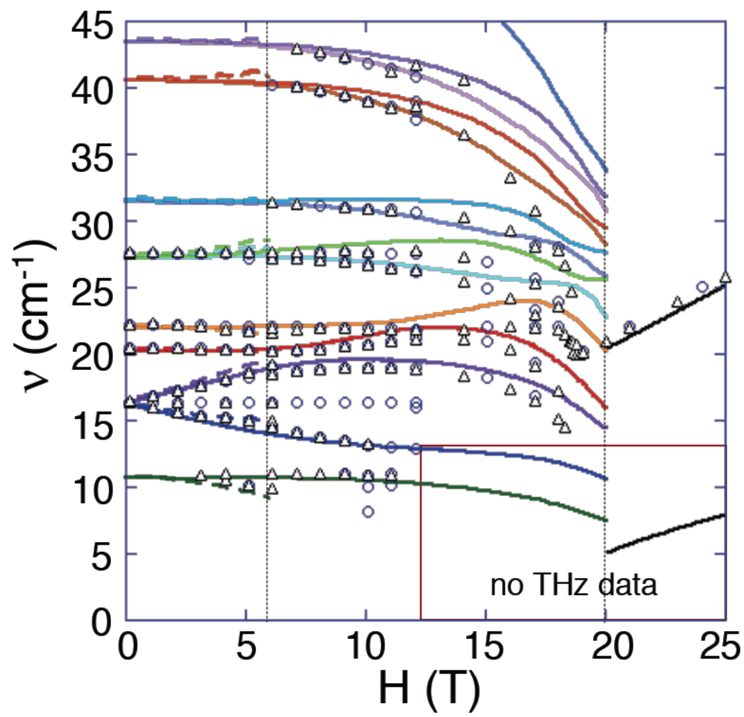
Fundamental Interactions of Multiferroic $BiFeO_3$

The agreement between the measured and predicted terahertz (THz) excitations indicates that a microscopic model can provide the foundation for future work on $BiFeO_3$, which is the only known room-temperature multiferroic. Due to the coupling between their electric and magnetic properties, mutliferroics would offer several advantages in magnetic storage devices. Most significantly, information could be written electrically and read magnetically without heating by an electric current. Hence, $BiFeO_3$ has the potential to radically transform the magnetic storage industry.



The spectroscopic modes of $BiFeO_3$ in a magnetic field. Triangles and circles are data points for the different orientations of the THz magnetic and electric fields. Solid and dashed curves are predictions for the lowest-energy and higher-energy magnetic domains.

The spectroscopic modes of $BiFeO_3$ provide detailed information about the very small interactions that produce the long-wavelength magnetic cycloid below 640 K. A microscopic model predicts the zero-field modes as well as their splitting and evolution in a magnetic field H along a cubic axis, as shown in the figure. While the three magnetic domains of the cycloid have the same energy in zero field, THz measurements imply that the higher-energy domains are depopulated above about 6 T, indicated by a vertical line in the figure. This work will appear in *Physical Review Letters*[1].

[1]U. Nagel, R.S. Fishman, T. Katuwal, H. Engelkamp, D. Talbayev, H.T. Yi, S.-W. Cheong, and T. Rõõm, "Terahertz Spectroscopy of Spin Waves in Multiferroic $BiFeO_3$ in High Magnetic Fields," *Physical Review Letters* **110**, 257201 (2013).