Deutsche Forschungsgemeinschaft

Information für die Wissenschaft Nr. 62 | 14. September 2018 Priority Programme “Giant Interactions in Rydberg Systems (GiRyd)” (SPP 1929)

In 2015, the Senate of the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) established the Priority Programme “Giant Interactions in Rydberg Systems (GiRyd)” (SPP 1929). The programme is designed to run for six years. The present call invites proposals for the second three-year funding period.

The Priority Programme wants to develop 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 area of “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, opto-mechanical 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 interacting 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.

Proposals must be written in English and submitted to the DFG by **4 February 2019**. Please note that proposals can only be submitted via elan, the DFG’s electronic proposal processing system.

Applicants must be registered in elan prior to submitting a proposal to the DFG. If you have not

yet registered, please note that you must do so by **21 January 2019** to submit a proposal under this call. Also, if you are planning to move to a different institution (e.g. with a temporary position for principal investigators) you need to register the new institutional address beforehand. You should receive confirmation of your registration by the next working day. Note that you will be asked to select the appropriate Priority Programme call during both the registration and the proposal process.

If you would like to submit a proposal for a new project within the existing Priority Programme, please go to Proposal Submission – New Project – Priority Programmes and select “SPP 1929” from the current list of calls. Previous applicants can submit a proposal for the renewal of an existing project under Proposal Submission – Proposal Overview/Renewal Proposal.

In preparing your proposal, please review the programme guidelines (form 50.05, section B) and follow the proposal preparation instructions (form 54.01). These forms can either be downloaded from our website or accessed through the elan portal. Please include a title page with your name, institution, and the title of your project in your application. A proposal template is available on the website of the Priority Programme. In addition to submitting your proposal via elan, please send an electronic copy to the programme coordinator.

The review colloquium for the Priority Programme will be held on 22/23 May 2019 at the Physikzentrum Bad Honnef.

Further Information

More information on the Priority Programme is available under:

- http://giryd.de
  http://giryd.de

The elan system can be accessed at:

- https://elan.dfg.de/en
  https://elan.dfg.de/en

DFG forms 50.05 and 54.01 can be downloaded at:

- www.dfg.de/formulare/50_05
  ../../../formulare/50_05/index.jsp
- www.dfg.de/formulare/54_01
  ../../../formulare/54_01/index.jsp

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