

Description of two « Hands-on Experiments” for the EPS’ TIG event @CERN on September 30th ->
October 2nd 2022

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Experiment 1: “Quantum Demonstrator”: Quantum-effect magnetic sensor based on NV- centers in Diamond

With Stefan Kubsky and colleagues, from the Surface Laboratory at Synchrotron Soleil (France) and Prof. Jan Meier (via video, Felix Bloch Institute, University of Leipzig, Germany)

A compact diamond-based device will be explained, set-up and used as a versatile and highly sensitive magnetic sensor via optical pumping and read-out in the visible. It is based on NV- centers implanted into diamonds (from Quantum Technologies, Leipzig) behaving as quantum objects – usable for quantum computing at room temperature if addressed individually. The session starts with a comprehensive introduction to the basic physical properties of NV- centers (20-30min).

Jan Meijer completes with in-depth explanations and discussion (~20-30 min). A short live demonstration of a free quantum-computer simulation code (Qiskit) can be envisaged as well.

Hands-on part: Participants will conceive, assemble and run three experiments (light source, Q-sensors, optical spectrometers, computer, software) in sub-groups (~90+ min).

Different situations will be tested and students will be invited to present their discoveries on the properties of these sensors.

Get your hands on this emerging field of physics and technology !

Experiment 2: “nm-precise actuation and sensing via a new, compact superresolution sensor”

With Stefan Kubsky and colleagues, from the Surface Laboratory at Synchrotron Soleil (France) and support from HORIBA (Saclay, France).

The session begins with a comprehensive introduction (20-30 min) about the state of the art in nm-positioning explaining the experimental challenge for the students. An experimental setup including a simple but nm-precise piezo-actuator will be created by the students. It will be powered by simple electronics and its movements monitored by an integrated strain gauge. In collaboration with HORIBA, a new optical sensor (OXYO, 2+1axes, nm-resolution), based on superresolution will be assembled and installed in parallel. Apart from the piezo-actuator and the OXYO-sensor, a PC with

adapted software, powersupplies, multimeters, some optical elements, mechanics and an oscilloscope are part of the setup.

Results of the measurements will be compared and presented.

Take a comprehensive peek into one of the basics of nano-science: To see where you are !