Quantum Sensing & Magnetometry

– from the nanoscale up to geological explorations –

701. Heraeus Seminar

August 12-14 2019
Physikzentrum
Bad Honnef

https://magnetometry.org/qsm

Aims:

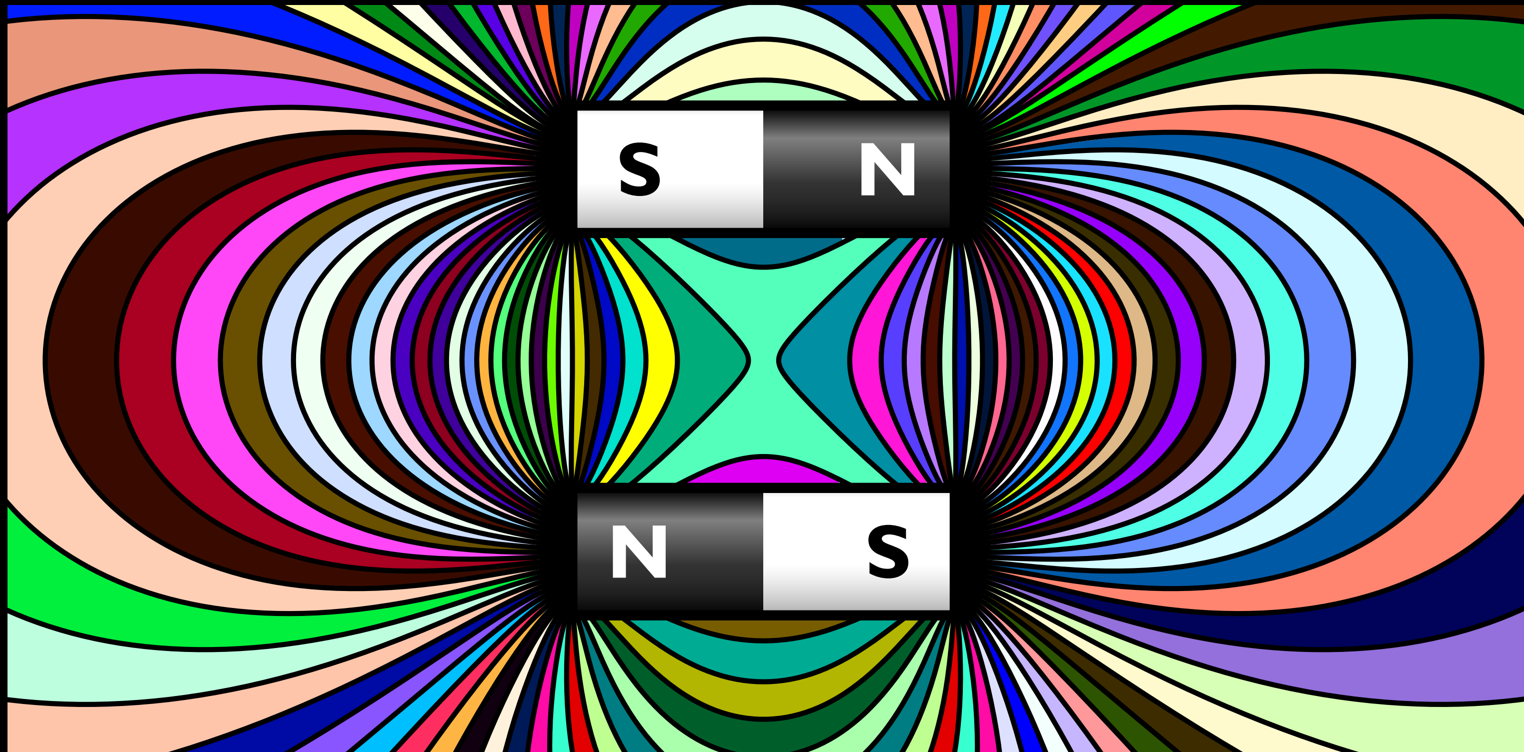
- Bring together developers and users of magnetometry based on quantum sensing
- Identify current limits of quantum sensing based magnetometry and envision its potential
- Explore novel applications of ultra-low field magnetometry

Scope:

- SQUIDs
- Optically Pumped Magnetometers
- Nitrogen Vacancy Centers
- Hybrid Sensors
- Magneto-cardiography and -encephalograpy
- Low energy probes of fundamental physics
- Nano-scale sensing
- Ultra-low field NMR/MRI
- Geoprospecting

Deadline:

- Pre-registration: May 1st 2019
- Abstracts: June 14th 2019



Organizers:

- Ilja Gerhardt (MPI for Solid State Research)
- Fedor Jelezko (University of Ulm)
- Lutz Trahms (Physikalisch-Technische Bundesanstalt)

qsm@magnetometry.org
https://magnetometry.org/qsm

WILHELM UND ELSE HERAEUS-STIFTUNG

Invited Speakers:

Quantum Sensing & Magnetometry

- Georg Bison, PSI Switzerland
- Dmitry Budker, HMI Mainz
- Corey Cochrane, NASA & JPL
- Lloyd Hollenberg, University of Melbourne
- Rainer Körber, PTB Berlin
- Svenja Knappe, University of Colorado & Fieldline Inc., Boulder
- Roland Lammegger, TU-Graz
- Morgan Mitchell, ICFO Casteldefells
- Eugene Polzik, Quantop, Copenhagen
- Szymon Pustelny, Jagiellonian University, Krakau
- Erling Riis, University of Strathclyde, Glasgow
- Mike Romalis, Princeton University
- Piet Schmidt, PTB Braunschweig
- Justin Schneiderman, Gothenburg University
- Ronny Stolz, IPHT Jena
- Alex Sushkov, Boston University
- Jörg Wrachtrup, University of Stuttgart
- Christof Wunderlich, University of Siegen

The impact of quantum sensing technologies ranges from ultra-high-precision spectroscopy and microscopy, positioning systems, clocks, gravitational, electrical and magnetic field sensors, to optical resolution beyond the wavelength limit.

Today, magnetometry is one of the most advanced quantum sensing technologies. Its application spans the detection of biological, medical, geological and environmental magnetic fields, as well as its use as a research tool in fundamental physics. Currently, three different quantum technology based magnetic sensor types are in a mature state of development, enabling ultra-sensitive measurements over a wide range of length and frequency scales:

- **SQUIDs** – Superconducting QUantum Interference Devices
- **OPMs** – Optically Pumped Magnetometers
- **NV-** – Nitrogen-Vacancy-centers

SQUIDs exhibit outstanding sensitivity and bandwidth and are routinely used in bio- and geomagnetism. While the bandwidth of OPMs is still smaller, their sensitivity has increased enormously in the past decades. Today, they represent an attractive alternative for many applications, considering their independence from liquid helium, their robustness, and their miniaturization potential.

NV-centers have not yet reached the sensitivity of SQUIDs or OPMs, but their outstanding spatial resolution enables new application areas down to molecular dimensions. The field of nano-scale and bulk quantum sensing with defect centers in diamond enabled a number of novel measurement schemes, such as memory assisted sensing. In addition, NV-centers can be utilized to sense stress, temperature and electric fields.

SQUIDs OPMs NV-centers Quantum Measurements Applications Fundamentals