Spin fluctuations in a spin-hedgehog-anti-hedgehog lattice state in Mn(Si,Ge) at zero magnetic field

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Topological spin orders in condensed matter physics have been an intriguing topic for both theorists and experimentalists in recent years. This topological spin orders give rise to a finite scalar spin chirality which acts as an effective magnetic field on conduction electrons resulting in the unconventional Hall effect or topological Hall effect (THE). One of example showing THE phenomenon is MnGe [1]. This material has a spin-hedgehog-anti-hedgehog (SHAH) lattice state which can be described by a superposition of three proper-screw-type magnetic modulations with the q-vectors of (q,0,0), (0,q,0) and (0,0,q). Such non-trivial spin textures induce THE due to having a finite scalar spin chirality.

By doping with Si on $MnSi_{1-x}Ge_x$, the system topologically undergoes the transition from cubic-3**q** (x = 0.7-1) to tetrahedral-4**q** (x = 0.3-0.6) SHAH lattice states [2]**.** Interestingly, it was reported that the sign of Hall resistivity turns into positive near the critical temperature for both cubic-3**q** and tetrahedral-4**q** SHAH lattice states. Moreover, the behavior of Hall resistivity on tetrahedral-4**q** SHAH lattice state is more complex since the positive sign of Hall resistivity was also observed at low temperature. A recent theoretical study has pointed out that the origin of the positive Hall resistivity is due to spin-fluctuations with finite scalar spin chirality while the negative one is induced by a static long-range order of SHAH lattice [3].

To verify the scenario described on the theoretical study, we performed the MIEZE-type neutron spin echo (NSE) experiment in $MnSi_{1-x}Ge_x$ sample with x = 0.6 (tetrahedral-4**q**) and x = 0.8 (cubic-3**q**). Such experimental technique measures the intermediate correlation function $I(Q,t)$ from the observed MIEZE signals [4]. By assuming single exponential relaxation function, we obtained the static/fluctuating fraction and the characteristic time of spin fluctuations as a function of temperature. The results will be discussed in the meeting.

References:

[1] N. Kanazawa *et al*., *Phys. Rev. Lett*. **106**, 156603 (2011).

[2] Y. Fujishiro *et al*., *Nat. Commun.* **10**, 1059 (2019).

[3] H. Ishizuka and N. Nagaosa, *Sci. Adv.* **4**, eaap9962 (2018).

[4] T. Oda *et al*., *Rev. Sci. Instrum.* **87**, 105124 (2016).