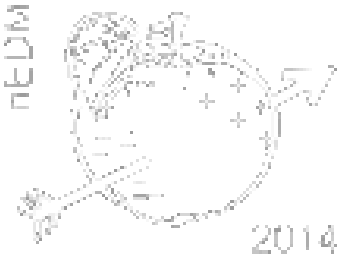

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Transverse magnetic field measurements with scalar cesium magnetometers at the nEDM experiment

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The nEDM experiment at the Paul Scherrer Institut uses ultra-cold neutrons (UCNs) to search for a neutron electric dipole moment using Ramsey's method of separated oscillatory fields.

In order to correct for drifts of the magnetic field, a mercury magnetometer (HgM) is present in the precession volume of the neutrons, which measures the average field. However, due to inhomogeneities in the magnetic field and the much lower kinetic energy of the UCNs relative to their gravitational potential, the UCNs feel a different average magnetic field than the mercury atoms.

In order to correct for this difference, sixteen scalar cesium magnetometers (CsMs) were installed around the precession chamber. These magnetometers locally measure the field's magnitude and hence provide information about the inhomogeneity of the magnetic field. Apart from merely providing a correction on the HgM measurements, they can also be used for an explicit homogenisation of the magnetic field itself.

However, homogenising the measured magnitudes was found to be insufficient for a homogenisation of the full magnetic field. Moreover, when comparing the average field readings from the HgM and the CsMs (using an approximated harmonic expansion to the second degree), the two magnetometers do not always agree. This is simply because the low order harmonic approximation is too crude. In order to improve the knowledge of the field's shape, we propose to measure the full vector components of the magnetic field at the position of each CsM, instead of merely its magnitude.

We discuss a method to measure components transverse to the main field direction by using the scalar CsMs. An oscillatory field is applied in a transverse direction and the scalar CsMs are used to measure the field's instantaneous magnitude. Since the direction and magnitude of the applied field is known from field maps, one can extract the transverse components of the original field.

As an interesting remark, a discrepancy was observed between the readings of the CsM and the expected magnetic field behaviour. So far, preliminary simulations have not yet found the origin of this inconsistency.

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