MAR05-2004-020114

Abstract for an Invited Paper
for the MAR05 Meeting of
the American Physical Society

Magnetically induced ferroelectric order in frustrated magnets

GAVIN LAWES, Wayne State University

Magnetoelectric coupling between magnetic and ferroelectric properties has been the object of intense study over the last four decades. Our understanding of magnetoelectric materials has been greatly enhanced by a rigorous exploration of the symmetry requirements for promoting magnetic and ferroelectric orders. Multiferroic materials, having simultaneous magnetic and ferroelectric order, have recently been proposed for incorporation into a range of spintronic devices. However, many of the multiferroics identified to date have different transition temperatures for ferroelectric and magnetic orders, leading to reduced magnetoelectric coupling strengths. I will discuss some recent experiments on several new multiferroics, including $TbMnO_3$, $DyMnO_3$, and $Ni_3V_2O_8$. These compounds are notable because the ferroelectric transition is coincident with magnetic ordering which leads to very large magnetoelectric couplings and large magnetocapacitive effects. Furthermore, using external magnetic fields to tune the magnetic structure has a pronounced effect on ferroelectricity in these systems. This allows us to destroy or promote ferroelectric order magnetically. While similar effects have been observed previously, these multiferroics remain poorly understood. I will present a model developed to explain the multiferroic order in $Ni_3V_2O_8$, in which the magnetic order spontaneously breaks inversion symmetry, allowing for the development of ferroelectricity. This magnetically-induced ferroelectric order is expected to appear in a wide range of antiferromagnets, and offers a new approach for designing and understanding multiferroic materials.