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A SUPERCONDUCTING MAGNETIC SHIELD FOR THE PHOTOELECTRON INJECTOR OF bERLinPro

ABSTRACT

- Magnetic fields are a big issue for SRF cavities, especially in areas with strong electromagnets or ferromagnetic materials
- **Mu metal shields (metal alloys with high magnetic permeability)** to reroute the external magnetic flux
- typically designed for weak magnetic fields (Earth's magnetic field)

-> BUT: next to strong magnetic field sources like **superconducting (SC) solenoids**, they can be **easily saturated**

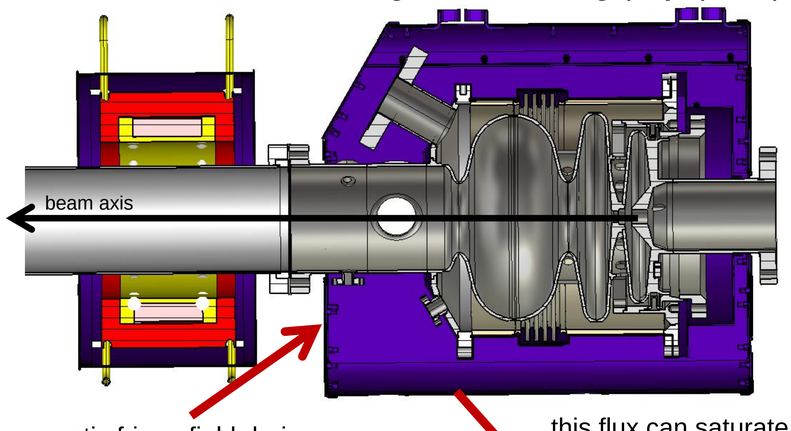
-> degradation of the shielding efficiency and permanent magnetization

-> we designed an **SC magnetic shield** placed between the solenoid and the cavity shield to protect the latter during solenoid magnet operation

INTRODUCTION

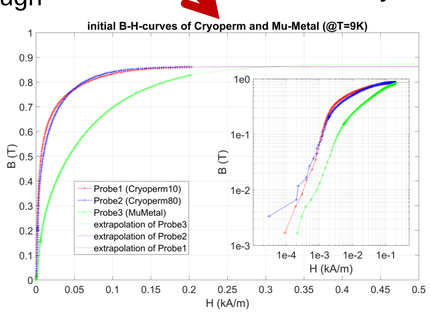
superconducting Solenoid

SRF Gun cavity with outer magnetic shielding (Cryoperm)



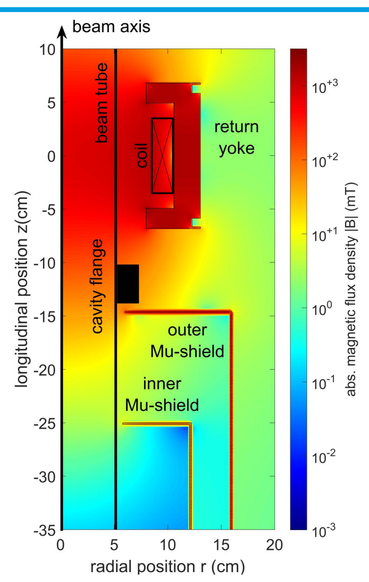
magnetic fringe field during magnet operation flows through the shielding of the cavity

this flux can saturate the metal alloys

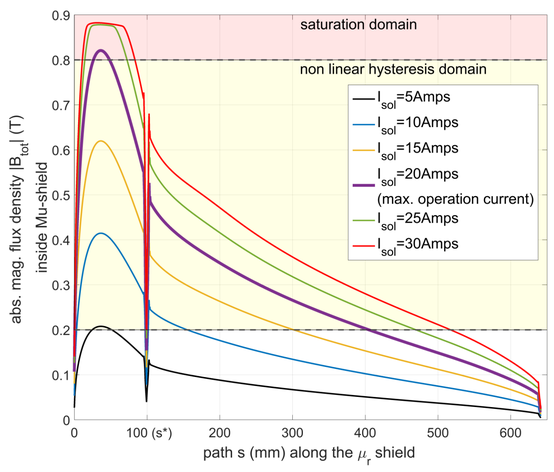


-> possible degradation of the shielding efficiency and magnetization

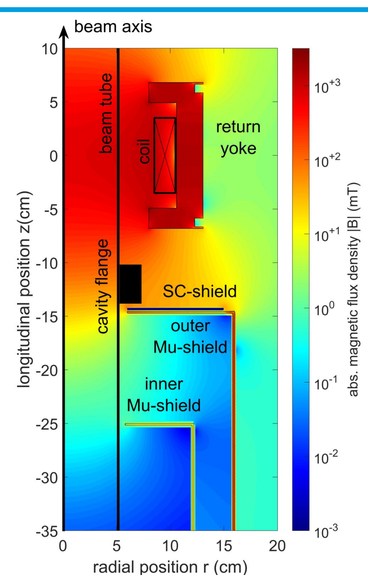
magnetic field distribution during solenoid operation

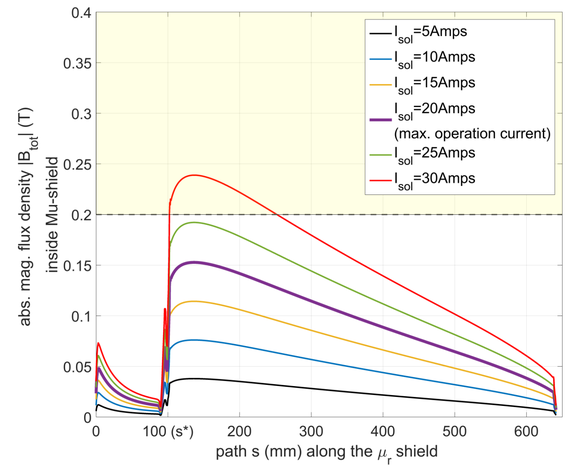


magnetic flux density inside shield material

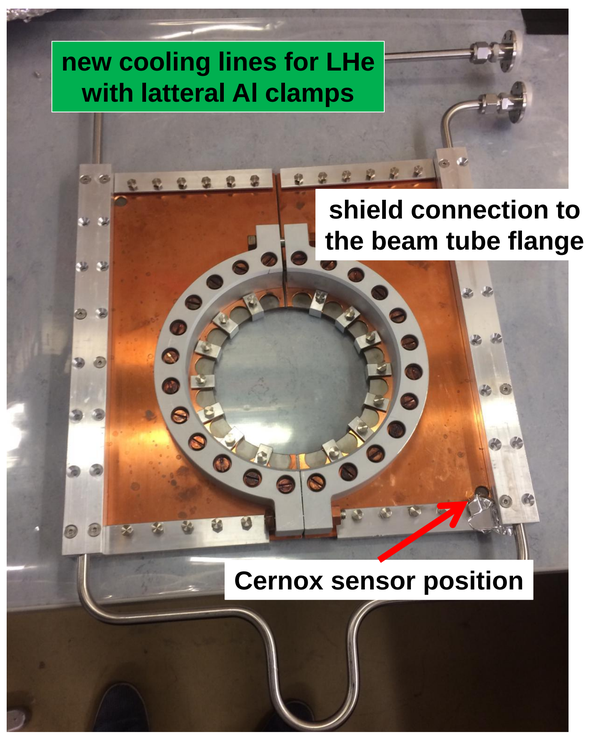


implementation of a superconducting (SC) shield (perfectly diamagnetic)





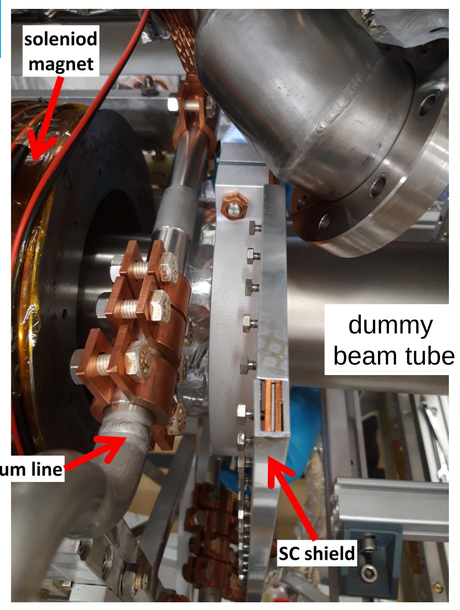
DESIGN AND EXPERIMENTAL SETUP

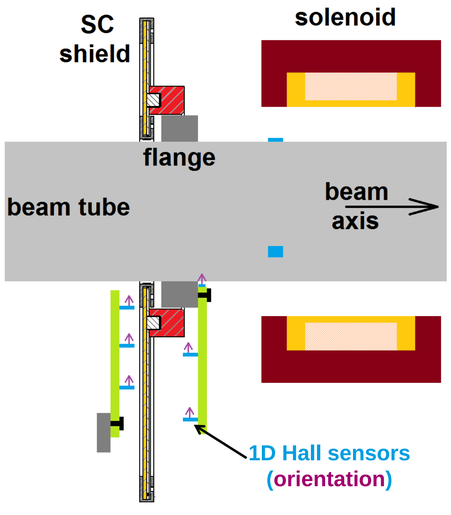


- two Cu plates for cooling around the Nb plates fixed by an Al framework
- this new design is directly cooled by LHe tubes at the latteral Al clamps

module

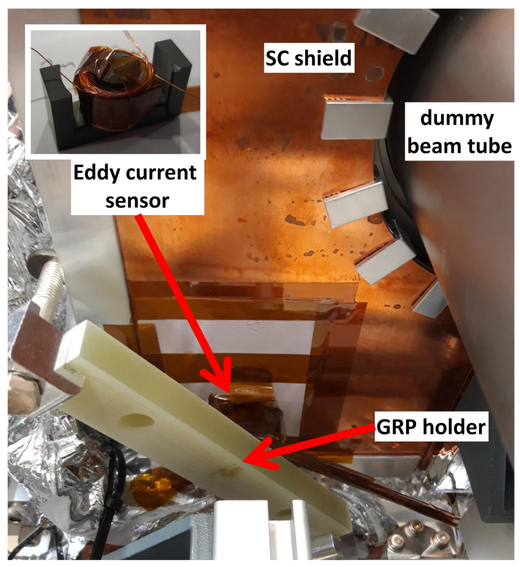
installation





- solenoid magnet, SC shied and a dummy beam tube were installed in the injector modul
- first test: only a passive shield cooling by the cold dummy tube (was not succesful)
- two cernox sensors connected with Nb plate
- six 1D-Hall sensors measure the magnetic field around the shield
- their values can be compared with the calculated field with respect to the sensor positions
- an Eddy-current sensor observes the ohmic resistance of the shield during cool down

-> second test: shield with a direct cooling is planned



CONCLUSION

- it is important to analyze interaction of magnetic sources with sensitive materials (Mu shields)
- fringe fields of magnets can produce high magnetic flux density in shield material, up to saturation
- one option to protect the shields is a superconducting shield next to the Mu shield (deflecting most of the magnetic flux)
- principle and improved design of an SC shield were presented
- up to now, it was not possible to achieve the superconducting state of the Nb shield.
- further tests with the improved cooling are planned.

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