# DY 24: Spintronics (joint session TT/MA/DY)

Time: Tuesday 14:00–16:00 Location: H23

DY 24.1 Tue 14:00 H23

**Long-lived chirality states in low-temperature strongly-coupled Rashba systems** — •Philipp C. Verpoort, James R. A. Dann, Gareth J. Conduit, and Vijay Narayan — Department of Physics, University of Cambridge, J.J. Thomson Avenue, Cambridge CB3 0HE, UK

We observe ultra-slow magnetoresistance dynamics at sub-Kelvin temperatures in various systems that display strong Rashba spin-orbit coupling. These dynamics display a striking magnetoresistance curve that follows different traces depending on direction and speed of a magnetic field sweep. This novel effect cannot be explained by magnetisation or magnetocaloric effects. We suggest that the dynamics arise from detuning of the Fermi levels of the two Rashba bands and the slowness of their relaxation into equilibrium due to the suppression of interband scattering mechanisms that would be expected in conventional systems. Surprisingly, the relaxation timescale of this non-equilibrium state is 10 seconds so exceeds typical electronic relaxation timescales by several orders of magnitude, which makes this effect intriguing to study and relevant for potential applications in information processing.

DY 24.2 Tue 14:15 H23

**Channel analysis of atomic Pd contacts by Andreev Reflections** — •Martin Prestel[1], Torsten Pietsch[1,2], and Elke Scheer[1] — [1]Department of Physics, University of Konstanz, 78457 Konstanz, Germany — [2]now at: Carl Zeiss AG, 73447 Oberkochen, Germany

For the strong paramagnetic material palladium (Pd) theoretical calculations predicted a local magnetic ordering [1]. In transport measurements a strong non-monotonic magneto-transport behaviour as well as indications for Kondo resonances have been reported for atomic contacts in Pd [2]. To get a more detailed view of the nature of this magnetic ordering we want to investigate the transport channel distribution and their spin polarisation in such contacts. Therefore we add superconducting leads to apply the method of multiple Andreev reflections [3, 4, 5]. In this talk I will present first experimental superconducting current-voltage characteristics revealing superconducting proximity effect into Pd depending on the exact atomic configuration.

[1] Delin et al., Phys. Rev. Lett. 92, 057201 (2004)
[2] Strigl et al., Phys. Rev. B 94, 144431 (2016)
[3] Scheer et al., Nature 394, 154 (1998)
[4] Andersson et al., Physica C 367, 117-122 (2002)
[5] Martin-Rodero et al., Physica C 352, 67-72 (2001)

DY 24.3 Tue 14:30 H23

**Quasiparticle cooling using a Topological insulator-Superconductor hybrid junction** — •D. Bercioux[1,2] and P. Lucignano[3,4] — [1]Donostia International Physics Center, Paseo Manuel de Lardizbal 4, E-20018 San Sebastián, Spain — [2]IKERBASQUE, Basque Foundation of Science, 48011 Bilbao, Spain — [3]CNR-SPIN, Monte S.Angelo, via Cinthia, I-80126 Napoli, Italy — [4]Dipartimento di Fisica "E. Pancini", Universitá di Napoli "Federico II", Monte S.Angelo, I-80126 Napoli, Italy

We investigate the thermoelectric properties of a hybrid junction realised coupling surface states of a three-dimensional topological insulator with a conventional *s*-wave superconductor. We focus on the ballistic devices and study the quasiparticle flow, carrying both electric and thermal currents, adopting a scattering matrix approach based on conventional Blonder-Tinkham-Klapwijk formalism [1]. We calculate the cooling efficiency of the junction as a function of the microscopic parameters of the normal region (*i.e.* the chemical potential etc.). The cooling power increases when moving from a regime of Andreev specular-reflection to a regime where Andreev retro-reflection dominates. Differently from the case of a conventional N/S interface [2], we can achieve efficient cooling of the normal region, without including any explicit impurity scattering at the interface, to increase normal reflection [3].

[1] Blonder, Tinkham & Klapwijk, Phys. Rev. B **25**, 4515 (1982).
[2] Bardas & Averin, Phys. Rev. B **52**, 12873 (1995).
[3] Bercioux & Lucignano, arXiv:1804.07170, EPJ ST, *in press* (2018).

DY 24.4 Tue 14:45 H23

**Magnetism in atomic Gd contacts: Noise and transport measurements** — •Marcel Strohmeier, Martin Prestel, and Elke Scheer — Department of Physics, University of Konstanz, 78457 Konstanz, Germany

Materials with partially filled f shells bear interesting electronic and magnetic properties, wich have been intensively studied in bulk. Yet, on the atomic scale they are still a widely unexplored topic. For gadolinium (Gd) first transport measurements and theoretical calculations on the influence of f electrons on the electronic transport have been carried out [1]. To get a deeper insight into the magnetic ordering at the atomic scale we use the mechanically controllable break junction (MCBJ) technique at low temperatures to produce tunable atomic-size contacts. Here we present first measurements on magnetic transport behavior as well as shot noise measurements. Shot noise is known to reveal the exact channel configuration [2] and is even sensitive to spin polarization [3].

[1] Olivera et al., Phys. Rev. B 95, 075409 (2017)
[2] Kumar et al., Phys. Rev. Lett. 108, 146602 (2012)
[3] Burtzlaff et al., Phys. Rev. Lett. 114, 016602 (2015)

DY 24.5 Tue 15:00 H23

**Magnetoconductance in Bi quantum well states: coupling of interfaces** — •Doaa Abdelbarey and Herbert Pfnür — Institut für Festkörperphysik, Leibniz Universität Hannover

Ultrathin epitaxial Bi films are governed by strongly spin-polarized bands that determine to a large extent their magneto-transport properties. Magneto-conductance of films grown epitaxially on Si(111) with a thickness of 10 to 100 bilayers (BL) was measured mostly at T= 8 K in magnetic fields up to 4T and with orientations both perpendicular and parallel to the surface plane. For B-fields normal to the surface weak anti-localization (WAL) was observed. Analysis within the theory by Hikami et al. [1] indicates strong coupling of the interfaces up to 50 BL, whereas above 80 BL two independently conducting channels were observed. For the in-plane B-field orientation, the magneto conductivity turned out to be anisotropic. Whereas for in-plane B-fields parallel to the current direction and for films up to 70 BL mainly weak localization is seen, it switches to WAL for larger thicknesses. For in-plane B-fields perpendicular to the current only WAL was observed irrespective of thickness. Both curves merge close to 100 BL, i.e. WAL becomes independent of B-field direction. These phenomena are explained within the framework of interface scattering, including superimposed effects of band structure and spin polarization due to the Rashba effect.

[1] Hikami S., et al., Prog. Theor. Phys. 63, 707 (1980)

DY 24.6 Tue 15:15 H23

**Manipulating orbitals with magnetic fields** — xionghua liu, •chun-fu chang, alexander komarek, steffen wirth, and liu hao tjeng — Max Planck Institute for Chemical Physics of Solids, Nöthnitzerstr. 40, 01187 Dresden, Germany

Magnetite ($Fe_3O_4$) is one of most controversially discussed materials in solid state physics due to its enigmatic Verwey transition, while being heavily studied as thin film for spintronic applications. Here, we report on our study of the Verwey transition under magnetic fields in $Fe_3O_4$ thin films on spinel substrates $Co_{2-x-y}Mn_xFe_yTiO_4$ and non-magnetic $Mg_2TiO_4$. The Verwey transition of these films is highly tunable and anisotropic with applied magnetic fields. The strong magnetostriction evidences an active spin-orbit effect of the $Fe^{2+}$ ($d^6$) ions in $Fe_3O_4$ which allows one to manipulate the $Fe^{2+}$ orbital occupation via magnetic fields. Remarkably, the high magnetic tunability of the Verwey transition results in a closed magnetoresistance (MR)-loop with an MR as large as 88% at 0.5 Tesla, which is up to 2 order larger than the reported values of $Fe_3O_4$ films.

DY 24.7 Tue 15:30 H23

**Noise of charge current generated by a precessing itinerant ferromagnet** — •Tim Ludwig[1], Igor S. Burmistrov[2,3,1,4], Yuval Gefen[5], and Alexander Shnirman[1,4] — [1]Institut für Theorie der Kondensierten Materie, Karlsruhe Institute of Technology, 76128 Karlsruhe, Germany — [2]L.D. Landau Institute for Theoretical Physics RAS, Kosygina street 2, 119334 Moscow, Russia — [3]Laboratory for Condensed Matter Physics, National Research University Higher School of Economics, 101000 Moscow, Russia — [4]Institut für Nanotechnologie, Karlsruhe Institute of Technology, 76021 Karlsruhe, Germany — [5]Department of Condensed Matter Physics, Weizmann Institute of Science, 76100 Rehovot, Israel

We determine the zero frequency noise of charge current that is generated by a precessing small itinerant ferromagnet which is tunnel-coupled to two normal metal leads. We assume the leads to be in equilibrium with each other, i.e. neither voltage nor thermal bias is applied. In this situation, the average charge current vanishes. However, the noise of charge current remains. While at high temperatures, we obtain the standard thermal noise; for low temperatures we find the noise of charge current to be governed by the precession frequency of the magnetization and the angle between magnetization and precession axis. We propose that this result can be used in FMR-type experiments to gain additional information about the magnetization dynamics.

DY 24.8 Tue 15:45 H23

**Time stable remanence in Dzyaloshinskii Moriya Interaction driven canted antiferromagnets** — Namrata Pattanayak[1], AAkanksha Kapoor[1], Arun kumar Nigam[2], and •Ashna Bajpai[1] — [1]Indian Institute of Science Education and Research, Pune, India — [2]Tata Institute of Fundamental Research , India

We report remanence measurements conducted on a number of magnetic oxides which are Dzyaloshinskii-Moriya Interaction (DMI) driven canted antiferromagnets or weak ferromagnets (WFM). All these systems are also symmetry allowed piezomagnets (PzM). We consistently observe an ultra-slow magnetization dynamics with a counter-intuitive magnetic field dependence in these WFM or PzM. This ultra- slow magnetization dynamics manifests itself in the form of a time-stable remanence and appears exclusive to these WFM. Though the effect is tunable with nano scaling, it is intrinsic in nature as these features are also observed in bulk single crystal. We further demonstrate that the magnitude of this unique remanence can be significantly enhanced at the room temperature by encapsulation of these WFM inside carbon nanotubes. These results illustrate why encapsulation of these functional magnetic oxides within carbon nanotubes is interesting from fundamental point of view and it can lead to nano spintronic devices tunable by electric field, magnetic field and possibly by stress.