Symposium SKM Dissertation Prize 2026 (SYSD)

jointly organised by
all divisions of the Condensed Matter Section of the DPG

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The divisions belonging to the Condensed Matter Section (SKM) of the DPG annually award the SKM Dissertation Prize. The prize acknowledges outstanding research during the doctoral studies in the research areas of the SKM completed between October 2023 and 2025, and its excellent oral presentation. Based on nominations, a jury consisting of the chair persons of all SKM divisions has selected five finalists to present their work in this symposium. The winner will be selected after the symposium and publicly announced Tuesday, March 10, 2026 in the afternoon during the ceremonial session (Lecture hall HSZ/AUDI starting at 16:00).

Overview of Invited Talks and Sessions

(Lecture hall HSZ/0002)

Invited Talks

SYSD 1.1	Mon	9:30–10:00	HSZ/0002	**Stochastic-Calculus Approach to Non-equilibrium Statistical Physics** — •Cai Dieball
SYSD 1.2	Mon	10:00–10:30	HSZ/0002	**Nonuniform magnetic spin textures for sensing, storage and computing applications** — •Sabri Koraltan
SYSD 1.3	Mon	10:30–11:00	HSZ/0002	**Anomalous Quantum Oscillations beyond Onsager's Fermi Surface Paradigm** — •Valentin Leeb
SYSD 1.4	Mon	11:00–11:30	HSZ/0002	**Coherent Control Schemes for Semiconductor Quantum Systems** — •Eva Schöll
SYSD 1.5	Mon	11:30–12:00	HSZ/0002	**On stochastic thermodynamics under incomplete information: Thermodynamic inference from Markovian events** — •Jann van der Meer

SYSD 1: SKM Dissertation Prize Symposium 2026

Time: Monday 9:30–12:00 Location: HSZ/0002

Invited Talk SYSD 1.1 Mon 9:30 HSZ/0002
Stochastic-Calculus Approach to Non-equilibrium Statistical Physics — •Cai Dieball — Max Planck Institute of Multidisciplinary Sciences, Göttingen, Germany

Truly understanding living matter requires understanding physical processes far from thermodynamic equilibrium on the level of individual molecules. While single-molecule experiments can probe individual stochastic trajectories, the strong influence of thermal noise and limited number of repetitions pose significant challenges. Here, we address these challenges using the mathematical framework of stochastic calculus. This approach yields important insights into fluctuations of time-averaged densities and currents, which are central observables in non-equilibrium stochastic thermodynamics [1]. Building on these methodological advances, we provide a new route to derive thermodynamic uncertainty relations that link observed currents to the distance to equilibrium, quantified via entropy production [2]. Strikingly, this new derivation generalizes to trade-off relations beyond thermodynamic uncertainty relations, enabling thermodynamic inequalities for bulk observables and dynamics with inertia [3]. Furthermore, we employ the stochastic framework to theoretically predict and experimentally confirm an asymmetry between heating and cooling dynamics far from equilibrium [4].

[1] C. Dieball, A. Godec, Phys. Rev. Lett. 129, 140601 (2022)
[2] C. Dieball, A. Godec, Phys. Rev. Lett. 130, 087101 (2023)
[3] C. Dieball, A. Godec, Phys. Rev. Lett. 133, 067101 (2024)
[4] M. Ibáñez, C. Dieball, et al., Nat. Phys. 20, 135 (2024)

Invited Talk SYSD 1.2 Mon 10:00 HSZ/0002
Nonuniform magnetic spin textures for sensing, storage and computing applications — •Sabri Koraltan — Insitute of Applied Physics, TU Wien, Vienna, Austria

Spintronic materials underpin many modern technologies, from hard-disk drives to magnetic sensors. While these applications traditionally rely on uniform magnetization states, recent advances focus on nonuniform magnetic textures such as vortices, and skyrmions. In my doctoral thesis, I explored such textures for sensing, storage, and computing applications [1].

The first part of my talk covers the discovery and characterization of spin textures with arbitrary topological charge in ferromagnetic [Co/Ni] multilayers [2]. Using simulations and experiments, we demonstrate coexisting higher-order skyrmions and antiskyrmions and uncover their distinct dynamics under spin-transfer torques.

The second part presents a three-dimensional magnetic-field sensor with a wide linear range and intrinsic offset cancellation, enabled by spin-orbit torque symmetry in a [W/CoFeB/MgO]*10 multilayer that stabilizes stripe domains and skyrmions [3]. I will show, through experiment and micromagnetics, how spin-orbit torques reshape the magnetic state at high current densities to achieve full 3D sensing, with topological transitions detected electrically via the anomalous Hall effect.

[1]SK (2025), PhD Thesis, doi:10.25365/THESIS.77909;[2] MH, SK et al., Nat. Phys. 20 (2024) 615*622;[3] SK et al., arXiv:2403.16725 (2024).

Invited Talk SYSD 1.3 Mon 10:30 HSZ/0002
Anomalous Quantum Oscillations beyond Onsager's Fermi Surface Paradigm — •Valentin Leeb — University of Zurich — Technical University of Munich

Quantum oscillation measurements are the most precise method for determining Fermi surface properties in bulk three-dimensional metals, owing to Onsager's relation, which connects the oscillation frequency to an extremal cross-section of the Fermi surface. This canonical, semiclassical theory of quantum oscillations has been remarkably successful in unearthing electronic properties of metals for over 75 years. However, with the emergence of modern quantum materials and advancements in experimental sensitivity, breakdowns of the semiclassical theory have recently come to light. In this talk, I demonstrate that additional quantum oscillation frequencies - breaking Onsager's relation - emerge generically in multiband metals. These anomalous frequencies, referred to as non-Onsager oscillations, are induced by impurities, scattering from fluctuations, or weak and strong electronic interactions. Using a combination of analytic theory, numeric modeling, and experimental verification, I establish them as fundamental features of quantum oscillation spectra. Properly identifying non-Onsager oscillations is essential for accurately reconstructing the Fermi surface. Moreover, these frequencies encode rich information about underlying material properties beyond the scope of the semiclassical theory. The results, presented here, refine our understanding of quantum oscillations in complex materials and open new avenues for probing electronic correlations, emergent phenomena, and unconventional metallic states.

Invited Talk SYSD 1.4 Mon 11:00 HSZ/0002
Coherent Control Schemes for Semiconductor Quantum Systems — •Eva Schöll — PhoQS Institute, CeOPP, and Department of Physics, Paderborn University, Paderborn, Germany — Institute of Semiconductor and Solid State Physics, Johannes Kepler University, Linz, Austria — Institute for Integrated Circuits and Quantum Computing, Johannes Kepler University, Linz, Austria

Single photons are fundamental building blocks for advancing quantum technologies. Therefore, quantum light sources that simultaneously exhibit properties such as high single-photon purity, indistinguishability, and entanglement fidelity are essential. Semiconductor quantum dots (QDs) are promising candidates that already meet many of these requirements. In this talk, I will provide a deeper understanding of the underlying quantum-level schemes and reveal an intrinsic limit on indistinguishability for photons arising from a radiative cascade. To address this, we studied QDs under s-shell resonant excitation and two-photon excitation (TPE), and introduced a novel excitation technique combining TPE with stimulation of the first transition. This method can overcome the previously mentioned limit on indistinguishability.

Invited Talk SYSD 1.5 Mon 11:30 HSZ/0002
On stochastic thermodynamics under incomplete information: Thermodynamic inference from Markovian events — •Jann van der Meer — Department of Physics No. 1, Graduate School of Science, Kyoto University, Kyoto 606-8502, Japan

Stochastic thermodynamics provides the framework for analyzing thermodynamic quantities along individual trajectories of small but fully observable systems. If, however, the observable dynamics is coarse-grained, i.e., does not capture all relevant degrees of freedom, the principles of stochastic thermodynamics generally cannot be applied directly. With access to some observables, preeminent results in the field (e.g. the thermodynamic uncertainty relation) often establish lower bounds on the average entropy production in terms of such observables.

However, there is no reason why attention should be limited to bounds on the averaged entropy production only. In my talk, I present the concept of a fluctuating entropy production on the coarse-grained level, which contains more information than about averages only, thereby allowing us to, e.g., estimate the strength of driving forces and localize entropy production spatially and temporally. From a theoretical point of view, these results rely on the identification of Markovian events, a systematic way of describing the dynamics and thermodynamics of a variety of possible coarse-grained dynamics in terms of semi-Markov processes.