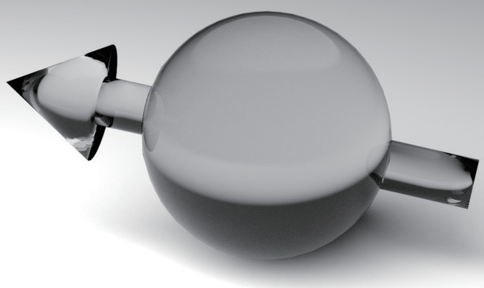
Grant-in-Aid for Scientific Research on Innovative Areas, MEXT, Japan

Nano-Spin Conversion Science

Research Highlights

Nano spin conversion



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Preface

Spintronics research emerged in the 1990s, has evolved throughout two decades, and still continues to grow. Japanese researchers have historically led this field, and the major participants in this innovative research area have made significant contributions in terms of intriguing physical phenomena such as the spin Hall effect, inverse Faraday effect and spin Seebeck effect. Another outcome of spintronics research has been the concept of spin current, which has been established among the community of solid-state research. The concept of spin current has since been extended and is recognized as an angular momentum flow including spin waves, circularly polarized light and mechanical vibration.

In this innovative research area, we focus on the itinerant and localized electron spins, phonons, and photons to explore and establish the principles of novel conversion mechanisms. Moreover, we aim to propose novel concepts and methods that are based on well-established physics, and finally to develop a spin conversion physics theory that can meet requests from industry. Ideally, we will present research outcomes that can contribute to building new paradigms for the development of practical devices and energy harvesting.

To maintain the future activity of this field, the education and securing of young talented researchers is considered to be an important and high priority. In addition to the securing of human resources in Japan and improvement of research performance, the fostering of top-level researchers that will contribute to innovative progress will be promoted. From a long-term perspective, we consider that educating talented young researchers in this research area, not only from Japan where we endure an aging society and science phobia, but also from overseas, and their promotion worldwide would offer a route to make Japan the world-leading country in the fields of advanced basic science and technologies, which are related to this innovative research area.

Finally, I sincerely hope that this research area will create outcomes that will make significant contributions to society and will stimulate further growth.

大谷義近

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Electrical detection of spin current due to the inverse spin Hall effect in Pt/(Ga,Mn)As

Hiroyasu Nakayama

H. Nakayama, L. Chen, H. W. Chang, H. Ohno, and F. Matsukura, "Inverse spin Hall effect in Pt/(Ga,Mn)As", Appl. Phys. Lett. **106**, 222405 (2015). [http://dx.doi.org/10.1063/1.4922197]

Generation and detection of spin current have attracted much attention in terms of fundamental physics and for future applications of spintronics devices. The combination of spin pumping and inverse spin Hall effect (ISHE) is one of the most powerful methods for quantitative study of spin current in nonmagnet/ferromagnet bilayer structures. We employ a Pt/(Ga,Mn)As bilayer structure (Fig. 1) for spin pumping/ISHE measurements to investigate possible spin injection from semiconducting to metallic materials. We have successfully detected dc voltage under ferromagnetic resonance in a Pt/(Ga,Mn)As structure, as shown in Fig. 2. The magnetic-field angle dependence of the observed dc voltages is explained well by a combination of the galvanomagnetic and spin pumping-induced-ISHE. The sign of the ISHE voltage is the same as that in a permalloy (Py)/Pt bilayer structure, even though the stacking order of ferromagnetic and nonmagnetic layers is opposite. The sign of the observed dc voltage induced by the ISHE suggests that the sign of the spin polarization at the Fermi level in (Ga,Mn)As is opposite to that of Py. The spin mixing conductance at the Pt/(Ga,Mn)As interface is determined to be 6.2×10^{19} m^{-2}, which is approximately ten times greater than that at the (Ga,Mn)As/p-GaAs interface reported in our previous work. This result indicates that hybrid structures with ferromagnetic semiconductors and metals are interesting systems for the investigation of spin-current related phenomena due to their large efficiency of spin current generation at the interface, which may enable control of the magnetic states in (Ga,Mn)As by the injected spin current.

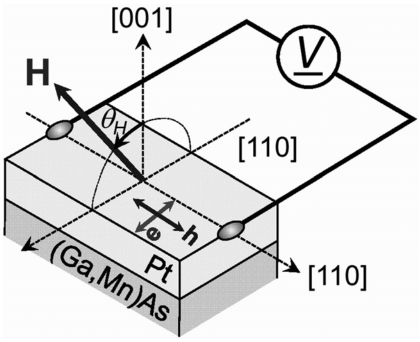

Fig. 1: Schematic diagram of the measurement configuration and definition of the magnetic field angle θ_H, where h and e denote the magnetic field and electric field of microwave radiation, respectively.

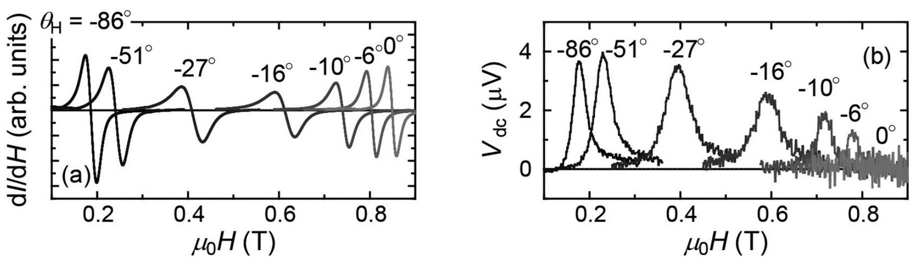

Fig. 2: Magnetic field angle θ_H dependence of (a) ferromagnetic resonance spectra and (b) dc voltage measured at 30 K.

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Revisiting the measurement of the spin relaxation time in graphene-based devices

Hiroshi Idzuchi and YoshiChika Otani

H. Idzuchi, A. Fert, and Y. Otani, "Revisiting measurement of the spin relaxation time in graphene-based devices", Phys. Rev. B **91**, 241407(R) (2015). [http://dx.doi.org/10.1103/PhysRevB.91.241407]

A long spin relaxation time (τ_{sf}) is key for the application of graphene to spintronics; however, experimentally measured τ_{sf} have been generally much shorter than expected. Here we demonstrate that a typical determination by the Hanle method underestimates τ_{sf} if an appropriate account of spin absorption by contacts is lacking. We have revisited Hanle curves for graphene lateral spin valves that were previously analyzed using the standard model without spin absorption. Our reanalysis shows that the reported differences in τ_{sf} for samples with different contact resistances is due to interface effects. After correction of these effects, τ_{sf} becomes much less dispersed. A general discussion shows that without correction for the back flow and spin absorption through contacts, and even with contact resistance in the 100 kΩ range for typical device geometries, the spin relaxation time is significantly underestimated when its intrinsic value is above the nanosecond range. We expect that discussion of the τ_{sf} underestimation with standard Hanle analyses will be useful to understand the differences with data derived from other approaches. This indicates a longer spin relaxation for graphene and thus more optimistic potential for spintronics.

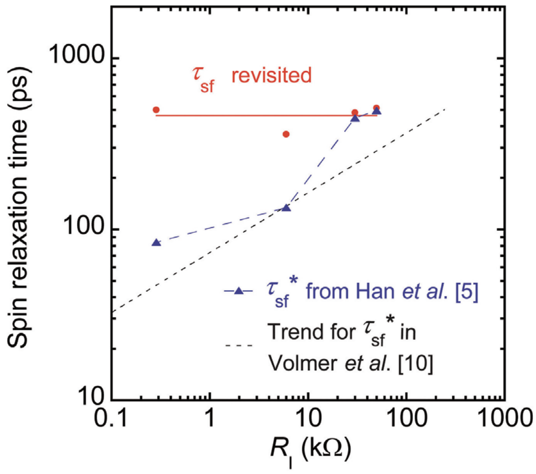

Figure: Comparison of the spin relaxation times derived from experimental Hanle curves in models with (this paper) and without spin absorption by contacts for samples with various contact resistances, *R*l. See the paper for reference number.

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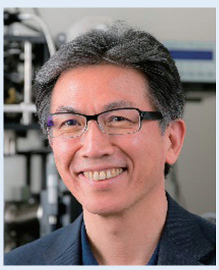

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Spin Hall Effect in a Superconductor

Taro Wakamura and YoshiChika Otani

Taro Wakamura, H. Akaike, Y. Omori, Y. Niimi, S. Takahashi, A. Fujimaki, S. Maekawa, and Y. Otani, "Quasiparticle-mediated spin Hall effect in a superconductor", Nat. Mater. **14**, 675 (2015). [http://dx.doi.org/10.1038/nmat4276]

Superconductivity provides spectacular phenomena relevant to spin transport, as well as charge counterpart through spin currents mediated by superconducting quasiparticles. In this study, the first experimental demonstration of the spin Hall effect (SHE) in a superconducting NbN is presented. Using a lateral spin valve structure, pure spin currents are injected into a superconducting NbN (Fig. 1). The injected pure spin currents are converted into charge currents via the inverse SHE and are detected as a voltage difference between two edges of the NbN wire. The inverse spin Hall (ISH) signals are measured both above and below the superconducting critical temperature (T_C) of NbN. Clear ISH signals are not only detected above, but also below T_C. Moreover, the signals detected below T_C are strongly enhanced with a decrease in the spin injection currents (I) flowed between the ferromagnet ($Ni_{81}Fe_{19}$) and the nonmagnet (Cu) to generate pure spin currents into NbN (Fig. 2). The signal with I = 0.01 μA becomes more than 2000-fold larger than that in the normal state. Calculations based on the relation between the ISH signals and the resistivity of quasiparticles reproduced the experimental data well, especially for smaller I. The first observation of gigantic SHE in a superconductor uncovers the significant potential of superconductors for spintronics and associated applications.

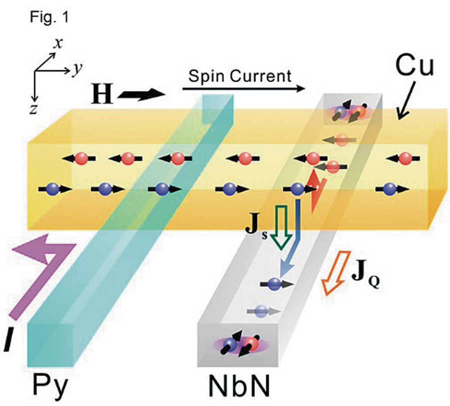

Fig. 1: Schematic illustration of the device.

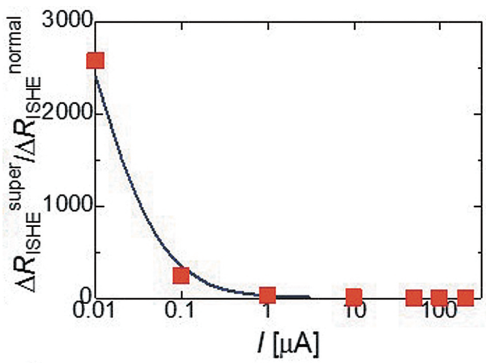

Fig. 2: Ratio of the inverse spin Hall signals (ΔRISHE) between superconducting and normal states.

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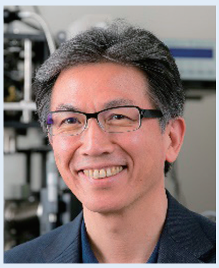

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Spin transport in Germanium at room temperature

Sergey Dushenko and Masashi Shiraishi

S. Dushenko, M. Koike, Y. Ando, T. Shinjo, M. Myronov, and M. Shiraishi, "Experimental demonstration of room-temperature spin transport in n-type germanium epilayers" Phys. Rev. Lett. **114,** 196602 (2015).
[http://dx.doi.org/10.1103/PhysRevLett.114.196602]

To fully utilize the advantages of spintronics requires a material that is capable of carrying spins over long distances at room temperature. Inside most materials, spins suffer from scattering and are subject to magnetic fields from the host and impurities of atoms, which cause loss of spin polarization. In germanium (Ge), loss of the spin polarization (spin relaxation) is reduced due to the particular crystal structure. In addition, the carrier mobility in Ge is an order of magnitude higher than in silicon (Si), which makes Ge devices superior to their Si counterparts. However, in contrast to Si, non-local spin transport in Ge has only been achieved at low temperatures to date.

From our studies, room-temperature spin transport has been realized and the dominant spin relaxation mechanism in Ge has been determined for the first time. The non-electric spin pumping method was used for spin injection. Under the ferromagnetic resonance, magnetization precession drove the spins from the permalloy (Py) strip into the highly doped n-Ge channel. Spins propagated through the Ge channel in the lateral direction were absorbed by the palladium (Pd) strip. The large spin orbit interaction of the Pd strip converted the spin current into a charge current and electric voltage was detected from the Pd strip. This success in achieving spin transport at room temperature in Ge has opened new opportunities for semiconductor spintronics. Furthermore, the measurement of spin transport at both low temperature and room temperature has enabled understanding and elucidation of the dominant spin relaxation mechanism in doped Ge, which is crucial for the control of spin transport and the design of Ge-based spintronics devices.
This breakthrough study received international praise, including highlights in "Featured in Physics" from the American Physical Society (APS, United States of America) and the "Physics World" magazine of the Institute of Physics (IOP, United Kingdom).

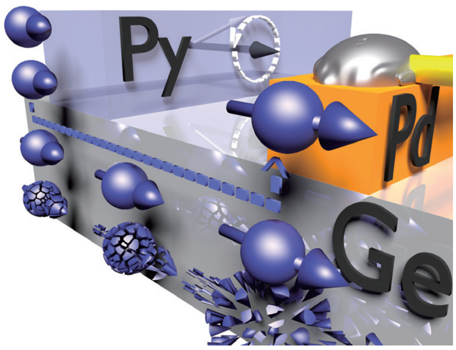

Fig. 1. Schematic layout of the spin transport experiment in the n-Ge channel.

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Heat Flow Generated by Spin-Current Injection

Kento Yamasaki, Shinya Yamada, and Kohei Hamaya

K. Yamasaki, S. Oki, S. Yamada, T. Kanashima, and K. Hamaya, "Spin-related thermoelectric conversion in lateral spin-valve devices with single-crystalline CO_2FeSi electrodes", Appl. Phys. Express **8**, 043003 (2015).
[http://dx.doi.org/10.7567/APEX.8.043003]

The spin dependent Peltier effect (SDPE) was observed at room temperature in a lateral spin valve (LSV) with epitaxial Heusler-compound, Co_2FeSi (CFS), electrodes. The SDPE, the conversion of pure spin currents to heat currents at a ferromagnet/nonmagnet interface, has been observed in a spin-valve nanopillar structure [Nat. Nanotechnol. **7**, 166 (2012)]. Although a method was proposed for observation of the SDPE in an LSV using a thermocouple (TC) on the spin-detector electrode [Phys. Rev. B **84**, 174408 (2011)], this has not yet been realized. Figure 1 shows a fabricated LSV with CFS electrodes. Using one CFS spin-injector electrode, a giant pure spin current of ca. 10^{11} A/m^2 can be generated in Cu wire, and the giant spin current is injected into another CFS. A heat flow is generated due to the SDPE at the Cu/CFS interface, which leads to a temperature difference between the TC positions. A signal with hysteretic nature (Fig. 2) is detected in the terminal arrangement shown in Fig. 1 at room temperature. This is the first observation of SDPE in a LSV, which is an interesting topic in the field of spin caloritronics.

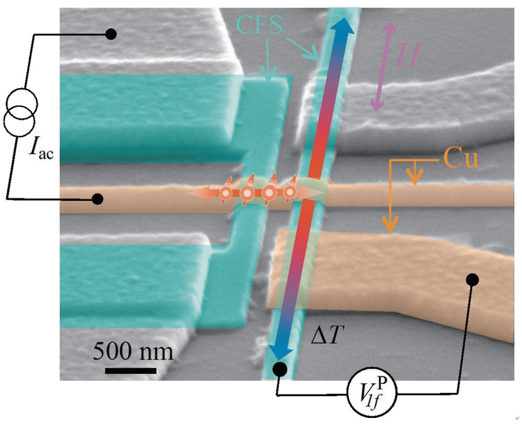

Fig. 1: Lateral spin valve for SDPE measurements.

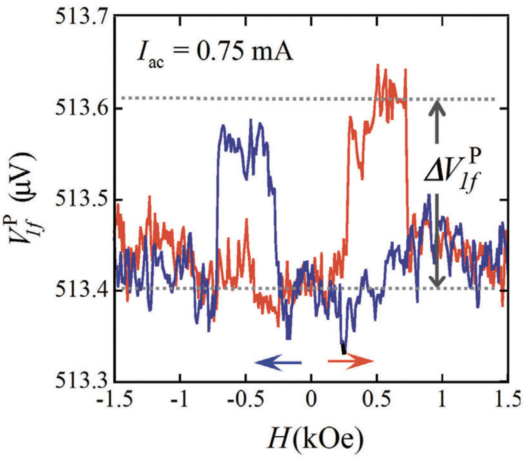

Fig. 2: Room-temperature SDPE signal (V_{1f}^{P}) detected in a LSV.

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Longevity magnons generated by nonlinear spin dynamics

Hiroto Sakimura and Kazuya Ando

H. Sakimura, T. Tashiro, and K. Ando, "Nonlinear spin-current enhancement enabled by spin-damping tuning", Nat. Commun. **5**, 5730 (2014). [http://dx.doi.org/10.1038/ncomms6730]

Spin-damping tuning triggered by magnon conversion was determined to enable the stabilized enhancement of spin-current emission from a magnetic insulator. Magnons, the collective excitation of localized spins in a magnetic insulator, emit a spin current into an adjacent metal through dynamical spin exchange coupling between magnetization and conduction electron spins at the interface. The spin-current emission is enhanced nonlinearly by three-magnon scattering, where the uniform magnon excited by a microwave splits into two magnons with nonzero wavevectors (Fig. 1). We demonstrate that the enhanced spin-current emission is stabilized by long-lived magnons created by magnon redistribution through magnon splitting. This is evidenced by direct measurements of the lifetime of nonequilibrium magnons in the magnetic insulator using the inverse spin Hall effect (see Fig. 2); the magnon redistribution creates secondary long-lived magnons, which increases the steady-state angular momentum stored in the spin system and gives rise to stabilized enhancement of the spin-current emission. Furthermore, we demonstrate nonlinear enhancement of the spin conversion triggered by scattering processes that conserve the magnon numbers, which illustrates the crucial role of spin-damping tuning in nonlinear spin-current emission.

The results illustrate the essential role of spin damping under the influence of nonlinear magnon interactions in spintronic devices. The damping of spin systems can be directly quantified using time-resolved measurement of the spin-current emission through spin-orbit coupling. These results therefore offer a route for the development of nonlinear spin-based devices through spin-damping engineering, and offer potential for important advances in insulator spintronics.

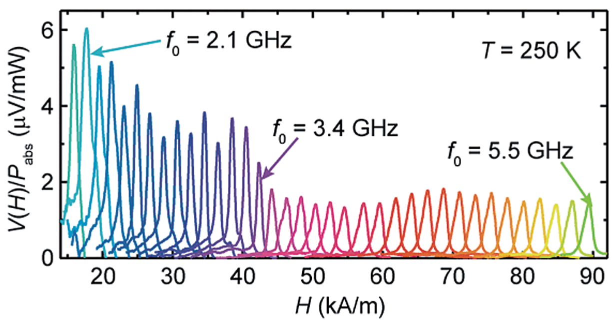

Fig. 1: Enhanced spin-current emission triggered by three-magnon splitting.

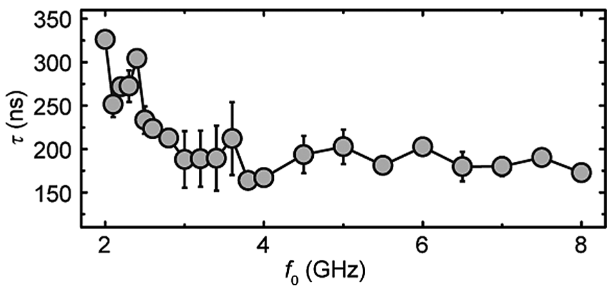

Fig. 2: Magnon lifetime measured by the combination of a pulsed spin current and the inverse spin Hall effect.

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Towards skyrmion-based spintronic devices

Daichi Hirobe, Yuki Shiomi, and Eiji Saitoh

D. Hirobe, Y. Shiomi, Y. Shimada, J. Ohe, and E. Saitoh, "Generation of spin currents in the skyrmion phase of a helimagnetic insulator Cu_2OSeO_3", J. Appl. Phys. **117**, 053904 (2015). [http://dx.doi.org/10.1063/1.4907040]

Spin-current generation was demonstrated from a skyrmion motion driven by microwave irradiation. Skyrmions provide rich topological physics and potential applications in spintronics; therefore, this result should have appeal in fundamental research and also be an important step towards novel skyrmionic devices. The magnetic skyrmion, which is a nanoscale vortex-like spin texture in real space, has attracted attention in condensed matter physics. The unique spin configuration produces various topological phenomena, such as the topological Hall effect. Besides its rich physics, the skyrmion has potential applications, such as an efficient information carrier. Magnetic skyrmions can be controlled by electric current with much lower energy costs than domain walls. Despite the potential applications of skyrmions, there have been few investigations on skyrmions in terms of the pure spin current, which is one of the central concepts in spintronics. Here, we report for the first time that pure spin currents can be generated from skyrmion dynamics. Using a Pt/helimagnetic insulator Cu_2OSeO_3 two-layer sample, we demonstrate that the spin angular momentum is transferred from the skyrmion crystal in Cu_2OSeO_3 to conduction electrons in Pt via the spin pumping effect. When a counterclockwise skyrmion motion is driven resonantly by the application of microwaves, a generated spin current is detected as an electromotive force in Pt via the inverse spin Hall effect, which converts spin currents into electromotive forces. Spin-current generation via skyrmion dynamics demonstrated here has potential as a new functionality in spintronic applications operating at microwave frequencies.

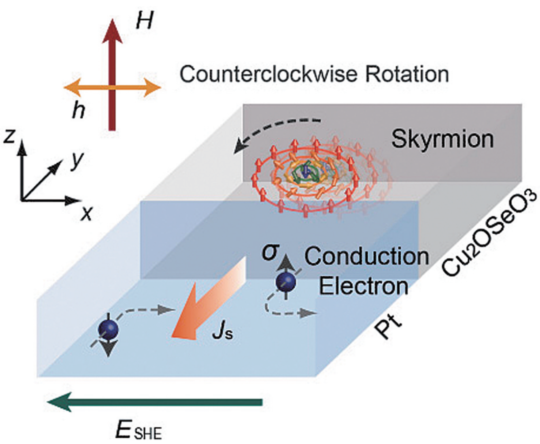

Fig. 1: Schematic diagram of spin-current generation from skyrmion dynamics and inverse spin Hall effect in Pt.

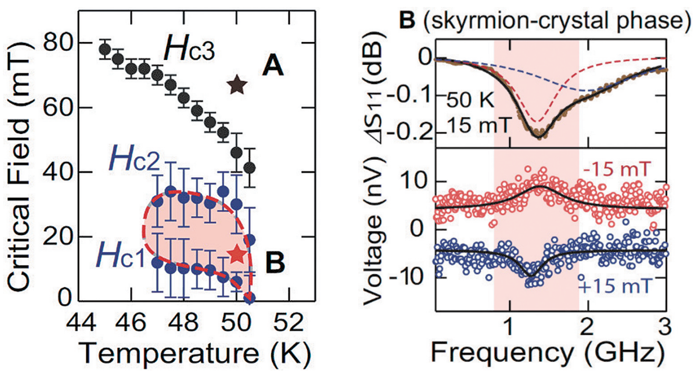

Fig. 2: Observation of the spin pumping effect induced by skyrmion dynamics.

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Observation of rotational Doppler effect and Barnett field by spinning NMR

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H. Chudo, K. Harii, M. Matsuo, J. Ieda, M. Ono, S. Maekawa, and E. Saitoh, "Rotational Doppler Effect and Barnett Field in Spinning NMR", J. Phys. Soc. Jpn. **84**, 043601 (2015). [http://dx.doi.org/10.7566/JPSJ.84.043601]

Spin dynamics were investigated for a mechanically rotating object. On the rotating frame of reference, an effective magnetic field known as the Barnett field acts on the magnetic moment. Observation of the Barnett field using magnetic resonance methods, such as nuclear magnetic resonance (NMR), revealed that the effect of the relative rotation between a wave emitter and a wave receiver, the rotational Doppler effect, must be considered. To clarify the relation between the Barnett effect and the rotational Doppler effect, NMR measurements were performed with a newly developed spinning-coil NMR technique. The rotational Doppler effect could be detected with this technique by rotating the wave receiver (sample coil) while the wave emitter (sample) remains stationary, and the Barnett field can be detected by rotating both the sample and sample coil. The experimental setups classified in terms of the rotational degree of freedom are summarized in Fig. 1. The experimental results are shown in Fig. 2. Both the rotational Doppler effect (Fig. 2a) and the Barnett effect (Fig. 2b) are observed as NMR frequency shifts, for which the magnitude is equal to the rotation frequency. Only with sample rotation (Fig. 2c) is no NMR shift apparent; in this setup, both sample rotation and relative rotation occur, so that both the Barnett field and rotational Doppler effect occur but cancel each other, which results in no shift of the NMR frequency. These results indicate that when both electron spin and nuclear spin are manipulated by mechanical rotation, the rotational degrees of freedom, both the relative rotation and sample rotation itself, must be taken into account.

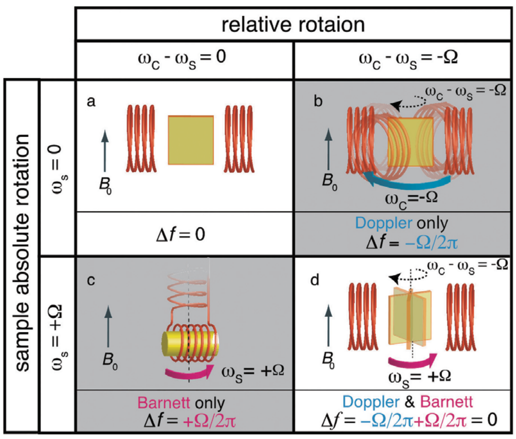

Fig. 1: Classification of the experimental setups in terms of the relative rotation between the sample coil and sample (columns), and sample rotation itself (rows). The experimental setups involving sample coil rotation, (b) and (c), are shown against a gray background.

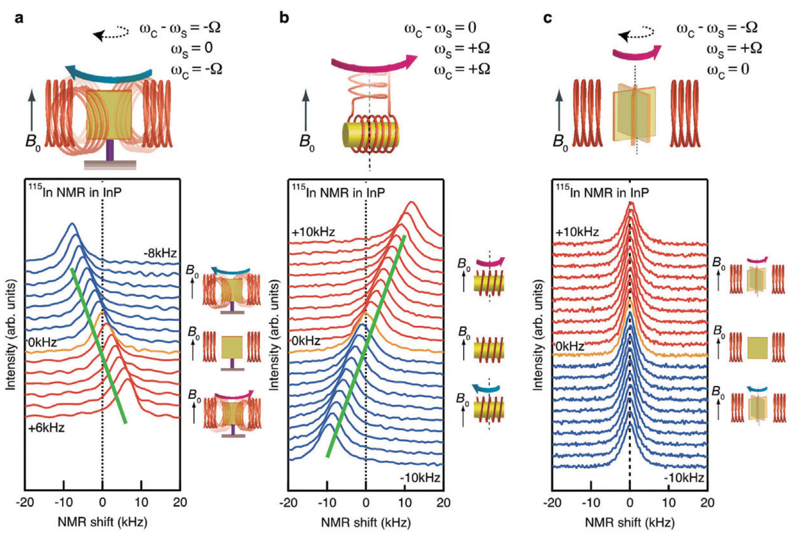

Fig. 2. 115In NMR spectra for InP measured using setups with (a) only sample-coil rotation, (b) both sample and sample-coil rotation, and (c) only sample rotation.

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Sign Change of the Spin Hall Effect due to Electron Correlation

Zhuo Xu and Sadamichi Maekawa

Z. Xu, B. Gu, M. Mori, T. Ziman, and S. Maekawa, "Sign Change of the Spin Hall Effect due to Electron Correlation in Nonmagnetic CuIr Alloys", Phys. Rev. Lett. **114**, 017202 (2015). [http://dx.doi.org/10.1103/PhysRevLett.114.017202]

The spin Hall effect (SHE), which converts an injected longitudinal charge current into a transverse spin current via spin-orbit interactions, is characterized by the ratio between the transverse and the longitudinal resistivities, referred to as the spin Hall angle (SHA). The magnitude of SHA describes conversion efficiency between the charge current and the spin current, while the sign distinguishes the scattering direction of electrons, i.e., clockwise or anticlockwise into the transverse direction. The SHA of CuIr alloys was measured experimentally to be a small positive, while previous theories could not consistently reproduce the positive sign. Such a discrepancy inspired us to elucidate the key physics that determine the sign of SHA. The Anderson model indicates that the local correlation effects in 5d orbitals will raise the 5d state of Ir, accompanied by a decrease of the 5d electrons, as shown in Fig. 1. This is partially balanced by an increase of the 6p electrons of Ir impurities that are neutrally charged in Cu. The establishment of two numerical approaches of combined methods, appropriately including the local correlations in the 5d orbitals of Ir, has demonstrated that the correlation induced electron redistribution generates a positive sign of SHA that is consistent with that measured. Furthermore, the sign of SHA for CuIr is sensitive to perturbation of the local correlations, which is favorable with respect to controlling the sign of the transverse spin Hall voltage, as illustrated in Fig. 2, and may provide a way to devise a spin current switch or a spin current diode.

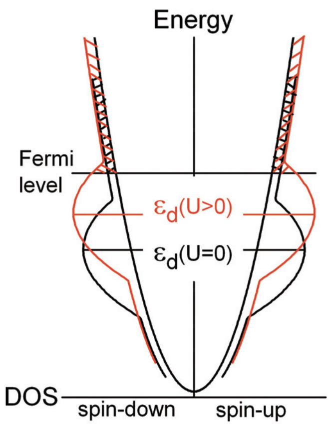

Fig. 1. Schematic diagram of the density of states (DOS) for nonmagnetic CuIr alloy with the 5d orbitals of Ir including the local correlation U, based on the Anderson model.

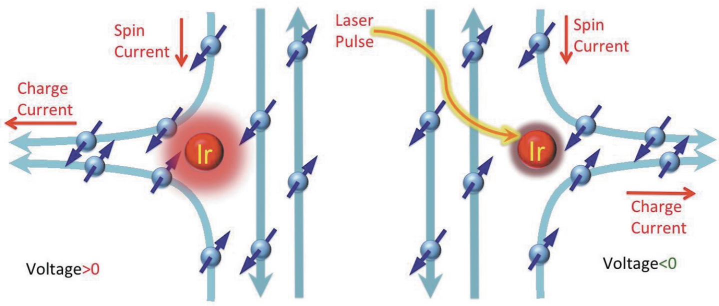

Fig. 2. Schematic diagram for external control of the sign of SHE in CuIr alloys.

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Charge and spin transport in edge channels of a ν=0 quantum Hall system of topological insulator thin films

Takahiro Morimoto and Naoto Nagaosa

T. Morimoto, A. Furusaki, and N. Nagaosa, "Charge and Spin Transport in Edge Channels of a ν=0 Quantum Hall System on the Surface of Topological Insulators", Phys. Rev. Lett. **114**, 146803 (2015). [http://dx.doi.org/10.1103/PhysRevLett.114.146803]

Since the discovery of topological insulators (TIs), the Weyl fermions at the surfaces of TIs have been predicted to exhibit a variety of novel phenomena, including the topological magneto-electric effect and the quantized anomalous Hall effect. In external magnetic fields, a single flavor Weyl fermion exhibits a *half-integer* quantum Hall effect (QHE). In TI thin films, Weyl fermions appear both at the top and bottom surfaces which leads to an odd-integer (ν=2N+1) QHE in total. However, a recent experimental report on TI thin films of $(Bi1_{-x}Sb_x)_2Te_3$ noted a novel plateau at ν=0 with gating [Yoshimi et al. Nat. Commun. **6**, 6627 (2015)]. The experimentally observed deviation from the odd-integer rule (ν=0 QHE) indicates that the degeneracy between the top and bottom surfaces is lifted in these experiments. Motivated by these advances, a theoretical investigation was performed on the ν=0 QHE at the surface of a TI thin film with potential asymmetry for top and bottom surfaces. As a result, the edge channels can appear at the side surface that connects the top and bottom surfaces under certain conditions. The edge channels govern transport properties in the ν=0 QHE. In particular, these edge channels account for the nonlocal charge transport that was recently observed in a magneto-transport experiment on $(Bi1_{-x}Sb_x)_2Te_3$ films. The edge channels connected to bulk Landau levels exhibit a nontrivial spin texture; therefore, we propose that the ν=0 quantum Hall system of TI thin films offer a new arena for various spintronics functions. The edge channels support spin current due to spin-momentum locking when a voltage (V_{12}) is applied along the side surface, as illustrated in Fig. 1. This spin current should be evidenced by an inverse spin Hall effect at electrode 3. Furthermore, a strong electric field applied by V_{12} leads to spin conversion at the side surface through Zener tunneling from the bulk Landau levels to the edge channels.

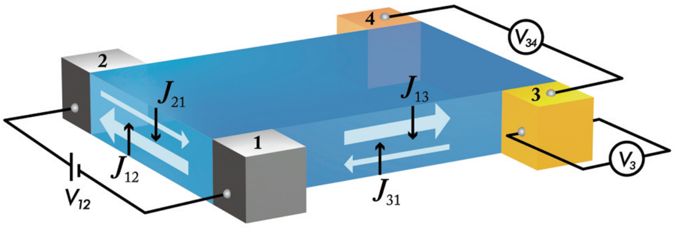
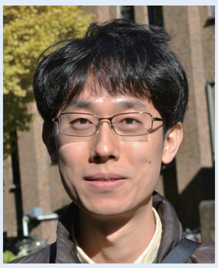


Fig. 1: Setup for the detection of charge and spin transport through edge channels.



Takahiro Morimoto
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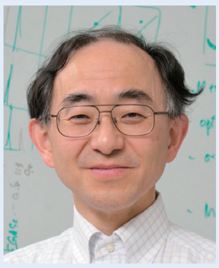

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Group home page http://www.cems.riken.jp/en/laboratory/sctrg

Thermal vector potential theory of transport induced by temperature gradient

Gen Tatara

G. Tatara, "Thermal vector potential theory of transport induced by temperature gradient",
Phys. Rev. Lett. **114**, 196601 (2015). [http://dx.doi.org/10.1103/PhysRevLett.114.196601]

Thermally-induced spin transport is essential in spintronics to realize devices that employ magnetic insulators and are suitable for fast magnetization switching and low-loss signal transmission. Luttinger's gravitational potential formalism, which was proposed 50 years ago, has been applied to date for the study of thermally-induced transport based on linear response theory. However, the formalism has been known to have not only technical difficulties, but also serious difficulties such as the appearance of non-physical divergence if the equilibrium contribution is not correctly subtracted. The problem arises from the modification of the equilibrium properties by the gravitational potential, besides inducing non-equilibrium responses. We have successfully developed an alternative description of the thermal effects by the introduction of a thermal vector potential, and confirmed that the formalism functions correctly without non-physical divergences for some typical examples of electron and spin transport phenomena. The thermal vector potential was demonstrated to couple to the energy current density via minimal coupling using the continuity equation of energy density. The vector potential formalism thus provides a foundation for theoretical studies of thermally-driven transport on an equal footing with electrically-driven transport, and is expected to significantly accelerate developments in thermal transport from both scientific and application perspectives.

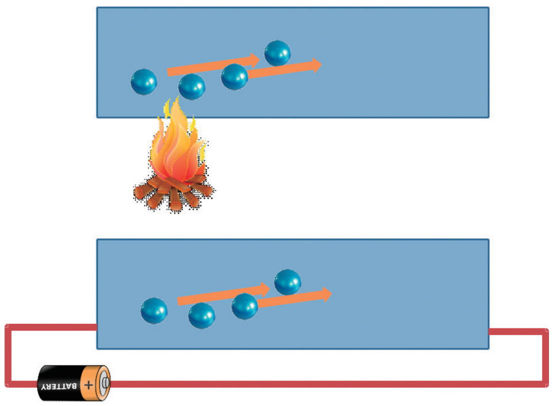

Fig. 1: Vector potential formulation has confirmed the equivalence of electric field and temperture gradient in transport phenomena.

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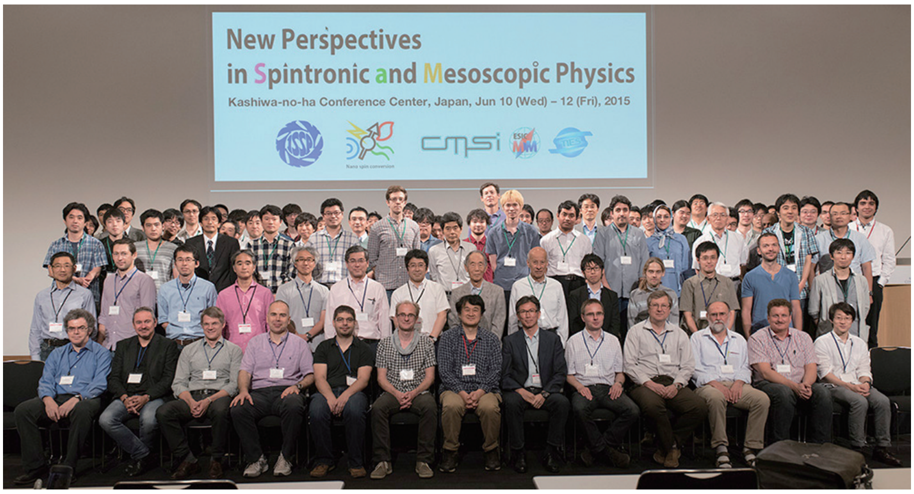
Meetings and Events

● Event Report

New Perspectives in Spintronics and Mesoscopic Physics (NPSMP2015)

The international symposium on New Perspectives in Spintronics and Mesoscopic Physics was held in Kashiwa, Japan from June 10 to 12, 2015. More than 130 researchers (including 40 foreign researchers) joined the symposium to share and discuss the latest experimental and theoretical topics in the interdisciplinary field of spintronics and mesoscopic science. At the symposium, 34 invited speakers and 54 posters on novel phenomena, materials and structures were presented. For detailed information, please refer to the symposium website:
http://www.issp.u-tokyo.ac.jp/public/npsmp2015.



(By Kazuya Harii, JAEA)

● Event announcement

9th International Conference on Physics and Applications of Spin-related Physics in Solids (PASPS 9)

url: http://www.pasps9.org/
August 8 (Mon) to 11 (Thu), 2016
Kobe International Conference Center, Kobe City, Japan
http://kobe-cc.jp/english/kaigi/index.html
Abstract deadline: April 1, 2016

The 9th International Conference on Physics and Applications of Spin-related Phenomena in Solids (PASPS 9) will be held at the Kobe International Conference Center in Kobe, Japan. PASPS is a biennial international conference that was initiated in Sendai (2002), and continued in Würzburg (2002), Santa Barbara (2004), Sendai (2006), Foz do Iguaçu (2008), Tokyo (2010), Eindhoven (2012) and Washington D.C. (2014). PASPS conferences have contributed to the development of spintronics as a leading research field for emerging novel fundamental physics and advanced device concepts in the last fifteen years. This conference aims to highlight the latest developments in the application of spin-dependent phenomena in nanoelectronics, and intends to provide not only an overview of the current understanding of the spin physics in solids, but also a forum for discussion of all the important issues and future challenges for spintronics technologies. Since PASPS VIII, the scope of the conference has been expanded to include the entire field of spin-related physics in semiconductors, metals, insulators, and organics.
We hope that this conference offers an opportunity for the exchange of ideas and to enjoy constructive discussion by addressing specific individual issues to realize new spintronics applications.

Plenary speakers: D. Awschalom (Chicago), J. Wrachtrup (Stuttgart), and Paul Crowell (Minnesota)

Invited speakers: Klaus Ensslin (ETH Zurich), H. Kurebayashi (UCL), C. Back (Regensburg), D. Chiba, (U. Tokyo), A. Imamoglu (ETH Zurich), A. Falk(IBM), H. Hwang (Stanford), W. Wernsdorfer (Institut NEEL), and K. Kondou (RIKEN)

(By Akira Oiwa, Osaka Univ.)

Organization of Nano Spin Conversion Science

Steering Committee

Principle Investigator YoshiChika Otani Institute for Solid State Physics, The University of Tokyo, Professor
Co-Investigator Eiji Saitoh Advanced Institute for Materials Research, Tohoku University, Professor, Tohoku University, Professor
Co-Investigator Masashi Shiraishi Graduate School of Engineering and Faculty of Engineering, Kyoto University, Professor
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Co-Investigator Koki Takanashi Institute for Materials Research, Tohoku University, Director
Co-Investigator Sadamichi Maekawa Advanced Science Research Center, Japan Atomic Energy Agency, Director General

Research group A01：Magnetic Spin Conversion

Principal Investigator YoshiChika Otani Institute for Solid State Physics, The University of Tokyo, Professor
Co-Investigator Takashi Kimura Faculty of Science, Kyushu University, Professor
Co-Investigator Fumihiro Matsukura Advanced Institute for Materials Research, Tohoku University, Professor
Co-Investigator Ronald Jansen Spintronics Research Center, National Institute of Advanced Industrial Science and Technology, Invited Senior Researcher
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Principal Investigator Shinji Miwa Graduate School of Engineering Science, Osaka University, Assistant Professor
Principal Investigator Toshu An School of Materials Science, Japan Advanced Institute of Science and Technology, Associate Professor

Research group A02：Electric Spin Conversion

Principal Investigator Masashi Shiraishi Graduate School of Engineering and Faculty of Engineering, Kyoto University, Professor
Co-Investigator Kohei Hamaya Graduate School of Engineering Science, Osaka University, Professor
Co-Investigator Shingo Katsumoto Institute for Solid State Physics, University of Tokyo, Professor
Co-Investigator Hidekazu Saito Spintronics Research Center, National Institute of Advanced Industrial Science and Technology,
Semiconductor Spintronics Team Leader
Co-Investigator Shik Shin Institute for Solid State Physics, University of Tokyo, Professor

Selected Projects

Principal Investigator Rai Moriya Institute of Industrial Science, University of Tokyo, Assistant Professor
Principal Investigator Shinobu Ohya Department of Electrical Engineering and Information Systems, The University of Tokyo, Associate Professor

Research group A03：Optical Spin Conversion

Principal Investigator Akira Oiwa The Institute of Scientific and Industrial Research, Osaka University, Professor
Co-Investigator Arata Tsukamoto Department of Electronic Engineering, Nihon University, Professor
Co-Investigator Shigemi Mizukami WPI Advanced Institute for Materials Research, Tohoku University, Professor
Co-Investigator Kazuya Ando Department of Applied Physics and Physico-Informatics, Keio University, Associate Professor

Selected Projects

Principal Investigator Sadashige Matsuo Department of Applied Physics, The University of Tokyo, Assistant Professor
Principal Investigator Osamu Sato Institute for Materials Chemistry and Engineering, Kyushu University, Professor

Research group A04：Thermodynamic Spin Conversion

Principal Investigator Eiji Saitoh Advanced Institute for Materials Research, Tohoku University, Professor, Tohoku University, Professor
Co-Investigator Masao Ono Advanced Science Reserch Center, Japan Atomic Energy Agency, Senior Scientist
Co-Investigator Koki Takanashi Institute for Materials Research, Tohoku University, Director

Selected Projects

Principal Investigator Atsushi Hatakeyama Department of Applied Physics, Tokyo University of Agriculture and Technology, Associate Professor
Principal Investigator Yukio Nozaki Department of Physics, Keio University, Associate Professor

Research Group A05：Functional design of Spin Conversion

Principal Investigator Shuichi Murakami Graduate School of Science and Engineering ,Tokyo Institute of Physics, Professor
Co-Investigator Sadamichi Maekawa Advanced Science Research Center, Japan Atomic Energy Agency, Director General
Co-Investigator Gen tatara RIKEN Center for Emergent Matter Science, Team Leader
Co-Investigator Naoto Nagaosa Department of Applied Physics, The University of Tokyo, Professor/ RIKEN Center for Emergent Matter Science, Deputy Center Director
Co-Investigator Gerrit E. W. Bauer Institute for Materials Research, Tohoku University, Professor

Selected Projects

Principal Investigator Tretiakov Oleg Institute for Materials Research, Tohoku University, Assistant Professor
Principal Investigator Fumiyuki Ishii Faculty of Mathematics and Physics, Kanazawa University, Associate Professor
Principal Investigator Shin Miyahara Faculty of Science Department of Applied Physics, Fukuoka University, Associate Professor
Principal Investigator Shigeki Onoda RIKEN Center for Emergent Matter Science, Senior Research Scientist