# Landau Theory of the Magnetic Phase Diagrams of Magnetoelectric Compounds

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**ABSTRACT**: The interaction between magnetic and positional degrees of freedom in a solid can have profound consequences. The discovery of new classes of materials over the past fifteen years which exhibit an unusually large magnetoelectric effect has led to a flurry of activity into the phenomena of magnetic (electric) field control of electric (magnetic) properties. Interest has also been enhanced by recent demonstrations of room temperature thin-film devices. In most of these compounds, the magnetoelectric effect is associated with non-collinear antiferromagnetic spin structures and complex magnetic field - temperature phase diagrams. Key to understanding such phenomena is the role played by crystal symmetry in the formulation of energy terms which account for interactions between magnetic, electric and elastic properties. The fundamental principles used to develop Landau-type free energies will be reviewed. The construction of a non-local Landau free energy applied to the unusual magnetic phase diagram of CuFeO2 is analyzed. Symmetry arguments are also used to explain the critical interaction between Mn and Ho ions in a related compound, HoMnO3, where Landau theory has been used to explore its complex series of magnetic phase transitions at zero field. In addition, symmetry arguments are applied to magnetoelecric CuO and used to predict a previously undetected phase transition, subsequently confirmed to exist through ultrasonic measurements.

ALL ARE WELCOME!!!