# DYNAMICS OF THE SPIN-ICE STATES WITH MAGNETIC CHARGES

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## ABSTRACTS

The magnetic monopoles have always been a theoretical concept, but recently, structural entities discovered in the spin-ices have similar behaviour to the magnetic charges. These entities are low energy excitation states in these magnetic structures which are produced via a spin flip between two contiguous tetrahedrons of its crystal structure. The proliferation of these spin-flips can produce sufficient free positive and negative charges in such a way that the system behaves in similar way to a neutral cold magnetic plasma which has been experimentally detected in specific heat measurement (1). Another sharp peak at lowest energy appears for decreasing temperature and which is produced by the Coulomb interaction among magnetic charges. This interaction generates a first phase transition toward a condensation of polo-antipole pairs, possibly having a Bose-Einstein condensate structure when the existence of pole-antipole pairs excludes free magnetic charges (2). These pairs can freely travel inside of the spin-ice compounds and then, the electromagnetic propagation it is possible. The electromagnetic wave interaction over the spin-ice in an unconfined system assisted by an intense and constant electric field allows us to determine the linear response, the effective mass of the magnetic monopoles, plasmon frequency of the plasma state and precession frequency of magnetic charges. This precession frequency coincides with a strong EM absorption of the system, and therefore it allows establish a true test for existence the magnetic charges. On the other hand, we carry out a second electromagnetic guided wave propagation analysis taking into account the existence of free magnetic charges. With this analysis, we can determine the frequency dependent conductivity, the cut-off propagation frequency, phase difference between current and field and the different expressions of the fields. All these EM propagation properties depend crucially on the magnetic charge density (3). This suggests that there are potential applications of these materials for constructing “Magnetronic” devices (dual concept of electronic devices) in order to propagate energy and information.

## REFERENCES

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