The AC Wien effect and non-linear non-equilibrium susceptibility in spin ice

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Abstract

The quasi-particle excitations above the degenerate ground state manifold of model spin ice constitute a Coulomb fluid of "magnetic monopoles" [1]. As a model Coulomb fluid, spin ice is thus susceptible to the Wien effect - a universal and robust charge density enhancement for Coulomb systems in an external field [2], whose origin is in the non-equilibrium response to an external field. I will review the physics of the Wien effect for both a lattice electrolyte [3] and its magnetic equivalent highlighting how the non-equilibrium environment allows a response forbidden by symmetry for a system in equilibrium. I will show that spin ice exhibits the Wien effect in the presence of an AC magnetic field [4] and further show that the monopole density increase is directly related to the non-linear magnetic response providing a signal of the Wien effect that is specific to magnetic systems. I will discuss conditions required to observe our predictions of the AC Wien effect in the non-linear susceptibility of **Dy2Ti2O7**.

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