

661st ASRC Seminar

Date: Monday, January 23, 13:30 ~

Location: Room 302, ASRC bldg.

Speaker: Dr. Kentaro Nomura
(Tohoku University)

Title: Spintronics phenomena in topological materials

Abstract: The electrical control of spin magnetization aims to be used in next-generation magnetic devices, allowing information to be written electronically. Recently, spintronics phenomena in topological materials have been drawn interests for achieving novel electrical manipulation of the magnetization, and generation of spin currents. In this presentation, we discuss theoretical proposals of spintronics phenomena in magnetic Weyl semimetals. A Weyl semimetal is a topologically protected gapless quantum state, with either time-reversal or spatial inversion symmetries broken in three dimensions. Weyl semimetals with broken time-reversal symmetry are more interesting and rewarding for spintronics applications. We derive an effective free energy functional of magnetization which describes electromagnetic responses of a Weyl semimetal with ferromagnetic order[1]. We demonstrate that Weyl electrons in a magnetic Weyl semimetal exert a spin torque on the local magnetization, without a flowing current, when the chemical potential is modulated in a magnetic field. The spin torque is proportional to the anomalous Hall conductivity, and its effective field strength may overcome the Zeeman field. Using this effect, the direction of the local magnetization is switched by gate control in a thin film. Dynamics of local magnetization is analyzed by solving the Landau-Lifshitz-Gilbert equation[2]. We also discuss magnetic textures such as domain walls in magnetic Weyl semimetals and show that the charge density and the current density are generated near the domain walls, which might be used to manipulate the motion of domain walls electrically.[3]

[1] K. Nomura and D. Kurebayashi, *Phys. Rev. Lett.* 115, 127201 (2015).

[2] D. Kurebayashi and K. Nomura, *Phys. Rev. Applied.* 6, 044013 (2016).

[3] Y. Araki, A. Yoshida, and K. Nomura, *Phys. Rev. B* 94, 115312 (2016).

<Contact>

Michiyasu Mori (81-3508)

Advanced Science Research Center