Q.ANT
Starting up with Quantum Sensors

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Head of Sensing Technologies

EPIC Technology Meeting on Industrial Quantum Photonics

This is Q.ANT
in figures, data and facts

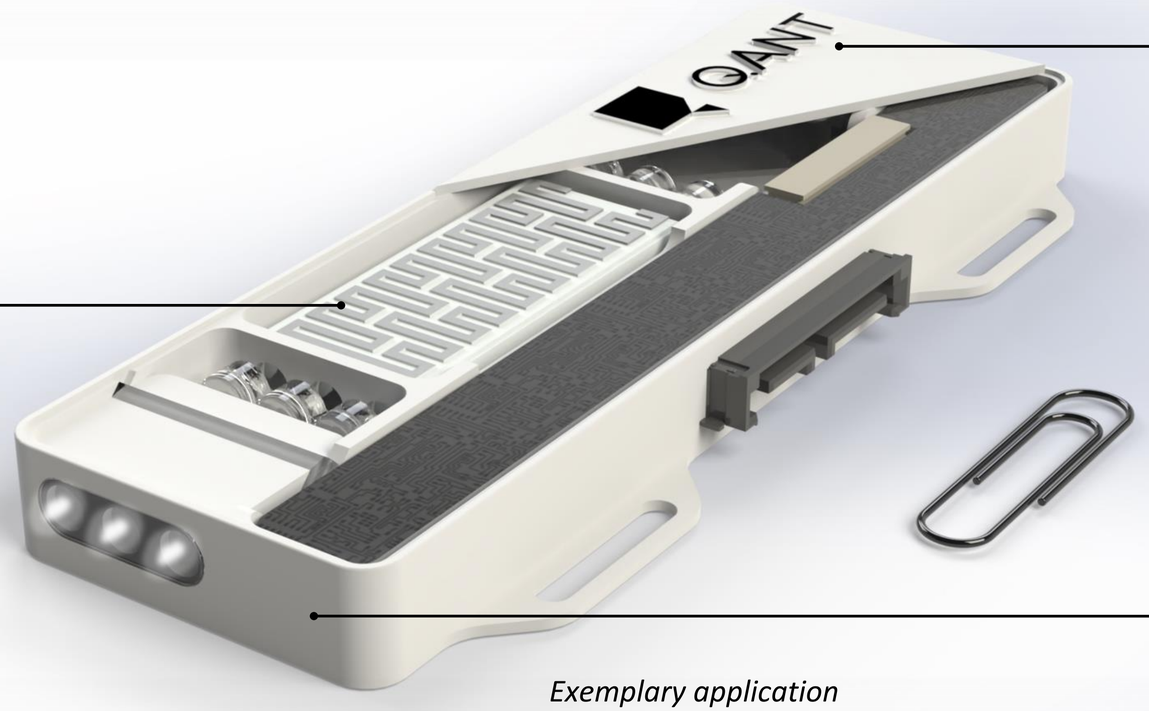
2018 Foundation	4 Product Lines	1.600 sqm Workspace
80 Q.ANTies	11 Nationalities	6 Publicly funded projects
23 Patent Families	2 World Premiers	7 Coffee machines

Q.ANT delivers Photonic Quantum Technology

for industrial applications together with our partners

Quantum controls

- Nonlinear waveguides
- Tailored optical elements



Exemplary application

Electron to photon conversion

- Solid state diodes
- Low-noise current drivers

Photon to Electron conversion

- Low-noise amplifiers
- Analog to Digital conversion
- Signal process

Q.ANT will grow towards Quantum Sensing and Quantum Computing

based on strong Enabling Technologies

Particle Metrology

Sensor for analyzing finest particles in gases, liquids and as powders.

- Chemistry, pharma and food processing
- Algae and bacteria analysis
- Material characterization

Atomic Gyroscope

Sensor for stabilization and localization of systems

- Satellite leveling
- Indoor Automated Guided Vehicle (AGV) Localization

Magnetic Sensing

Sensor for measuring finest signals in magnetic fields.

- Prosthesis control by neuronal signals
- Outdoor Automated Robotic Localization
- Human-Machine Interface

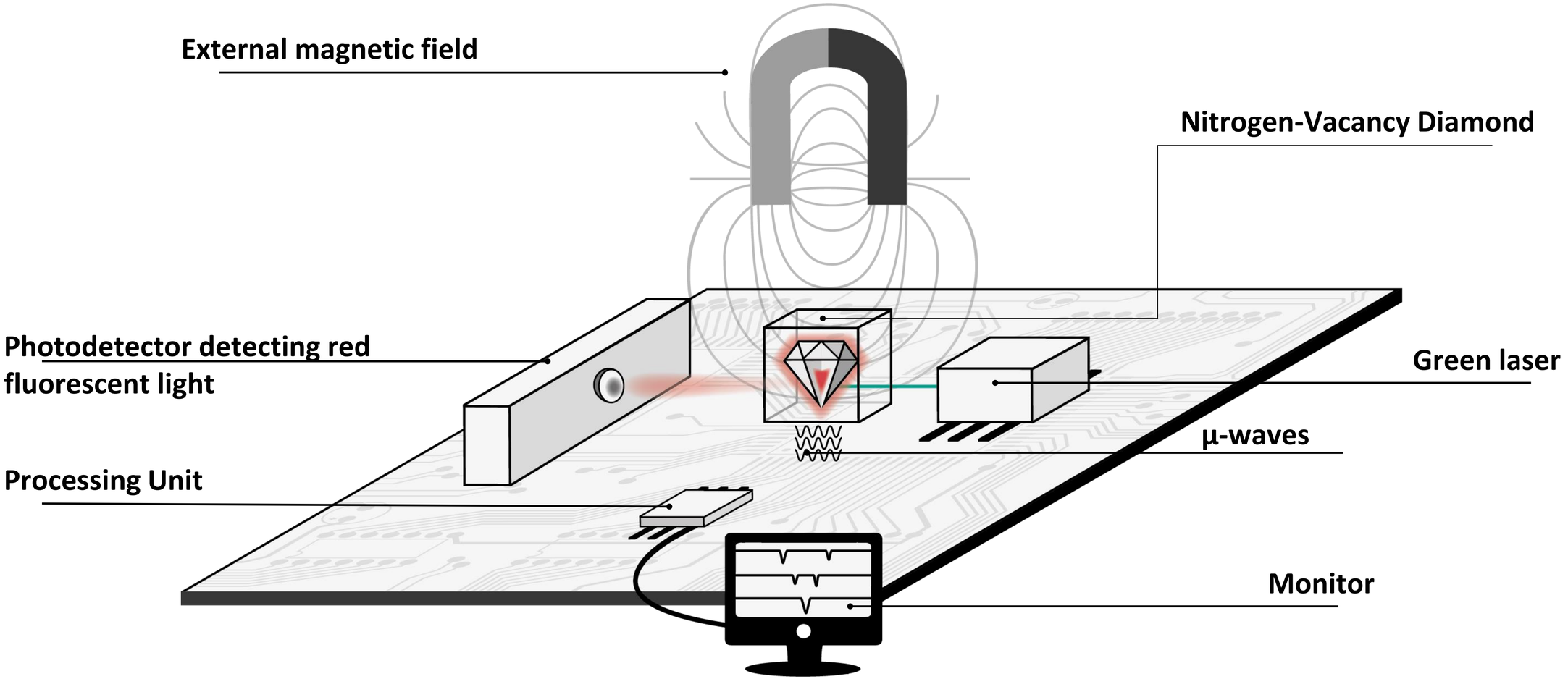
Photonic Computing

Photonic Chips and Computing for solving complex algorithms

- Quantum Computing
- Complex Optimization
- Neuromorphic Computing

Working principle of diamond magnetometers

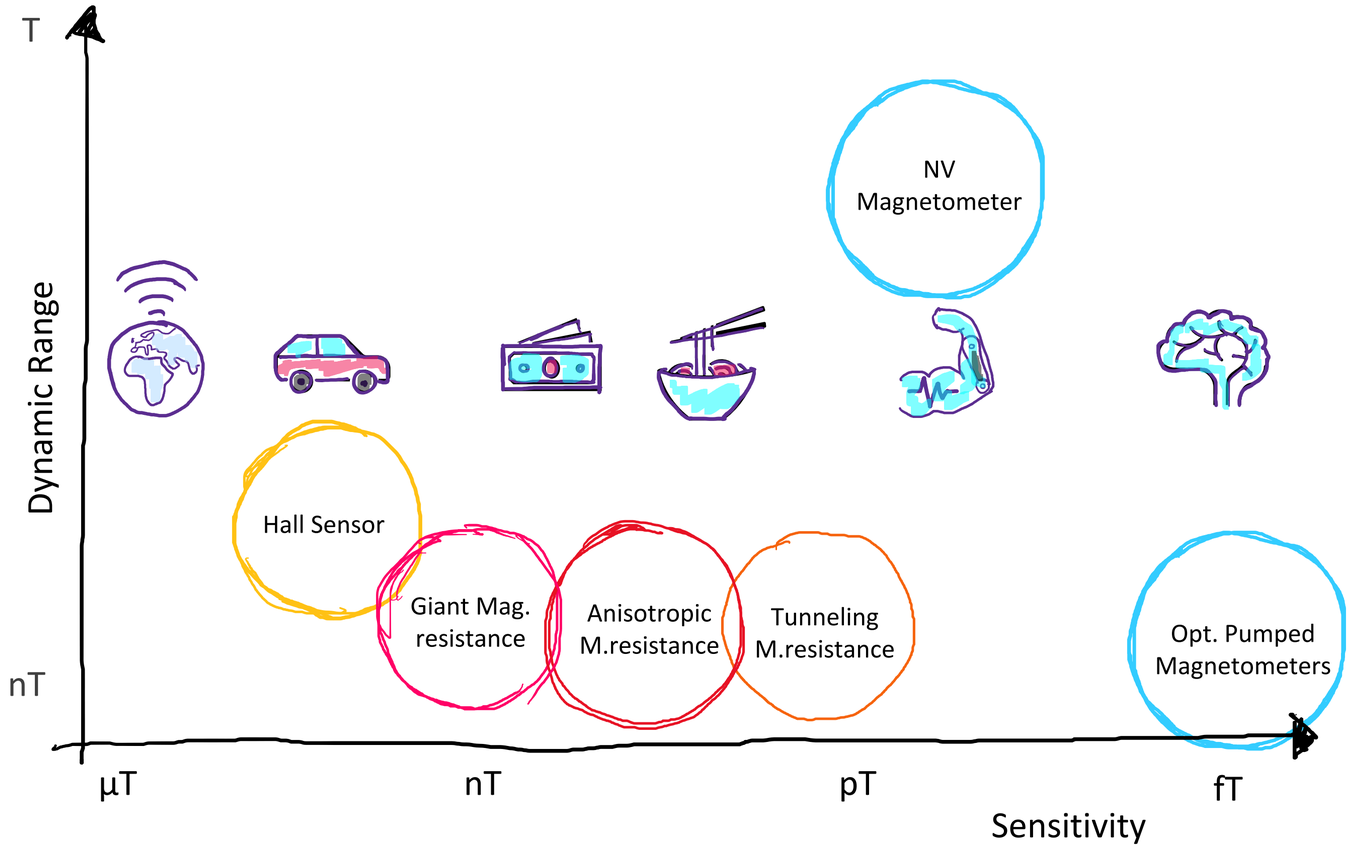
Detection of red fluorescence under irradiation with green light and resonant microwaves



Quantum based Magnetic Sensors combine high resolution on a small footprint…

… and open new applications in the human-machine interfacing.

Room-temperature magnetometer



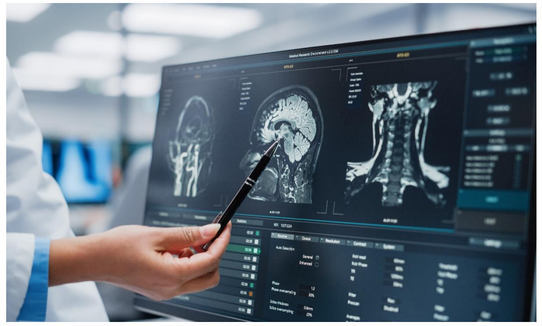
- Room temperature operation
- High sensitivity (pT/sqrt(Hz))
- Large bandwidth (dc - kHz)
- Large dynamic range (up to several T)
- Contactless measurement
- Vector-magnetometry
- Miniaturizable
- Biocompatible

- Diamond magnetometers enable detection of smalles field changes at strong backround fields

Application areas of Diamond Magnetometers

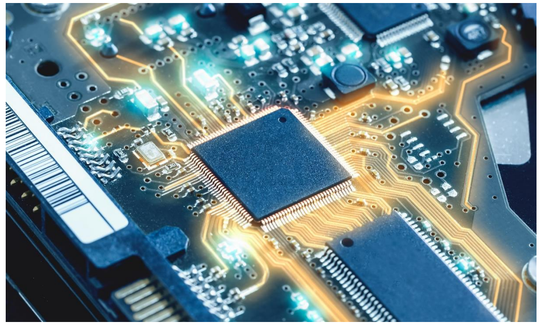
The use-cases are widespread

Medical Technology



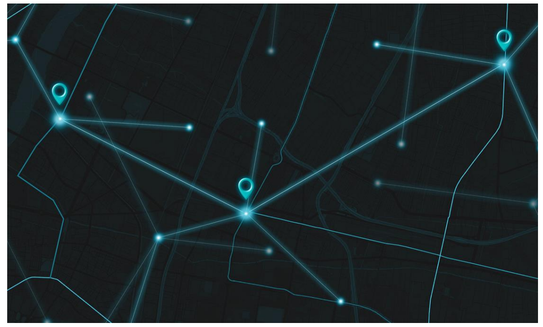
- MMG-based prosthesis control
- MEG-based measurement of neuronal brain activity for Human-Machine interaction

Component and material analysis



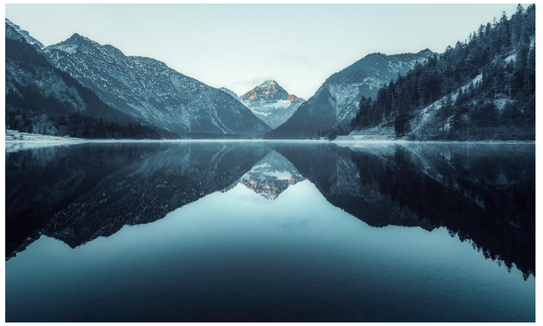
- Current imaging in integrated circuits for quality control or fault analysis
- Detection of defects in the material structure of components
- Characterisation of magnetic materials and nanoparticles

Localization



- Indoor and outdoor automated guided vehicles
- Localization applications in automotive

Geophysics



- Exploration of magnetic fields in the Earth's interior to study plate tectonics and mineral deposits

Our goal is to measure biosignals for prosthesis control

Detection of the magnetic instead of the electric signals offers many advantages for the user

Muscle movement causes electric and magnetic signals
Both can be used for prosthesis control

Electric-signal detection with surface electrodes

Dr. Tie Liu, School of Electrical Engineering, Shenyang University of Technology

- State-of-the-art technique for prosthesis control
- Direct skin contact needed
- Signal distortion due to sweat, body hair and scar tissue
- Low spatial resolution (< cm)
- Signal distortion due to limb movement

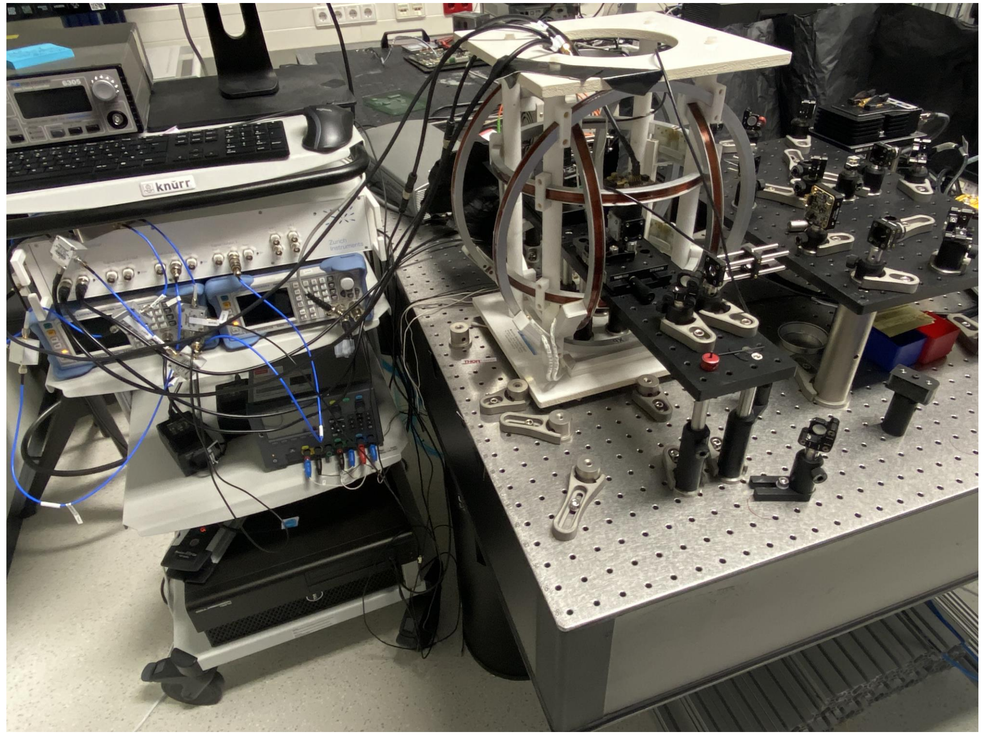
Magnetic-signal detection with Quantum sensors

- Neuronal-signal detection demonstrated (shielded environments)
- Contactless measurement
- Insensitive to sweat, body hair and scar tissue
- High spatial resolution (< mm)
- Stable signals under limb movement possible

- Magnetic biofield detection allows for reliable and user friendly sensor application

A prototype of a fully integrated sensor has been demonstrated at the Hanover fair…

… marking an important step in bringing the technology from the laboratory to the market.



We have developed the first, commercially available, fully integrated sensor

Performance data of the sensor

Size		150 x 107 x 120 mm
Weight		1,5 kg
Power	12 W	
Interface		Ethernet
Sensitivity		< 300 pT/sqrt(Hz)
Sensor Volume		0.5 x 0.5 x 0.5 mm
Dynamic Range		Zero field to mT
Laser Wavelength		520 nm

Until 2026, we plan to develop a miniaturized, ultra-sensitive gradiometer

2023 First portable magnetometer

- First portable, integrated magnetometer
- Sensitivity < 300 pT/sqrt(Hz)
- Volume < 2000 ccm

First prototype developed and ready for miniaturization

2024 Field study with portable magnetometer

- PoC experiments to measure muscle activity in shielded environments
- Sensitivity < 100 pT/sqrt(Hz)
- Volume < 500 ccm

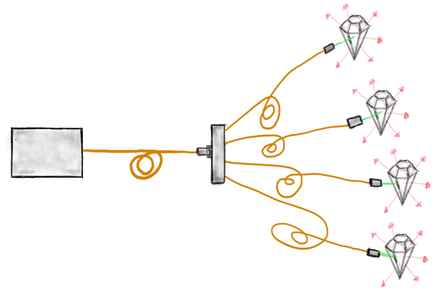
Prototype optimized to measure muscle activity

2025 Integrated, portable gradiometer

- Measurement of muscle activity in unshielded environments
- Sensitivity < 10 pT/sqrt(Hz)
- Volume < 150 ccm

Bio-signal detection and prosthesis control demonstrated

2026 Ultra-sensitive miniaturized gradiometer

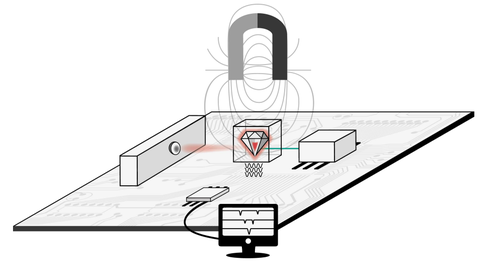


- Sensor arrays for neuronal-signal detection
- Sensitivity < 1 pT/sqrt(Hz)
- Volume < 500 ccm

Neuronal-signal detection demonstrated, extension to multiple sensor heads

Key success factors for starting up (so far)

- Identify a technology which offers high gain compared to state of the art
  - E. g. 10 times better or 10 times cheaper

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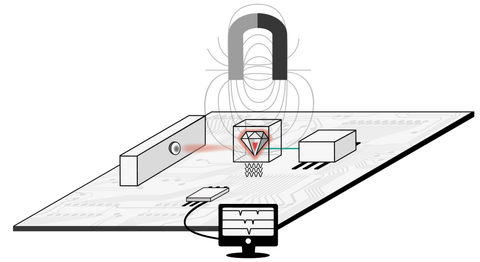

- Identify a technology which offers high gain compared to state of the art
  - E. g. 10 times better or 10 times cheaper
- Have experts that understand the physics and working principles
- Have engineers (software, electronics, mechanical) that bring in practical expertise

- Offer an open work environment/work culture/communication to enable formation of high performing teams consisting of experts, engineers, software developers etc.
- Partnering to source out development tasks being not in your core expertise

Federal Ministry of Education and Research

Qyro Quantenbasierte Gyroskope

QSens

QUAMAPOLIS

PHOQUANT

- Early and fast development and professional demonstration of first functional prototypes
- Diversify your envisioned product lines to minimize risk of complete failure and use synergy effects