QEED

Intelligent Electronics and Manufacturing Technologies for Quantum Imaging

Quantum imaging offers new opportunities to investigate tissue samples for personalised medicine. The QEED collaborative research project is developing a spectrally resolved imaging method based on entangled photon pairs. It aims to enable tissue analysis without staining and support the early detection and differentiation of cancer-related biomarkers. Project information in the official project atlas

Sacher Lasertechnik is developing compact, low-noise control electronics for the required quantum light modules. In parallel, robot-assisted assembly processes are being developed to prepare for reproducible small-series production.

Project at a glance

- **Collaborative project:** Quantum Light for New Imaging Methods for the Early Detection and Differentiation of Biomarkers in Personalised Medicine
- **Acronym:** QEED
- **Project duration:** 1 January 2023 to 31 December 2027
- **Consortium coordinator:** Miltenyi Biotec B.V. & Co. KG
- **Sacher Lasertechnik subproject:** Intelligent Drive Electronics for Quantum Light Modules and Manufacturing Technologies
- **Funding reference:** 13N16382
- **Funding:** German Federal Ministry of Research, Technology and Space (BMFTR), under the initiative “Lighthouse Projects in Quantum-Based Metrology to Address Societal Challenges”

Project duration, coordination and funding details are provided in the official project atlas.

Objectives and Approach

In the mid-infrared spectral range, molecules provide characteristic information about the chemical composition of tissue. QEED uses entangled photon pairs to transfer measurement information from this range to the more readily detectable near-infrared range.

The project targets label-free microscopy with a measurement time of two minutes for a ten-megapixel image. Demonstrators are planned for biomedical research and automated pathology, including a system with an integrated fluorescence unit. The method is to be evaluated through animal experiments and clinical studies. QEED objectives and approach

Sacher Lasertechnik’s Contribution

The quantum light modules require precise, coordinated control of their laser components. Sacher Lasertechnik is developing a miniaturised electronic platform based on a field-programmable gate array (FPGA). This platform is intended to combine the necessary control functions and enable simultaneous operation of multiple modules.

Development focuses on low-noise current and voltage supplies, fast control algorithms, and precise control of multi-section lasers and their integrated heater segments. Energy efficiency, thermal management and suitable communication interfaces are intended to support a compact design and

integration into the consortium’s measurement systems. The electronics will be built and tested across several development generations, incorporating feedback from the project partners.

In parallel, Sacher Lasertechnik is working with project partner FBH to develop robot-assisted microassembly processes. Optical and mechanical components are to be positioned precisely, monitored through in-process measurements and then secured in place. A compact enclosure concept is also planned to bring together the quantum light modules, electronics and required interfaces.

Expected Results and Outlook

By the end of the subproject, a compact, energy-efficient and flexibly configurable control unit for the quantum light modules is expected to be available. Together with the assembly processes developed, it is intended to facilitate the transition from individual laboratory setups to reproducibly manufactured systems.

Beyond the project application, the electronics offer potential for use in other Sacher Lasertechnik laser systems. Possible applications include spectroscopy, environmental monitoring and industrial process control, where compact designs and precise laser control are also essential.