HIGH MAGNETIC FIELD STUDIES OF GEOMETRICALLY FRUSTRATED MULTIFERROIC HoMnO$_3$

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Introduction

“Multiferroic” materials possess simultaneous ferroelectric and magnetic order. In general, it is not understood how these two well-known ground states of materials may interact and/or coexist. Hexagonal multiferroic HoMnO$_3$ has an additional complexity: the Mn $S=3/2$ spins are geometrically frustrated. This material orders ferroelectrically at more than 700 K, while antiferromagnetic order that is associated with Mn ordering occurs at around 80 K. Interestingly, the rare earth Ho seems to induce a spin reorientation in the Mn subsystem, while undergoing its own sort of magnetic order at low temperature. All of these factors lead to an interesting, low temperature, high field phase diagram [1] extracted from both dielectric and magnetization measurements. Based on this phase diagram, there is reason to believe that additional high field physics may appear in this compound.

Experimental

We have measured the dielectric constant and magnetization in pulsed fields down to 2 K in the 50 T mid-pulse magnet. The dielectric constant was measured along the $c$ direction. Magnetization was also measured along the $c$ direction.

Results and Discussion

A typical measurement of dielectric constant is shown in Fig. 1 at $T=15$ K. There were no sharp changes in the dielectric constant at the lowest temperatures achieved (about 2 K) in the high field regime. Consistent with this observation, the magnetization did not reveal any sharp phase transition like features (not shown). Instead, a slow saturation of the Ho moments was observed. In future experiments, it may be interesting to check the other crystallographic directions for any high field physics, as this compound is also magnetically anisotropic.

![Fig 1](image.png)

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References