Magnetometry challenges in fundamental science

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Many experiments designed to test our understanding of the Universe at a fundamental level (see e.g. [1]), especially those searching for electric dipole moments (EDM) [2], require stable and homogeneous magnetic fields. Statistical and systematic uncertainties in such experiments depend on temporal and spatial variations of the magnetic field and can be the limiting factor in the overall experimental sensitivity. Improving the precision at which such fundamental physics tests can be performed thus poses increasingly demanding challanges for the creation and measurement of highly stable and homogeneous magnetic fields.

Taking the neutron EDM experiment at PSI as an example, the presentation will introduce fundamental physics tests and show how the relevant aspects of the magnetic field can be monitored by a variety of special magnetometer systems based on optically-pumped Cs [3], ^{199}Hg [4], and ^{3}He [5]. The used magnetometer techniques include multi-beam vector readout [6], accurate all-optical field readings, and the readout of precessing ^{3}He spins with Cs OPM [7]. The measurement of magnetic field gradients requires a large number of Cs sensors similar to arrays previously designed for bio-magnetometry [8].

References

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