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High-field re-entrance of the magnetoelectric effect in LiNiPO₄ investigated in pulsed fields

E. Fogh¹, R. Toft-Petersen², H. Nojiri¹, T. Kihara¹, G. E. Granroth¹, M. B. Stone¹, J. Lee¹, K. Fritsch², N. H. Andersen¹, D. Vaknin⁵ and N. B. Christensen¹

INTRODUCTION

Material LiNiPO₄ belongs to the family of the magnetoelectric lithium-ortho-phosphates. The material exhibits an XY-like behavior and the strong antiferromagnetic interactions are mainly in the (b,c)-plane.

Goal More transitions have been reported at fields up to 22 T [4] and our goal is to investigate and characterize these.

Magnetism The magnetic phase diagram of LiNiPO₄ as function of temperature and applied magnetic field along c has been thoroughly investigated up to 17.3 T in DC fields. Several different antiferromagnetic phases have been characterized [2,3].

Neutrons 1274 neutrons were detected with a field on! Despite the low statistics we are still able to follow the position of the propagation vector as the field is increased.

RE-ENTRANCE OF THE LINEAR MAGNETOELECTRIC EFFECT

The magnetization and electric polarization were measured in pulsed fields by T. Kihara. The results of both bulk and neutron experiments are presented below. Note that the phases C, ICₜₐ and 1/5-C correspond to the phases I, II and III respectively.

Magnetization Five phases were observed up to 30 T and the material is only magnetized ~ 1/3 Mₘ at 30 T, where Mₘ = 2.2 μₛ.

Polarization A re-entrance of the linear magnetoelectric effect was discovered in phase IV. The field was applied along c and the polarization measured along a. The effect is absent in phase V.

POSSIBLE MAGNETIC STRUCTURES IN THE HIGH-FIELD PHASES

The neutron statistics are low and only one Bragg peak has been measured for each phase. However, together with the bulk measurement we can still suggest possible spin structures at high fields.

Phase IV The re-entrance of the magnetoelectric effect and the propagation vector q = (0K0) indicate that the magnetic structure is similar to the low-field commensurate structure in phase I.

Phase V Using M ≈ 1/3 Mₘ and the propagation vector q = (0,4/3,0) Jens Jensen was able to stabilize a meta-stable state which is a superposition of a commensurate and an incommensurate structure.

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REFERENCES

[1] A. Szweczyk et al., PRB, 84(104419), 2011

¹ Department of Physics, Technical University of Denmark, Kongens Lyngby, Denmark
² Helmholtz Zentrum Berlin für Materialien und Energie, Berlin, Germany
³ Institute for Material Research, Tohoku University, Sendai, Japan
⁴ Neutron Scattering Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee
⁵ Ames Laboratory and Department of Physics and Astronomy, Iowa State University, Ames, Iowa