Numerical Modeling of Superconductors and Their Application for Magnetic Shielding

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Table of contents

Introduction

- Numerical and experimental investigating of SC shields
- Results for Electron Cooling System for NICA collider

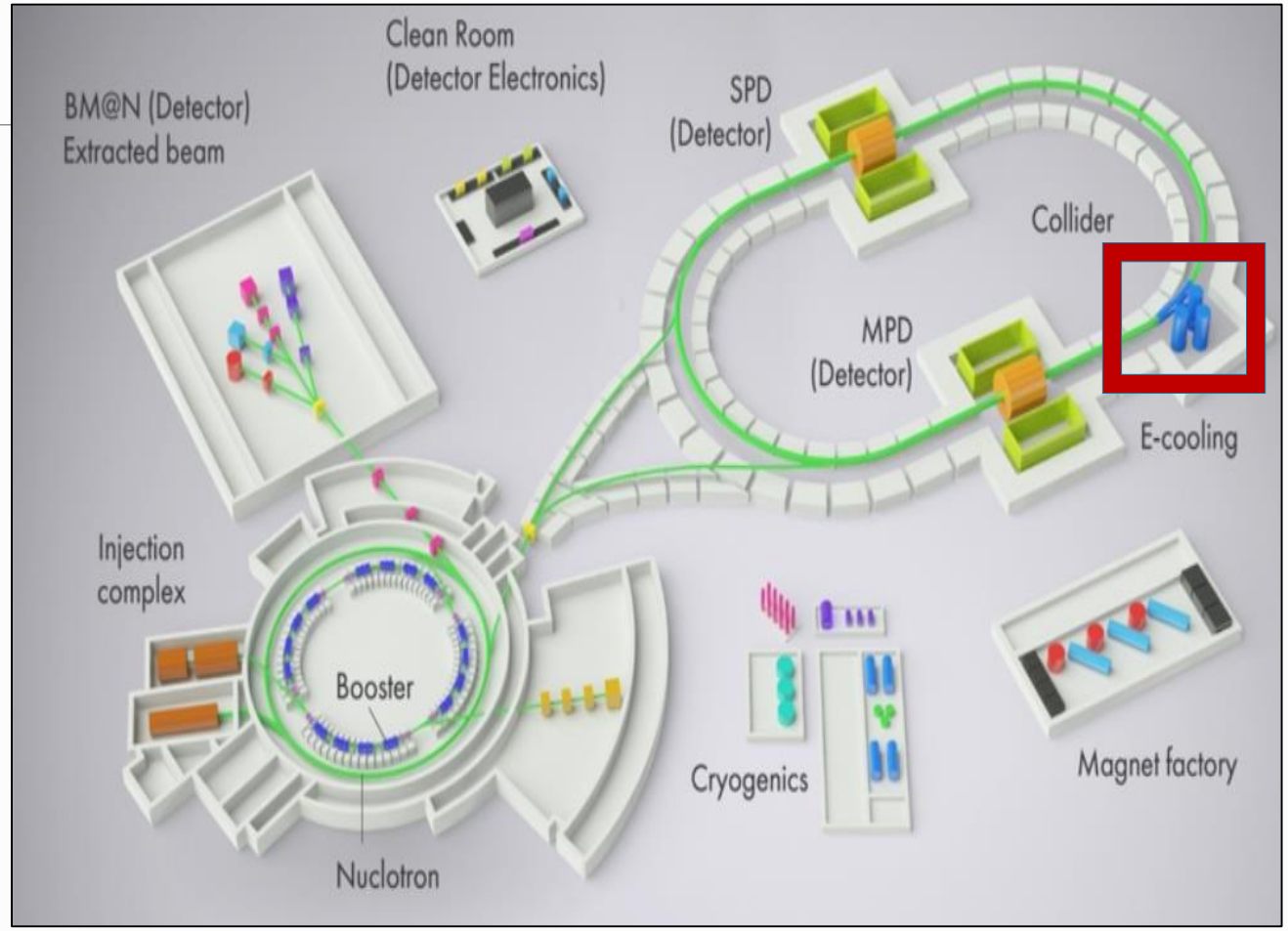

Figure 1 Nica complex

Electron Cooling System

- Decreases the velocity range of ions
- Requires high homogeneity of magnetic field
- Usage of HTS screens for lowering the costs

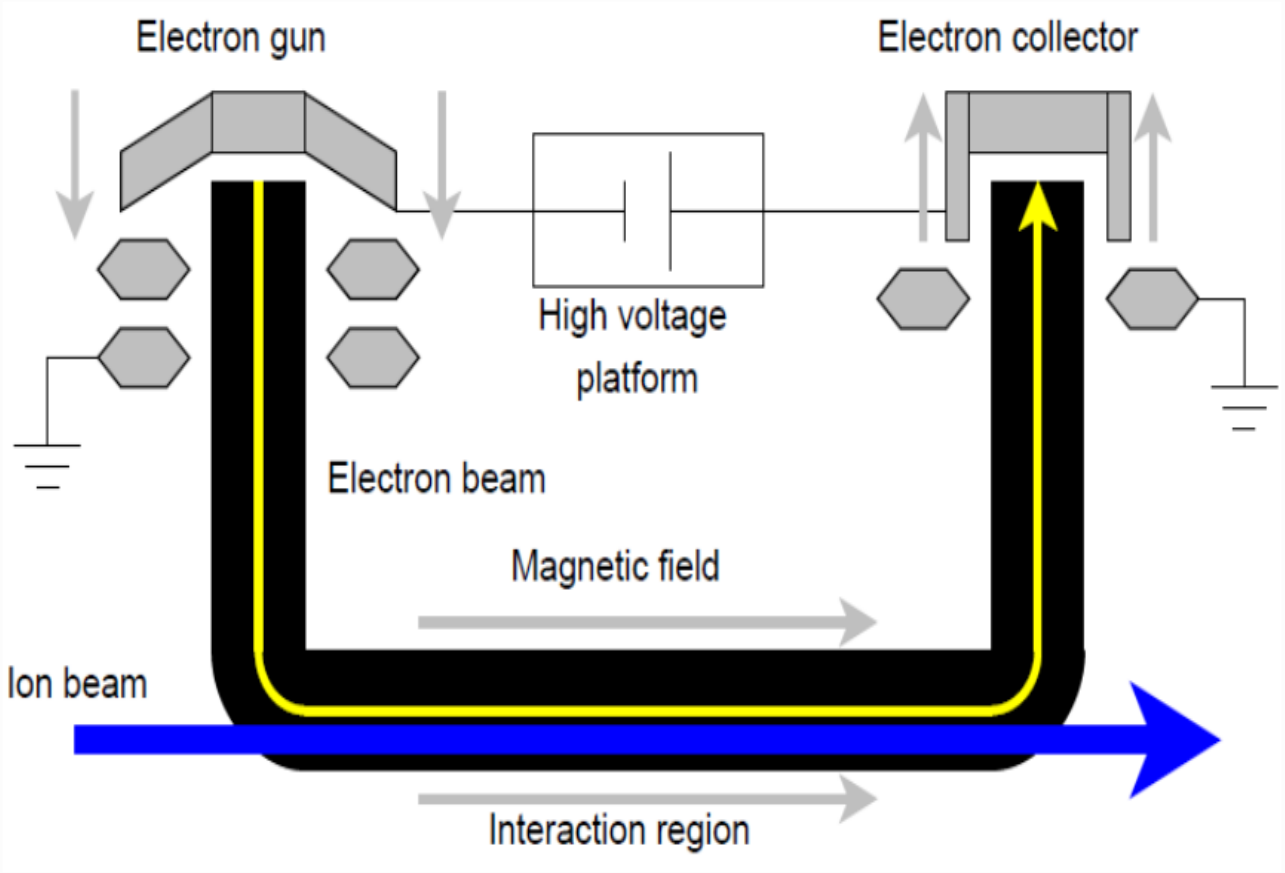

Figure 2 Scheme of Electron Cooler

Superconducting properties

- Perfect conductors
- Meissner effect
- Described by critical parameters
- Classification:
  - LTS and HTS
  - type I and type II

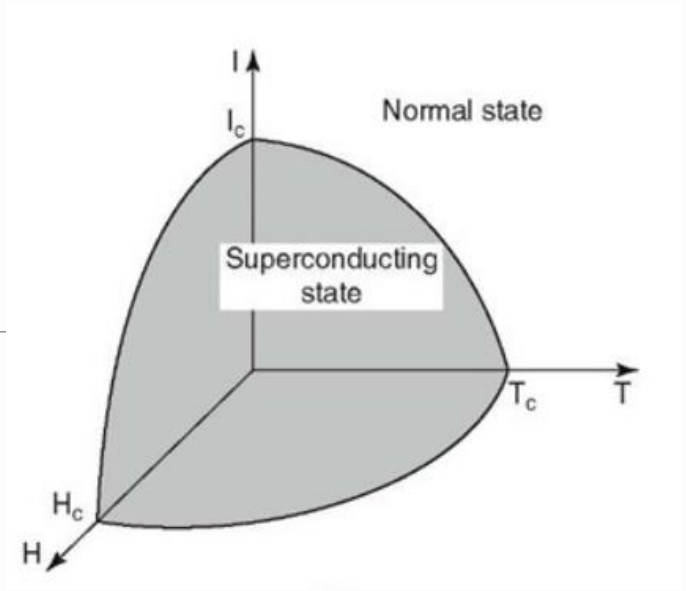

Figure 3 Superconducting critical parameters

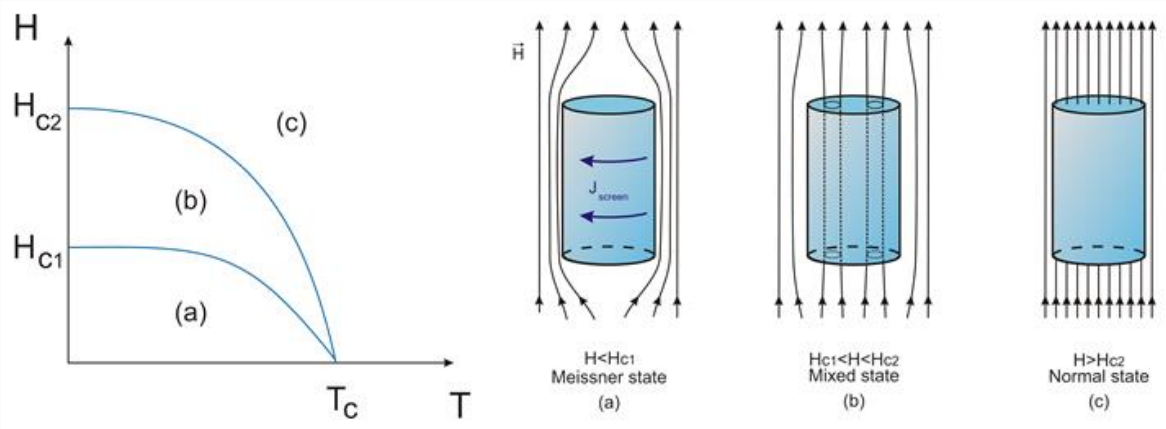

Figure 4 Critical magnetic field and Meissner effect in first and second type superconductors

Magnetic shielding

Two types: open and closed

Homogeneity of magnetic field
Trapping/Separating magnetic field

Applications:

- Cryocoolers
- Magnetic levitation systems
- Medicine
- Particle accelerators
- Superconducting synchronous machines

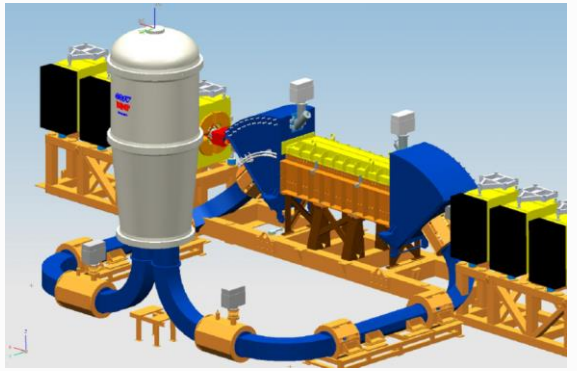

Figure 5 Examples of magnetic shielding application:
ECS (top left), MRI (bottom left) and G-M Cryocooler (right)

Shielding effect

Open-type shield **Without shield** **Closed-type shield**

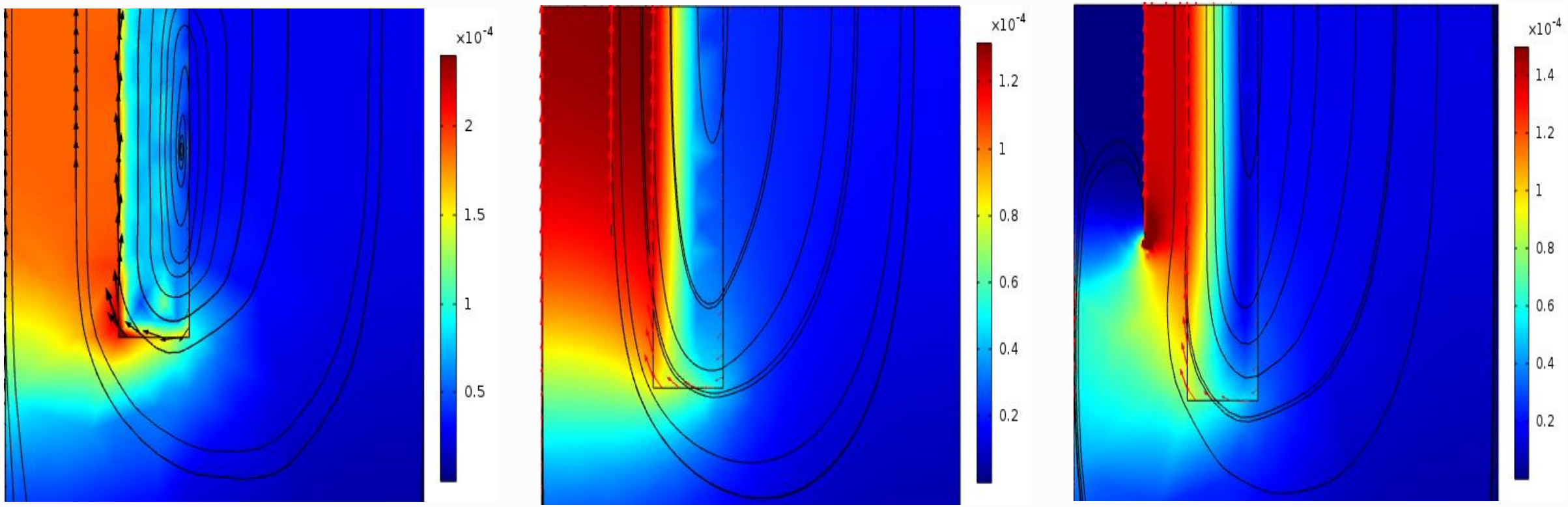

Figure 6 Results of numerical modeling – comparison of shielding effect

Shielding effect

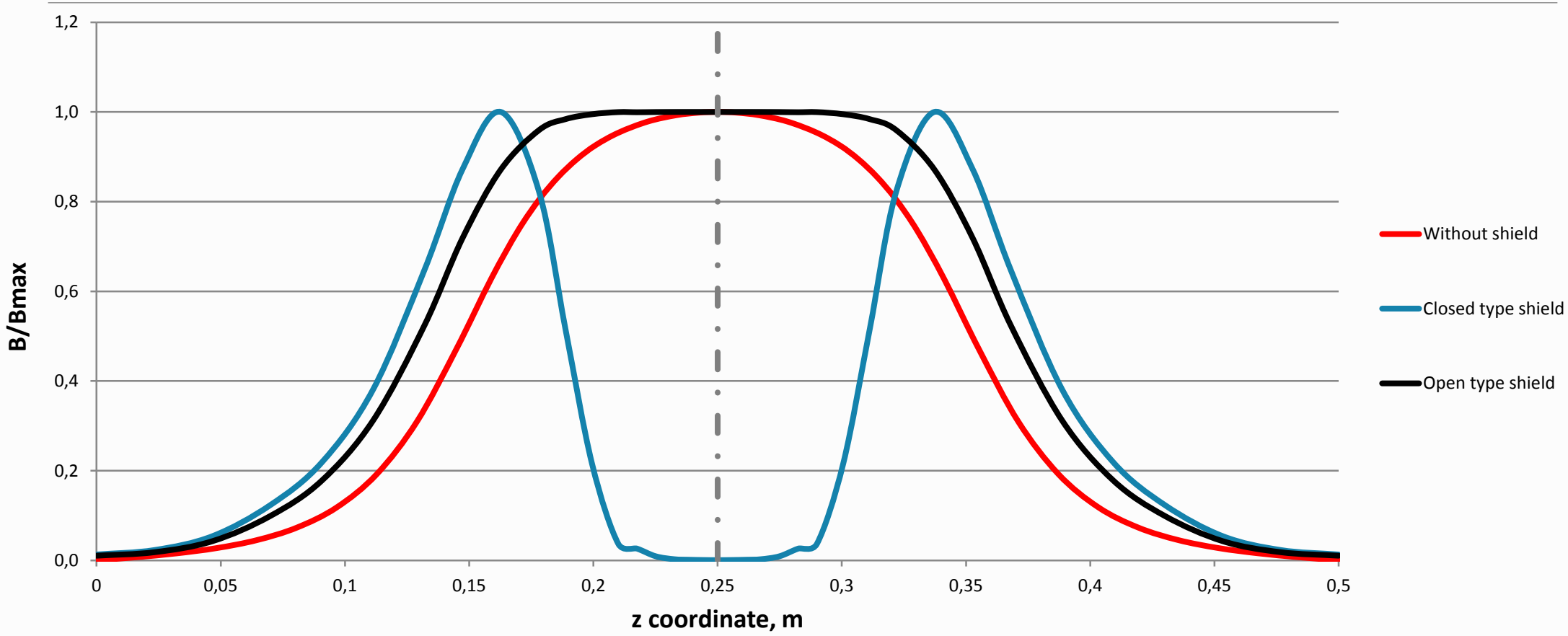

Figure 7 Results of numerical modeling – comparison of shielding effect

Experimental setup

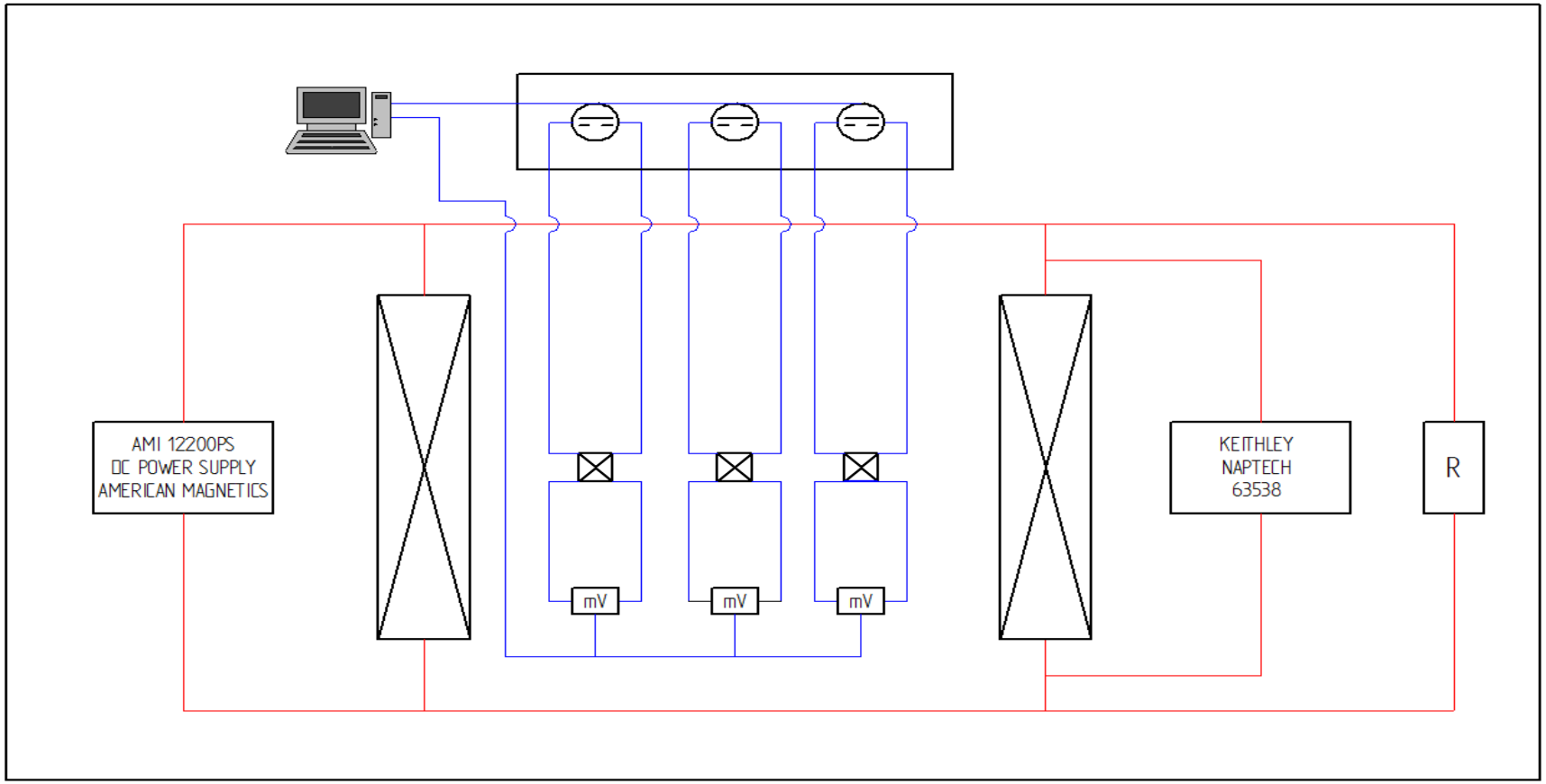

Figure 8 Experimental setup - connections scheme

Operating range of the magnet

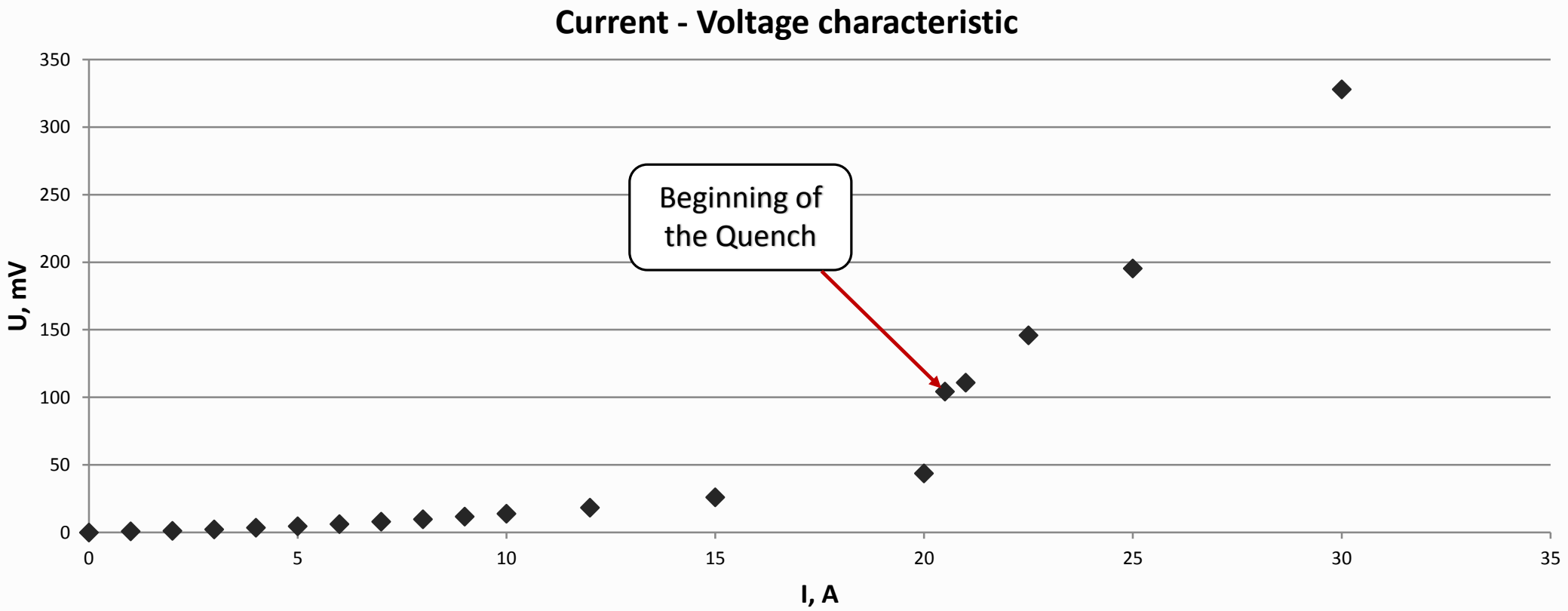

Figure 9 Current – voltage characteristic of the superconducting magnet

Experimental results

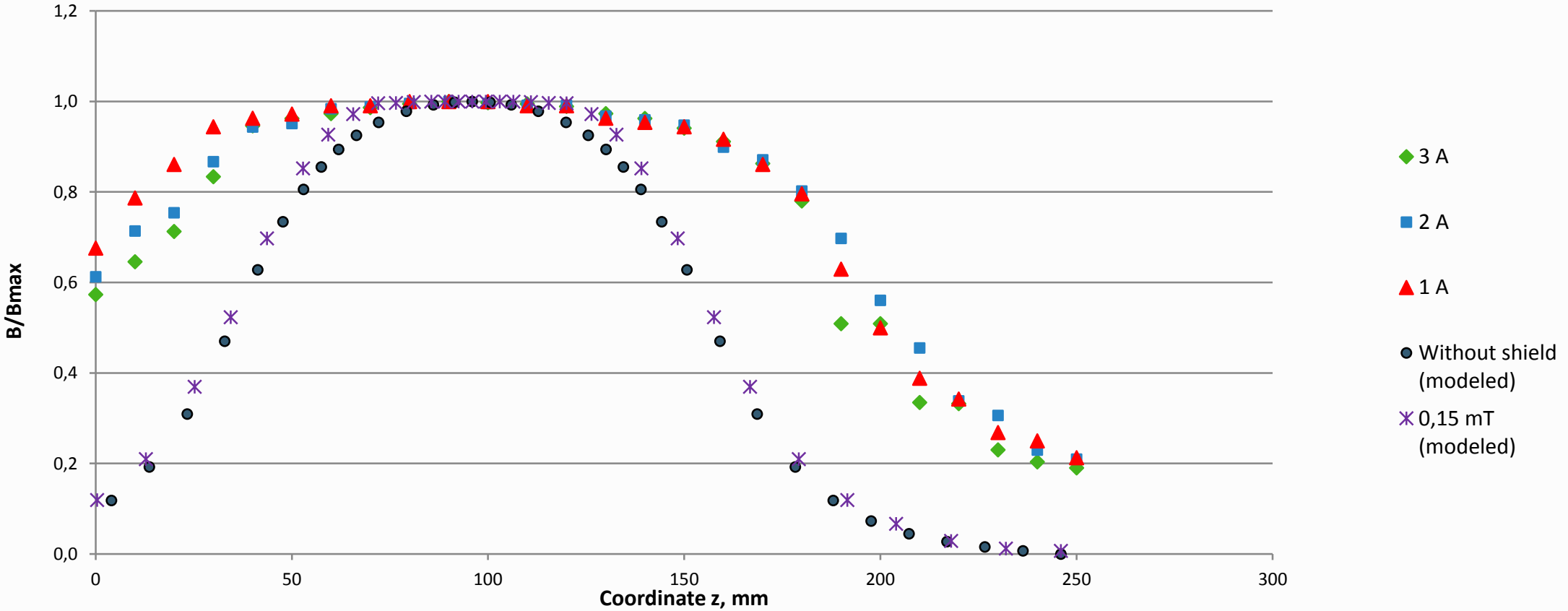

Figure 10 Results of magnetic screening

Results and summary

- Maximum safe current for test stand magnet is ~20 A
- Open-type shields allow to increase field homogeneity
- Experiments will be continued with higher currents

Thank you for your attention!