Experimental report

14/05/2022

Proposal: **5-54-361** **Council:** 10/2020

Title: Ground State Magnetic structure ofHexagonal-(Mn0.82Fe0.18)3.2Ge WeylSemimetal

Research area: Physics

This proposal is a new proposal

Main proposer: **Venus RAI**

Experimental team: Anne STUNAULT

Local contacts: Jose Alberto RODRIGUEZ VELAMAZAN
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Samples: (Mn0.82Fe0.18)3.2Ge

Instrument	Requested days	Allocated days	From	To
D3 CPA	4	4	17/05/2021	19/05/2021
			31/05/2021	02/06/2021

Abstract:

The aim of the proposal is to determine the ground state magnetic structure of the (Mn0.82Fe0.18)3.2Ge. 17-22% Fe doped Mn3Ge has gained special attention due to multiple magnetic transitions below room temperature which arises due to the competing FM and AFM interactions [9-11]. In contrast to the parent compound Mn3Ge, we have observed (a) strongly field dependent anomalous Hall effect and, (b) the anomalous Hall effect is present only in a limited temperature range (above 100 K). Since the anomalous Hall effect and magnetic structure of the Mn moments are directly correlated, an accurate magnetic structure determination is urgently needed. Our proposed polarized neutron diffraction will definitely shed light on the correlation between the magnetic structure and the anomalous Hall effect: a prerequisite for the understanding of the Weyl semimetal.

Experimental report

Title: Ground State Magnetic structure of Hexagonal - $(Mn_{0.82}Fe_{0.18})_{3.2}Ge$ Weyl Semimetal

Instrument: D3 (CRYOPAD)

Proposal number: 5-54-361

Date of Experiment: 17/05/2021 - 19/05/2021; 31/05/2021 - 02/06/2021

Main proposer: Venus Rai (Jülich Centre for Neutron Science (JCNS-2), Forschungszentrum Jülich, Germany)

Neutron diffraction of the single crystal Hex. - $(Mn_{0.82}Fe_{0.18})_{3.2}Ge$ was performed using the CRYOPAD setup installed over the D3 instrument. The experiment was split into two parts, where, initially, the sample was installed with the a axis along the vertical direction to access the (*hk*0) reflections. After this, the sample was installed with the *b* axis along the vertical direction to access the (*h*0*l*) reflections. Different sets of reflections were required in order to determine the true ground state magnetic structure. The data at both temperatures were fitted using the Mag2Pol software. The various magnetic models at 4 K and 130 K can be guessed on the basis of the magnetization of the compound. Possible magnetic models at 130 K and 4 K are shown in Figures 1 (I - IV) and Figure 1 (V, VI), respectively. Polarization analysis corresponding to all the reflections clearly suggests that the sample possesses magnetic model V, and I at 4 K, and 130 K, respectively.

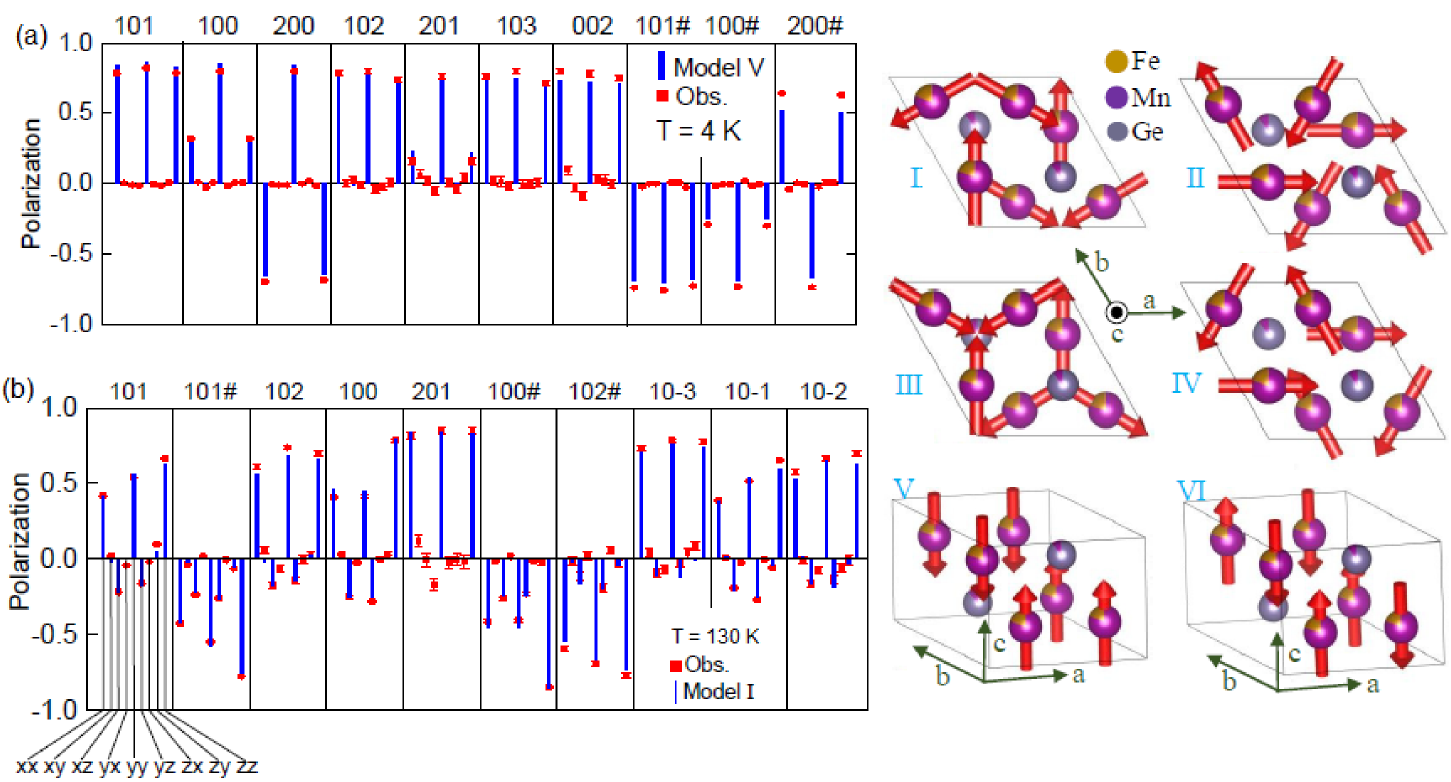

Figure 1: (a) and (b) denote observed and calculated polarization at 4 K and 130 K, respectively. The (hkl) values corresponding to the polarization data are mentioned on the top. The symbol '#' suggests the polarization is measured in the reversed direction. (I - IV) denote possible magnetic models at 130 K. V, VI denote possible magnetic models at 4 K.