

Call for Proposals

No. 29

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Priority Programme “Skyrmionics: Topological Spin Phenomena in Real-Space for Applications” (SPP 2137)

The Senate of the Deutsche Forschungsgemeinschaft (DFG) has announced the establishment of the Priority Programme “Skyrmionics: Topological Spin Phenomena in Real-Space for Applications” (SPP 2137). The programme is scheduled to run for six years; the DFG invites with this call proposals for the first three-year funding period.

The main objective of the Priority Programme will be fundamental research towards the development of devices and applications based on topological spin solitons in real space, alluding to skyrmions as most prominent examples. It is motivated by the recent discovery of skyrmion lattices and isolated skyrmions in magnetic materials exhibiting bulk or interface inversion-asymmetry and associated Dzyaloshinskii-Moriya interaction. Skyrmions can be found in bulk compounds and tailored thin film and nano-systems. Studies of the fundamental properties of skyrmion systems have revealed several remarkable features associated with non-trivial topological winding. As one prime example, electrons traversing this spin-texture accumulate geometrical phases – Berry phases – that may be described by emerging electric and magnetic fields, leading to new transport phenomena. Others are novel mechanisms of creating and deleting magnetic configurations and metastable states, new capabilities to create and destroy magnetically encoded information as well as exceptionally efficient coupling to spin currents generating spin transfer torques at dramatically reduced current densities.

Experimental and theoretical evidence that thin films, nano-wires and nano-dots are particularly amenable to the formation of topological spin solitons, underscore their potential for major breakthroughs in applications. Moreover, advances in thin film heterostructures demonstrate that skyrmions stabilised by interface mediated Dzyaloshinskii-Moriya interactions may be tailored for applications at room temperature.

The main new aspects to be addressed within the programme concern in particular non-trivial topological characteristics (e.g. skyrmions, antiskyrmions, hybrid-particles composed of skyrmions and magnetic singularities) and associated solitonic properties stabilised by anti-symmetric (chiral) spin-orbit coupling and additional interactions.

The Priority Programme will be organised in three research areas:

- (1) new materials and tailored design of static and dynamic properties of topological spin solitons,
- (2) topological spin solitons in nanostructured systems,
- (3) topological spin solitons in artificial composite systems,

pursuing the following milestones:

- tailored design of topological spin phenomena in thin films including bulk samples in the thin film limit, focussing on non-centrosymmetric materials with a vision of potential applications,
- the creation, destruction and external manipulation of skyrmions and related topological spin phenomena in nano-structured systems exploiting interface asymmetry driven spin interactions,
- insights in advanced hybrid architectures revealing new functionalities of topological spin phenomena in real space such as fractional excitations.

The programme has an interdisciplinary character. It aims to connect the spintronics community with fundamental research on new materials, as well as engineering, mathematics and chemistry related aspects. The progress on skyrmionics is gained through mathematical reasoning, micromagnetic and atomistic simulations, computational and theoretical condensed matter physics, cutting edge synthesis techniques, advanced and highly specialised imaging and characterisation methods, supplemented with engineering strategies developed for the design of nano-electronic devices.

The Priority Programme encourages a broader exchange of scientific ideas and concepts with areas such as particle and nuclear physics, quantum Hall systems and soft matter (polymers and liquid crystals). However, specific proposals from these communities are not in the focus of the programme.

For organisational reasons applicants are kindly requested to send an outline of their proposal for the first three-year funding period in electronic form (pdf-file) to the DFG office (cosima.schuster@dfg.de) and the coordinator (christian.pfleiderer@frm2.tum.de) by 10 July 2017. The outline, with a maximum length of one page, should contain a short description of the project, an assignment to one of the three research areas, information about the applicants, and registration for the networking meeting. The submission of a proposal outline is voluntary and non-committal.

A networking meeting (participation optional) with poster presentations of the planned projects and subsequent discussions will take place on 11 July 2017 at the University of Mainz (local organiser: Dr. Karin Everschor-Sitte; kaeversc@uni-mainz.de). Detailed information may be requested from the DFG office, the programme coordinator, the local organiser, or may be found at the Priority Programme's website.

Proposals for the first three-year funding period may be submitted by **23 October 2017** through the DFG's electronic proposal processing system "elan". In the "elan" system please select the SPP "Skyrmionics" when submitting your proposal. All proposals must be written in English. Proposal guidelines and preparation instructions are outlined in DFG forms 54.01en and 50.05en, part B. Please study carefully the publication rules set by the DFG.

If you are using the "elan" system for the first time, please note that you need to register yourself and your institutional address before being able to submit a proposal. Please make sure that all applicants of your project (in case there is more than one) start their registration at the latest two weeks before the submission deadline.

The review will be held during an evaluation workshop on 18 & 19 January 2018 at the Physik-Zentrum in Bad Honnef (arrival on 17 January in the evening).

Further information

For further information please refer to the Priority Programme's website:
www.skyrmionics.ph.tum.de

The DFG's electronic portal "elan" can be found at:
<https://elan.dfg.de>

Proposal guidelines and preparation instructions are outlined in DFG forms 50.05 and 54.01, which can be found on the DFG's website at:
www.dfg.de/formulare/50_05
www.dfg.de/formulare/54_01

For scientific enquiries please contact the programme coordinator:
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For administrative enquiries please contact:
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For questions about the networking meeting in Mainz please contact:
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