Dr. Carsten Pitsch, Fraunhofer IOSB

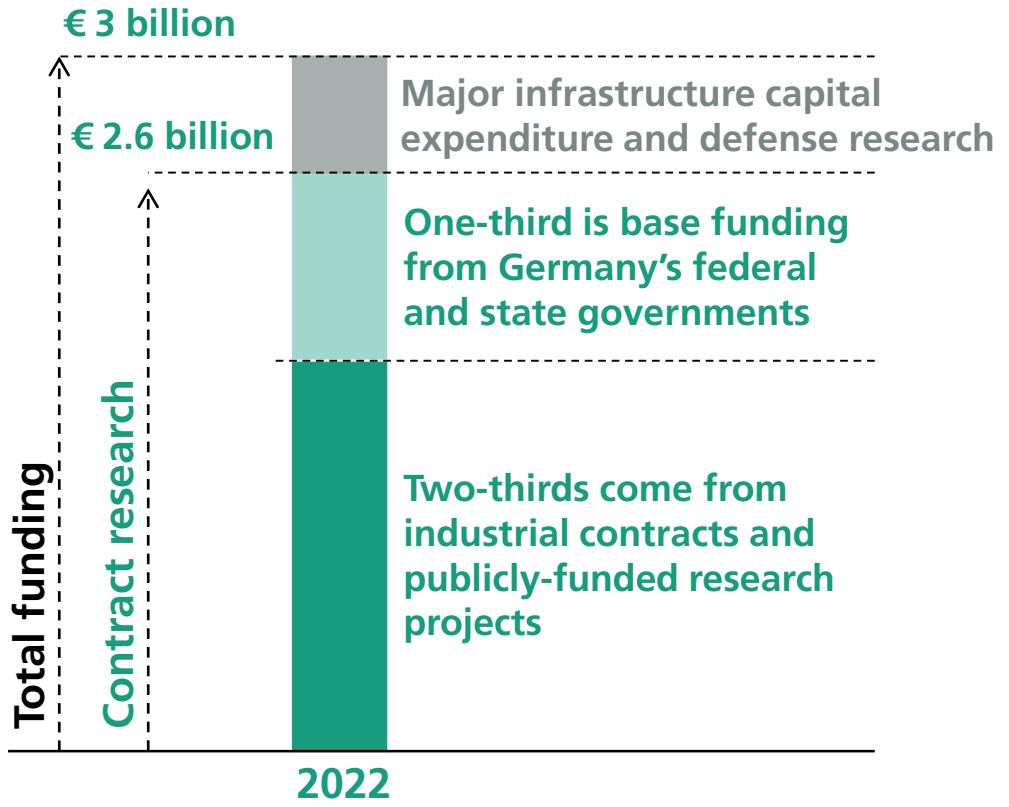
Optics and Photonics Activities at Fraunhofer IOSB

Section 01

Fraunhofer Overview

The Fraunhofer Society

At a glance



IOSB core competencies

Optronics – System Technologies – Image Exploitation

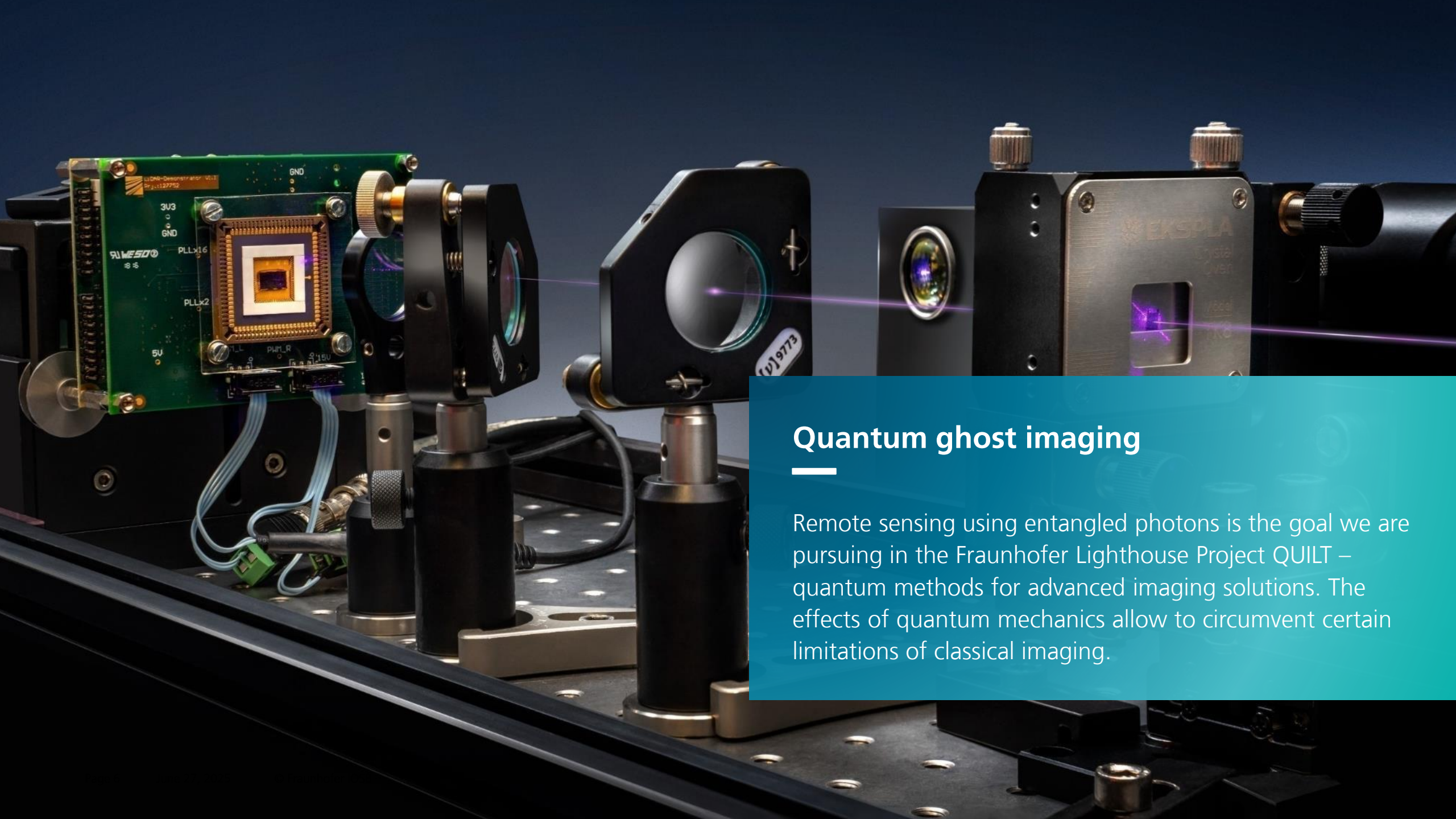
Optronics
Understanding and control of the generation of light, its beam forming, propagation and conversion into electronic signals

System Technologies
Ability to analyze, understand, model, develop and control complex systems

Image Exploitation
Preparation and real-time processing of images and videos as well as automatic and interactive information extraction

Section 02

Our Technologies and Current Needs and Challenges

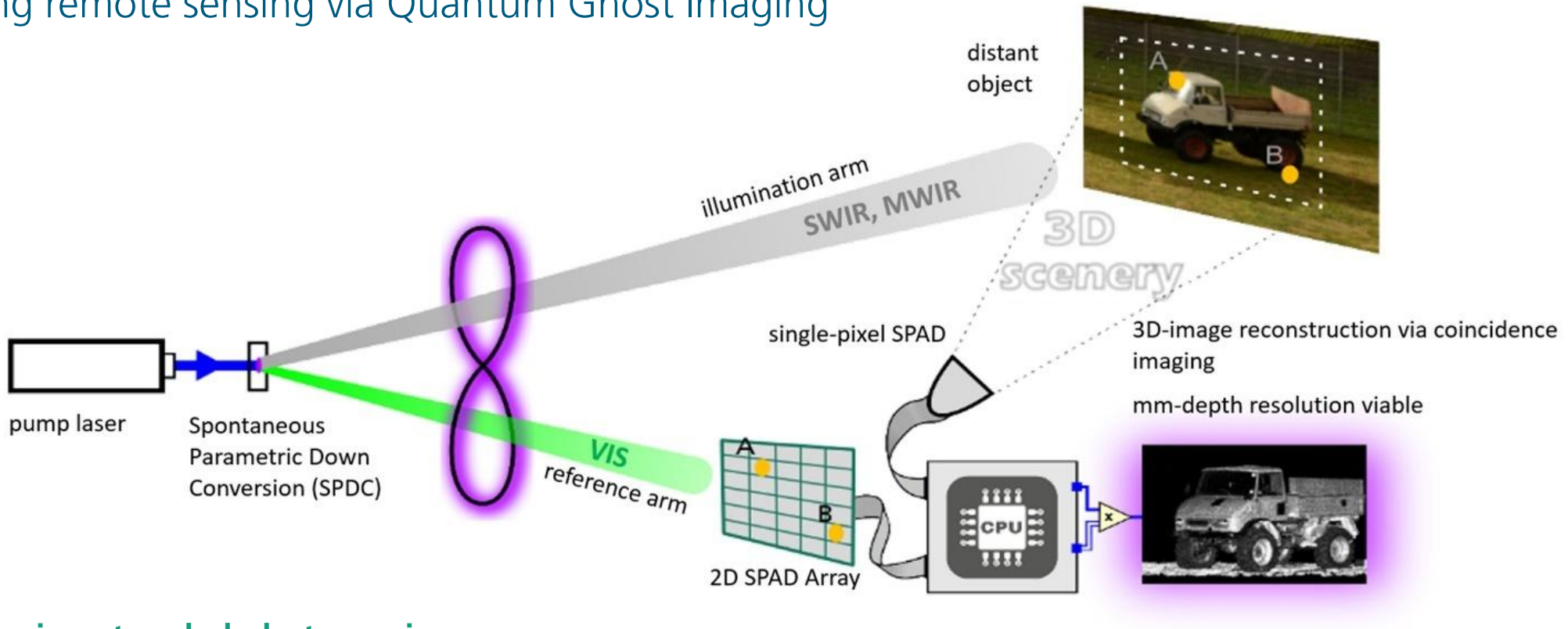


Quantum ghost imaging

Remote sensing using entangled photons is the goal we are pursuing in the Fraunhofer Lighthouse Project QUILT – quantum methods for advanced imaging solutions. The effects of quantum mechanics allow to circumvent certain limitations of classical imaging.

QT @ FhG IOSB - Asynchronous Quantum Ghost Imaging

Enabling remote sensing via Quantum Ghost Imaging



Imaging via entangled photon pairs

- Illumination in the IR (1550 nm) while imaging in the VIS (550 nm)

Pair identification via temporal correlation

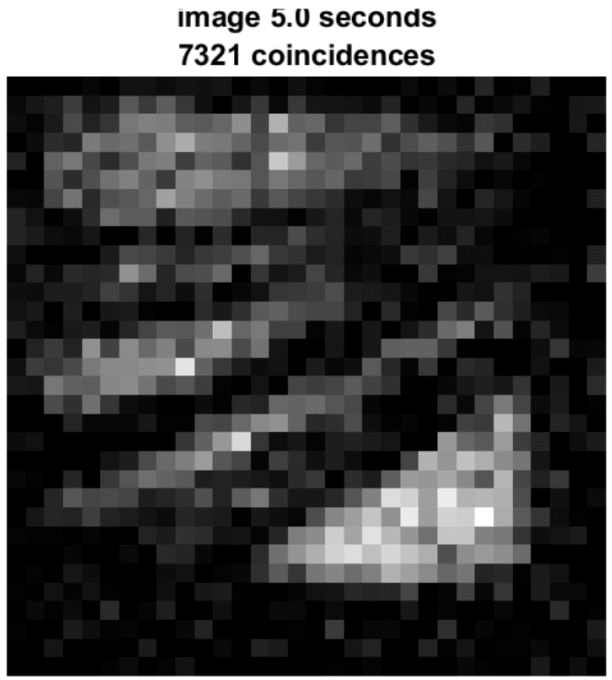
- Photons are time-tagged and compared

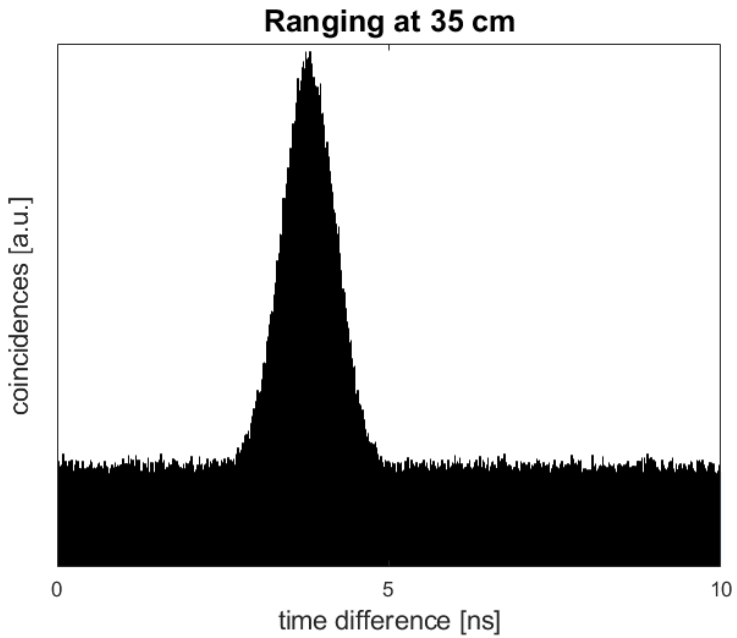
Features

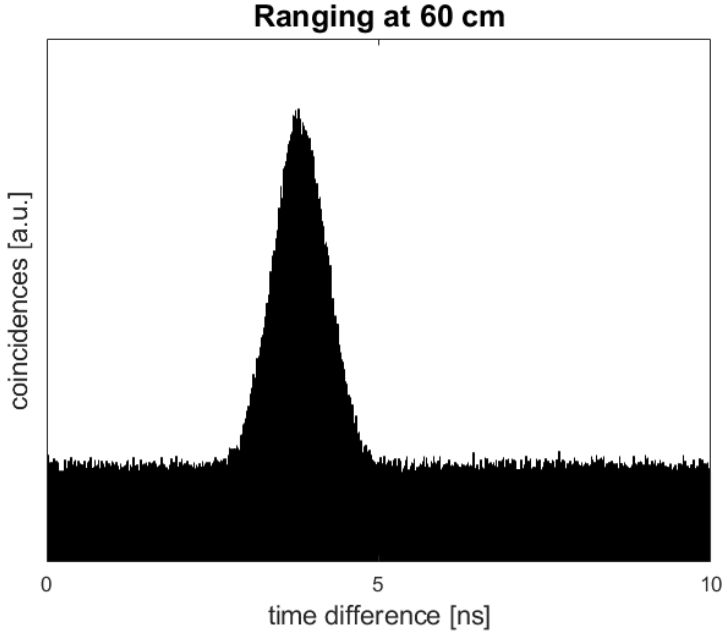
- Depth resolution (3D imaging)
- Covert Imaging (imaging below natural background)
- Easy tuning of illumination and imaging wavelengths

Current results – ADEQUADE project

Video-rate acquisition and diffuse targets







New SPAD camera, designed for aQGI

- High duty-cycle & fill-factor

Video-rate acquisition

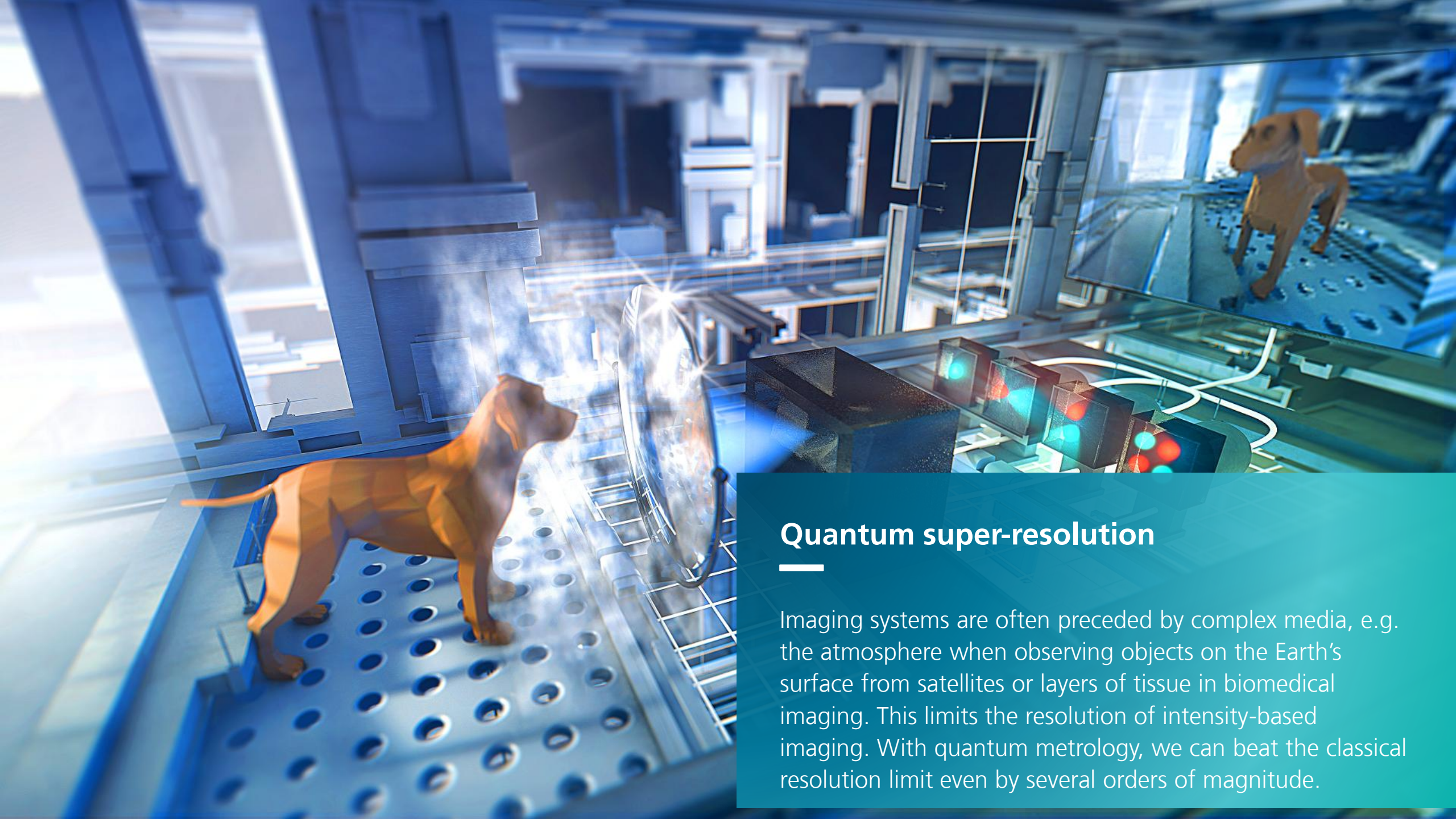
- Imaging with pW illumination (≙ background during starry night)

Range finding on diffuse scattering target

- Sanded aluminum plate, at distances <1 meter

Performance scaling to higher distances

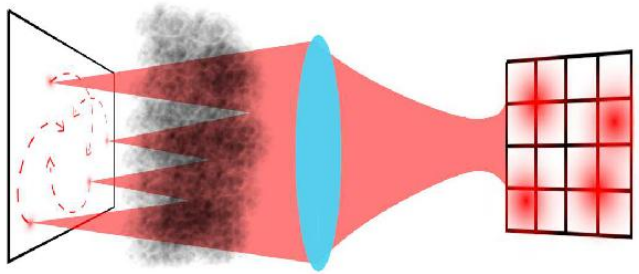
- Currently up to 5 000 coincidences per second at 10 meter distance



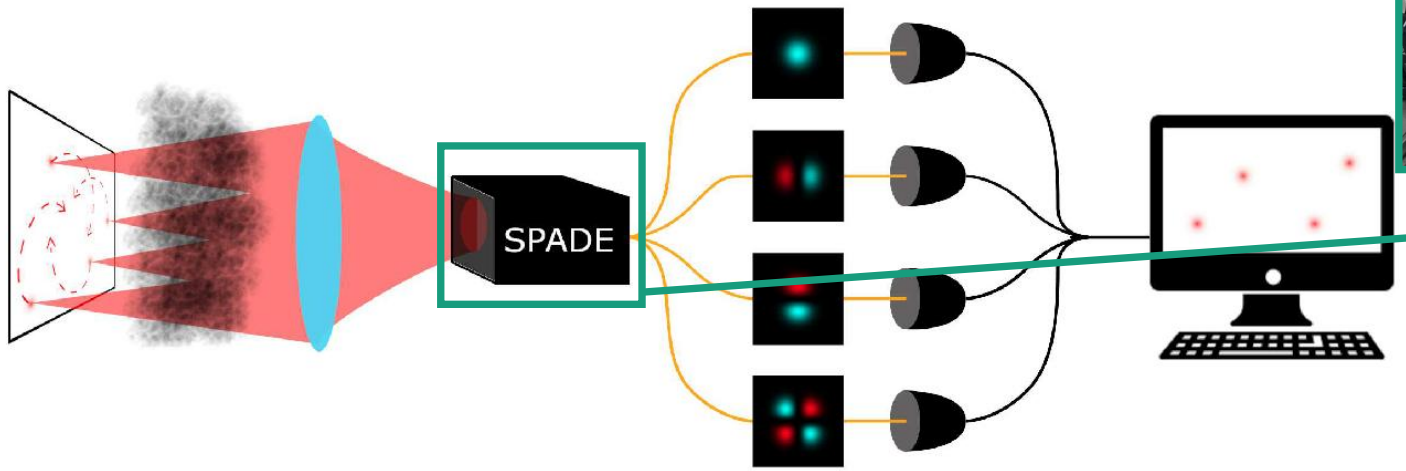
Quantum super-resolution

Imaging systems are often preceded by complex media, e.g. the atmosphere when observing objects on the Earth's surface from satellites or layers of tissue in biomedical imaging. This limits the resolution of intensity-based imaging. With quantum metrology, we can beat the classical resolution limit even by several orders of magnitude.

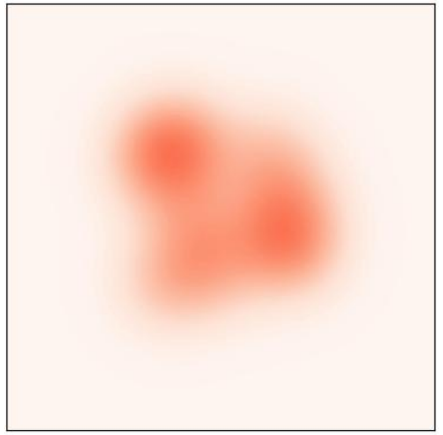
Spatial-Mode Demultiplexing (SpaDe)

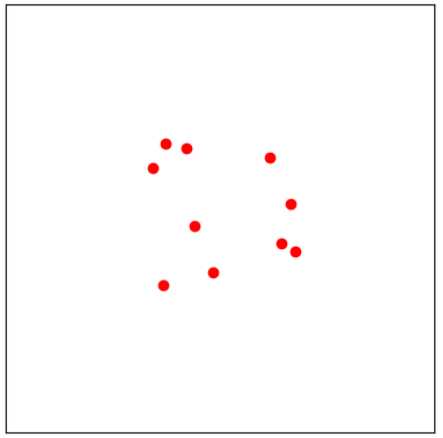


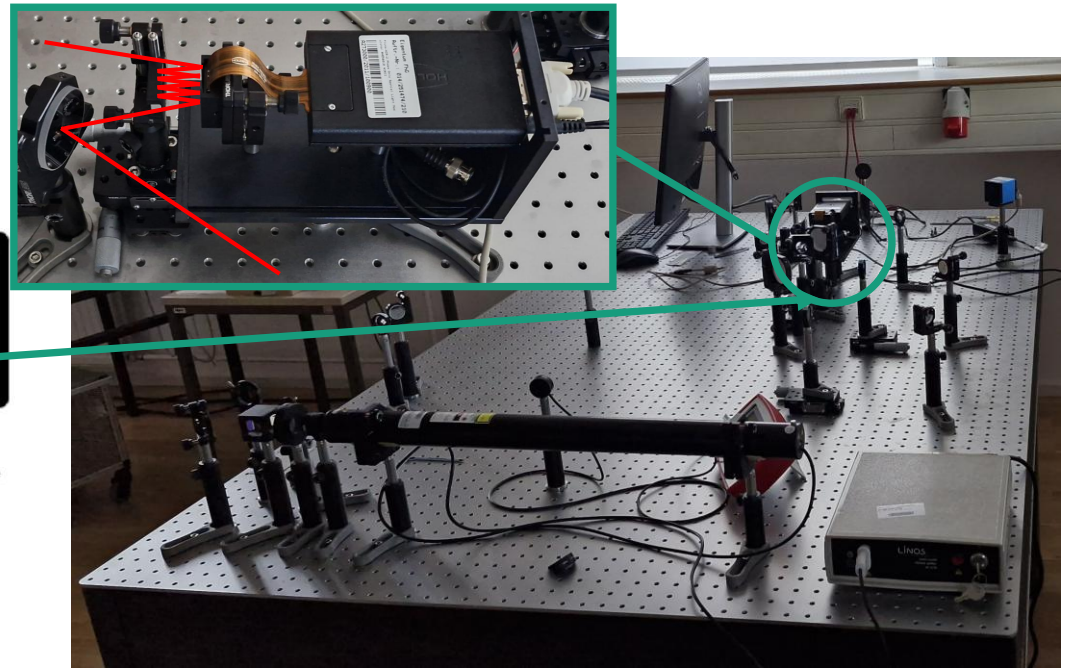
Direct imaging



SpaDe-based imaging

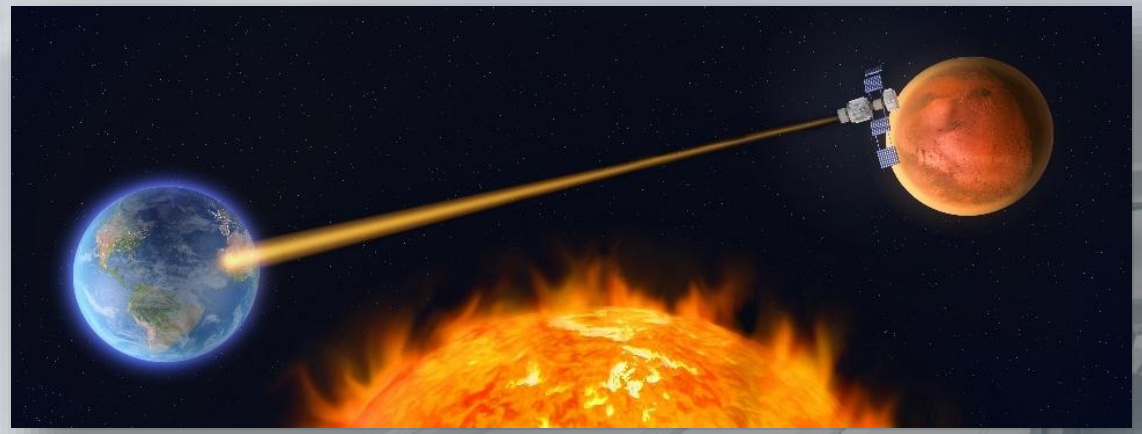


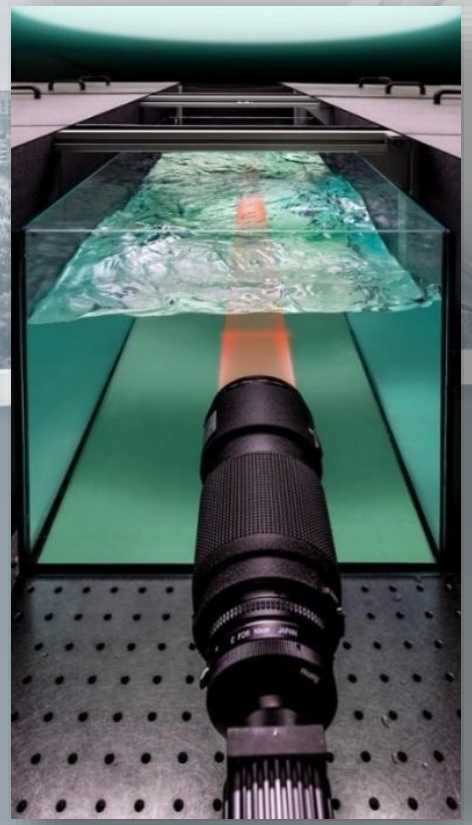




Free-space optical communications

We develop laser-based communications systems and suitable adaptive optics solutions for correction of time-evolving aberrations for all three domains: terrestrial, space and underwater.





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Contact

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