

PROMISE Project Unveils Next-Generation Quantum Imaging Sensors for Industrial Breakthroughs

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Innovative consortium to develop industrial-ready NV-based widefield magnetometers that deliver unprecedented speed, accuracy, and practicality for real-world applications.

On February 5th, 2025, an international consortium launched the PROMISE (<u>**PRO**</u>totypes of <u>**M**</u>agnetic <u>**I**</u>maging <u>**S**</u>ystems for <u>**E**</u>urope) research project, a pioneering initiative designed to revolutionize quantum sensing technology. With a dual focus on cutting-edge technology development and rigorous industrial use-case testing, PROMISE is set to elevate nitrogen-vacancy (NV) based quantum imaging sensors to a pre-industrial Technology Readiness Level (TRL7) for practical, everyday applications.

Advancing quantum sensing for tomorrow's industries

Quantum sensing is emerging as the quantum technology with the most immediate market potential, and NV-based sensors are at the forefront due to their remarkable simplicity and performance. Operating without the need for vacuum systems, cryogenics, or magnetic shielding, these sensors offer calibration-free, quantitative, robust, and absolute measurements. By interacting with local magnetic and electric fields, temperature, strain, and pressure, NV centres provide rich, detailed image-based insights that surpass conventional optical systems.

However, traditional scanning-probe systems—though powerful—are hampered by slow, point-by-point measurements, making them less suitable for dynamic, real-time applications. PROMISE addresses this challenge head-on by developing industrializable widefield magnetometers that capture rapid changes with speed and efficiency, opening up new possibilities in sensing, imaging, analysis, and monitoring. Moreover, the resulting prototypes will have significantly lower size, weight, power consumption and cost compared to the current lab setups, paving the way for rapid market adoption.

A consortium of experts driving innovation

The PROMISE project brings together an impressive array of expertise from both research and industry:

- Technology pioneers: Research and technology organisations Tecnalia (ES) and TNO (NL) are leading the design, setup, and testing of the new systems, ensuring that each prototype meets the demands of real operational environments.
- Advanced sensor development: Fondazione Bruno Kessler (IT) is engineering specialized single



photon avalanche diode (SPAD) pixel array sensors, while SME Diatope (GE) is crafting bespoke diamond membranes tailored with optimal NV configurations.

- **Data intelligence:** Machine learning specialists at Tecnalia are fine-tuning data acquisition and analysis, leveraging deep insights into NV centre physics to enhance sensor performance.
- Standards and certification: Italian national metrology institute INRIM contributes critical expertise in diamond-based quantum technologies, helping to standardize designs for smooth industrial integration.

Transforming key industries

Industrially relevant use cases by Graphenea Semiconductor (ES), Airbus and MagnetFab (FR), along with an academic partner Universidad Del Pais Vasco/ Euskal Herriko Unibertsitatea (ES), will help validate the developed prototypes in different settings and challenge their performance. PROMISE is set to make a significant impact in three key sectors:

- Semiconductor metrology: Enabling ultra-fast, high-resolution measurements critical for the next generation of microelectronics.
- Materials engineering: Offering enhanced imaging capabilities for the development and analysis

of advanced materials.

• Biotechnology: Providing dynamic, real-time monitoring tools that can revolutionize diagnostic and research processes.

AMIRES, The Business Innovation Management Institute (CZ), will ensure that PROMISE achieves its foreseen impact by supporting its partners in the development of ambitious commercialization roadmaps and by disseminating its results to the target audiences.

A quantum leap forward

By merging advanced quantum sensing with practical industrial applications, PROMISE is not just advancing technology—it's paving the way for the commercialization of mature quantum sensing solutions. This breakthrough will empower industries with faster, more precise tools than ever before, marking a significant leap in quantum imaging—follow our journey and be part of this transformation.

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