Name of the Technology: Rubidium atom based Atomic Magnetometer for Magnetic Field Sensing

Summary: The objective of the know-how titled "Rubidium atom based Atomic Magnetometer for Magnetic Field Sensing" is to develop an SI-traceable, self-calibrating magnetic field sensor capable of operating across an ultra-sensitive, low frequency range. It aims to overcome the limitations of conventional probe-based magnetic field sensors, which generally operate over limited bandwidths, perturb local field distributions, and require periodic calibration.

The developed sensor utilizes Rubidium (85Rb) vapour and the phenomenon of Continuous-Wave Non-Linear Magneto-Optical Rotation (CW-NMOR) for magnetic field sensing at low frequency. Experimental demonstrations were successfully conducted across Hzz frequency regimes. The developed atomic sensor demonstrated high sensitivity while maintaining direct traceability to SI units through fundamental atomic constants.

The experimental setup uses a probe laser beam of wavelength 780.24 nm from the Toptica DL Pro laser system. The probe laser excites Rubidium atoms from the ground state to the excited state. The probe laser is frequency stabilized using Saturated Absorption Spectroscopy (SAS) and Toptica TOPAS software.

The vapor cell forms the core sensing element of the atomic sensor. It contains Rubidium vapor and facilitates optical interaction with the laser beams. The team successfully demonstrated Saturated Absorption Spectroscopy for validating vapor cell functionality.

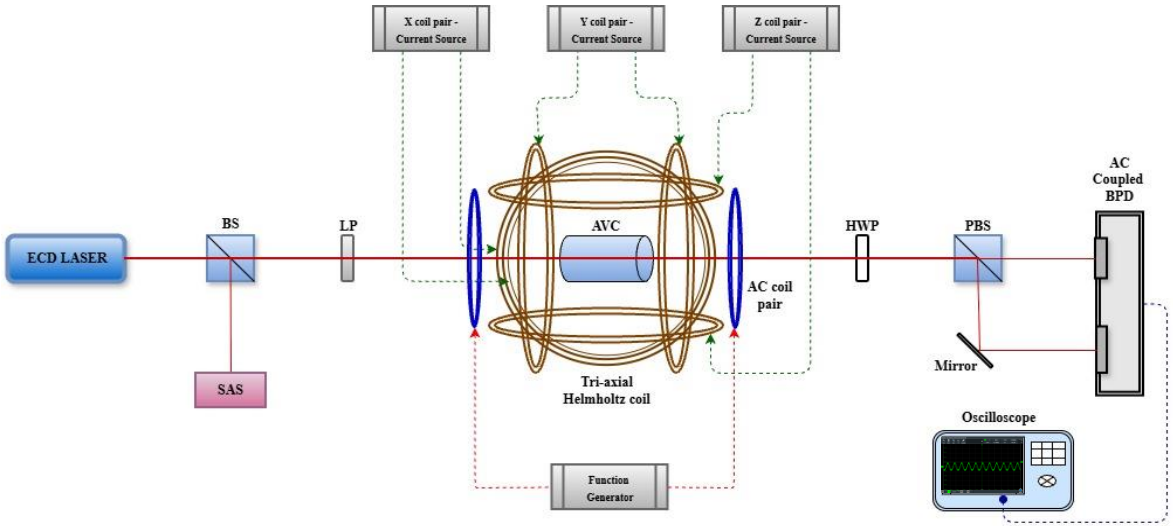


Figure 1. Experimental schematic of the NMOR based atomic magnetometer

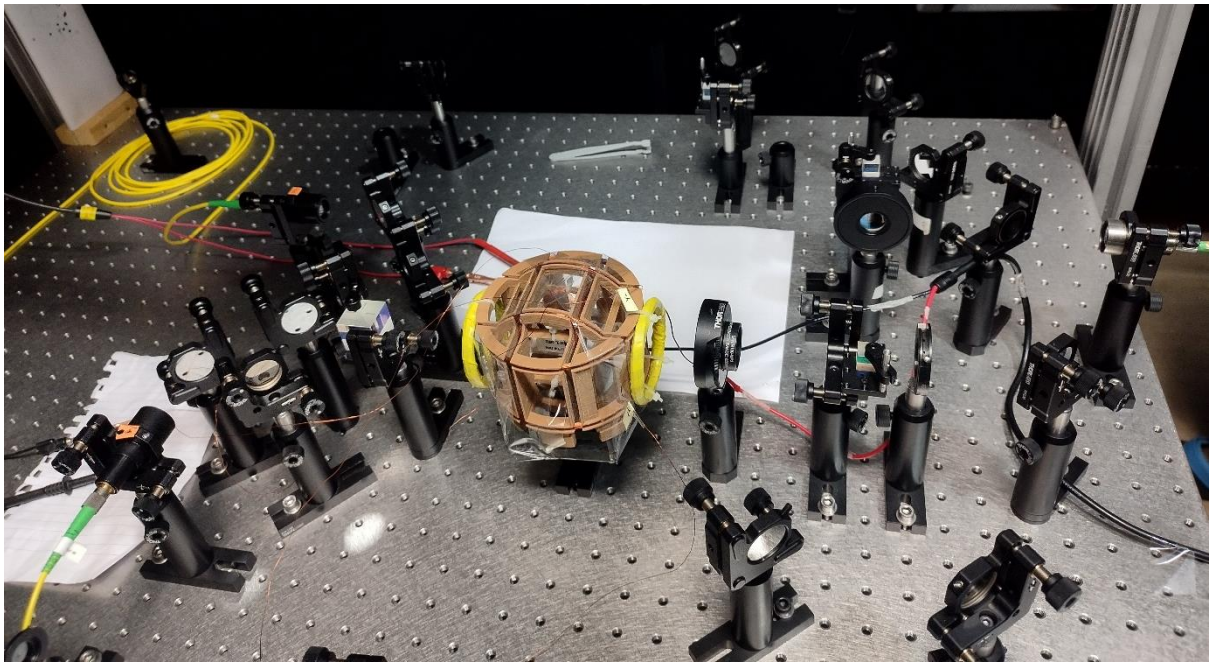


Figure 2. Experimental set-up of the NMOR based atomic magnetometer

Applications:

- ✓ Biomedical sensing
- ✓ Geological Survey and Mining.
- ✓ Fundamental Physics.
- ✓ Space and Defence system.
- ✓ Scientific instrumentation.
- ✓ National standards and calibration laboratories in low field magnetic standards.

Novelty Features:

- ✓ SI Traceability
- ✓ Self-calibration
- ✓ High sensitivity (0.493 pT/√Hz) across Hz
- ✓ Minimal Field perturbation

Advantages:

- ✓ Low frequency coverage
- ✓ Direct SI traceability
- ✓ Intrinsic self-calibration
- ✓ Minimal perturbation of electromagnetic fields because of Magnetic shield
- ✓ High sensitivity

Technology Readiness Level:

Idea	Concept Definition	Proof of Concept	Prototype	Lab Validation	Technology Development	Technology Demonstration	Technology Integrated	Market Launch

Broad Area / Category: Electronics & Instrumentation

User Industries: Quantum domain-based Industries

CSIR Theme: AEISS

CSIR Sub-Theme: Electronics & Instrumentation