Magnetoelastic Coupling in the Multiferroic $BiFeO_3$

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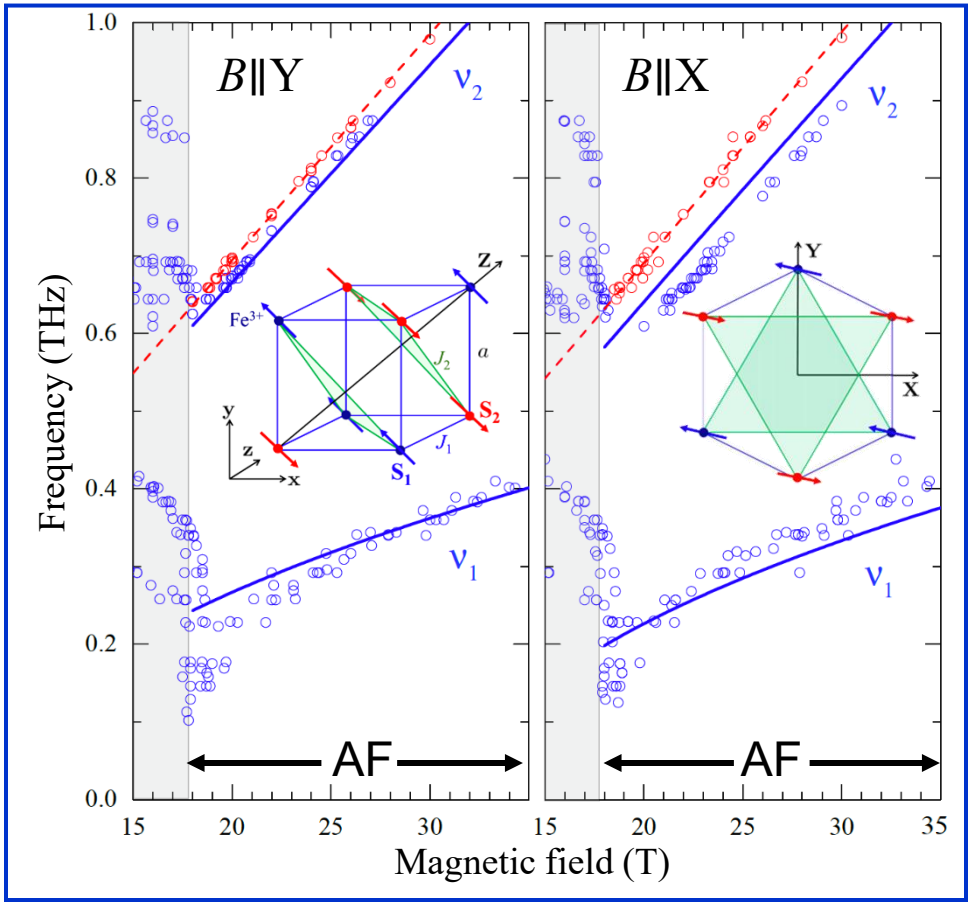
The room-temperature multiferroic $BiFeO_3$ is one of the most technologically important materials in the rapidly expanding field of spintronics, with applications ranging from nano-electronics to photovoltaics. One of the most useful ways to control the properties of $BiFeO_3$ thin films is through strain, which unwinds its cycloidal spin structure and stabilizes a canted antiferromagnetic (AF) state. Despite great interest in controlling its magnetic properties, little is known about the effects of magnetoelastic strain on bulk $BiFeO_3$.

Magnetic fields above 18T are also known to destroy the low-field cycloidal spin structure in $BiFeO_3$, again stabilizing a canted AF state (see Figure). In this work, high-resolution spectroscopic studies of the spin-wave spectrum in the high-field phase of $BiFeO_3$ reveal direct evidence for the magneto-elastic coupling through a change in lattice symmetry from rhombohedral to monoclinic. This transformation activates two new coupling terms in the spin Hamiltonian describing the spin-wave spectrum (solid/dashed curves in the Figure are fits to this model). This collaborative study demonstrates how high-field electron magnetic resonance measurements in the terahertz range can be used to determine the magnetoelastic coupling constants in the AF phase of $BiFeO_3$.



Facilities and instrumentation used: Joint EMR/DC-Field Facility Operation (Broadband Backward Wave Oscillator (BWO) Spectrometer)

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