Shielding of magnetic field gradients.

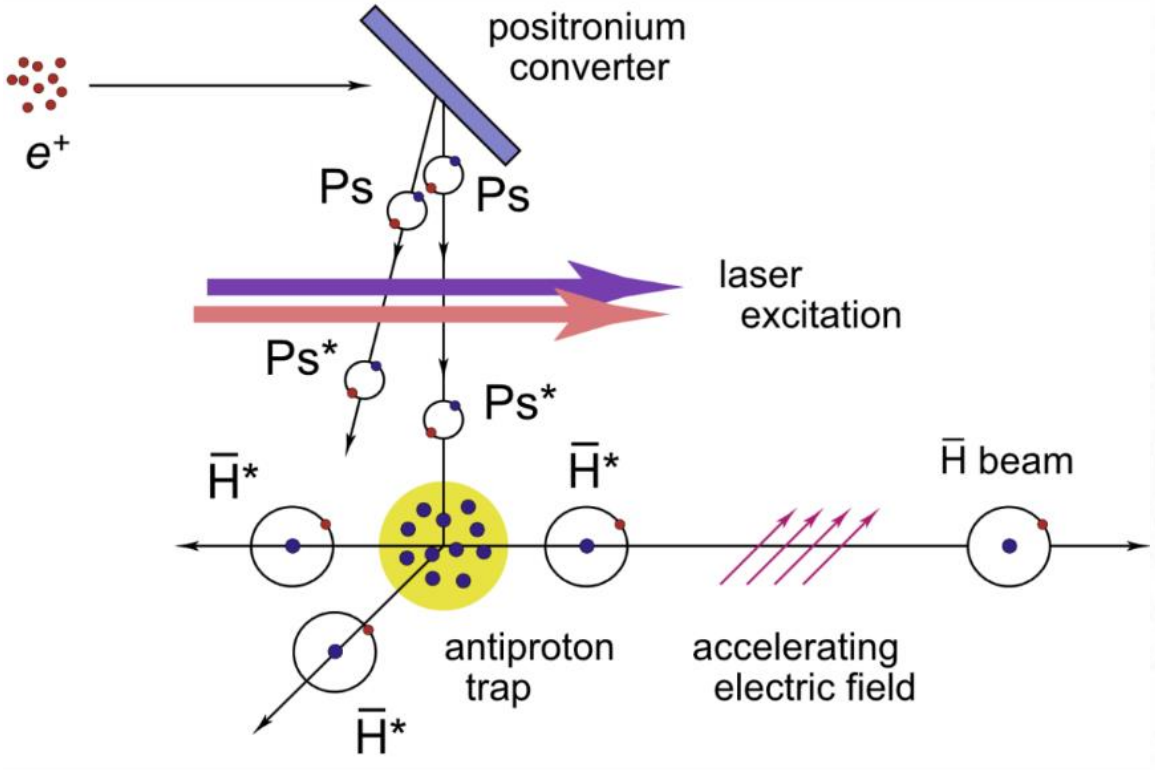
By Alexander Hinterberger

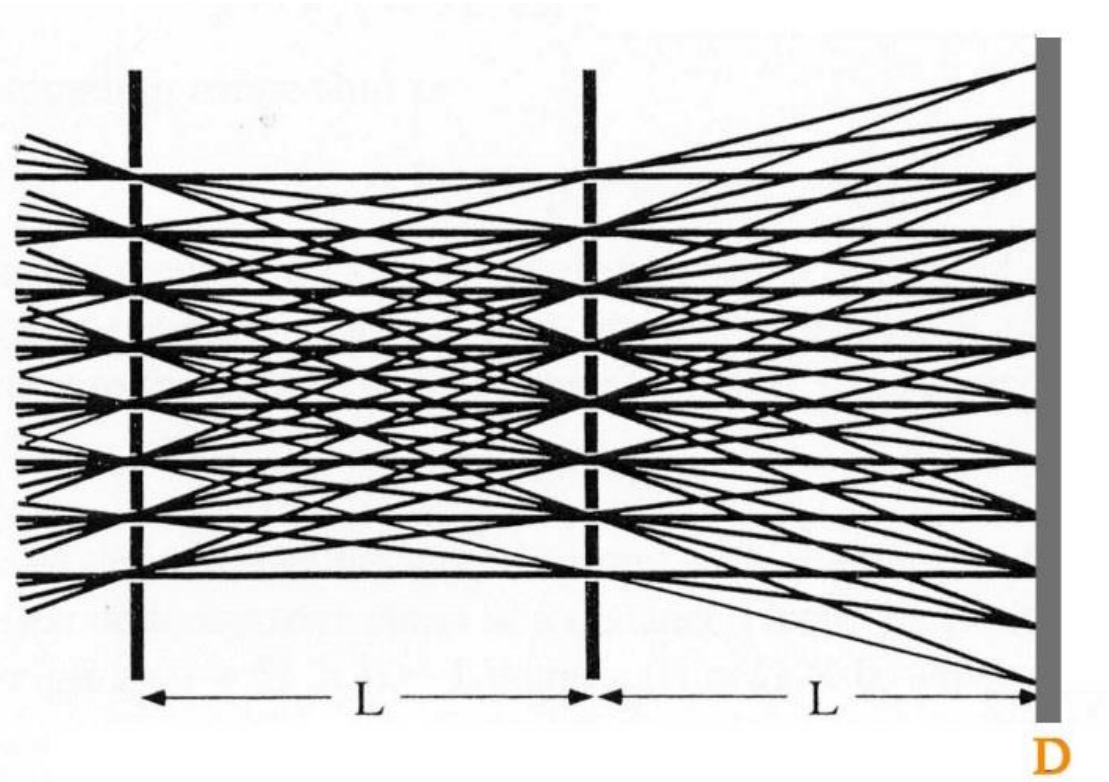
CERN route de meyrin 385, 1217 Meyrin

alexander.hinterberger@cern.ch

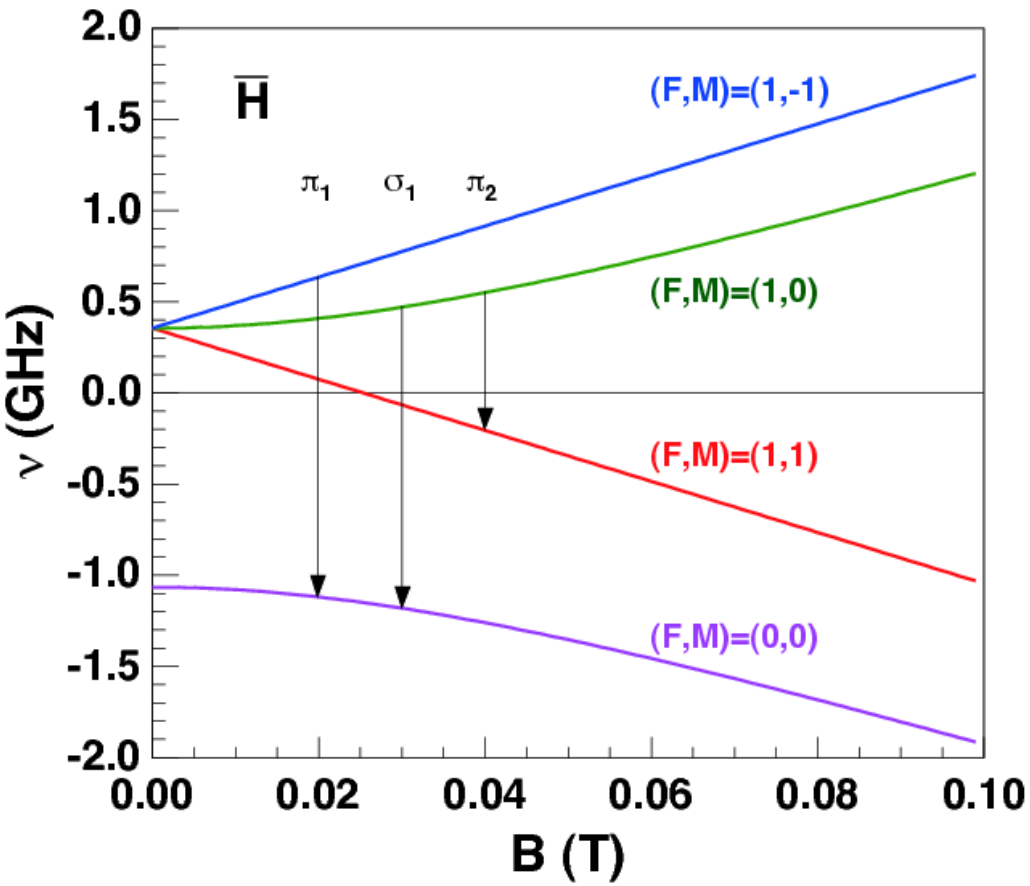
AEgIS

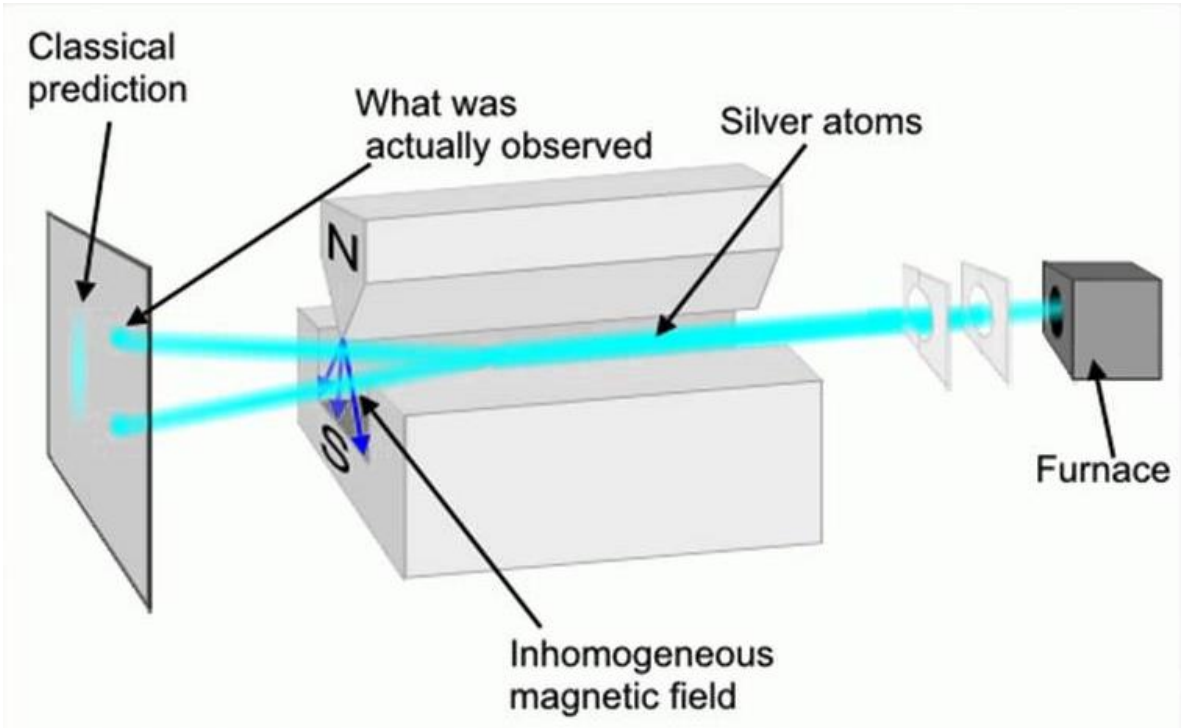
Antimatter Experiment gravitation Interferometry and Spectroscopy





Zeeman Force $F_z = \mu_B m_j \frac{dBz}{dz}$ $F_z \sim F_g \; at \; \frac{dB(1\mu T)}{dz(1cm)} \; at \; m_j = 30$





Stern Gerlach experiment

Superconducting „Meissner-Tube“

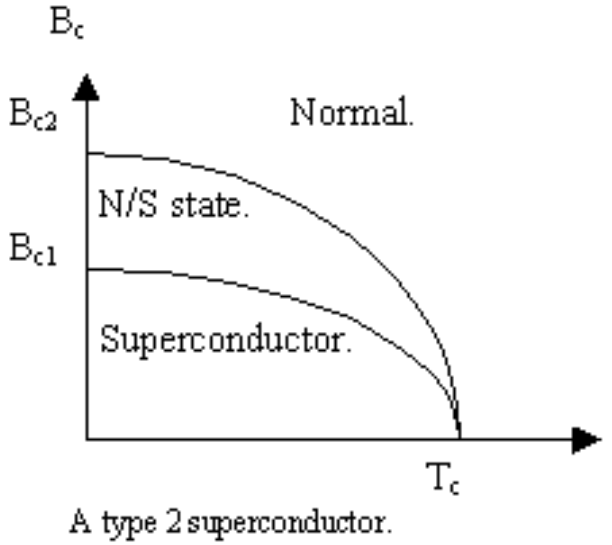
Meissner Phase :

Magnetic Field is pushed out completely

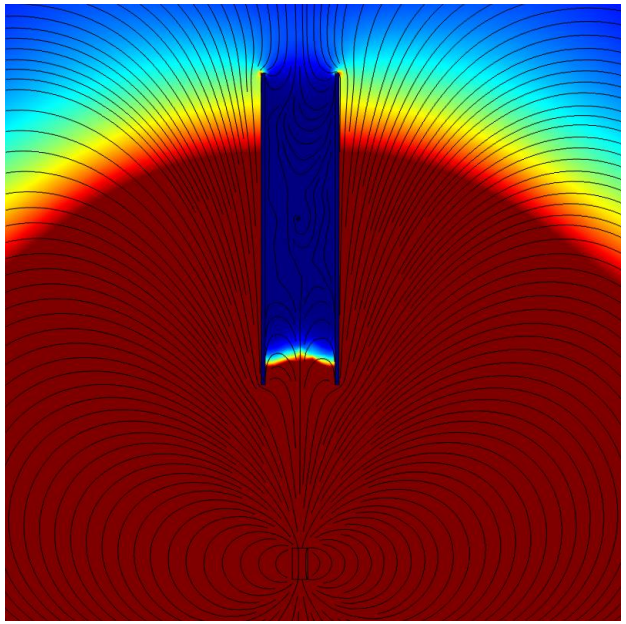
Shubnikov Phase: Fluxlines move through the superconductor

Normal Phase:

No field is shielded.



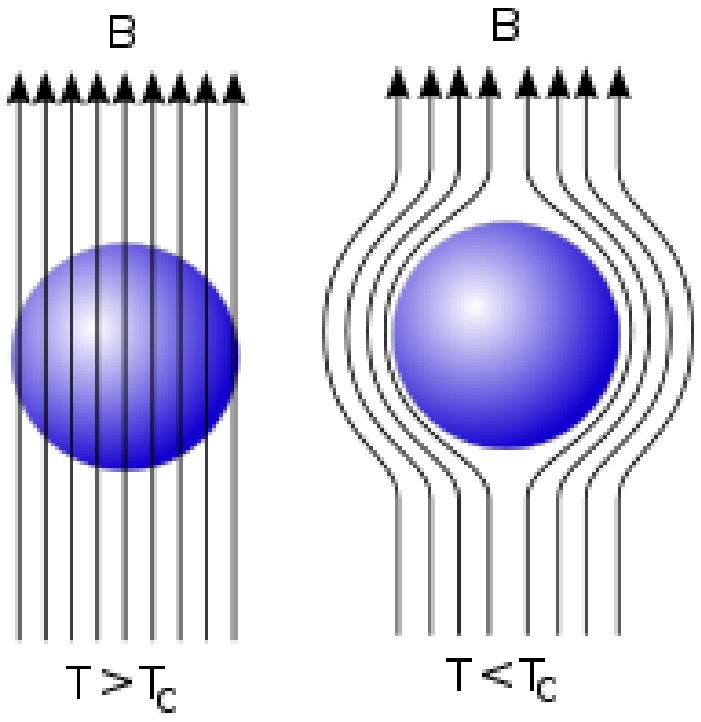
A type 2 superconductor.



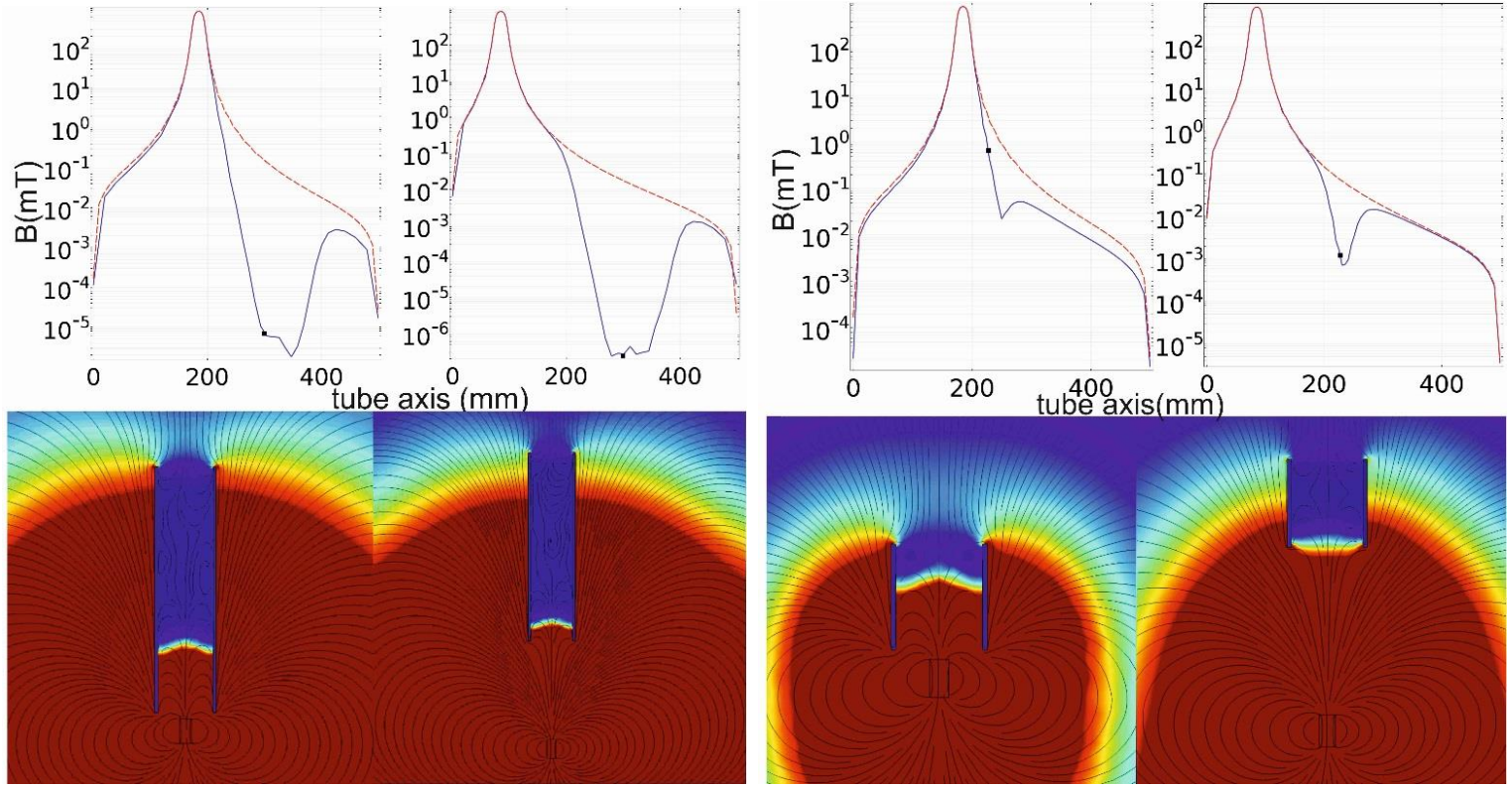
Field lines and Field strength
in a 200 mm long 45 mm diameter
Niobium tube from a SmCo magnet
with 40 mT in 10 mm distance

Shielding

Magnetic field lines shape around a sphere

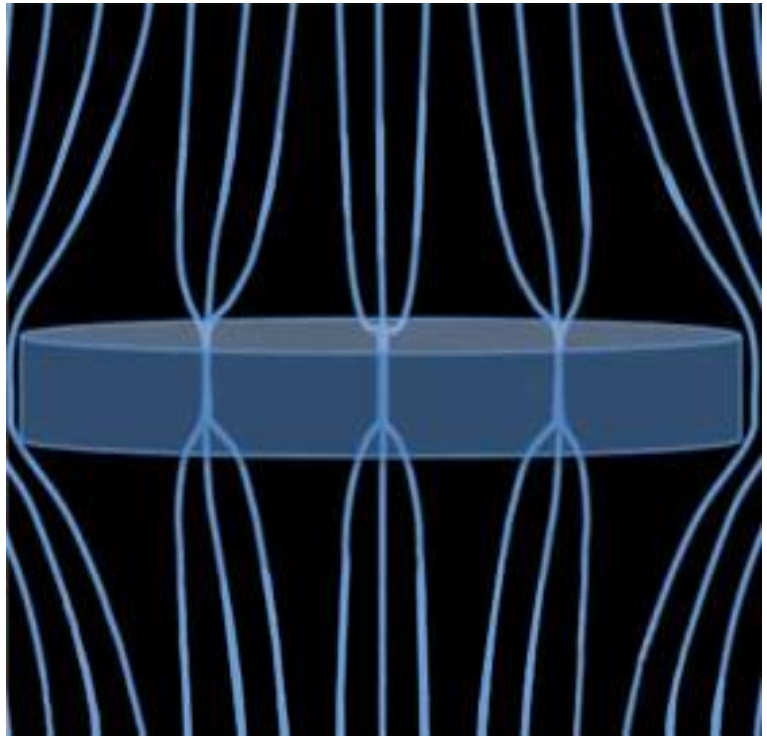


Shielding of tube geometries

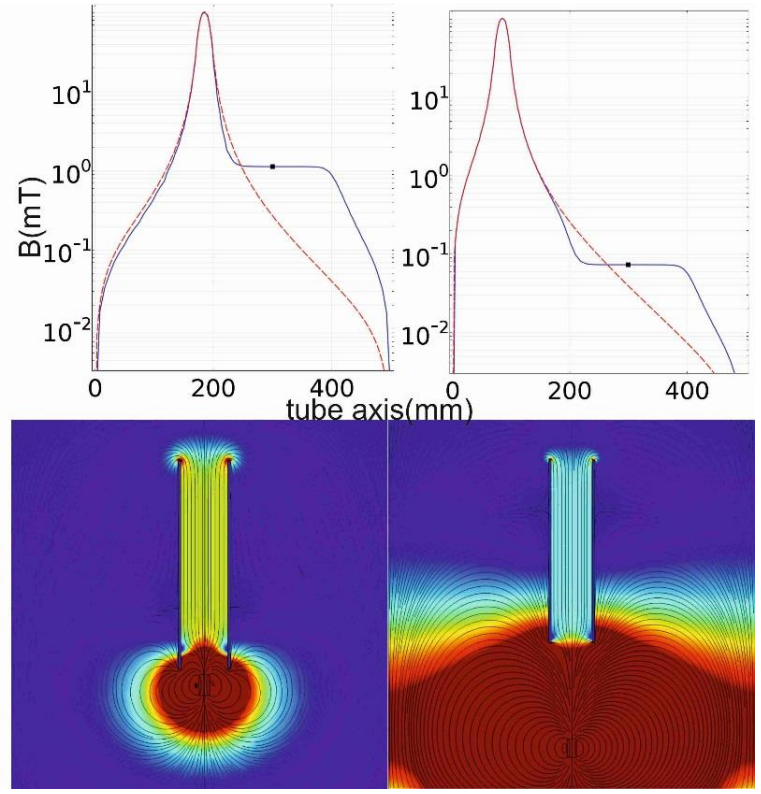


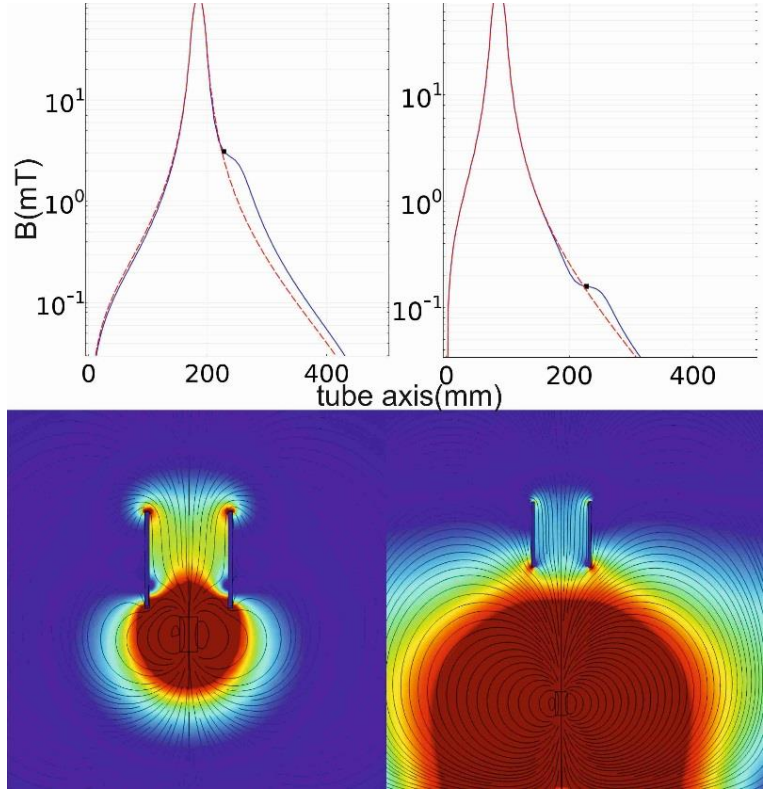
Field Trapping

Trapping on impurities and grain boundaries



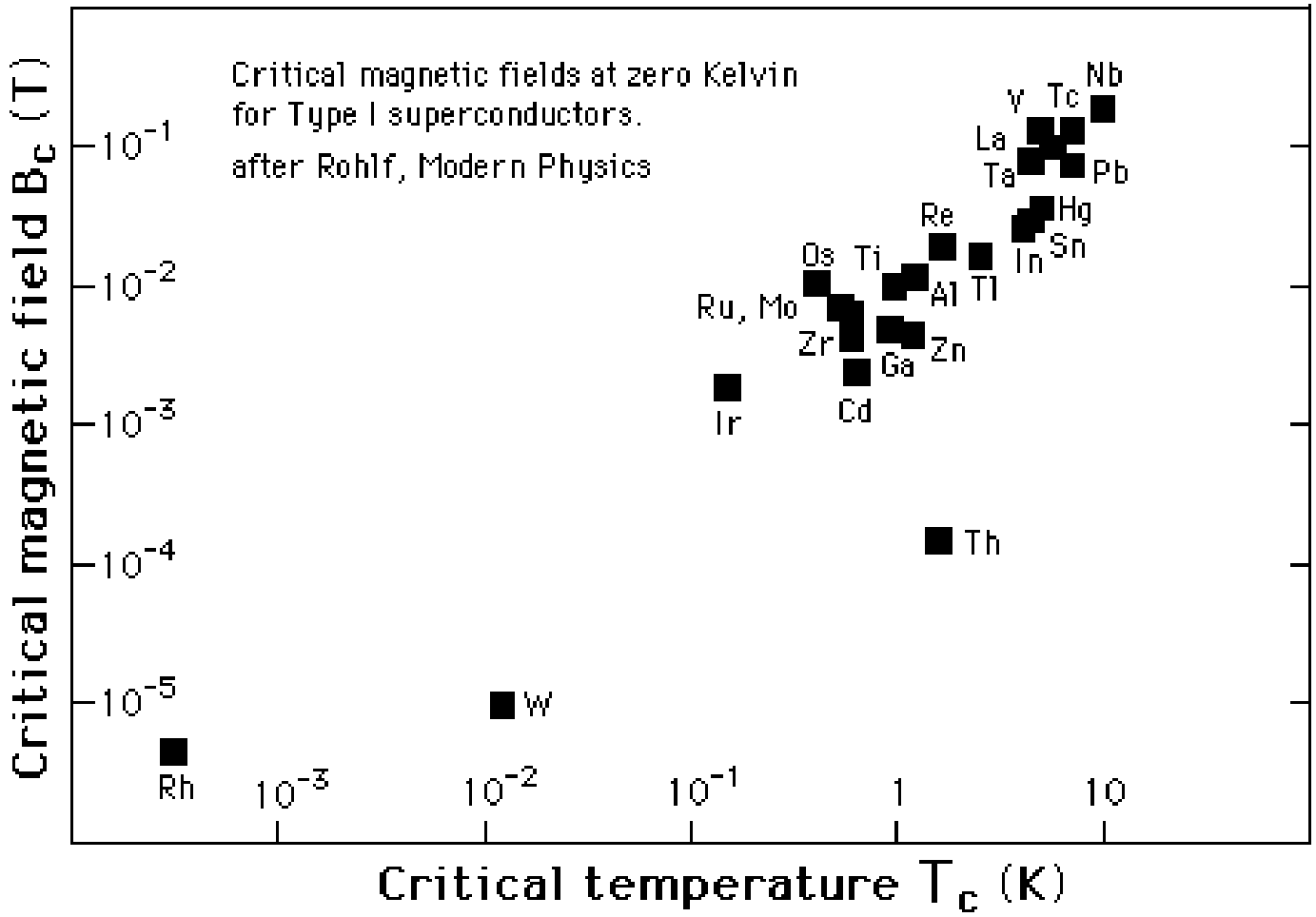
Trapping in closed geometry



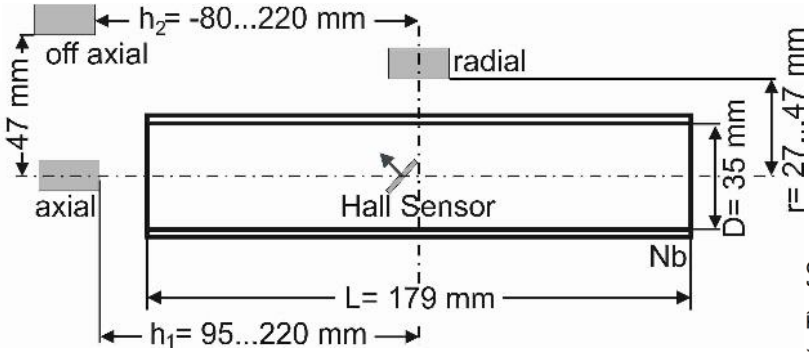


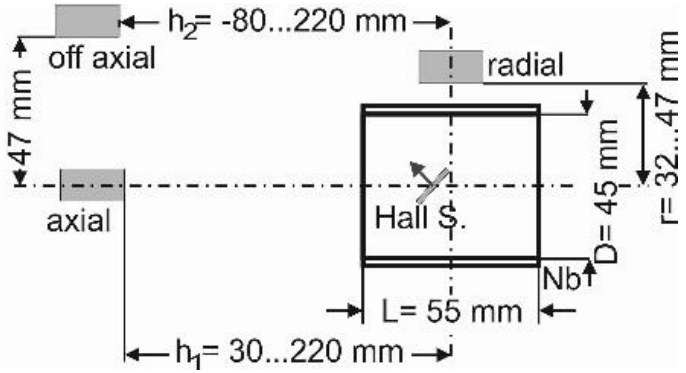
Measurements on lead and niobium tubes

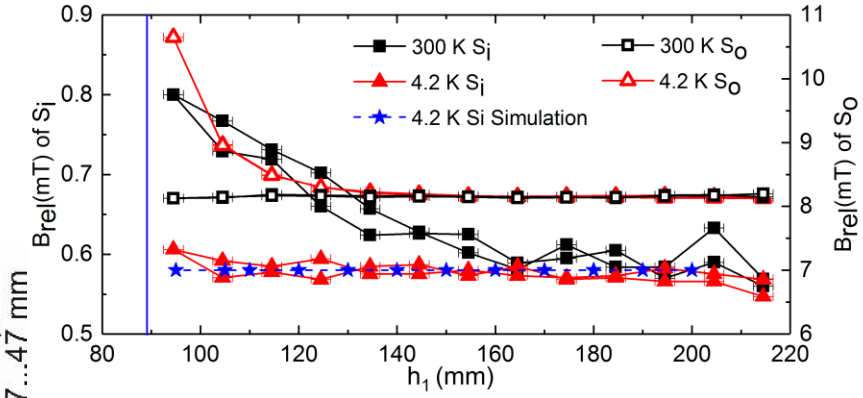
Lead tubes 99.95% Pure:
Tc =7.1K
Niobium tubes R.R.R.=300:
Tc =9.2K
Aspect ratio is important.
Long thin tubes reduce field and gradient more than short wide ones.

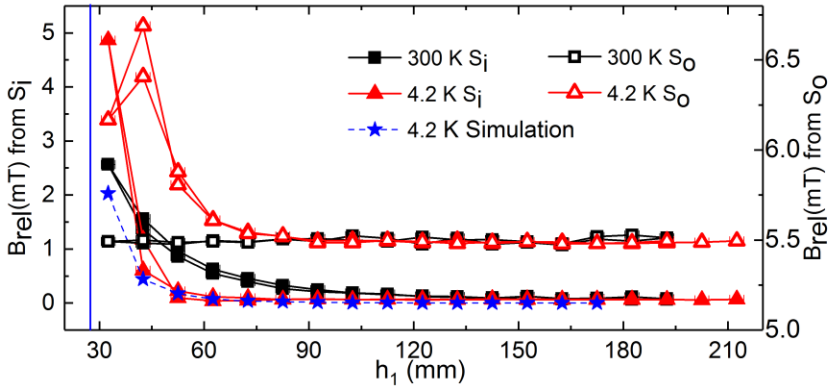


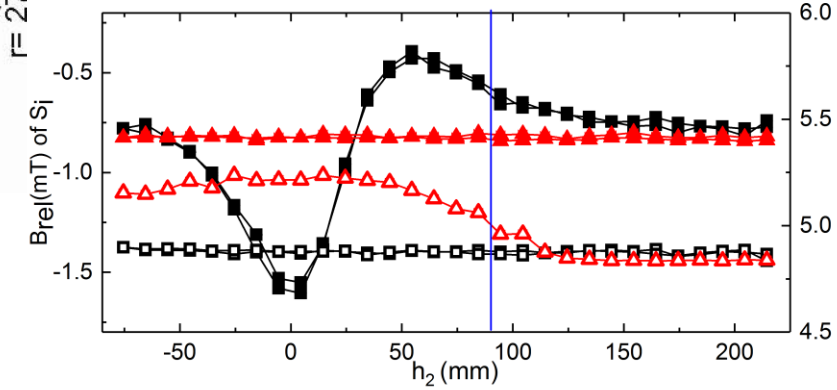
Niobium Tubes

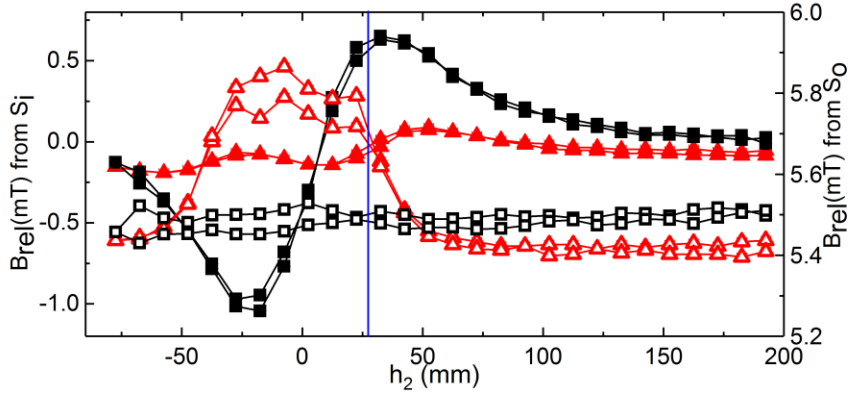


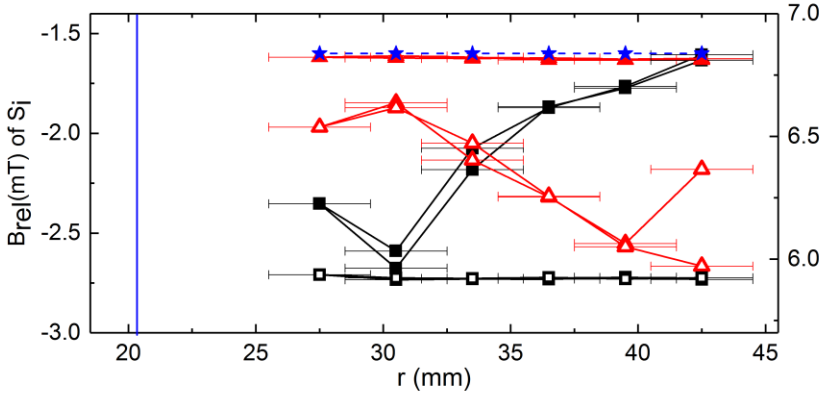


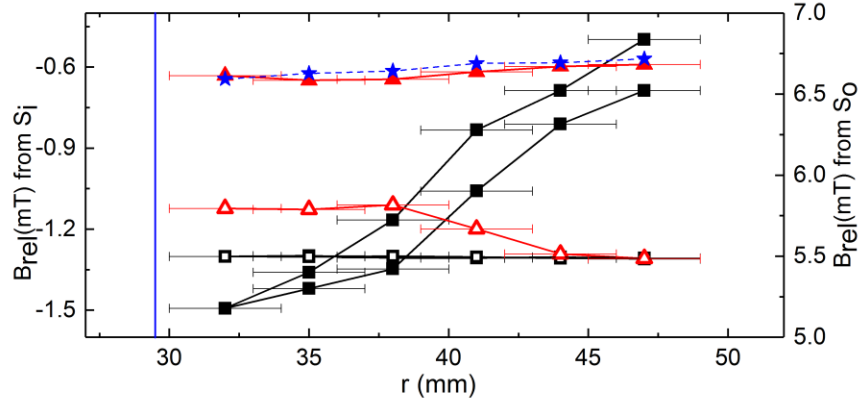












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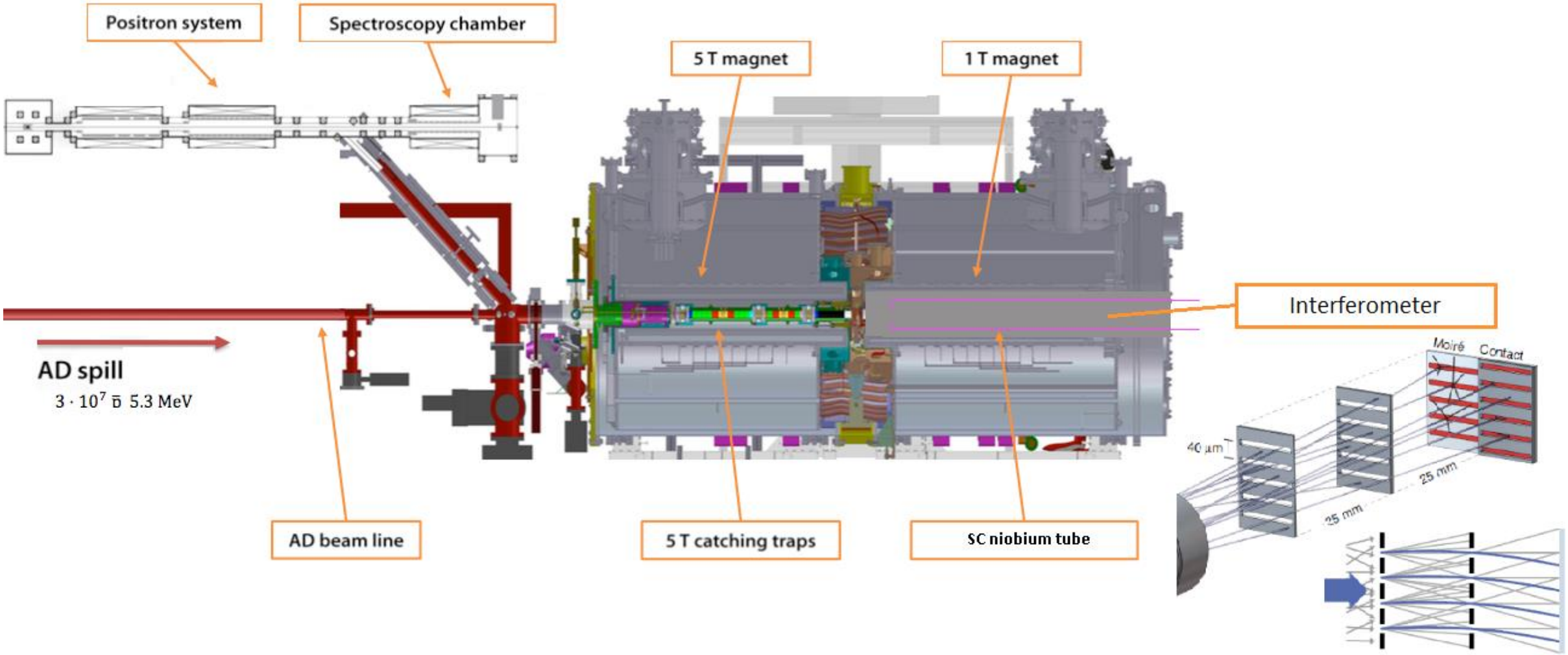
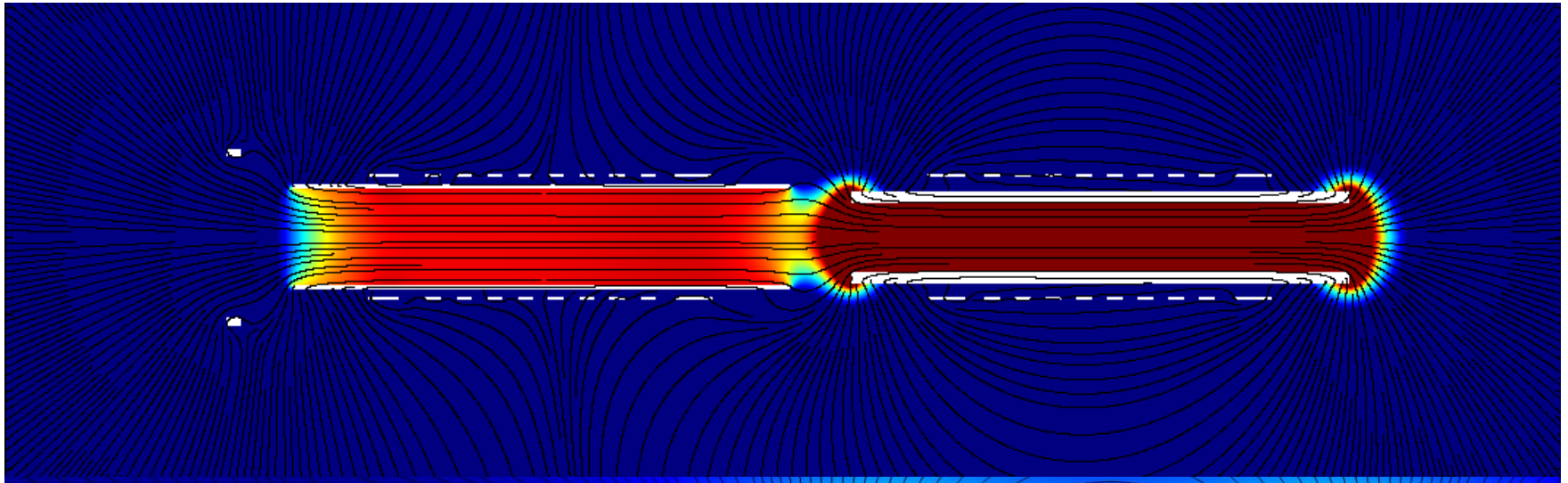
Tube Implementation in AEgIS

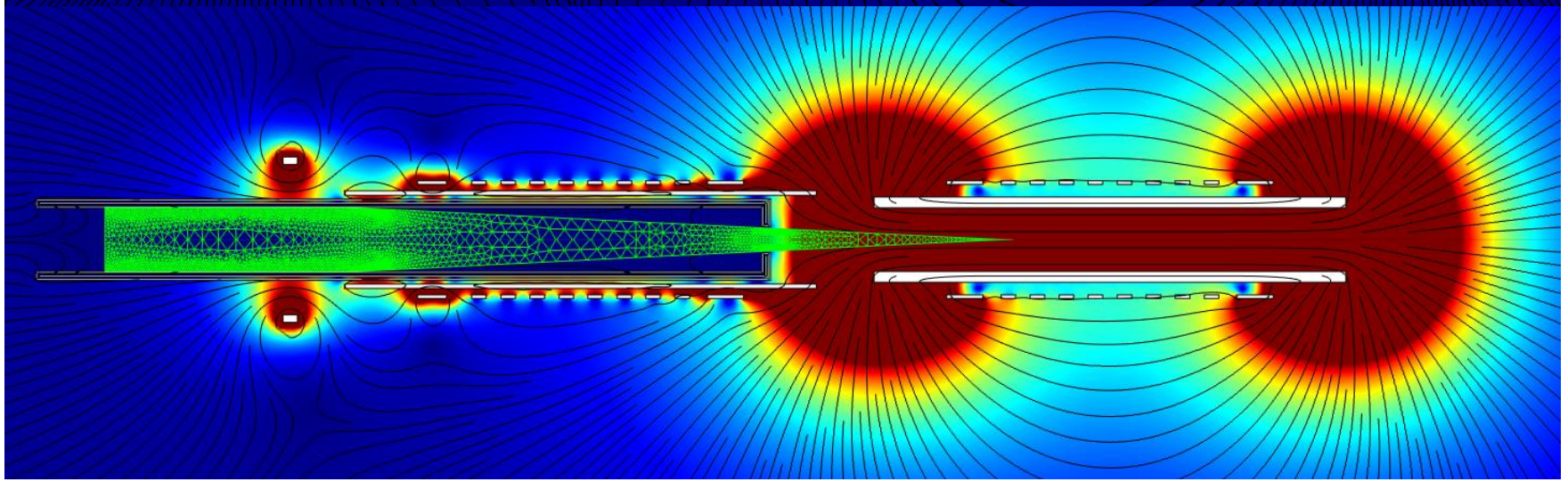


Magnetic Field in AEgIS Apparatus

1T and 5T region at the AEgIS apparatus
With current magnetic fields

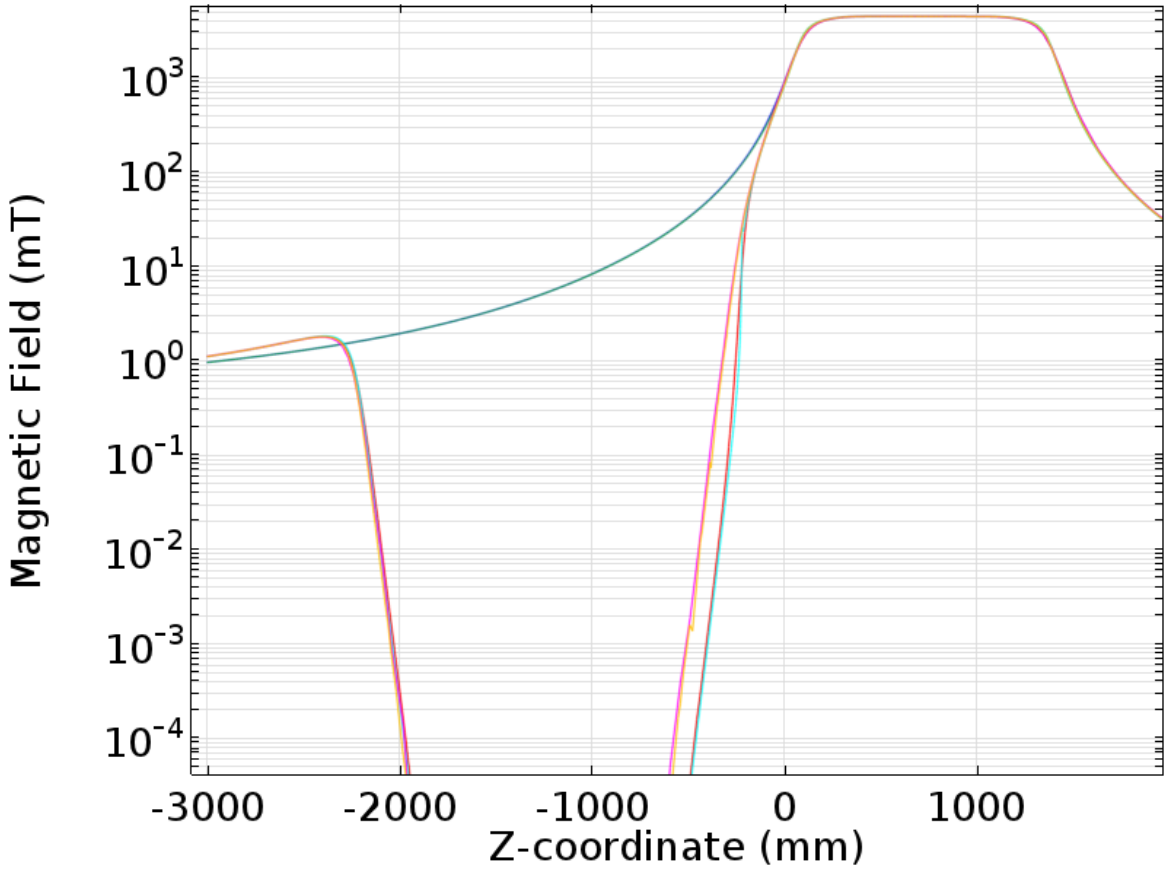


Superconducting Tube with 8 cm iris in 30 cm distance to 5T magnet
Correction coils needed to keep magnetic field under Hc1

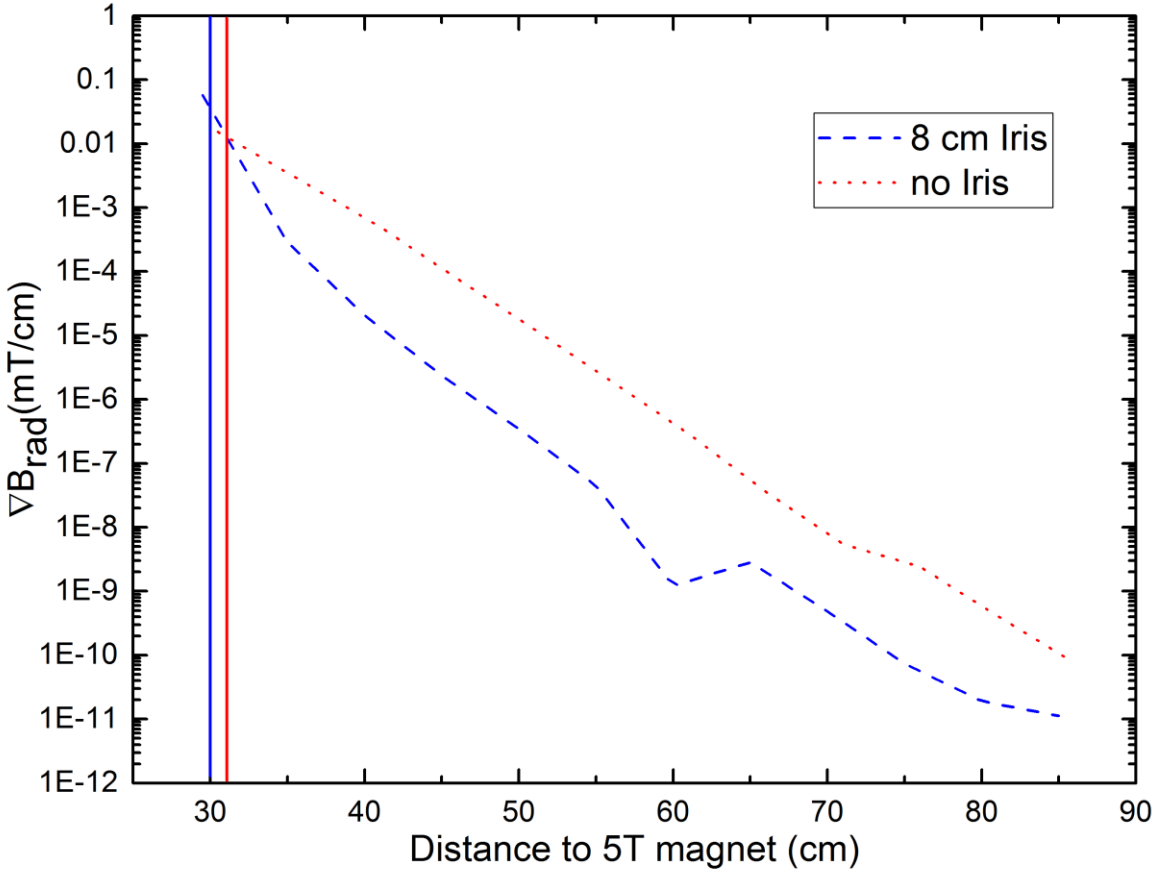


Superconducting „Meissner-Tube“

Field Strength without SC
Field Strength with SC tube
Field strength with SC tube and 8 cm iris.



Radial gradient of field along z-axis
Blue: Tube with 8 cm diameter iris in 30 cm distance
Red: Tube without iris in 31 cm distance



Thank you for your attention