Education and Outreach

- Enhancing public and school engagement
- Providing structured education at all levels
- Providing plannable career paths
- Increasing the diversity of ideas
- Coordinating with BMBF and QT Flagship programes

Equal Opportunity and Diversity

Mentoring programmes, e.g.

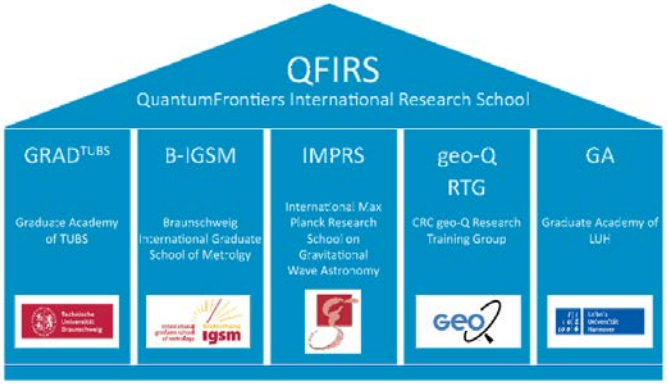
- Leadership in science for female professors
- Team mentoring for female PhD students
- Niedersachen Technikum for young students

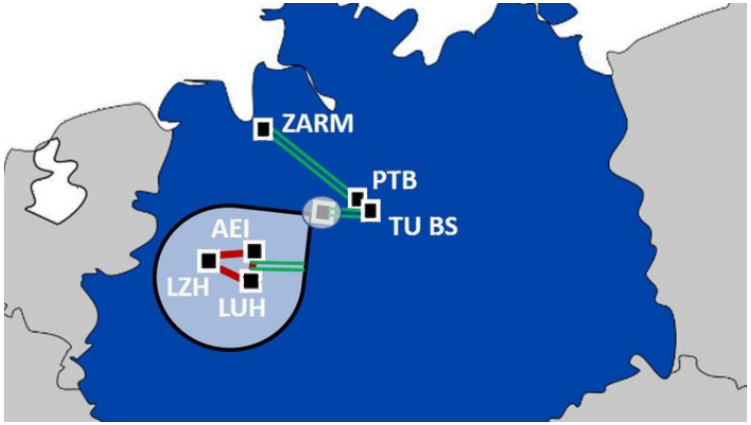
Tech Transfer

- QuantumFrontiers Entrepreneuer Excellence Programme (QuEEP)
- Quantum Engineering Master's Degree
- Industry Collaborations

QuantumFrontiers International Research School (QFIRS)

- Linking physics and engineering
- Internationalisation: send PhDs abroad
- Establish scientific & alumni network





Partners

- Leibniz Universität Hannover (LUH)
- Technische Universität Braunschweig (TUBS)
- Physikalisch-Technische Bundesanstalt (PTB)
- Albert-Einstein-Institut (AEI)
- Laser-Zentrum Hannover e.V. (LZH)
- Zentrum für angewandte Raumfahrttechnologie und Mikrogravitation (ZARM)

Contact point

Leibniz Universität Hannover

Exzellenzcluster QuantumFrontiers
QUEST Leibniz Forschungsschule

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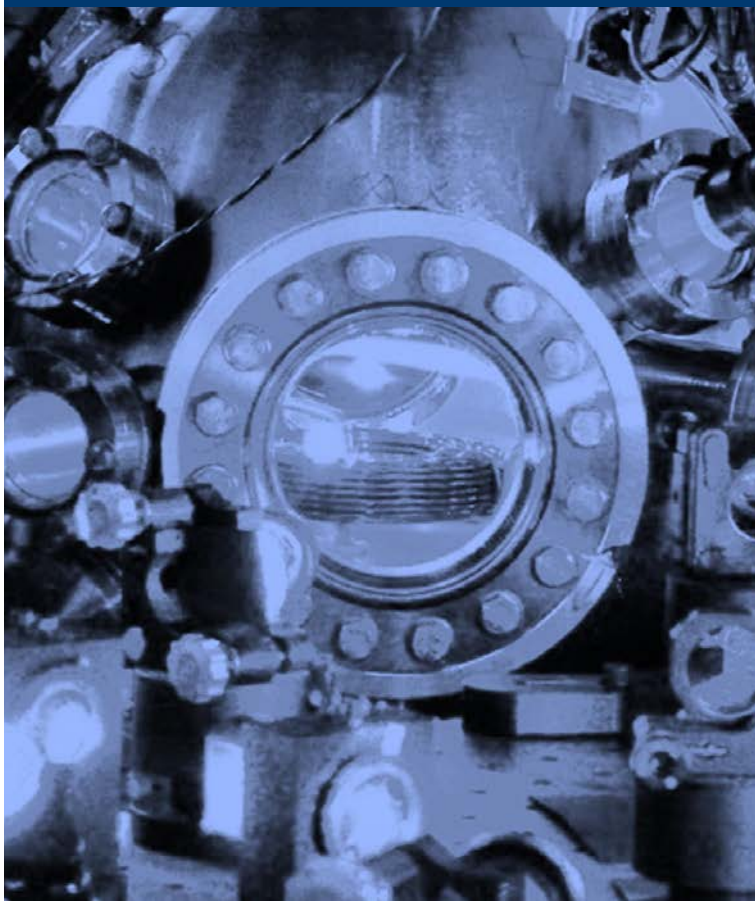
Leibniz Universität Hannover

PTB

Technische Universität Braunschweig

QuantumFrontiers

Light and Matter at the Quantum Frontier: Foundations of and Applications in Metrology



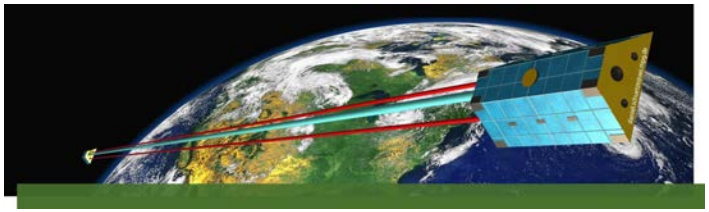
Gravitational wave detection

The detection of gravitational waves is a success story of quantum & nano-engineering & metrology that is at the heart of QuantumFrontiers. By using quantum non-demolition interferometers, by optimising lasers to beat quantum noise and by overcoming thermal noise of the mirrors, QuantumFrontiers aims at expanding the observability by a factor 10,000,000 in order to reach the dark ages of the Universe.

The 10m-prototype is an interferometer that is quantum limited by design!

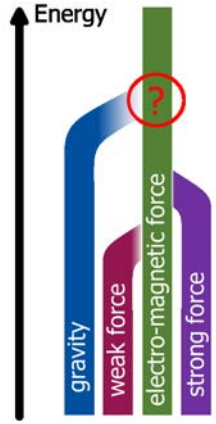
Geodesy and Gravimetry

QuantumFrontiers develops space-based laser interferometers and transportable atomic gravimeters and clocks for conquering the next level of precision in geodesy. These quantum technologies are required for water monitoring and height determination. Multi-testmass laser interferometry will be established as a standard tool in satellite gravimetry. Likewise, Bose-Einstein condensates on chips will revolutionise terrestrial gravimetry observations.

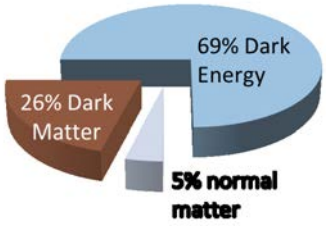


Fundamental physics

QuantumFrontiers tackles a number of grand challenges in fundamental physics, e.g. the unification of fundamental forces and the composition of the universe.



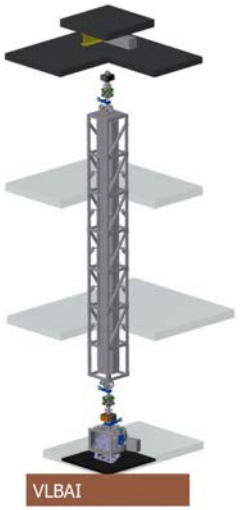
Can all forces be united?

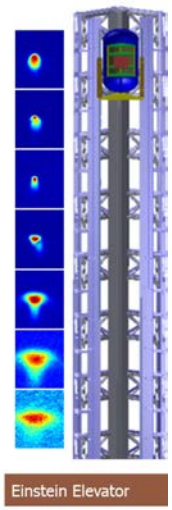


Dark Matter & Dark Energy?

QuantumFrontiers uses precision measurements to perform competitive tests at low energies. We search for changes in fundamental constants with ultra-sensitive clocks to constrain dark matter models and we push the signal-to-noise ratio of atom interferometry beyond the current limits. We will develop the necessary atom interferometry techniques for a future space mission conducting a dual-species free-fall test of Einstein's equivalence principle with quantum matter.

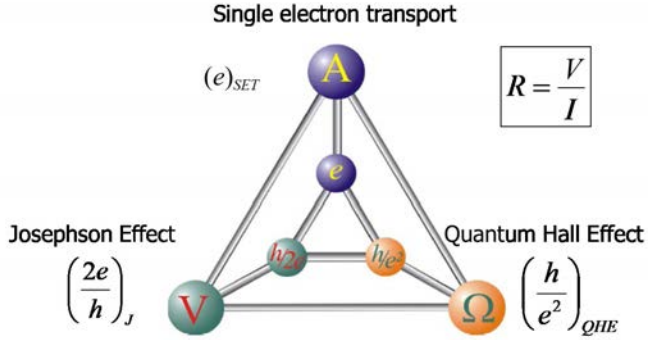
The Hanover Institute of Technology (HITec) brings together all partners under one roof.


VLBAI


Einstein Elevator

Nano– and Quantum Engineering

QuantumFrontiers investigates our theoretical understanding and experimental precision of three macroscopic quantum effects; namely, the quantum Hall effect, the Josephson effect and single-electron currents. These three electrical quantum effects are correlated via Ohm's law forming the so-called quantum electrical triangle. Any measured deviations from Ohm's law would require a modification of the quantisation.

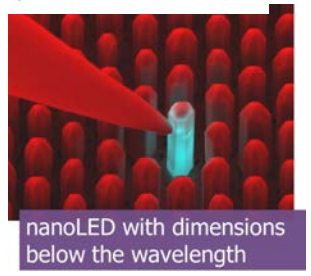


QuantumFrontiers also integrates nanophotonic platforms and aims at making nanoLEDs with dimensions smaller than visible light wavelengths.

Today


High power large area LED

QF Vision


nanoLED with dimensions below the wavelength

QuantumFrontiers will merge the strong nano- and quantum engineering capabilities of all partners into a **joint technology node called TrapFab**. Silicon CMOS chips will be integrated with photonic platforms.