Symposium SKM Dissertation-Prize 2016 (SYSD)

jointly organized by
the divisions of the Condensed Matter Section (SKM)

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The divisions belonging to the Condensed Matter Section (SKM) of the DPG award a Dissertation Prize in 2016 again. The prize acknowledges outstanding research during the PhD work in the research areas of SKM completed in 2014 or 2015, and its excellent oral presentation. Based on nominations a jury formed by the chairpersons of all SKM divisions has selected four finalists for the award to present their work in this symposium. The winner will be selected after the symposium and publicly announced Tuesday, March 8th, in the afternoon during the ceremonial session.

Overview of Invited Talks and Sessions

(Lecture room H2)

Invited Talks

SYSD 1.1	Mon	10:30–10:55	H2	**Parallel pumping: Novel means of spin-wave manipulation on the micro-scale** — •Thomas Brächer
SYSD 1.2	Mon	10:55–11:20	H2	**Self-referenced quantized current source** — •Lukas Fricke
SYSD 1.3	Mon	11:20–11:45	H2	**Signatures of Majorana states in magnetic adatom chains** — •Falko Pientka
SYSD 1.4	Mon	11:45–12:10	H2	**Imaging Spin Textures on Curved Magnetic Surfaces** — •Robert Streubel, Peter Fischer, Florian Kronast, Oliver G. Schmidt, Denys Makarov
SYSD 1.5	Mon	12:10–12:35	H2	**Observing Electron Dynamics in Two Dimensions** — •Søren Ulstrup

Sessions

SYSD 1.1–1.5	Mon	10:30–12:35	H2	**SKM Dissertation-Prize 2016**

SYSD 1: SKM Dissertation-Prize 2016

Time: Monday 10:30–12:35 Location: H2

Invited Talk SYSD 1.1 Mon 10:30 H2

Parallel pumping: Novel means of spin-wave manipulation on the micro-scale — •Thomas Brächer — Univ. Grenoble Alpes, CNRS, CEA, INAC-SPINTEC, 17, rue des Martyrs 38054, Grenoble, France — Fachbereich Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany

Spin waves and magnons, their quanta, are highly promising candidates for the realization of a wave-based logic beyond CMOS, which transmits information in the form of amplitude and phase of spin waves. In this context, the amplification of spin waves is a central issue. Parallel pumping, i.e., the conversion of microwave photons into pairs of magnons at half the microwave frequency, is a versatile technique to realize frequency-selective generation and amplification of spin waves. I studied these effects in microstructured spin-wave waveguides of various geometries, proving its applicability on the micro-scale. Moreover, I demonstrated that beyond a mere amplification, parallel pumping can also be used to perform logic operations in the spin-wave system.

Invited Talk SYSD 1.2 Mon 10:55 H2

Self-referenced quantized current source — •Lukas Fricke — Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany — CQC2T, UNSW, Sydney, Australia

Scheduled for 2018, the International System of Units is about to undergo a fundamental change by introducing seven defining constants, leading to a universal system of units based on constants of nature as proposed already by Maxwell and Planck. In the case of the Ampere, the defining constant will be the elementary charge e: Employing a single-electron pump, the current I is realized by transferring a precisely known number of electrons in a clocked manner, leading to the relation $I = \langle n \rangle ef$ with $\langle n \rangle$ the average number of charge carriers transferred per cycle and f the driving clock frequency.

Here, we demonstrate a complex circuit involving serially connected electron pumps and single-electron transistors attached to the interconnecting nodes. This allows to investigate electron pumps on the level of individual transfer cycles using full counting statistics. This method enables us to derive the single-electron transfer accuracy $1 - \langle n \rangle$ of the pump and to determine the underlying mechanisms of charge transfer.

Finally, the self-referenced single-electron source is discussed which enables the *in-situ* verification of the output current. By counting and attributing rare transfer errors, the uncertainty of the average number of transferred electrons $\langle n \rangle$ can be reduced by orders of magnitude, thereby making a practical realization of a quantum current standard based on a clocked single-electron source feasible.

Invited Talk SYSD 1.3 Mon 11:20 H2

Signatures of Majorana states in magnetic adatom chains — •Falko Pientka — Dahlem Center for Complex Quantum Systems and Fachbereich Physik, Freie Universität Berlin, 14195 Berlin, Germany — Department of Physics, Harvard University, Cambridge, Massachusetts 02138, USA

Recently, topological phases in superconductors hosting exotic Majorana states have become the subject of intense experimental and theoretical investigation. Majoranas exhibit nonabelian exchange statistics potentially useful for topologically protected quantum computing.

Possible signatures of Majorana states have been found in a recent STM experiment probing magnetic adatoms chains on the surface of a superconductor. In this talk, I will discuss the intriguing physics of the proximity effect in this system, which gives rise to a series of unexpected phenomena such as strongly localized Majorana states and an unconventional topological phase with long-range couplings.

I will also address experimental challenges of STM experiments on superconductors and show how an improved understanding of the relevant tunneling processes can be used to determine quasiparticle dynamics of superconducting bound states.

Invited Talk SYSD 1.4 Mon 11:45 H2

Imaging Spin Textures on Curved Magnetic Surfaces — •Robert Streubel[1,2], Peter Fischer[1,3], Florian Kronast[4], Oliver G. Schmidt[1], and Denys Makarov[1,5] — [1]Institute for Integrative Nanosciences, IFW Dresden, Dresden, Germany — [2]Materials Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, USA — [3]Physics Department, UC Santa Cruz, Santa Cruz, USA — [4]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin, Germany — [5]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf e.V., Dresden, Germany

Extending 2D structures into the third dimension allows for modifying conventional or for launching novel functionalities. A proper characterization of 3D magnetic objects demands tomographic imaging reconstructing the magnetization vector field. State-of-the-art techniques, i.e. magnetic neutron tomography and vector field electron tomography, provide means to investigate macroscopic and nanoscopic samples; An characterization of mesoscopic specimens is not possible, yet highly demanded.

The main objective of the thesis was to develop a visualization technique that provides nanometer spatial resolution to image magnetic domain patterns on extended 3D curved surfaces. The proposed and realized concept of magnetic soft X- ray tomography (MXT), based on the X-ray magnetic circular dichroism (XMCD) effect with soft X-ray microscopies, is demonstrated by reconstructing the magnetic domain patterns on 3D curved surfaces resembling hollow cylindrical objects.

Invited Talk SYSD 1.5 Mon 12:10 H2

Observing Electron Dynamics in Two Dimensions — •Søren Ulstrup — Advanced Light Source, Lawrence Berkeley National Laboratory, Berkeley, 94720 CA, USA - Department of Physics and Astronomy, Aarhus University, 8000 Aarhus C, Denmark

Since the discovery of the all-carbon two-dimensional (2D) material graphene more than a decade ago the library of available 2D materials has been rapidly expanding. These materials not only host interesting physics, but may also lead to technological advances due to highly promising electronic and optical properties.

Here, I will discuss how we can directly study the energy and momentum distributions of the 2D electrons that give rise to many of these important properties in a variety of systems, including graphene and single layers of the semiconducting transition metal dichalcogenides (TMDCs). By using angle-resolved photoemission spectroscopy (ARPES), as well as recent advances of this method that have added either spatial resolution or femtosecond time-resolution, we are able to gain information that allows us to tailor new interesting 2D material systems, to investigate and tune the light-matter interaction in these materials and to discover new important physical phenomena.