Quantification of magnetic shielding caused by metallic beam pipes

TECHNISCHE UNIVERSITÄT DARMSTADT

Proposal for a Bachelor's Thesis, Master's Thesis, student project
October 15, 2024

Description

A multitude of devices is required to accelerate charged particles on a closed orbit of a synchrotron ring. A beam pipe separates the vacuumized particle beam trajectory from all other equipment in the tunnel and consists classically of conducting material. Bending magnets apply a strong Lorentz force on the particles which must rise proportionally to the particles' energy. According to Lenz' law, unwanted eddy currents are induced in the beam pipe in order to resist the change of magnetic flux density.

This work aims to quantify this disadvantageous effect of beam pipes on the field quality of bending magnets.

Work plan

- Literature study of magnetic field computation, beam pipe design and eddy current effects.
- Set up a 2D (or 3D) model of an accelerator magnet with beam pipe using GetDP or CST Studio Suite.
- Analyze the field's dependence on frequency and beam pipe thickness.
- Provide empirical formula which summarize your findings.
- Suggest a procedure which allows to estimate the effect of a beam pipe with infinitesimal wall-thickness ($\propto 1\,\mu$m).

Prerequisites

Interest in electromagnetic processes and applications (especially accelerator magnets) and their simulation.

Contact:
Dominik Moll, M.Sc.
`dominik.moll1@tu-darmstadt.de`
Office: S2|17 140

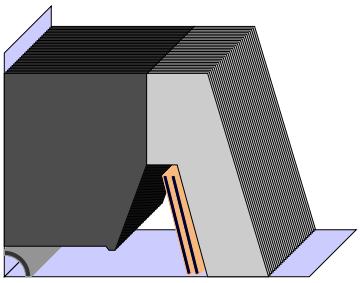

Figure 1: One quarter of a bending magnet.

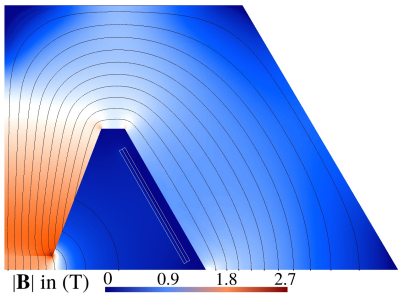

Figure 2: Magnetic flux density (not considering a beam pipe).