Optics & Photonics
Humboldt-Universität zu Berlin

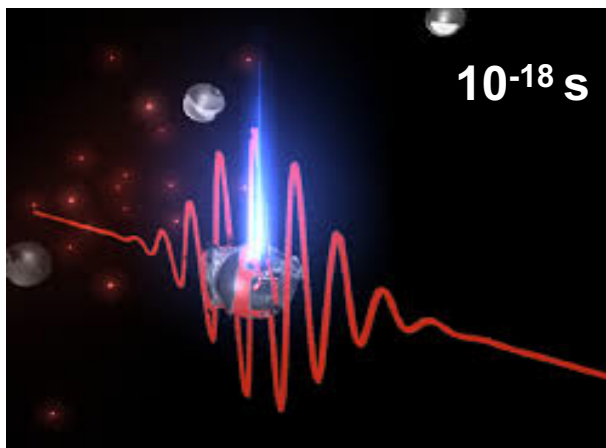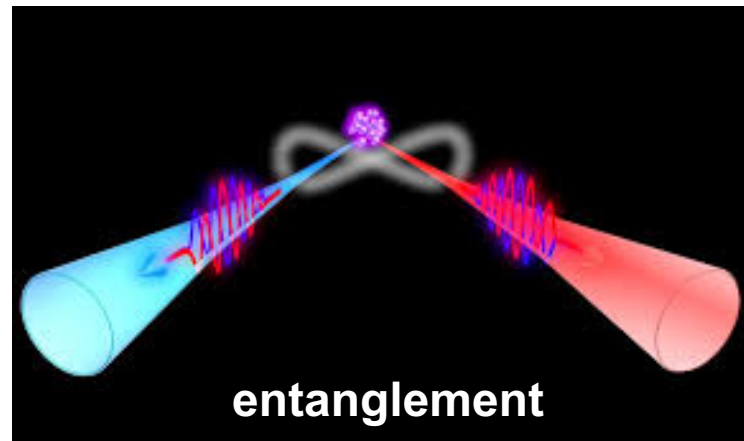**https://www.physik.hu-berlin.de/de/op**

Light is …

… precise

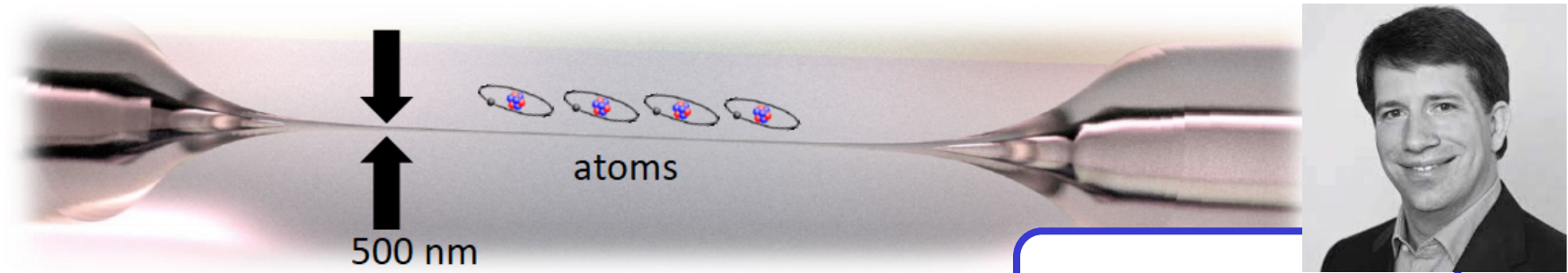LIGO

… fast

10⁻¹⁸ s

… quantum

entanglement
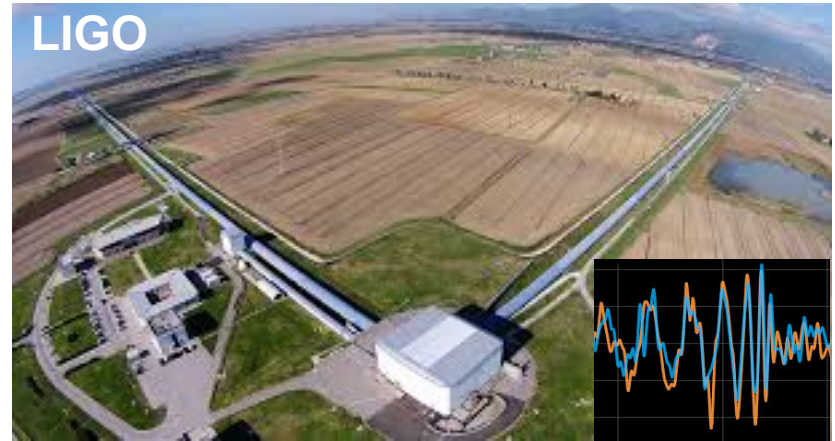
Fundamental Light-Matter Interaction

„Atoms on a string": optical fibers with nanofiber waist connected to single atoms

atoms

500 nm

AG Rauschenbeutel

nanofiber   atom cloud

evanescent coupling with cold atoms:
strong quantum light-matter interaction

Fundamental research:
- new regimes of light-matter-coupling (near-field effects)
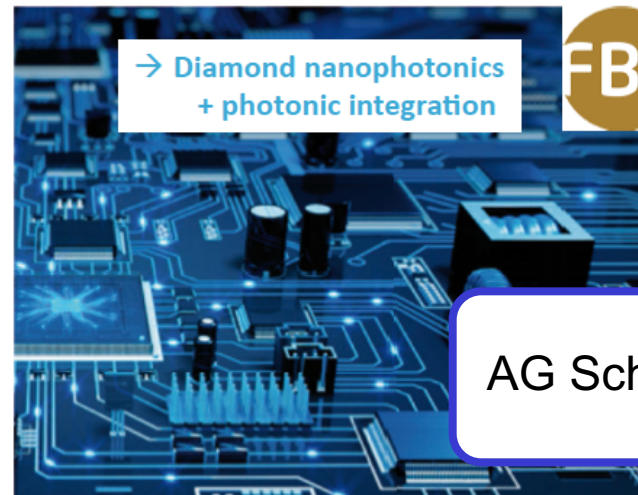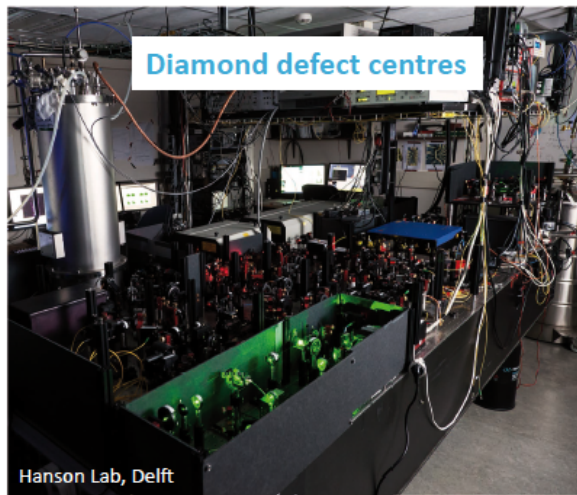- single photon-single atom interaction & collective effects

Applications:
- quantum information (quantum memoires, quantum gates)
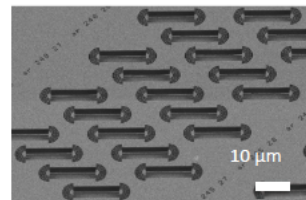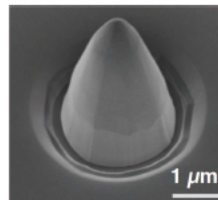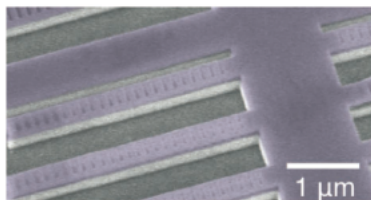- few-photon non-linear devices

Integrated Quantum Photonics

Solid-state quantum emitters as building blocks for quantum technology
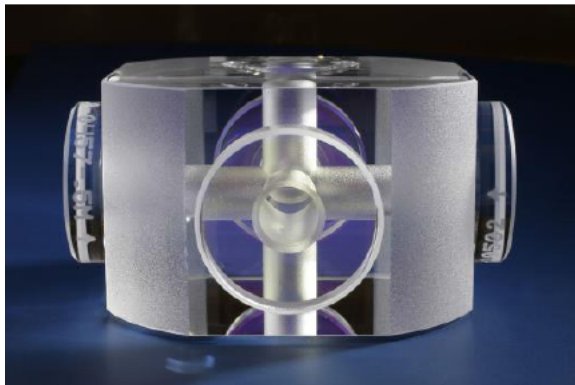
color centers in diamond structures

Research Topics:
- shrink optical labs into quantum devices (q. computing, q. simulation)
- realization of quantum photonics for complex quantum tasks
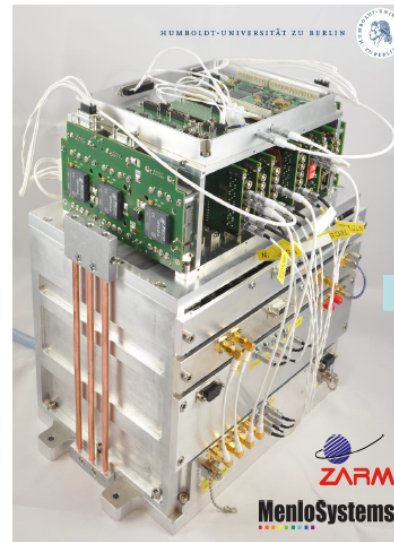
Optical Metrology and Integrated Quantum Sensors

Ultra-precise optical measurements & bringing quantum optics into space

integrated laser experiments

optical resonators

Fundamental research:
- Is Lorentz invariance violated?
- Are natural constants constant?

Applications:
- quantum optics in space
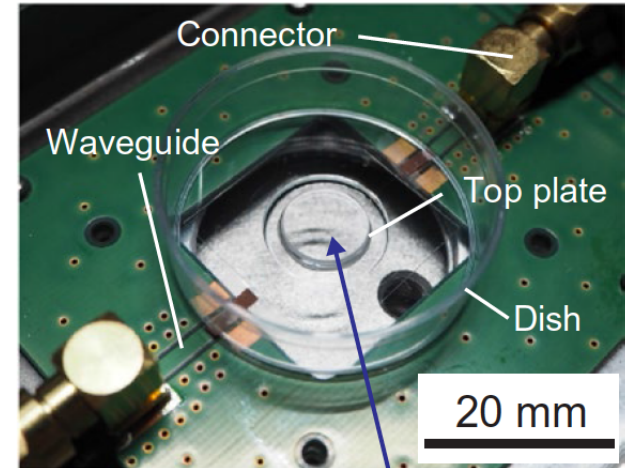- optical clocks, gravitational waves, geodesy
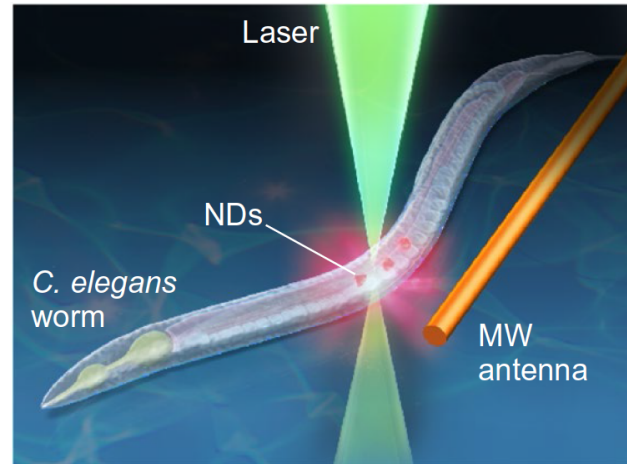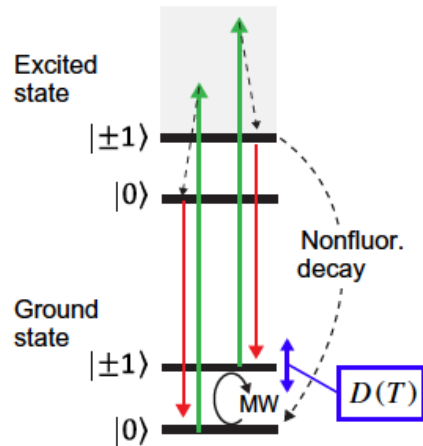
AG Peters
AG Krutzik

Nano-Optics

Controlable quantum system for quantum devices & quantum sensing

single electron spins as nanothermometers
in living organisms

Measurement area

Fundamental research:
- optical control of single electron & nuclear spins
- few-photon interaction & collective effects

Applications:
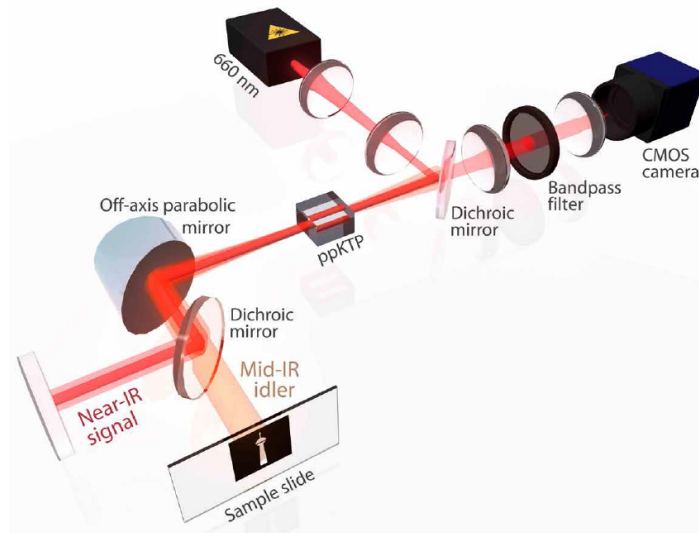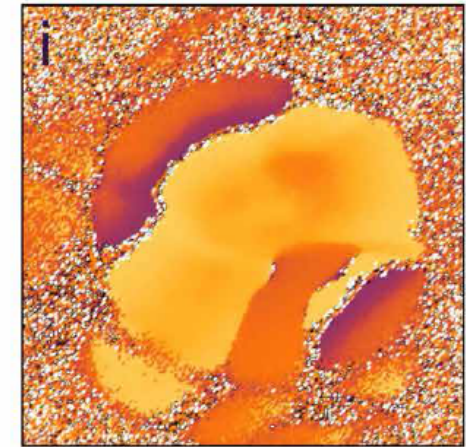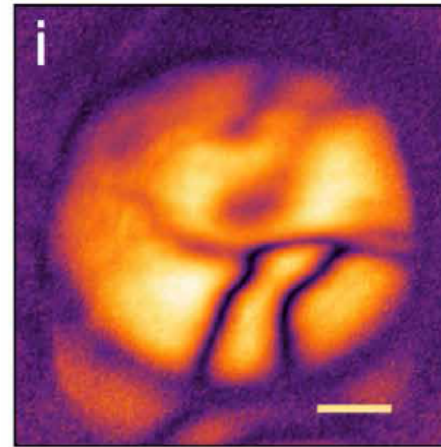- quantum communication & processing
- quantum sensing

AG Benson

Nonlinear Quantum Optics

Circumvent problems for IR imaging through quantum entanglement

photon pair source

IR absorption & phase imaging of mouse heart

Fundamental research:
- generation of (hyper-)entangled photons
- fundamental principles of quantum physics

Applications:
- quantum microscopy & spectroscopy

AG Ramelow

Theoretical Optics & Photonics and Modern Optics

Fundamental optical science with „Pencil, Mathematica, Numerics"

Tritium Neutrino Experiment (KATRIN)
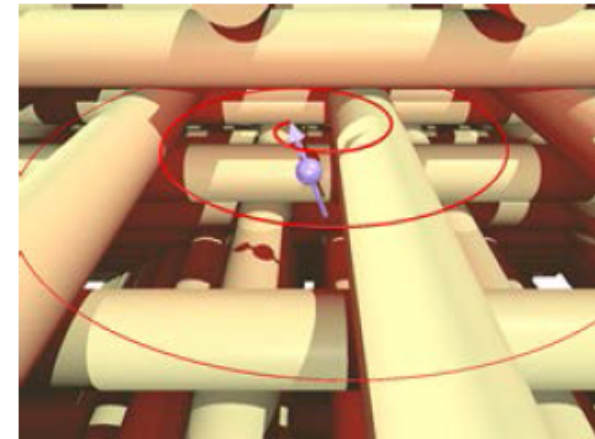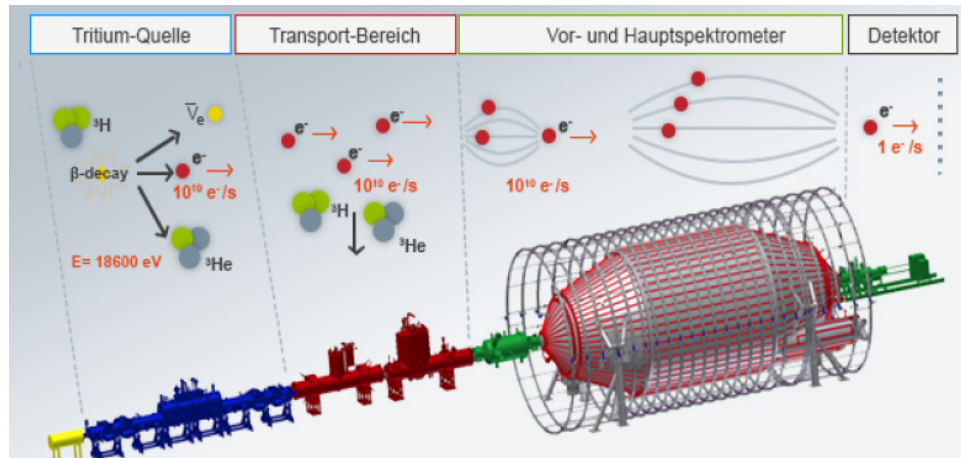
(quantum) light-matter interactions in complex nanostructures

Research topics:

- ultra-fast processes in intense light fields
- cold atom gases (quantum simulation)
- optical precision measurements
- optical interactions in reduced geometry
- fluctuation-induced phenomena
- Are photons bosons?

AG Busch
AG Saenz

Research Groups in Optics & Photonics

Experiment:

HUB: Benson, Peters, Rauschenbeutel
S-Profs: Elsässer (MBI), Hübers (DLR), Schneider (HZB), Steinmeyer (MBI)

Theory:

HUB: Busch, Saenz
S-Profs: Ivanov

Junior groups:

Ramelow (HU/DFG), Schröder (HU/BMBF), Krutzik (HU/FBH)

Publications with Impact Factor >9 (2016-2019):
Nature, Science, PRL, Optica, Laser & Photon. Rev.

Patents: >12

Third Party Funding

Spezialization in Optics & Photonics

Master 120 LP, darin „Fachlicher Wahlbereich"
(davon zwei Schwerpunktmodule mit je 8 LP)

40 LP

P23.: Laserphysik (8 LP)

8 LP (+ 8 LP)

P24.4. Vertiefungsmodule (je 6 LP)
a: Angewandte Photonik

b: Quantenoptik

c: Optik / Photonik: Projekt und Seminar

d: Computerorientierte Photonik

e: Physik ultraschneller Prozesse

f: Quanteninformation und Quantencomputer

g: Terahertz-Spektroskopie und Bildgebung

h: Fourieroptik und Röntgenmikroskopie

+4 x 6 LP

(mind. eines)

Spezialization Optics & Photonics

Optics Specialization in Physics Master Program

Optical Sciences Master Program

Networking in Optics & Photonics (berlinoptik.de)

Optics Student Chapter

BERLIN OPTIK

light

The future is ~~bright~~!

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