Magnetic Shielding for the ^{129}Xe EDM Experiment

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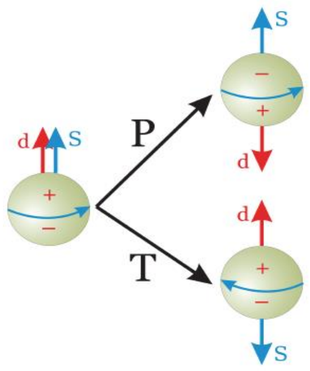


Motivation and Method

- Look for Electric Dipole Moments (EDMs) in fundamental particles and atoms, as they indicate CP-violation!
- The ^{129}Xe atom is very sensitive to different sources of CP-violation.
- Measure the frequency of precessing gaseous, nuclear spin-polarized ^{3}He and ^{129}Xe atoms in magnetic and electric fields.
- A finite EDM changes the precession frequency of ^{129}Xe as the electric field is inverted. The EDM is proportional to the frequency change.
- Use ^{3}He as a comagnetometer to get independent of magnetic field drifts.

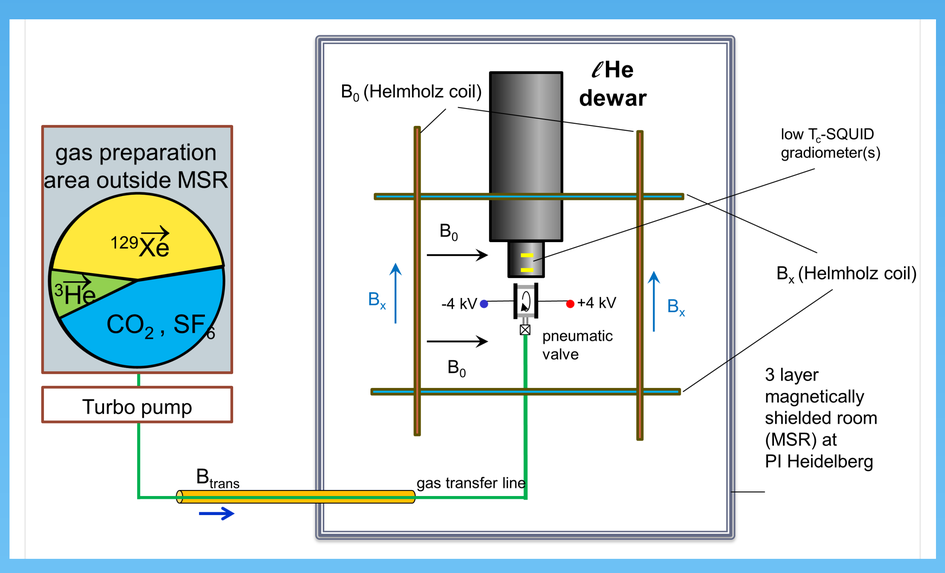
Required magnetic conditions

- Stable residual magnetic field below 1 nT
- Gradients below 10 pT/cm
- Low magnetic noise below 1 fT/Sqrt(Hz)
- In a volume of 20x20x20 cm³

Further use cases

- Search for CPT-violation (prefered frame)
- Search for Axion like particles (pseudoscalar coupling)
- Search for Axion like dark matter
- R&D of spatial resolved Magnetometrie by optical readout of Xe
- R&D of magnetometry for neutron-EDM (PanEDM ILL)
- R&D of low noise SQUIDs

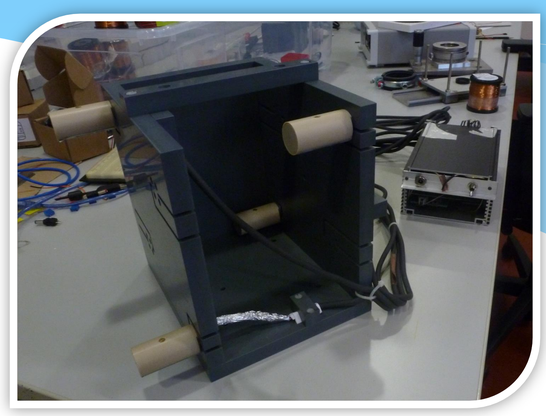
New Setup at Heidelberg: Excellent magnetic shielding



MSR Specs

- 3-layer Mu-metal magnetic shielding, 3 mm each
- Additional RF shielding, 10mm Aluminum
- Inner volume 256x256x256 cm³
- Door: 200x100 cm²

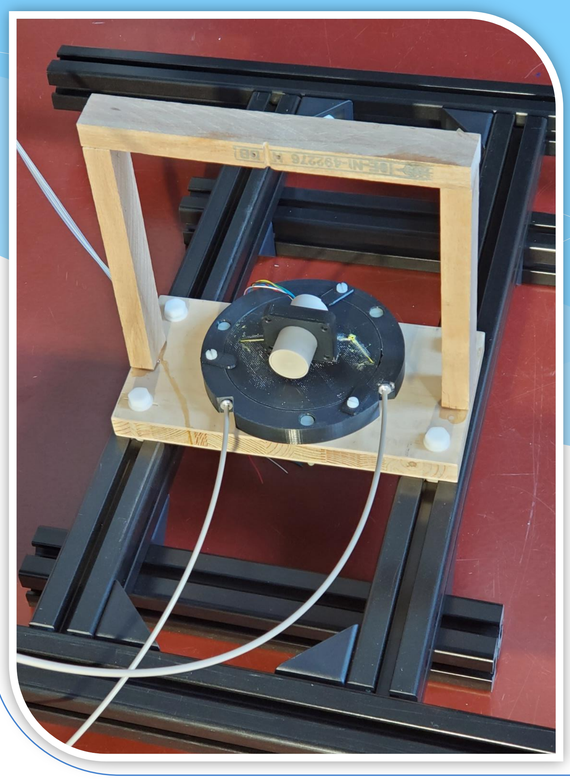
Flux gate vector gradiometer

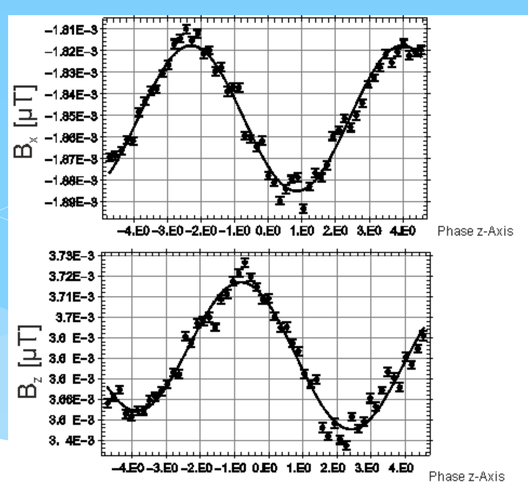


Measurement of external magnetic fields and all gradients with frequency up to 1kHz

Shielding performance measurements

Residual field below 1 nT, measured by about 2 axes rotating 3-axis Fluxgate magnetometer





max. B-field xy-plane
B_{xy} = 1.18 ±0.03 nT
phase = 2.34±0.03