Universität Basel

Research Project

Quantum theory of condensed matter: spin effects in nanostructures and quantum information

Third-party funded project

Project title Quantum theory of condensed matter: spin effects in nanostructures and quantum information
Principal Investigator(s) Loss, Daniel ;
Project Members Adelsberger, Christoph ; Hetényi, Bence ; Bosco, Stefano ;
Organisation / Research unit
Departement Physik / Theoretische Physik Mesoscopics (Loss)
Department
Project Website https://quantumtheory.physik.unibas.ch/people/loss/
Project start 01.10.2019
Probable end 30.09.2023
Status Completed

The proposed research covers and interconnects multiple topics from the fields of quantum computing and quantum condensed-matter theory. It contributes to the long term goal of finding realistic architectures that allow the coherent manipulation of solid state systems at the quantum level. Since this goal necessarily involves the study of complex many-body systems, our research goes across many subfields of modern condensed matter and solid state theory and uses a very broad range of sophisticated technical tools.The strategy we pursue encompasses the refinement of the well-established scheme of spin-based quantum computing, as well as efforts to discover novel and realistic platforms that allow the storage and manipulation of quantum information. In view of the desired industrial feasibility and scalability of the results, we focus on the solid state as the basis of our research. Exciting and promising new materials will be examined and their suitability for quantum information processing will be evaluated. Moreover, we will study intriguing issues that are also of interest in fundamental research, ranging from exotic types of topological quantum phases to non- equilibrium dynamics, with focus on spin effects in semiconducting, superconducting, and insulating magnetic nanostructures. Also these fundamental aspects of our proposal are targeted on the ability to gain access to the quantum world. In particular, we plan to work on the following topics:2.A Quantum information and surface code2.B Spin qubits in Si and Ge nanowires2.C Majorana fermion qubits and hybrid spin qubits2.D Stability of topological excitations and qubits2.E Proximity effect in semiconducting nanostructures2.F Topological magnonics2.G Quantum effects of magnetic Skyrmions

Keywords magnonics and skyrmions; quantum computation and surface code; Hole spin qubits in nanowires; Majorana fermion and parafermion qubits
Financed by
Swiss National Science Foundation (SNSF)

Add publication

Add documents

Specify cooperation partners