HORIZON-CL4-2023-DIGITAL-EMERGING-01-41
Digital and emerging technologies for competitiveness and fit for the Green Deal

SPINUS

Spin based quantum computer and simulator

Starting date of the project: 01/01/2024
Duration: 48 months

= Deliverable D6.1 =

Initial communication kit

Due date of deliverable: 30/04/2024
Actual submission date: 30/04/2024

Work Package: Communication, dissemination, exploitation
Responsible Work Package Leader: Stefania Pavel, AMIRES
Responsible Task Leader: Stefania Pavel, AMIRES
Version: V1.0

Dissemination level		
P	Public	x
SEN	Sensitive, limited under the conditions of the Grant Agreement	

This project has received funding from the European Union's Horizon Europe research and innovation program under grant agreement No 101135699.
Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or European Commission. Neither the European Union nor the granting authority can be held responsible for them.

AUTHOR

Author	Institution	Contact (e-mail, phone)
Stefania Pavel	AMIRES	pavel@amires.eu / +420 733 135 868

DOCUMENT CONTROL

Document version	Date	Change
V0.1	29/04/2024	First draft
V1.0	30/04/2024	Coordinator Review

VALIDATION PROCESS

Reviewers	Name	Validation date
Work Package Leader	Stefania Pavel	29/04/2024
Project Manager	Stefania Pavel	30/04/2024
Project Coordinator	Martin Koppenhöfer	30/04/2024

DOCUMENT DATA

Keywords	Dissemination materials (logo, leaflet, roll-up, factsheet, press release), website, social media channels
Point of Contact	Name: Stefania Pavel Partner: AMIRES Address: Na Okraji 335/42, 162 00, Prague, Czech Republic Phone: +420 733 135 868 E-mail: pavel@amires.eu
Delivery date	30/04/2024

DISTRIBUTION LIST

Date	Version	Recipients
30/04/2024	V0.1	Martin Koppenhöfer (Coordinator review)
30/04/2024	V1.0	Stefania Pavel (Project Manager re-edit & revision)

Executive Summary

Deliverable 6.1. Initial Communication Kit is part of task 6.1 Dissemination and business development activities, integral to Work Package 6. Communication, dissemination, exploitation. This deliverable contributes to disseminating the results of the project to the European research and industrial community and will be communicated to the general public, the scientific community, technicians, experts, media, policymakers, industries, end-users, and other stakeholders. The initial communication kit of SPINUS is a set of promotional materials aimed to inform the wider public about the project, its objectives, and its expected impact. The package includes SPINUS (1) logo, (2) leaflet, (3) roll-up, (4) factsheet, and (5) press release. The materials will be updated throughout the lifetime of the project as warranted. In addition, the dedicated website and social media accounts of the project are presented herein.

Table of Contents

1. Introduction

Deliverable D6.1 is associated with the task 6.1 Dissemination and business development activities. The objective of this task is to ensure that the results of the project will be disseminated to the European research and industrial community, will target all important stakeholders, and will assure an ongoing communication flow with the general public, the scientific community, technicians, experts, media, policymakers, industries, and end-users. The task also includes the creation of a dedicated website for the project, presenting comprehensive information about the project visually and interactively. This public website is created at the beginning of the project and will be actively maintained during the whole implementation of the project. The social media channels, LinkedIn and Twitter respectively, will be used for regularly posting project updates and project-related and relevant pieces of information from the quantum ecosystem.

2. Results and discussion

2.1. SPINUS logo

The project logo was prepared by an AMIRES designer and then proposed in three initial iterations to all project partners at the kick-off meeting, in January 2024. Upon collecting feedback from the attending partners, AMIRES team rendered a final version of the logo. The logo (**Figure 1**) is integral to the project overall visual identity. It is used in all project-related communication materials, websites, leaflets, and brochures as well as internal templates and confidential materials.

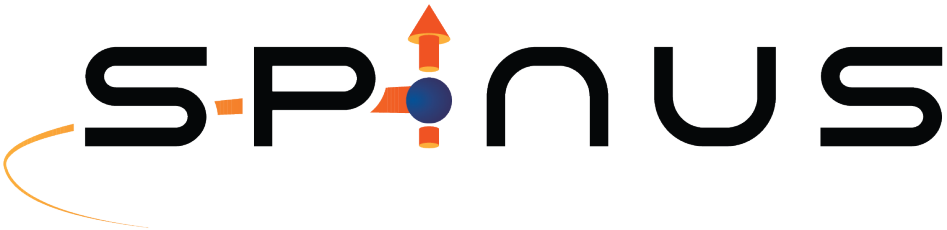


Figure 1: SPINUS logo

2.2. SPINUS leaflet

The project leaflet (**Figure 2**) is a short print material to provide an overview of the project in a visually attractive manner, with the intent of attracting the recipient to learn more via the project's website, respectively social media channels. Its content includes the project's brief description, key information, partners, and main contacts. The leaflet can be distributed at conferences, events, and on the premises of the partners. The leaflet adequately acknowledges the project being funded by the European Union; the EU emblem is included herein.

Figure 2: SPINUS leaflet

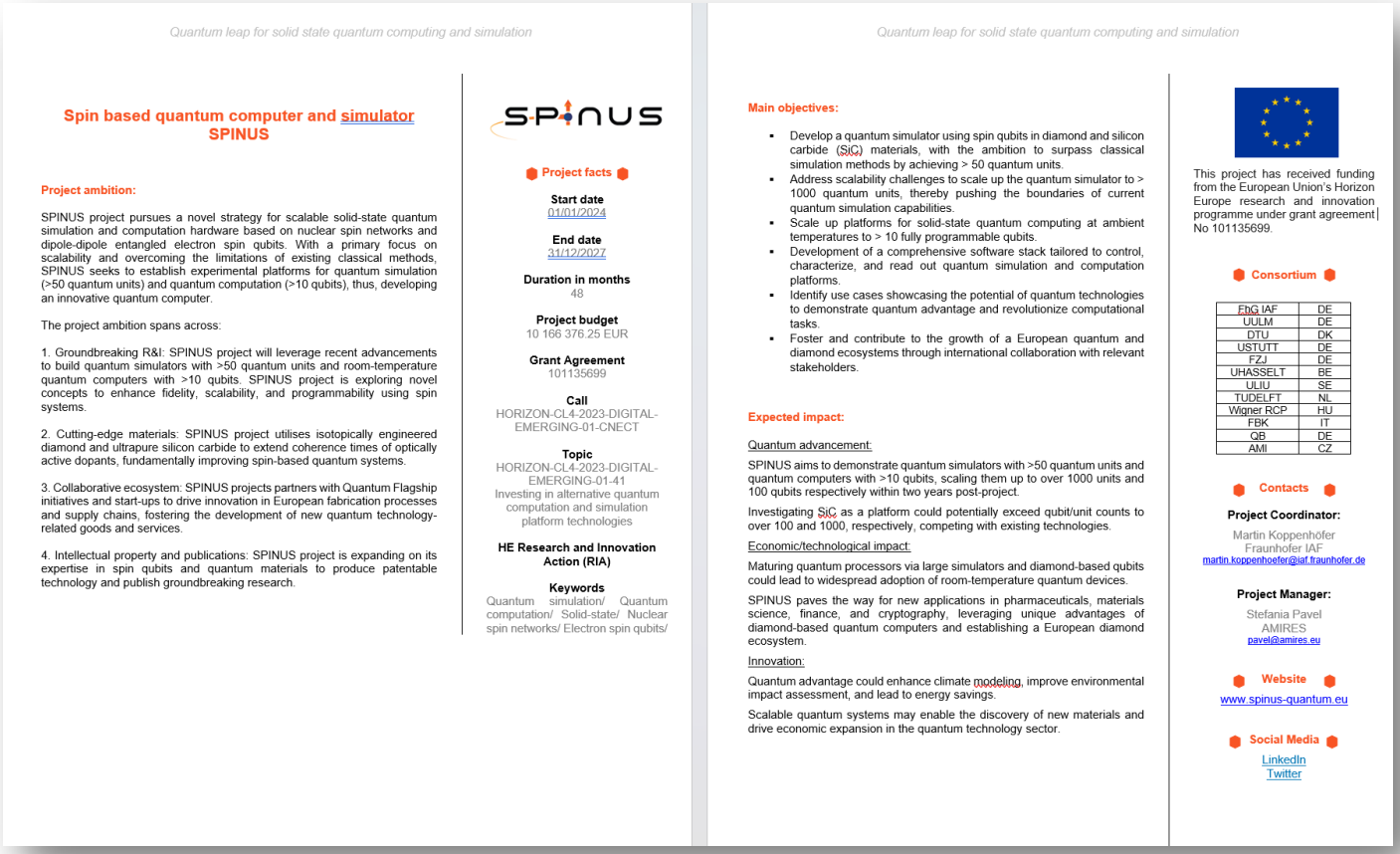
2.3. SPINUS roll-up

The SPINUS roll-up (**Figure 3**) will be displayed during key events and project meetings. The roll-up is meant to be highly visible and function as an "information radiator" when put up during conferences, events, and on the premises of the partners. It also serves as background when taking pictures for dissemination purposes.

Figure 3: SPINUS r

2.4. SPINUS factsheet

The SPINUS factsheet (**Figure 4**) provides general information about the project while including more details on the scientific developments than the leaflet, as the latter is limited by the format. The factsheet elaborates on project objectives, expected impact, partners, and funding details. The contacts of the Project Coordinator, Project Manager, as well as the website and social media accounts are added herein. The factsheet provides acknowledgment of EU funding and it includes the EU emblem.



Quantum leap for solid state quantum computing and simulation

Spin based quantum computer and simulator SPINUS

Project ambition:

SPINUS project pursues a novel strategy for scalable solid-state quantum simulation and computation hardware based on nuclear spin networks and dipole-dipole entangled electron spin qubits. With a primary focus on scalability and overcoming the limitations of existing classical methods, SPINUS seeks to establish experimental platforms for quantum simulation (>50 quantum units) and quantum computation (>10 qubits), thus, developing an innovative quantum computer.

The project ambition spans across:

1. Groundbreaking R&I: SPINUS project will leverage recent advancements to build quantum simulators with >50 quantum units and room-temperature quantum computers with >10 qubits. SPINUS project is exploring novel concepts to enhance fidelity, scalability, and programmability using spin systems.

2. Cutting-edge materials: SPINUS project utilises isotopically engineered diamond and ultrapure silicon carbide to extend coherence times of optically active dopants, fundamentally improving spin-based quantum systems.

3. Collaborative ecosystem: SPINUS projects partners with Quantum Flagship initiatives and start-ups to drive innovation in European fabrication processes and supply chains, fostering the development of new quantum technology-related goods and services.

4. Intellectual property and publications: SPINUS project is expanding on its expertise in spin qubits and quantum materials to produce patentable technology and publish groundbreaking research.

SPINUS

Project facts

Start date
01/01/2024

End date
31/12/2027

Duration in months
48

Project budget
10 166 376.25 EUR

Grant Agreement
101135699

Call
HORIZON-CL4-2023-DIGITAL-EMERGING-01-CNECT

Topic
HORIZON-CL4-2023-DIGITAL-EMERGING-01-41
Investing in alternative quantum computation and simulation platform technologies

HE Research and Innovation Action (RIA)

Keywords
Quantum simulation/ Quantum computation/ Solid-state/ Nuclear spin networks/ Electron spin qubits/

Quantum leap for solid state quantum computing and simulation

Main objectives:

- Develop a quantum simulator using spin qubits in diamond and silicon carbide (SiC) materials, with the ambition to surpass classical simulation methods by achieving > 50 quantum units.
- Address scalability challenges to scale up the quantum simulator to > 1000 quantum units, thereby pushing the boundaries of current quantum simulation capabilities.
- Scale up platforms for solid-state quantum computing at ambient temperatures to > 10 fully programmable qubits.
- Development of a comprehensive software stack tailored to control, characterize, and read out quantum simulation and computation platforms.
- Identify use cases showcasing the potential of quantum technologies to demonstrate quantum advantage and revolutionize computational tasks.
- Foster and contribute to the growth of a European quantum and diamond ecosystems through international collaboration with relevant stakeholders.

Expected impact:

Quantum advancement:

SPINUS aims to demonstrate quantum simulators with >50 quantum units and quantum computers with >10 qubits, scaling them up to over 1000 units and 100 qubits respectively within two years post-project.

Investigating SiC as a platform could potentially exceed qubit/unit counts to over 100 and 1000, respectively, competing with existing technologies.

Economic/technological impact:

Maturing quantum processors via large simulators and diamond-based qubits could lead to widespread adoption of room-temperature quantum devices.

SPINUS paves the way for new applications in pharmaceuticals, materials science, finance, and cryptography, leveraging unique advantages of diamond-based quantum computers and establishing a European diamond ecosystem.

Innovation:

Quantum advantage could enhance climate modeling, improve environmental impact assessment, and lead to energy savings.

Scalable quantum systems may enable the discovery of new materials and drive economic expansion in the quantum technology sector.

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

Consortium

FhG IAF	DE
UULM	DE
DTU	DK
USTUTT	DE
FZJ	DE
UHASSELT	BE
ULIU	SE
TUDELFT	NL
Wigner RCP	HU
FBK	IT
QB	DE
AMI	CZ

Contacts

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

Project Manager:
Stefania Pavel
AMIRES
pavel@amires.eu

Website
www.spinus-quantum.eu

Social Media
LinkedIn
Twitter

Figure 4: SPINUS factsheet

2.5. SPINUS first press release

The first SPINUS press release (**Figure 5**) was sent to all the partners via email and to a preapproved list of organisations and journalists. The press release was accordingly republished by eight entities, among them counting European Quantum Industry Consortium (QuIC), Quantum Flagship, and European Photonics Industry Consortium (EPIC). The first press released focused on key project information and the proceedings from the kick-off meeting which took place 22-23 January 2024, hosted by Fraunhofer IAF, in Freiburg, Germany. Future notable project developments warranting wider publicity will be included in the upcoming press releases.

SPINUS

Date: 29/01/2024 | For Immediate Release

EU-funded project SPINUS pioneers scalable solid-state quantum computing

SPINUS kick-off meeting | Freiburg, Germany | January 22-23, 2024

In January 2024, a new Horizon Europe funded project started with the ambition to significantly advance the research in the field of solid-state quantum computing. Project SPINUS aims to establish experimental platforms based on solid-state spin qubits for quantum simulations and quantum computing. What sets the project apart is its comprehensive approach towards the critical aspects of these platforms, focusing on material design, control techniques, and readout technology as well as tailored quantum algorithms.

Coordinated by the Fraunhofer Institute for Applied Solid State Physics IAF, SPINUS benefits from 12 international partners whose expertise covers experimental realization of solid-state quantum simulators, room temperature spin-based quantum computers, and scalable arrays of diamond qubits.

Over the past decade, various quantum simulation architectures have been developed based on a diverse range of systems, including ultracold neutral atoms, trapped ions, Rydberg atoms, photonic systems, and superconducting circuits. While significant advancements have been made, it remains a challenge to create large-scale quantum simulators that can be effectively engineered, initialized, and controlled to explore intricate aspects of quantum many-body dynamics.

A promising approach towards quantum computation is the utilization of so-called nitrogen vacancy (NV) centers in diamond. Their unique characteristics—stable and controllable quantum states at room temperature—have been proven in pioneering experiments. To harness this potential, project SPINUS builds on recent developments in engineered electronic and nuclear spin networks, solid-state quantum simulators as well as computers to push this technological approach towards scalable solid state quantum computing. Dr. Martin Koppenhöfer, project coordinator of SPINUS at Fraunhofer IAF, summarizes:

"The possibility for room-temperature operation distinguishes NV centers from other quantum computing architectures. We are excited to advance this platform technologically and to demonstrate quantum simulation and quantum computation at larger scales."

What further excels SPINUS is its comprehensive and collaborative nature alongside its innovative concepts and approaches. SPINUS aims to foster breakthroughs in quantum technologies, complementing existing efforts within the field by closely collaborating with associated start-ups and complementary projects in the quantum computing ecosystem. "We aim to make a lasting impact on the field of quantum technologies and contribute to the development of large-scale quantum systems in Europe by pushing the boundaries of what is currently feasible," states Dr. Daniel Hähnel, Head of Department Quantum Technologies at Fraunhofer IAF.

Spin-based quantum simulation beyond 50 quantum units

To reach mature hardware platforms for quantum simulation to unlock quantum advantages in a wide range of use cases, improvements in system size, controllability and programmability are essential. In SPINUS, researchers will advance beyond the state of the art along all those axes, based on three different types of quantum simulator prototypes: 3D nuclear-spin simulator (application: Floquet phases, spin diffusion), 3D electron-spin simulator (application: open systems, disordered and strongly correlated systems), 2D nuclear-spin simulator (application: spin liquid, topological phases, Heisenberg models, Kitaev models, spin diffusion). The aim is to establish experimental platforms for quantum simulation beyond 50 quantum units.

While all simulators are based on the same premise—controllable interacting spin networks in diamond and silicon carbide (SiC) accessed through optically active defects—each uses different configurations of spins (e.g., 2D vs 3D, naturally disordered vs ordered) to tailor the simulator to specific applications.

Figure 5: SPINUS first press release, sampl

2.6. SPINUS website

As of April 2024, the SPINUS website (**Figure 6**) was published with general information about the project and its partners. The website will undergo further improvements and alterations per the partners' dissemination needs, the project work progress, and wider communication trends which benefit the visibility of the project. The website development and maintenance are led by AMIRES.

SPINUS website address: https://spinus-quantum.eu/

The SPINUS website seeks to attain the following objectives:

1. To be a digital "business card" for partners and entities outside of the project consortium; it clearly presents the project's ambition, objectives, expected impacts, consortium composition, and upcoming public results;
2. To relay timely information about the project developments, such as organisation of/attendance to events and publication of non-confidential results;
3. To create a digital contact channel via a contact form;
4. To mention and redirect to SPINUS social media accounts.

Figure 7: SPINUS website landing page

2.7. SPINUS social media

In addition to the webpage and printable promotional materials, LinkedIn and X (formerly Twitter) accounts have been set up to permit interaction with the project content and partners. The channels are meant to provide dynamic, regular updates on project progress, enable engagement with a wider audience (especially the younger audiences) and enable feedback from various social media users. Short news stories about the project and their development will be prepared and shared via the LinkedIn account, especially during events, conferences, and symposia. The social media channels will also be leveraged to connect with other complementary projects and/or initiatives in view of mutually beneficial collaboration, respectively clustering.

LinkedIn handle: SPINUS project at https://www.linkedin.com/company/spinus-quantum/
X handle: @SpinusEurope at https://twitter.com/SpinusEurope

Both LinkedIn and X pages were created immediately after the kick-off meeting, by end of January 2024. Thus, the first posts herein concern the aforementioned meeting. LinkedIn recorded a faster growth, with more self-published content herein. The X account boasts less content as of now, yet it is actively expanding its followship. X relies more on reposting. The growth of both accounts has been steady.

Nonetheless, more interest is expected after the 6-month milestone as the project will start releasing public results, publications, and more news about participation at various events. Furthermore, as of June 2024 – 6-month milestone – SPINUS will also have a first version of the Plan for dissemination, exploitation and communication activities. This document will provide strategic guidance on what content will be created and how these channels will be deployed to enhance and expand the dissemination, communication, and exploitation efforts.

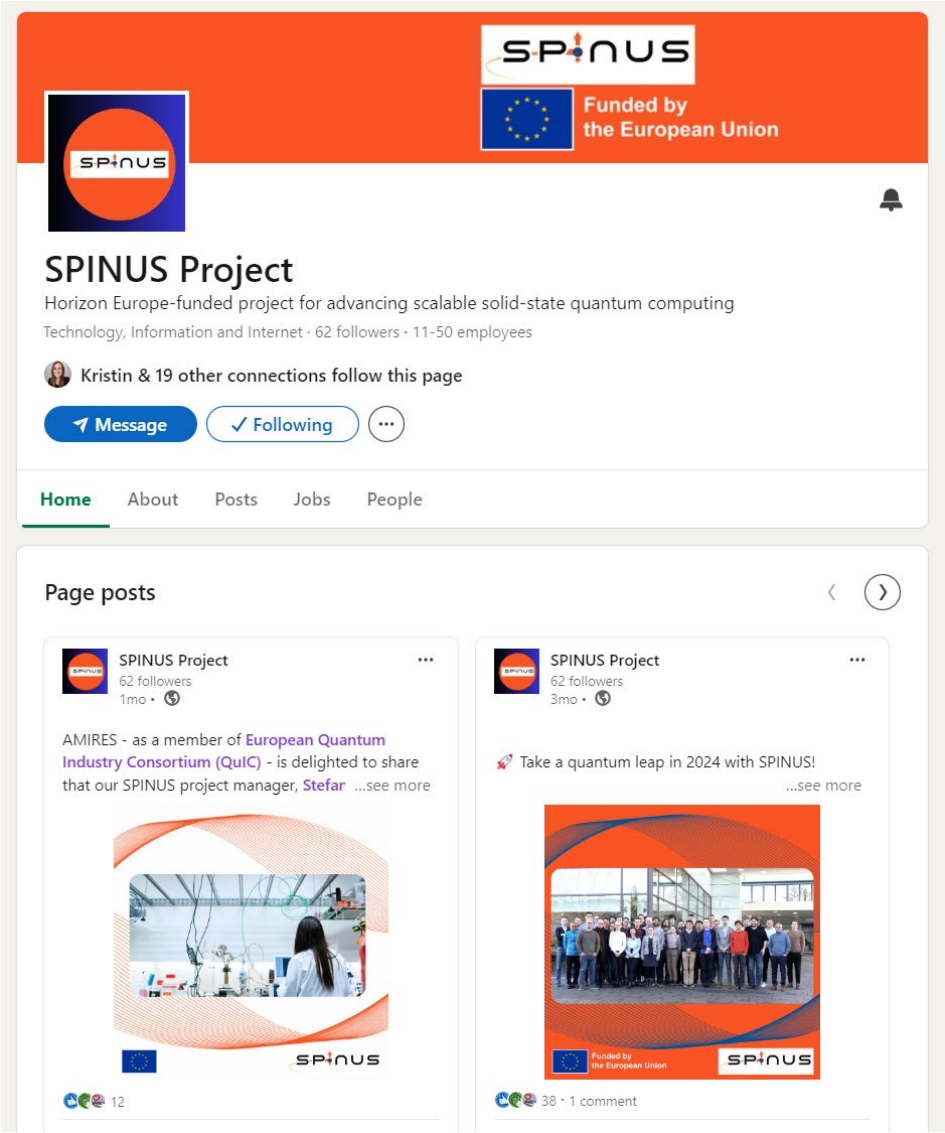


Figure 7: SPINUS LinkedIn account

Figure 8: First post on LinkedIn page about the successful KOM in Freiburg, Germany

Figure 9: SPINUS X account

3. Conclusions

This document represents the report-format of the Deliverable D6.1 Initial Communication Kit. It includes the first iteration of the promotional materials for SPINUS project. These materials will be extensively used by SPINUS partners whenever they present at conferences, publish in journals and magazines, establish contacts with media, attend exhibitions, organise workshops, etc. The materials will be revised over the course of the project to integrate the project results as the latter are being produced. Moreover, the communication kit can be expanded to include project presentation slide decks, videos, and other multimedia materials to match the progress of the project implementation.

When disseminating the results of the SPINUS project, the following sentence, alongside the EU emblem, will always be included: "This project has received funding from the European Union's Horizon Europe research and innovation program under grant agreement No 101135699. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or European Commission. Neither the European Union nor the granting authority can be held responsible for them."

Lastly, the dissemination of the project's achievements should never jeopardize the potential protection of generated intellectual property and further industrial application. Therefore, before any dissemination activity (publication, presentation) strict rules of prior notice to all partners will be applied, according to European Commission guidelines and SPINUS Consortium Agreement: prior notice of any planned publication should be given to other consortium members at least 45 calendar days before the publication. The Dissemination Manager (Stefania Pavel, AMIRES) will follow the approval processes and will act as an internal approval body for any dissemination/exploitation action organized by different partners.

4. Degree of progress

The deliverable is 100% fulfilled in respect of what is foreseen in the Grant Agreement.

5. Dissemination level

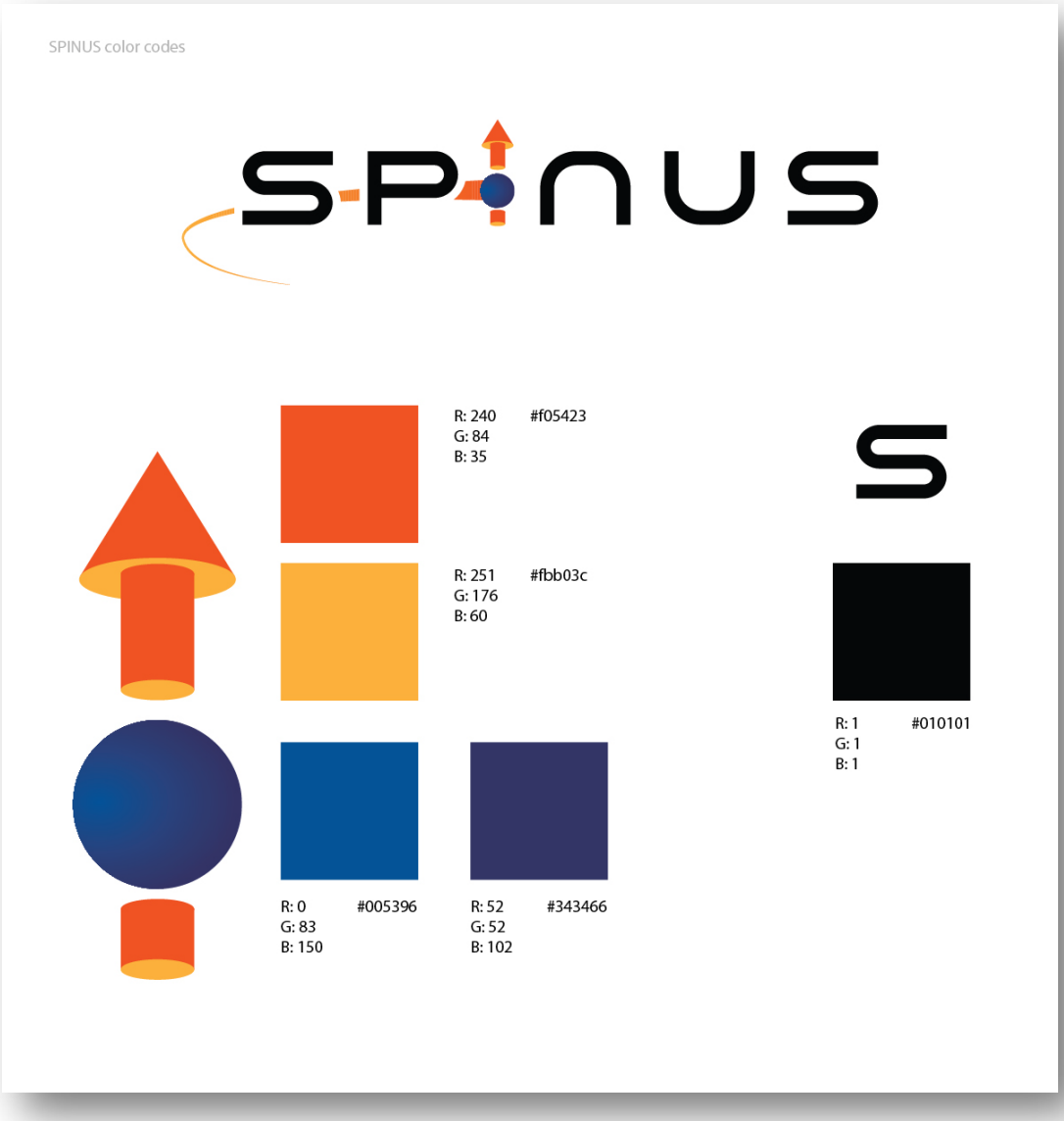
This deliverable is public.

6. References

None.

7. Annexes

7.1. SPINUS logo



7.2. SPINUS leaflet


Social media
spinus-quantum.eu
@SPINUS Project
@SpinusEuropet
SPINUS
Basic data
Project starting date: 1 January 2024
Project end date: 31 December 2027
Project duration: 48 months
Budget: 10 166 376.25 EUR
No. partners: 12 partners
Contacts
SPINUS Coordinator
Martin Koppenhöfer
martin.koppenhoefer@iaf.fraunhofer.de
SPINUS Project Manager
Stefania Pavel
pavel@amires.eu
This project has received funding from the European Union's Horizon Europe research and innovation program under grant agreement No 101135699.

7.3. SPINUS roll-up

7.4. SPINUS factsheet

Quantum leap for solid state quantum computing and simulation

Spin based quantum computer and simulator SPINUS

Project ambition:

SPINUS project pursues a novel strategy for scalable solid-state quantum simulation and computation hardware based on nuclear spin networks and dipole-dipole entangled electron spin qubits. With a primary focus on scalability and overcoming the limitations of existing classical methods, SPINUS seeks to establish experimental platforms for quantum simulation (>50 quantum units) and quantum computation (>10 qubits), thus, developing an innovative quantum computer.

The project ambition spans across:

1. Groundbreaking R&I: SPINUS project will leverage recent advancements to build quantum simulators with >50 quantum units and room-temperature quantum computers with >10 qubits. SPINUS project is exploring novel concepts to enhance fidelity, scalability, and programmability using spin systems.

2. Cutting-edge materials: SPINUS project utilises isotopically engineered diamond and ultrapure silicon carbide to extend coherence times of optically active dopants, fundamentally improving spin-based quantum systems.

3. Collaborative ecosystem: SPINUS projects partners with Quantum Flagship initiatives and start-ups to drive innovation in European fabrication processes and supply chains, fostering the development of new quantum technology-related goods and services.

4. Intellectual property and publications: SPINUS project is expanding on its expertise in spin qubits and quantum materials to produce patentable technology and publish groundbreaking research.

SPINUS

Project facts

Start date
01/01/2024

End date
31/12/2027

Duration in months
48

Project budget
10 166 376.25 EUR

Grant Agreement
101135699

Call
HORIZON-CL4-2023-DIGITAL-EMERGING-01-CNECT

Topic
HORIZON-CL4-2023-DIGITAL-EMERGING-01-41
Investing in alternative quantum computation and simulation platform technologies

HE Research and Innovation Action (RIA)

Keywords
Quantum simulation/ Quantum computation/ Solid-state/ Nuclear spin networks/ Electron spin qubits/

Main objectives:

- Develop a quantum simulator using spin qubits in diamond and silicon carbide (SiC) materials, with the ambition to surpass classical simulation methods by achieving > 50 quantum units.
- Address scalability challenges to scale up the quantum simulator to > 1000 quantum units, thereby pushing the boundaries of current quantum simulation capabilities.
- Scale up platforms for solid-state quantum computing at ambient temperatures to > 10 fully programmable qubits.
- Development of a comprehensive software stack tailored to control, characterize, and read out quantum simulation and computation platforms.
- Identify use cases showcasing the potential of quantum technologies to demonstrate quantum advantage and revolutionize computational tasks.
- Foster and contribute to the growth of a European quantum and diamond ecosystems through international collaboration with relevant stakeholders.

Expected impact:

Quantum advancement:

SPINUS aims to demonstrate quantum simulators with >50 quantum units and quantum computers with >10 qubits, scaling them up to over 1000 units and 100 qubits respectively within two years post-project.

Investigating SiC as a platform could potentially exceed qubit/unit counts to over 100 and 1000, respectively, competing with existing technologies.

Economic/technological impact:

Maturing quantum processors via large simulators and diamond-based qubits could lead to widespread adoption of room-temperature quantum devices.

SPINUS paves the way for new applications in pharmaceuticals, materials science, finance, and cryptography, leveraging unique advantages of diamond-based quantum computers and establishing a European diamond ecosystem.

Innovation:

Quantum advantage could enhance climate modeling, improve environmental impact assessment, and lead to energy savings.

Scalable quantum systems may enable the discovery of new materials and drive economic expansion in the quantum technology sector.

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

Consortium

FhG IAF	DE
UULM	DE
DTU	DK
USTUTT	DE
FZJ	DE
UHASSELT	BE
ULIU	SE
TUDELFT	NL
Wigner RCP	HU
FBK	IT
QB	DE
AMI	CZ

Contacts

Project Coordinator:

Martin Koppenhöfer
Fraunhofer IAF
martin.koppenhoefer@iaf.fraunhofer.de

Project Manager:

Stefania Pavel
AMIRES
pavel@amires.eu

Website

www.spinus-quantum.eu

Social Media

LinkedIn
Twitter

7.5. SPINUS first press release

SPINUS

Date: 29/01/2024 | For Immediate Release

EU-funded project SPINUS pioneers scalable solid-state quantum computing

SPINUS kick-off meeting | Freiburg, Germany | January 22-23, 2024

In January 2024, a new Horizon Europe funded project started with the ambition to significantly advance the research in the field of solid-state quantum computing. Project SPINUS aims to establish experimental platforms based on solid-state spin qubits for quantum simulations and quantum computing. What sets the project apart is its comprehensive approach towards the critical aspects of these platforms, focusing on material design, control techniques, and readout technology as well as tailored quantum algorithms.

Coordinated by the Fraunhofer Institute for Applied Solid State Physics IAF, SPINUS benefits from 12 international partners whose expertise covers experimental realization of solid-state quantum simulators, room temperature spin-based quantum computers, and scalable arrays of diamond qubits.

Over the past decade, various quantum simulation architectures have been developed based on a diverse range of systems, including ultracold neutral atoms, trapped ions, Rydberg atoms, photonic systems, and superconducting circuits. While significant advancements have been made, it remains a challenge to create large-scale quantum simulators that can be effectively engineered, initialized, and controlled to explore intricate aspects of quantum many-body dynamics.

A promising approach towards quantum computation is the utilization of so-called nitrogen vacancy (NV) centers in diamond. Their unique characteristics—stable and controllable quantum states at room temperature—have been proven in pioneering experiments. To harness this potential, project SPINUS builds on recent developments in engineered electronic and nuclear spin networks, solid-state quantum simulators as well as computers to push this technological approach towards scalable solid state quantum computing. Dr. Martin Koppenhöfer, project coordinator of SPINUS at Fraunhofer IAF, summarizes:

> *"The possibility for room-temperature operation distinguishes NV centers from other quantum computing architectures. We are excited to advance this platform technologically and to demonstrate quantum simulation and quantum computation at larger scales."*

What further excels SPINUS is its comprehensive and collaborative nature alongside its innovative concepts and approaches. SPINUS aims to foster breakthroughs in quantum technologies, complementing existing efforts within the field by closely collaborating with associated start-ups and complementary projects in the quantum computing ecosystem. "We aim to make a lasting impact on the field of quantum technologies and contribute to the development of large-scale quantum systems in Europe by pushing the boundaries of what is currently feasible," states Dr. Daniel Hähnel, Head of Department Quantum Technologies at Fraunhofer IAF.

Spin-based quantum simulation beyond 50 quantum units

To reach mature hardware platforms for quantum simulation to unlock quantum advantages in a wide range of use cases, improvements in system size, controllability and programmability are essential. In SPINUS, researchers will advance beyond the state of the art along all those axes, based on three different types of quantum simulator prototypes: 3D nuclear-spin simulator (application: Floquet phases, spin diffusion), 3D electron-spin simulator (application: open systems, disordered and strongly correlated systems), 2D nuclear-spin simulator (application: spin liquid, topological phases, Heisenberg models, Kitaev models, spin diffusion). The aim is to establish experimental platforms for quantum simulation beyond 50 quantum units.

While all simulators are based on the same premise—controllable interacting spin networks in diamond and silicon carbide (SiC) accessed through optically active defects—each uses different configurations of spins (e.g., 2D vs 3D, naturally disordered vs ordered) to tailor the simulator to specific applications.

Spin-based quantum computing beyond 10 qubits

SPINUS aims at elevating quantum computing platforms based on NV centers by increasing the usable qubit number of quantum computers beyond 10 qubits. For this purpose, the consortium will realize coupled arrays of NV centers while maintaining and improving gate fidelities towards more than 99.9 %. The researchers will also work towards developing photoelectric detection of NV magnetic resonances (PDMR) and selective read-out technology to overcome the current bottleneck of selective addressability for higher number of qubits compared to optical techniques. The resulting platforms shall allow for universal quantum computation based on two-qubit gate operations facilitated by controllable dipolar couplings between adjacent NV centers, realized between electronic and nuclear spins.

In addition to the technical challenges of scaling up NV-based quantum computers, there is a need for developing the requisite hardware and software infrastructure. This will involve devising improved methods for controlling and reading out the state of the qubits, which is critical for achieving high-fidelity gates and accurate measurements. Furthermore, the performance of quantum algorithms with respect to their distinct use cases, both, on an algorithmic level and regarding their implementation on the spin-based computation platform is another decisive factor. While considerable efforts along these lines have already been made by the consortium partners, SPINUS will meet the challenges within materials design, control, readout, device characterization and quantum algorithms in order to advance quantum computing platforms based on NV centers.

Project SPINUS is funded by the European Union's Horizon Europe research and innovation program and runs for four years. Within SPINUS, the unique expertise of 12 partners from eight different countries is brought together. The consortium consists of: Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung e. V. for their Institute Fraunhofer IAF, University of Ulm, Danmarks Tekniske Universitet, University of Stuttgart, Forschungszentrum Jülich GmbH, Universiteit Hasselt, Linkopings Universitet, Technische Universiteit Delft, Wigner Fizikai Kutatokozpont, Fondazione Bruno Kessler, Quantum Brilliance GmbH and AMIRES SRO.

Contacts

LinkedIn: SPINUS Project

Twitter: @SpinusEurope

Dr. Martin Koppenhöfer	Stefania Pavel
Project Coordinator	Project and Dissemination Manager
Fraunhofer IAF	AMIRES
martin.koppenhoefer@iaf.fraunhofer.de	pavel@amires.eu

Funded by the European Union

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