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# SPP 2514

Kickoff | Working Groups | YIN | Q-STAV

## Logo

SPP 2514
Quantum Software, Algorithms & Systems

## Mailing List

The newsletter will be distributed via the mailing list spp2514-newsletter@lists.kit.edu

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## What an inspiring start!

On 26 November, we officially celebrated the start of the DFG Priority Programme 2514 "Quantum Software, Algorithms and Systems" in Berlin! This exciting six-year research initiative drives foundational methods and tools for the quantum software stack.

The kickoff workshop brought together researchers from computer science, physics, mathematics and engineering to exchange ideas, build connections, and set the stage for interdisciplinary collaboration over the coming years.

We are proud to highlight the diversity of projects that form this programme, addressing key challenges in quantum computing from multiple angles – quantum algorithmic foundations; quantum programming languages, patterns and environments; quantum simulation, compilation, optimization; quantum systems co-design and engineering; benchmarking, analysis and simulation.

The energy, enthusiasm and broad engagement across all these disciplines and involved institutions is a strong signal that an active and vibrant community is developing around this initiative.

A huge thank you to everyone who participated, shared insights, and helped make the kickoff a success. We're looking forward to a productive journey together!

## Projects

The SPP 2514 consists of the following 13 projects, lead by the listed PIs.

**P1: Practical Measurement-based Quantum Computing**
PIs: Stefanie Barz, Anna Pappa

**P2: Error-Aware Compilation of Quantum Circuits for the Rydberg Atom Platform (ECQuRyd)**
PIs: Hans Peter Büchler, Ilia Polian, Sebastian Weber

**P3: ACE-QC Fully Classical and Efficient Autonomous Calibration of Quantum Computers**
PIs: Tommaso Calarco, Mariami Gachechiladze

**P4: Bridging finite dimensional and infinite dimensional quantum systems – simulations and computational power**
PIs: Alessandro Ciani, Sevag Gharibian

**P5: Towards Software for Fault Tolerant Quantum Computing**
PIs: Jens Eisert, Markus Müller, Robert Wille

**P6: Novel quantum algorithms via classical cryptography**
PIs: Jens Eisert, Jean-Pierre Seifert

**P7: Scaling Verification of Digital Quantum Simulation**
PIs: Benedikt Fauseweh, Ben Hermann, Falk Howar

**P8: Optimized Quantum Software Testing based on Functional Property Specifications and Quantum**

### *Working Groups*

Thanks to the valuable input from the working group discussions at our kickoff event, we were able to launch the trial phase for the working groups.

The working groups aim to foster networking within the SPP by bringing together experts across a wide range of topics that require collaboration. They are formed based on the needs of all SPP participants, operate for a defined period, and can be concluded once their objectives are met. Currently, working groups are reviewed at the SPP's annual meetings and then continue to meet independently—either in person or virtually—according to their needs. Each group is led by an SPP member who organizes meetings, oversees activities, and documents progress and results.

The trial phase, which began in early January and runs until April, focuses on answering key questions: What is the precise goal of the working group? What tasks are necessary to achieve this goal? Should the group continue after the trial phase? And is the overall process for establishing and managing working groups effective?

We started this phase with seven working groups actively engaging in these questions. The seven groups include, for example, the WG Abstraction, WG Compiler, WG Algorithms, and WG QEC (Quantum Error Correction).

# The Young Investigators Network (YIN)

The Young Investigators Network (YIN) forms a central element of SPP 2514's efforts to support early-career researchers. Coordinated by Benedikt Fauseweh (TU Dortmund) and Tobias Stollenwerk (FZ Jülich), the YIN aims to provide opportunities for personal and professional development, strengthen community-building, and foster exchange across institutions and disciplines.

The initial meeting, held during the SPP kickoff in November 2025, laid the foundation for a collaborative and supportive environment for young researchers across the programme. The concrete activities and priorities will be refined together with the members to ensure the YIN develops in line with their interests and needs.

**State Verification Techniques**
PIs: Otfried Gühne, Malte Lochau

**P9: Noise-aware Quantum Programming (NawaQ)**
PIs: Benjamin Kaminski, Tobias Stollenwerk

**P10: Seamless Development of Quantum Software with Stakeholder-Specific Views**
PIs: Wolfgang Mauerer, Ina Schaefer

**P11: Attestation for verification and validation in the quantum computing stack**
PIs: Jasmin Meinecke, Jean-Pierre Seifert, Janik Wolters

**P12: Compilation Environment and Benchmarking for Trapped-ion Quantum Computing**
PIs: Ferdinand Schmidt-Kaler, Robert Wille

**P13: ConAD-QC: Construction of Advanced Dynamic Quantum Circuits: Towards Resource Optimization and Fidelity Improvement**
PIs: Rolf Drechsler, Abhay Kole

## Organization

Malte Lochau
(University of Siegen)

Benedikt Fauseweh
(TU Dortmund / DLR)

Anna Pappa
(TU Berlin)

Benjamin Kaminski
(Saarland University)

# Join Us at Q-STAV in Bern!

This year, on February 23th, the international workshop on quantum software engineering, previously known as the Quantum Software Engineering MeetUp (QSE), will take place in Bern, Switzerland, under its new name: Q-STAV.

The workshop brings together researchers from classical software engineering and quantum computing to jointly discuss current developments and future directions in the emerging field of quantum software engineering.

To enable today's and future developers of quantum software to fully leverage the potential of quantum computing, there is a growing need for software, tools, and engineering techniques–well established in classical software engineering–to be made available for the quantum computing stack as well. This requires collaborative research across a wide range of disciplines, including programming languages and software abstractions, compiler construction, software testing and verification, and the development of processes, guidelines, and benchmarks for creating new quantum algorithms and deploying them on target hardware.

For 2026, Q-STAV received 18 submissions, of which 10 were accepted for presentation. The accepted contributions are:

- A. Joch, B. Fauseweh and G. Uhrig
  **Summary: Entanglement-informed construction of variational quantum circuits**
- P. Hopf, E. O. Lopez, Y. Stade, D. Rovara, N. Quetschlich, I. A. Florea, J. Izaac, R. Wille and L. Burgholzer
  **Integrating Quantum Software Tools with(in) MLIR**
- S. Thelen and W. Mauerer
  **Predict and Conquer: Navigating Algorithm Trade-offs with Quantum Design Automation**
- D. Eichhorn, N. Poser, M. Schweikart and I. Schaefer
  **ProvideQ: Short Overview of a Hybrid Optimization Toolbox**
- J. Winklmann and M. Schulz
  **Optimizing Neutral Atom Rearrangement Times using the HiPARS Sorting Library**

## Programm Committee

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(RWTH Aachen)

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(Uni Saarbrücken)

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Robert Wille
(TU München)

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Tobias Stollenwerk
(FZ Jülich)

Wolfgang Mauerer
(OTH Regensburg/Siemens)

Adrián Marín Boyero
(University of Siegen)

- L. Müller, A. Bärligea, A. Knapp and J. S. Kottmann
  **PauliEngine: High-Performant Symbolic Arithmetic for Quantum Operations**

- Y. Chen, Y. Wang, C. Mendl and H. Seidl
  **Classical Compiler Passes, Quantum Edition: Static Analyses for Quantum Programs**

- L. Southall, J. Ammermann, R. Kelmendi, D. Eichhorn and I. Schaefer
  **Investigating Retargetability Claims for Quantum Compilers**

- X, Guo and M. Schulz
  **Hardware-Efficient Neural Networks for Low-Latency Multiplexed Superconducting Qubit Readout**

- J. Eisinger, F. Schmidt-Kaler, U. Poschinger, L. Schmid, D. Schoenberger, R. Wille and J. Hilder
  **Computational capabilities of the trapped ion quantum computer and optimized compilation strategies**

As keynote speaker, Q-STAV will welcome Ivano Tavernelli from IBM Zurich, who will share his insights into the ongoing and future work in quantum computing.

A detailed program can be found here:

We highly encourage all interested researchers and practitioners to join Q-STAV in Bern, on February 23th, and participate in the exchange of perspectives and ideas shaping the future of quantum software engineering!