

Call for Proposals

No. 52

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Priority Programme “Disruptive Memory Technologies” (SPP 2377)

In March 2021, the Senate of the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) established the Priority Programme “Disruptive Memory Technologies” (SPP 2377). The programme is designed to run for six years. The present call invites proposals for the first three-year funding period.

Motivation

Ever since pioneers like Konrad Zuse and John von Neumann laid the foundation for today’s computer architectures, memory has been a central component in every system. The hardware technology of memories has evolved over the decades, leading to greater capacities and higher speeds, but essential properties of the interface between hardware and software have remained the same: Main memories were usually volatile, passive and largely homogeneous. These typical properties are now so firmly anchored in the expectations of software developers that they manifest in their products.

We are currently observing a wave of innovations in the field of memory that nullify these assumptions and, in this sense, are disruptive for the entire software industry and various sub-domains of computer science. For example, current server processors allow the use of non-volatile main memory modules with a low price and very high capacity. An increasing number of embedded computer systems is also being equipped with non-volatile memories, e.g. on the basis of FRAM technology. In the area of high-performance computing, there are platforms with hybrid memories that combine extremely fast “high-bandwidth memories” with classic memory modules. Intensive research and development is also being done on “in-memory” and “near-memory” computing approaches, which abandon the traditional Von Neumann architecture. They allow a large number of parallel operations on data objects in or close to the memory with an enormous potential for performance improvements.

Overall, these and other ongoing innovations in main memory technology promise various improvements for all computer systems, for example lower energy consumption, higher processing power, more reliability, and simplifications and thus cost reductions. However, how to make use of all these new possibilities for existing and future software and thus overall systems is largely unclear.

Goals

The aim of this Priority Programme is therefore to explore the potentials of ongoing developments in the field of main memory technologies and architectures. Despite the disruptive nature of these technologies, systems software and applications shall be enabled to fully exploit them. In order to master disruptive memory technologies and their impact on the overall memory hierarchy, research efforts are required on all levels of the classic system software stack, for example:

- **Computer Architecture (Technical Computer Science):** innovative architectures, for example, sensor nodes with fully-persistent state; improving/adapting existing architectures, for example, issues of volatile and non-volatile memory co-existence; instruction set extensions and memory management units
- **Operating Systems:** software abstractions for new types of memory; integration into the memory hierarchy; fine-grained isolation and sharing of persistent objects; synchronisation mechanisms and memory transactions; systems that never reboot; removal of “persistent” faults or bugs
- **Algorithms / Data Structures:** dealing with heterogeneity (high/low bandwidth, different read/write performance); lightweight transactions on data structures
- **Databases:** optimised usage of different memory types, for example, index structures in persistent memory or optimised query execution
- **Languages / Compilers / Software Engineering:** support for In/Near-Memory Computing; evolution of persistent state; extended type systems and other models for novel classes of memory; conversion of legacy software; potential bugs related to the new technology

Proposed projects must have a clear relation to the above-mentioned aim of the Priority Programme. The addressed research questions are expected to be evolutionary (improving existing systems in a focused manner), disruptive (making use of novel memory technology for new and potentially incompatible features), or visionary (rethinking systems completely). All three kinds of projects are welcome and cross-project collaboration during the runtime of the project will be encouraged for mutual benefit.

Programme Structure

Since the memory technologies in focus are all new, the initiators have planned a “bottom-up” approach for exploring the field. In the first funding period, projects are expected to conduct basic research with an explorative character and a close relation to hardware and systems software. The second funding period builds upon the insights of the first and extends the research questions more towards higher abstraction levels and applications. The projects within the programme will be explicitly encouraged to cooperate during the first funding period and to continue as tandem projects in the second.

Application

To discuss questions related to the application and for networking/coordination between applicants, an online workshop is planned for September, which offers the opportunity to briefly present and discuss ideas for project proposals.

Proposals must be written in English and submitted to the DFG by **9 November 2021**. Please note that proposals can only be submitted via elan, the DFG’s electronic proposal processing system. To enter a new project within the existing Priority Programme, go to Proposal Submission – New Project/Draft Proposal – Priority Programmes and select “SPP 2377” from the current list of calls.

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.

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 **26 October 2021** to submit a proposal under this call; registration requests received after this time cannot be considered. You will normally 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.

With the submission of a proposal within this programme, the applicants agree that DFG shares all necessary information with the coordinator of the Priority Programme after the call deadline.

Further Information

More information on the Priority Programme and the planned preparatory workshop in September is available at: <https://spp2377.uos.de>

The elan system can be accessed at: <https://elan.dfg.de/en>

DFG forms 50.05 and 54.01 can be downloaded at: www.dfg.de/formulare/50_05
www.dfg.de/formulare/54_01

For scientific enquiries, please contact the Priority Programme coordinator:
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