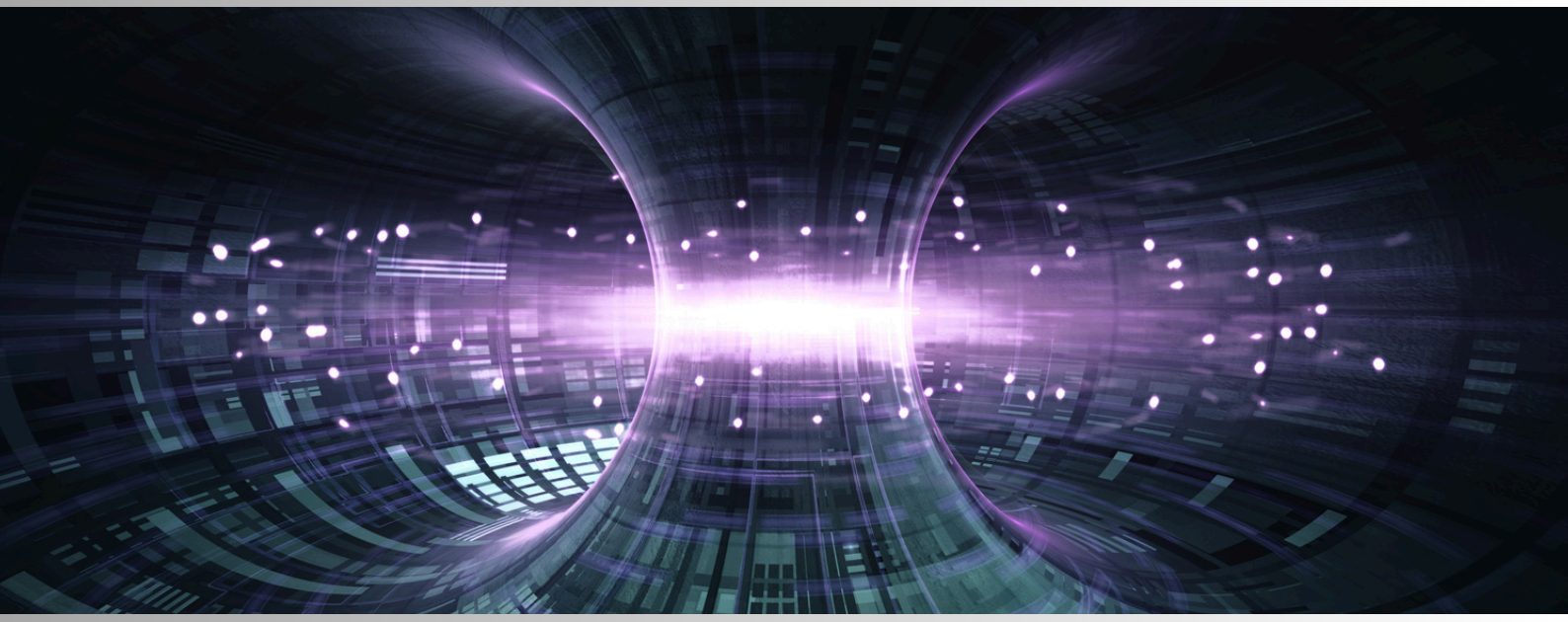
NEWSLETTER #1

heisingberg

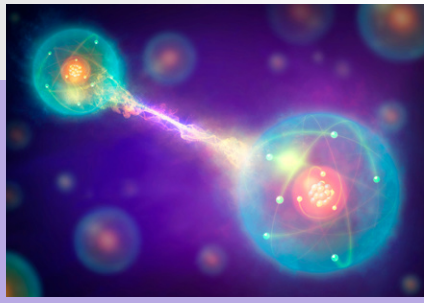
SPATIAL QUANTUM OPTICAL ANNEALER FOR SPIN HAMILTONIANS



Welcome to **Heisingberg** Newsletter!

The project

HEISINGBERG aims to develop a novel photonic Ising machine operating at room temperature, leveraging newly established holographic and nonlinear photonics principles for the efficient solution of NP-hard problems. HEISINGBERG proposes an alternative approach to existing photonic simulators exploiting the mature technology of spatial light modulation. The latter introduces a range of advantages that mitigate systemic bottlenecks associated with the scalability and applicability ofthese devices, with the most pronounced of these being: i) cost effective, ii) easily programmable, iii) environmentally friendly, low power consumption, iv) scalability, v) non-cryogenic operation.



Partners

UBITECH ubiquitous solutions

SAPIENZA UNIVERSITÀ DI ROMA

FORTH INSTITUTE OF ELECTRONIC STRUCTURE AND LASER

UBITECH quantum supremacy

CSIC CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

UNIVERSITY OF CAMBRIDGE

Funded by the European Union
GA No: 101114978.

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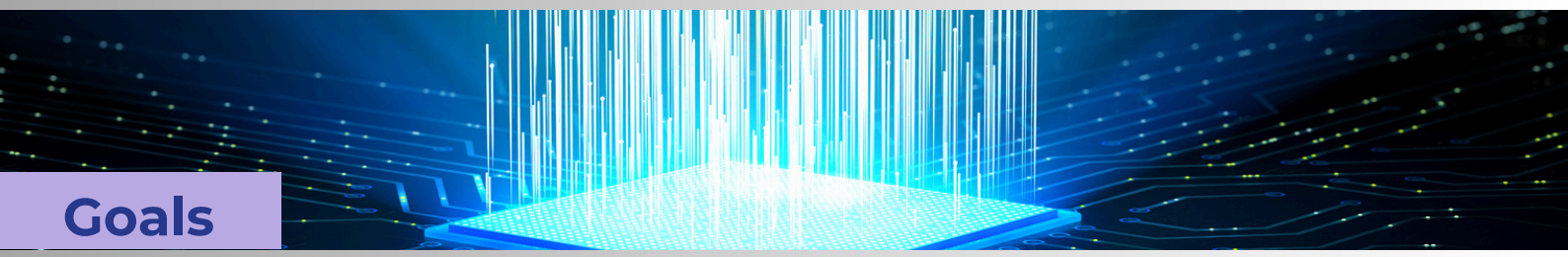

Goals

HEISINGBERG envisions to offer the following value propositions:

- Demonstrate fully programmable spin coupling up to 100,000 spins.
- Incorporation of an effective magnetic field, enabling the solution of a range of optimization problems
- Deployment of annealing algorithms based on HEISINGBERG mode of operation.
- Theoretical model describing the simulator beyond the mean-field approximation using squeezed light states
- Proof-of-principle experimental showcase of the Quantum HEISINGBERG annealer with a 3x3 lattice
- Development of a dedicated graphical control software for the HEISINBERG platform and online server for open access

Challenges

Real-life NP-hard problems solution is challenging since:

- Require improved computational efficiency, that conventional von Neumann architectures struggle to provide as they are reaching their scalability and power efficiency limits

- Existing approaches, such as GQC and analog quantum simulators, suffer from limited qubit count, high error rates (need for error mitigation protocols), quantum decoherence, hardware complexity, low temperature operation (sophisticated cryogenics required), high Energy consumption and they are costly.

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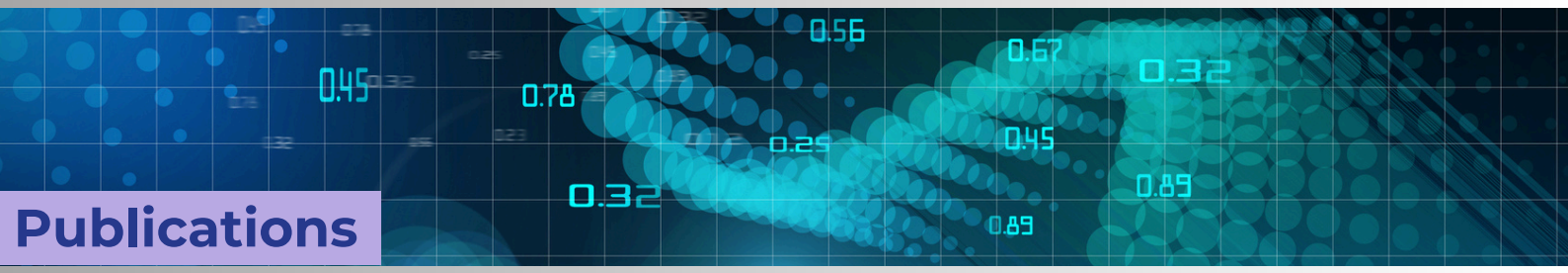


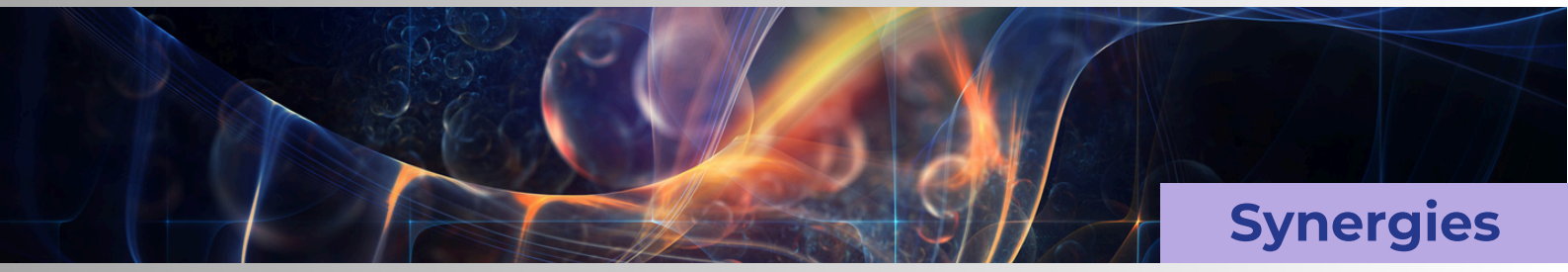
Publications

1. Alexander Johnston and Natalia G. Berloff
Macroscopic Noise Amplification by Asymmetric Dyads in Non-Hermitian Optical Systems for Generative Diffusion Models
Phys. Rev. Lett. 132, 096901 (2024) – Published 26 February 2024

https://doi.org/10.1103/PhysRevLett.132.096901

2. Lorenzo Cirigliano, Valentina Brosco, Claudio Castellano, Claudio Conti and Laura Pilozzi
Optimal Quantum Key Distribution Networks: Capacitance versus Security
npj Quantum Information 10, 44 (2024) - Published: 29 April 2024

https://www.nature.com/articles/s41534-024-00828-7



Synergies

veriqub

Synergy with the HorizonEU-funded **Veriqub project**, entitled "efficient VERIfication of QUantum computing architectures with Bosons", aiming to to develop a new approach to the efficient verification of quantum computing architectures with bosons, using continuous-variable measurements.

Q-ONE

Heisingberg joins forces with **Q-ONE** to bring innovation to Quantum information processing through creative solutions

Holo-CIM

HEISINGBERG and **HoloCIM Project** will be collaborating on shared research objectives that focus on quantum computing, quantum technologies and quantum information

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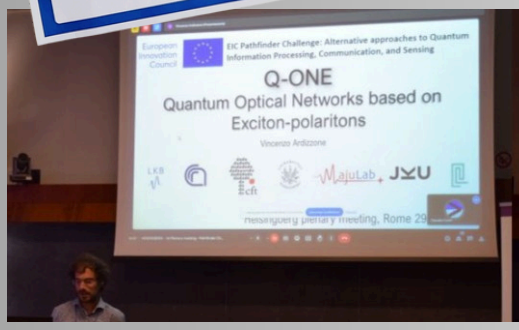
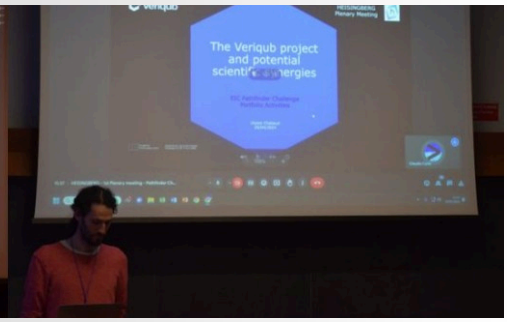
HEISINGBERG Plenary Annual Meeting | Rome

The 1st Plenary Annual Meeting of Heisingberg took place on 28 and 29 April 2024, hosted at the Physics Department of Sapienza Università di Roma, where the consortium had the chance to discuss the latest advancements in their activities.





Fact Sheet

Title: **Spatial Quantum Optical Annealer for Spin Hamiltonians**

Acronym: HEISINGBERG

GA No: 101114978

Start: 01 November 2023

End: 31 October 2027

Budget: € 3.260.250 €

EU Fund: € 3.260.250 €

Topic: HORIZON-EIC-2022-PATHFINDERCHALLENGES-01-06

Scheme: HORIZON-EIC Grants

Call: EIC Pathfinder Challenge: Alternative approaches to Quantum Information, Processing, Communication, and Sensing

$$H = -\sum_{ij} J_{ij}\,\sigma_i\,\sigma_j$$

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www.heisingberg.eu

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Media Kit

Heisingberg Brochure

Heisingberg Leaflet

Events

1. Fabrice Laussy (CSCIC), Perfect photons, International Conference of Physics of Light Matter Coupling in Nanostructures 9-13 April, 2024 Tbilisi, Georgia.
2. Pavlos Savvidis (FORTH), Prototype polariton superfluid analog in annular traps, International Conference of Physics of Light Matter Coupling in Nanostructures 9-13 April, 2024 Tbilisi, Georgia.
3. Davide Pierangeli (SAP), Spatial photonic machines for large-scale computing and polarization imaging, SPIE Photonics Europe, 7-11 April, 2024 Strasbourg, France.
4. Marcello Calvanese Strinati (SAP), Simulating continuous spin models via the hyperspin machine, International Workshop on Ising Machines, 16–8 April, 2024 - Messina, Italy
5. Natalia Berloff (CAM), Light-matter coupling in gain-based computing, International Workshop on Ising Machines – 2024, 16th – 18th April,2024 - Messina, Italy
6. Alexis Askitopoulos (QUBI), Invited Seminar in Demokritos Quantum Computing Master Program, April 2024, Athens, Greece.
7. Alexis Askitopoulos (QUBI), Presentation in Qiskit Fall Fest, December 2023, Thessaloniki, Greece.