Funded by the European Union

The SPINUS Project

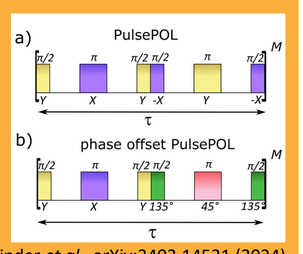
Spin-based Quantum Computer and Simulator

The SPINUS project is a collaboration of **12 research institutions** across Europe with the mission to significantly advance solid-state **quantum computation and quantum simulation** based on nuclear-spin networks and dipole-dipole-entangled electron spin qubits. SPINUS seeks to establish experimental platforms for quantum simulation (> 50 quantum units) and quantum computation (> 10 qubits) in **diamond and silicon-carbide** materials. The project also addresses scalability challenges to provide a route to scale up to >1000 quantum units and >100 qubits after the end of the project.

SPINUS Work Packages

Tools for initialization, readout and control

Develop efficient protocols to
- Initialize the quantum hardware
- Synthesize quantum Hamiltonians
- Implement quantum gates
- Read out and characterize the quantum hardware



Blinder *et al.*, arXiv:2403.14521 (2024)

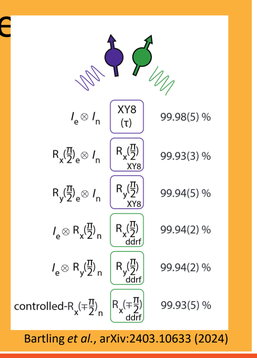
Materials development

Develop and improve processes to
- Synthesize quantum-grade isotopically pure / engineered diamond as well as isotopically engineered silicon-carbide and graphene
- Create individual color centers


© Fraunhofer IAF

Quantum computing platform

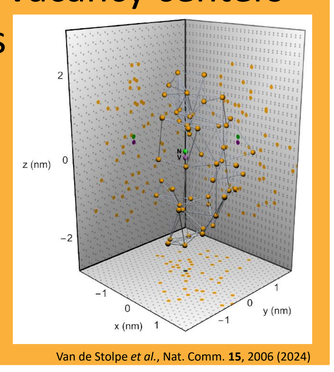
Develop a scalable quantum-computing platform operating near room temperature
- Demonstrate high-fidelity gate
- Provide a modular design
- Develop novel methods for fast electrical readout



Bartling *et al.*, arXiv:2403.10633 (2024)

Quantum simulation platforms

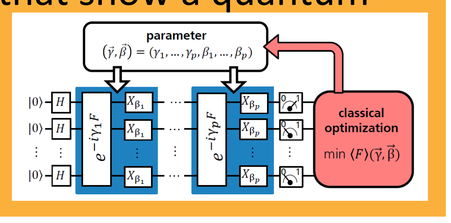
- 2D & 3D networks of nuclear spins
- 3D networks of Nitrogen-Vacancy centers
- Study many-body models (e.g., spin liquids and topological phases of matter) and dissipative phase transitions



Van de Stolpe *et al.*, Nat. Comm. **15**, 2006 (2024)

Quantum advantage

- Benchmark quantum hardware against best classical simulation techniques
- Tailor hybrid variational algorithms (QAOA, VQE, QML) to the platform
- Identify use cases that show a quantum advantage



Communication, dissemination, exploitation

- Increase awareness for the potential of quantum technologies
- Contribute to standardization
- Foster and contribute to a European quantum and a European diamond ecosystem

Project details

Launch date: January 1, 2024

End date: December 31, 2027

Budget: 10 Mil. EUR

Partner institutions: 12

Grant agreement ID: 101135699

Pillar: HE Research and Innovation Action (RIA)

Contacts

Project Coordinator:
Martin Koppenhöfer
Fraunhofer IAF
martin.koppenhoefer@iaf.fraunhofer.de

Project Manager:
Stefania Pavel
AMIRES
pavel@amires.eu

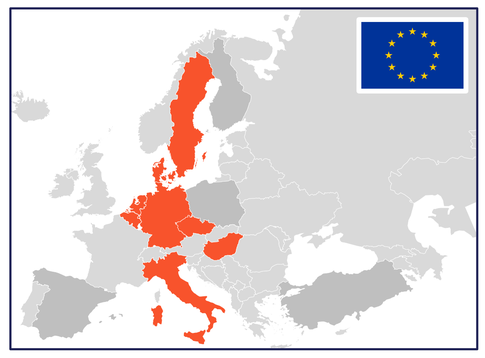
Further information

spinus-quantum.eu

@SPINUS Project

@SpinusEurope

SPINUS Partner Institutions



This project has received funding from the European Union's Horizon Europe research and innovation program under grant agreement No 101135699.