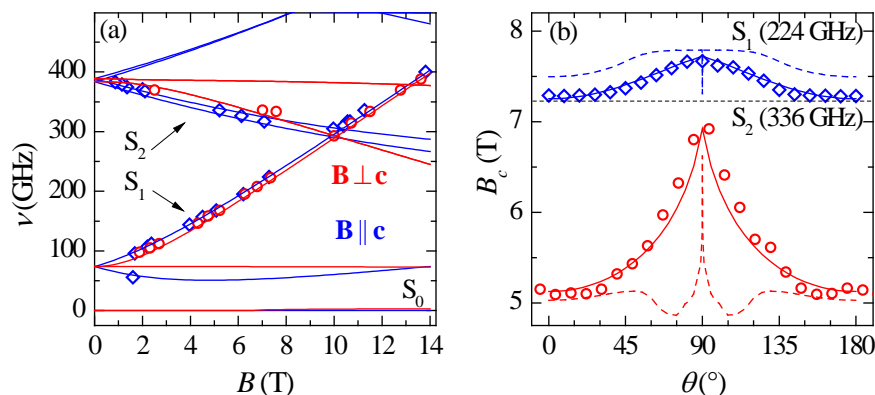


Fig. 2: (a) Frequency-field diagram and (b) angular dependence of AFMR modes measured in BNFSO at 4 K. Fits to DM and SI models are shown with solid and dashed lines, respectively.

Facilities: EMR facility, 12.5 T and 17 T magnets.

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