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Thu-Mo-Po4.03-01 [12]: Development of a radiation resistant magnetometer

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The operation of next generation accelerator facilities like the Facility for Antiproton and Ion Research (FAIR) around the world requires novel approaches for instrumentation to survive the expected radiation doses in, for example, secondary beam production regions. As particle beams at high energies are guided with strong magnetic fields one key piece of instrumentation is a precise, radiation-resistant magnetic field sensor. However, conventionally used NMR- and Hall probes can't survive the anticipated radiation doses. Therefore, we propose to employ a Penning trap mass spectrometer for the magnetic field measurements in such inhospitable environments. They can be made compatible with radiation, as all required electronic components can be kept shielded at a safe distance.
Penning traps have been utilized in mass spectrometry for decades by measuring strong magnetic fields via the cyclotron frequency of an ion of known charge-to-mass ratio. For the purpose of monitoring the magnetic field a miniature magnetometer was developed within the LEBIT group at the National Superconducting Cyclotron Laboratory (NSCL) demonstrating a relative precision better than 0.1ppm, being competitive to the performance of NMR probes. Its size is almost compatible to tight space conditions inside beam line magnets and will only require moderate miniaturization.
In this contribution, we are going to present the current status of the project and where these magnetometers will be employed. Additionally, we will outline our plans to miniaturize the device even further.

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