Call for Proposals

No. 37 **3 June 2015**

Priority Programme "Giant Interactions in Rydberg Systems" (SPP 1929)

The Senate of the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) has established the Priority Programme "Giant Interactions in Rydberg Systems" (SPP 1929). The programme is designed to run for six years; the present call invites proposals for the first three-year funding period.

The Priority Programme wants to establish a crossdisciplinary research platform in Germany for the investigation and exploitation of the extraordinary interaction properties of quantum systems in highly excited Rydberg states. It addresses not only fundamental questions relying on Rydberg interactions in few and many-body systems, quantum nonlinear optics and surface science but also applications in various fields of classical and quantum technology as well as metrology.

Successful proposals will go beyond traditional Rydberg physics and address topics from the following four research areas:

- The research area "Rydberg quantum optics", which exploits the giant interaction between Rydberg atoms for strong photon-photon coupling to develop and explore key elements of quantum information technology such as few photon devices. One objective could be the theoretical modelling and experimental realisation of novel many-body photon states. The physical systems might include trapped, cold atomic gases and vapour cells but could also be extended to promising new technological platforms such as vapour-filled hollow core fibres or Rydberg excitons in semiconductors.
- The research area "Rydberg aggregates", in which new materials with Rydberg-like excitations such as carbon nanotubes and nano-structured arrays of nanotubes may be investigated. The focus should lie on the properties of novel liquid states of Rydberg matter, and on exotic Rydberg molecules.
- The research area "Rydberg interfaces", in which it is planned to couple Rydberg systems coherently to other physical systems in a controlled way. This might include light, optomechanical oscillators, trapped ions, surfaces and superconducting circuits.
- The research area "Rydberg many-body physics", in which the strength and the non-local character of resonant dipole-dipole interactions of Rydberg systems may be exploited to study many-body physics. Here, new quantum phases based on Rydberg dressing, such as the elusive super-solid, could be explored. Many-body Rydberg systems are furthermore an ideal platform for simulating quantum spin models or realising exotic magnetic phases. Rydberg gases offer also new experimental approaches to study immersed quantum systems such as neutral or charged impurities, or the formation of polarons in the strongly in-

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teracting regime. Novel many-body phenomena can arise in solid state systems due to the interplay between Coulomb and Rydberg interactions in semiconductor Rydberg excitons.

Proposals for this Priority Programme should not deal with more traditional fields of single atom Rydberg physics like, for example, spectroscopy in astrophysics, single electron wavepacket dynamics or single atom micromaser physics.

Research proposals for the first three-year funding period, to be written in English, are now invited. All proposals should follow the guidelines in DFG forms 50.05 (Priority Programmes, Part B) and 54.01 (Project Proposals). Please include a title page with your name, institution, and the title of your project in your application. The deadline for proposal submission is **25 November 2015.** A proposal template is available on the website of the Priority Programme at http://www.giryd.de.

Proposals must be submitted via the DFG's electronic submission system elan, selecting "SPP 1929". If you are using the elan system for the first time, please note that you need to register yourself and your institutional addresses before being able to submit a proposal. If you are planning to move to a different institution (e.g. with a Temporary Position for Principal Investigators) you need to register with the address of the new institution. Please make sure that all applicants of your project start their registration at the latest two weeks before the submission deadline as registration requests are taken care of manually by DFG staff. In addition to submitting your proposal to the DFG, please send an electronic version (pdf format) to the coordinator.

A colloquium and review panel meeting is scheduled from 6 April 2016 to 7 April 2016 in Bad Honnef.

Further information

For further information on the Priority Programme and for a proposal template please refer to:
www.giryd.de

The DFG's electronic proposal processing system elan with proposal instructions and guidelines can be found at:
https://elan.dfg.de

Proposal guidelines and preparation instructions are outlined in DFG forms 54.01en and 50.05en, part B, and guidelines for publication lists in DFG form 1.91en which can be found on the DFG's website at:
www.dfg.de/foerderung/formulare/

For scientific inquiries concerning the scope of the Priority Programme, please contact the programme's coordinator:
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