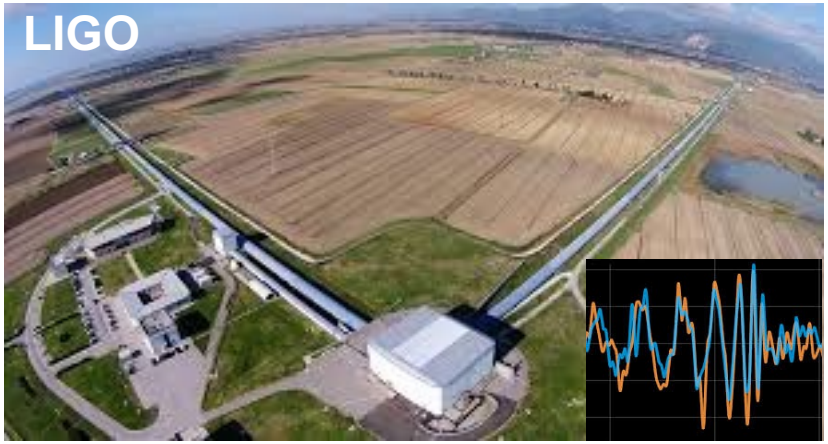
Optics & Photonics
Humboldt-Universität zu Berlin

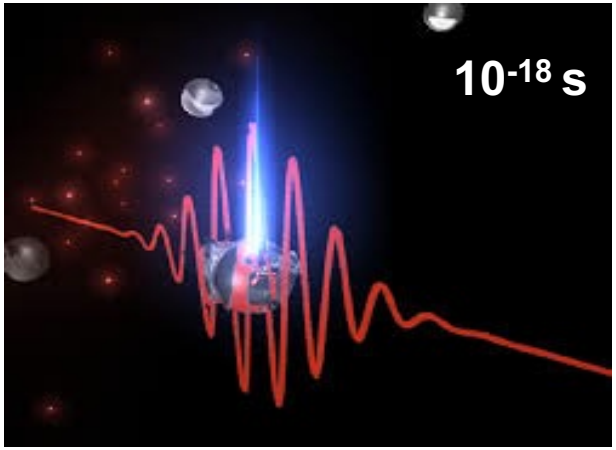
https://www.physik.hu-berlin.de/de/op

Light is …

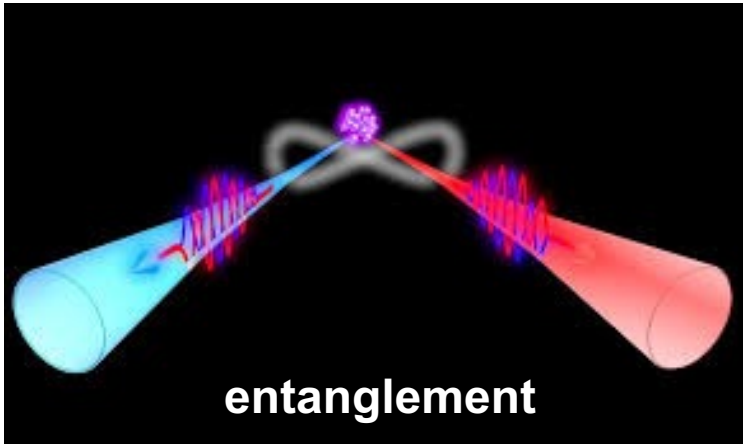
… precise



… fast



… quantum



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:

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

Publications with Impact Factor:

Nature, Science, PRL, Optica, Laser & Photon. Rev.

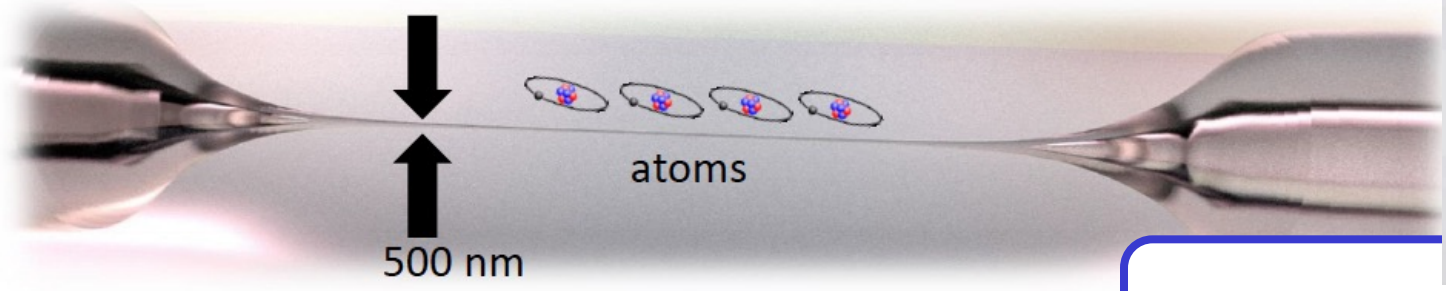
Patents: optical & QT applications

Third Party Funding

DFG Deutsche Forschungsgemeinschaft
Bundesministerium für Bildung und Forschung
Bundesministerium für Wirtschaft und Technologie
DLR Projektträger
esa
Emmy Noether-Programm
EUROPEAN UNION
erc

Fundamental Light-Matter Interaction

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



AG Rauschenbeutel

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

Fundamental research:

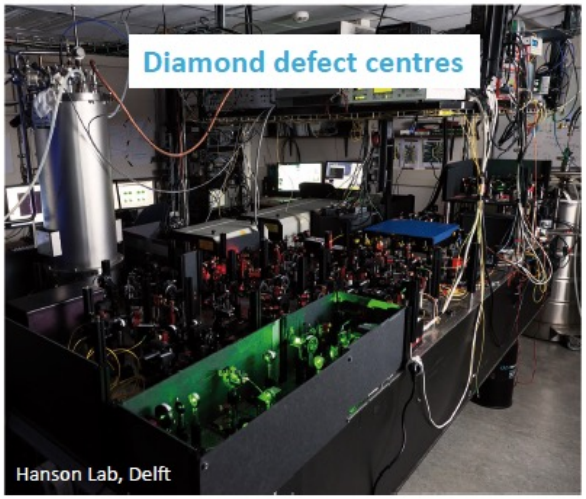
- new regimes of light-matter-coupling (near-field effects)
- single photon-single atom interaction & collective effects

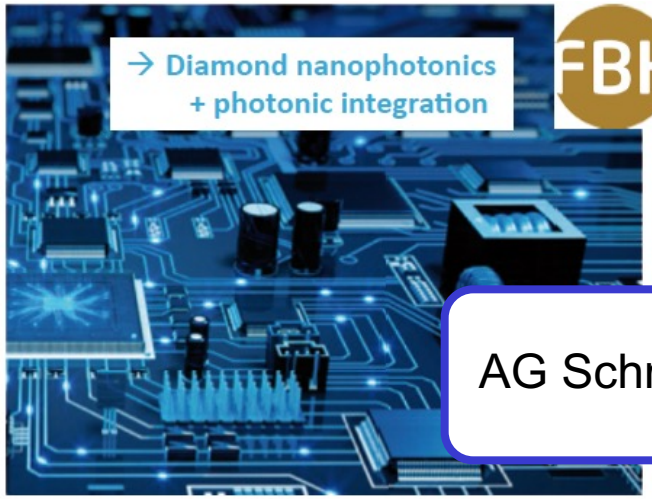
Applications:

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

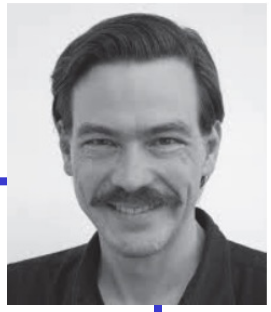
Integrated Quantum Photonics

Solid-state quantum emitters as building blocks for quantum technology

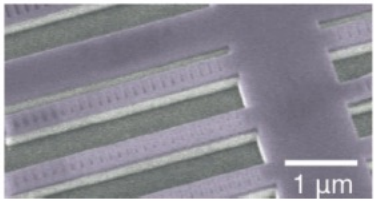


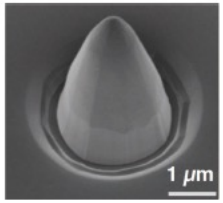


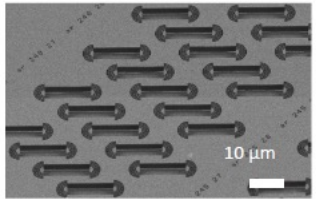
AG Schröder

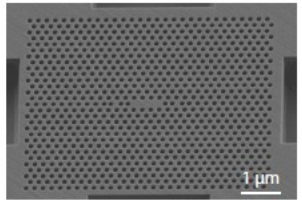


color centers in diamond structures









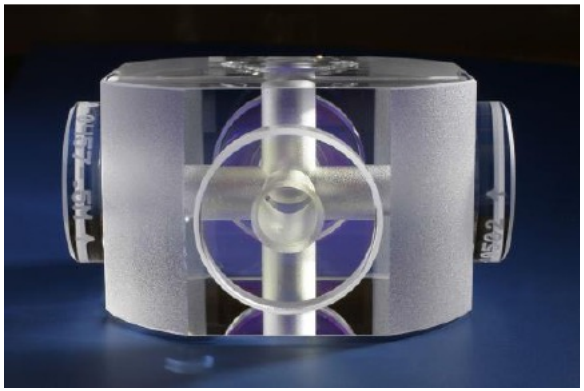
Research Topics:

- shrink optical labs into quantum devices (q. computing, q. simulation)
- realization of quantum photonics for complex quantum tasks

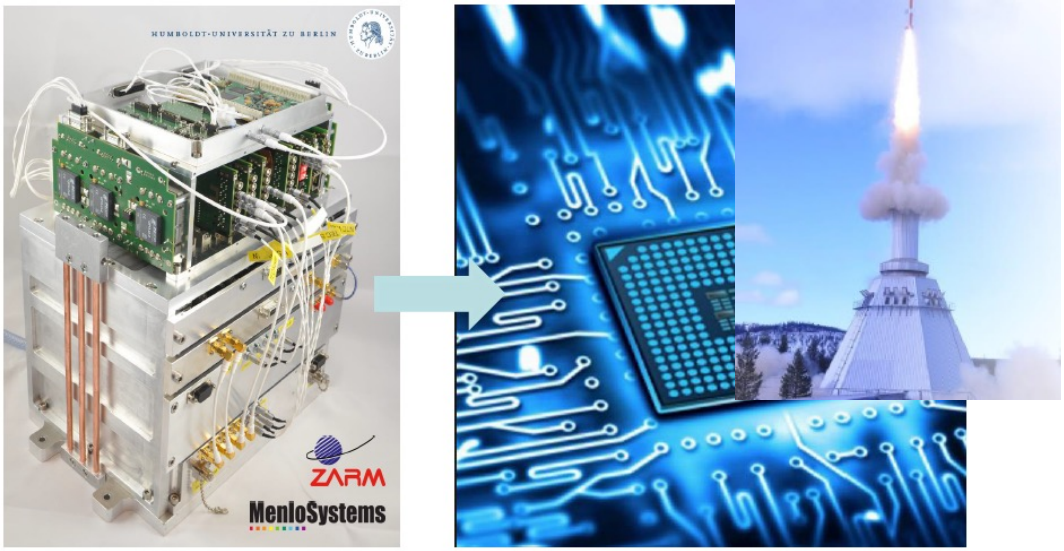
Optical Metrology and Integrated Quantum Sensors

Ultra-precise optical measurements & bringing quantum optics into space

optical resonators



integrated laser experiments



Fundamental research:

- Is Lorentz invariance violated?
- Are natural constants constant?

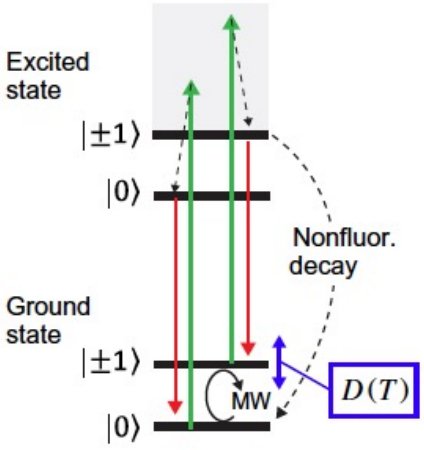
Applications:

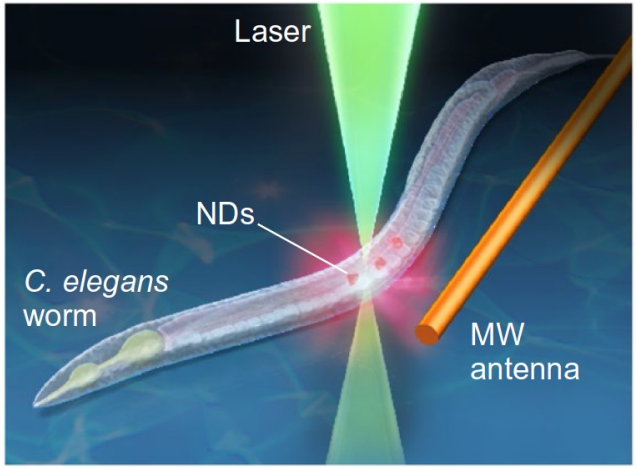
- quantum optics in space
- optical clocks, gravitational waves, geodesy

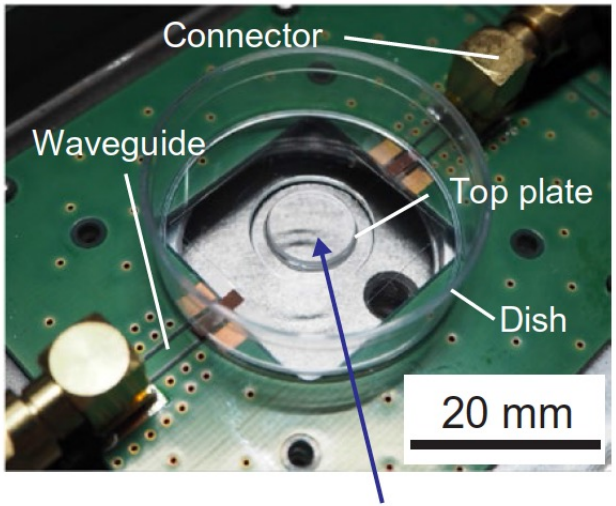
AG Peters
AG Krutzik

Nano-Optics

Controlable quantum system for quantum devices & quantum sensing







single electron spins as nanothermometers in living organisms

Fundamental research:

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

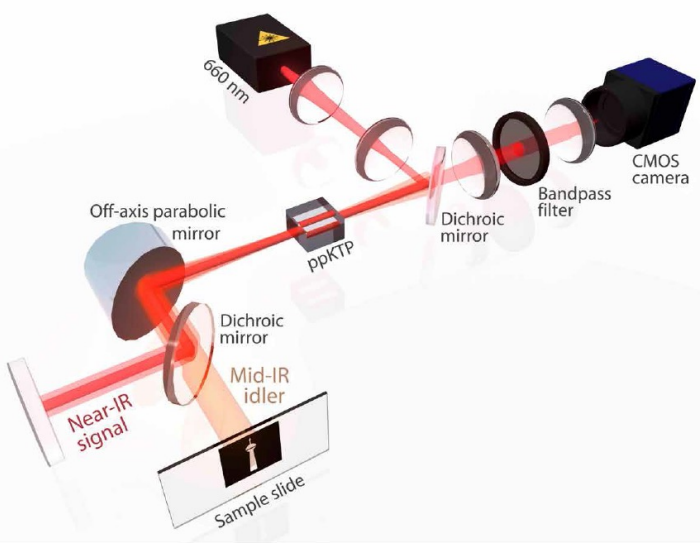
Applications:

- photonic quantum computers
- quantum sensing

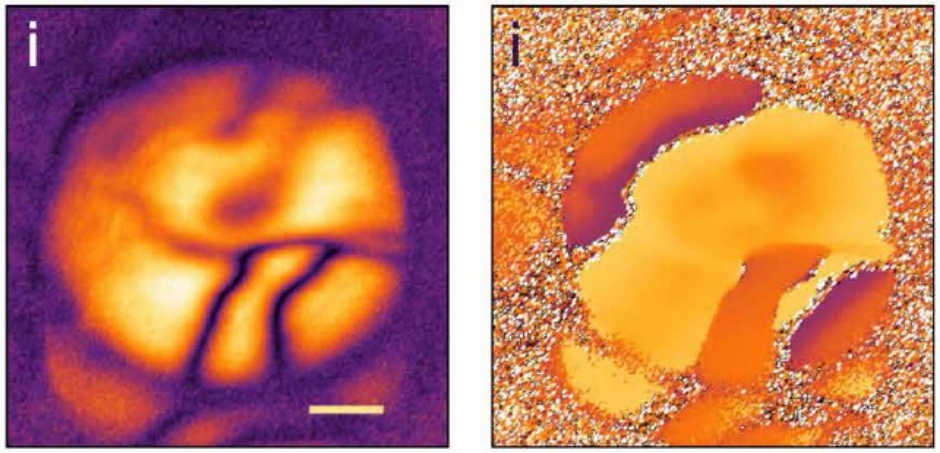
AG Benson

Nonlinear Quantum Optics

Circumvent problems for IR imaging through quantum entanglement



photon pair source



IR absorption & phase imaging of mouse heart

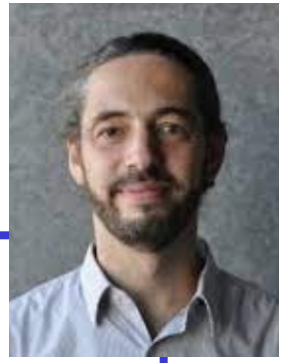
Fundamental research:

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

Applications:

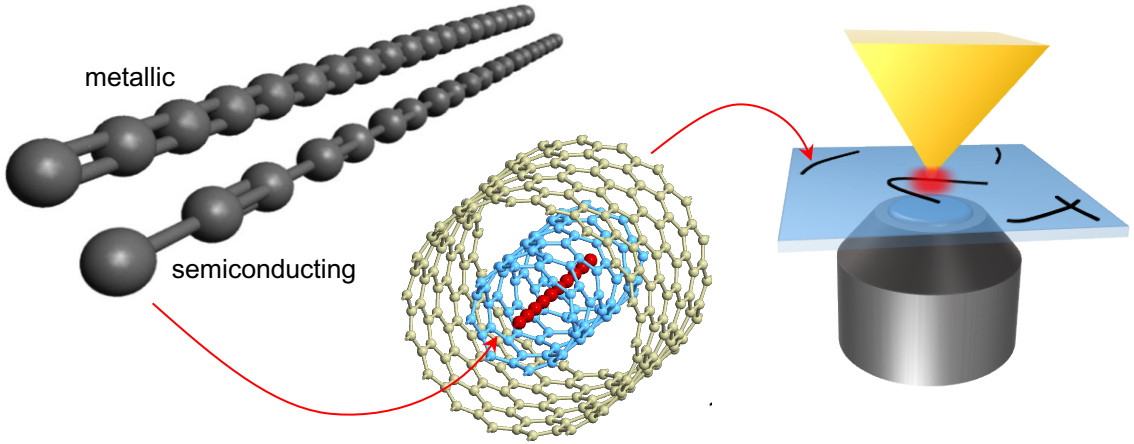
- quantum microscopy & spectroscopy

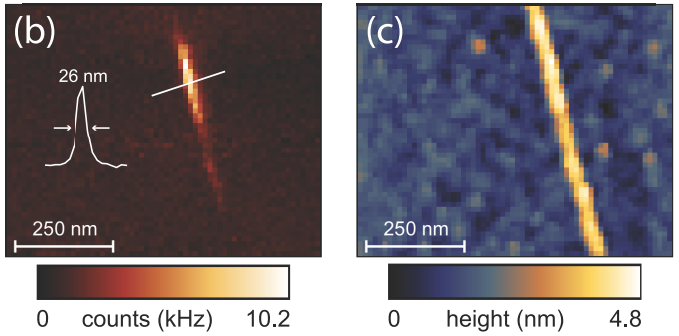
AG Ramelow



Physics of low-dimensional systems

Understand and tune interaction of 1D/2D systems with light and each other





Carbyne – 1D carbon chain

Tip-enhanced Raman spectroscopy

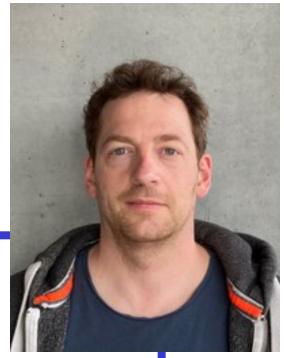
Fundamental research:

- explore optical and vibrational properties of carbyne
- tune 1D and 2D systems i.e. by strain & doping

Advanced material characterization

- Optical imaging with <30 nm resolution

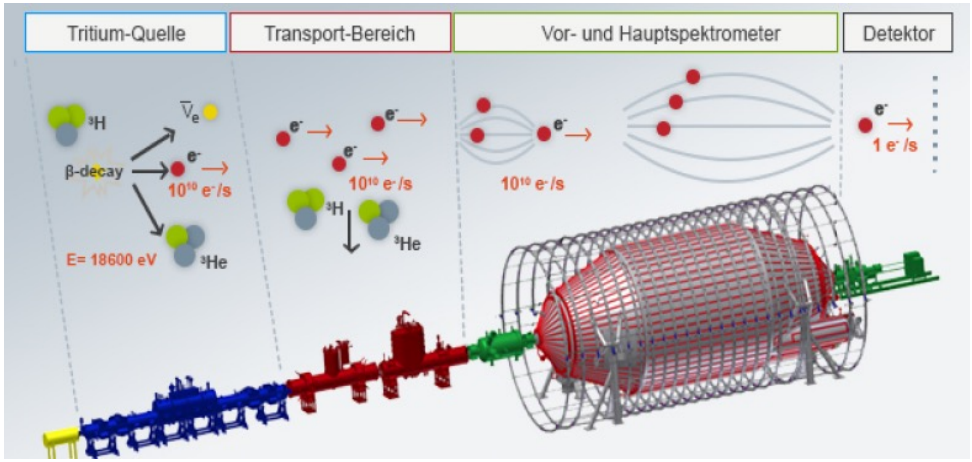
AG Heeg

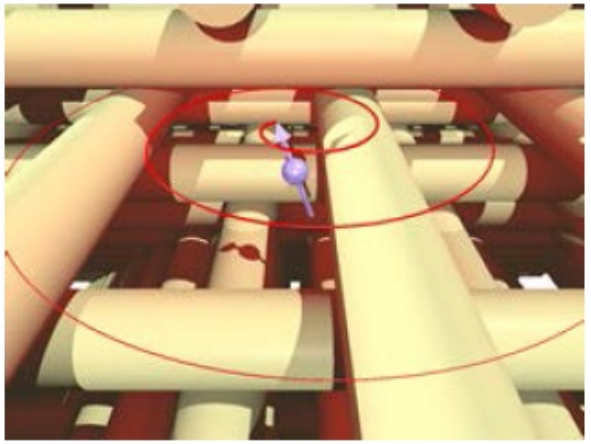


Theoretical Optics & Photonics and Modern Optics

Fundamental optical science with „Pencil, Mathematica, Numerics“

Tritium Neutrino Experiment (KATRIN)

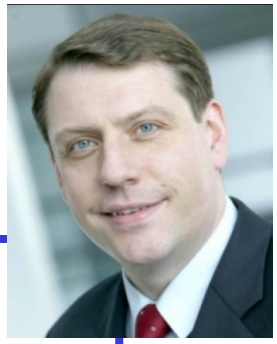




(quantum) light-matter interactions in complex nanostructures

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

S-Professors:
Elsässer, Ivanov, Steinmeyer (MBI), Hübers (DLR), Schneider (HZB)

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)

Int. Master of Optical Sciences

https://opticalsciences.physik.hu-berlin.de

1. Semester	**Fundamentals of Optical Sciences**	31 ECTS

2. Semester	**Advanced Optical Sciences + Electives**		29 ECTS
Nonlinear Photonics	Quantum Optics	Short-Wavelength Optics	Theoretical Optics

3. Semester	**Specialization**	30 ECTS
Introduction to Independent Scientific Research	Advanced Optical Sciences Laboratory	

4. Semester	**Master Thesis**	30 ECTS

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~~!

contact: oliver.benson@physik.hu-berlin.de

Spezialization Optics & Photonics

Optics Specialization in Physics Master Program

Optical Sciences Master Program

Networking in Optics & Photonics (berlinoptik.de)

Optics Student Chapter

Berlin School of Optical Sciences and Quantum Technology

light

The future is ~~bright~~!

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