

A high temperature superconducting demonstrator coil for a novel toroidal magnetic spectrometer for an astroparticle physics experiment in space

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Magnetic spectrometers detect the rigidity of charged particles by measuring the bending of their trajectories as they pass through a magnetic field. A novel magnetic spectrometer for an astroparticle physics experiment in space should have a maximum detectable rigidity of about 100 TV. This motivates the design of a toroidal spectrometer magnet with a bending strength of 3 T m. To facilitate operation temperatures of about 20 K, the toroid consists of twelve high temperature superconducting (HTS) coil packs, where each coil pack contains two coils. The toroid is about 2 m in outer diameter and 2 m in height. The toroidal magnet requires about 60 km of 12 mm wide REBCO tape with a current density of 1200 A/mm², and has a peak magnetic field of about 12 T. Within the HTS Demonstrator Magnet for Space (HDMS) project, we have designed and are building a small-scale demonstrator coil pack for the toroidal magnet system. The demonstrator coil pack consists of two individually built racetrack-shaped soldered metal insulation coils enclosed with copper bands. Self-protection against quenches is obtainable with the use of soldered metal insulation coils. The surrounding copper bands function as current leads and layer jumps. The coils are supported by a lightweight mechanical structure made from aluminium alloy. A copper block electrically connects the two coil layers. We describe the design and manufacturing method of the demonstrator coil.

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1. Introduction

Particle detection in space: AMS-02 and other proposals for future spectrometers: AMS-100, Aladino

2. A novel magnetic spectrometer in space

2.1 The [name of spectrometer] spectrometer

Performance requirements,
Engineering constraints (geometrical restrictions, zero magnetic moment),
Basic geometry (toroid),
Acceptance of detector system: Proposal for constellation

2.2 Detector system for a toroidal magnetic spectrometer

Types of detectors
Monte Carlo simulation.

2.3 Toroidal spectrometer magnet

Quench self-protection coil
cryogen free choice
Magnet design
current density,
magnetic field,
Mechanical structure

3. HTS demonstrator magnet for space

The HTS Demonstrator Magnet for Space (HDMS) project aims to design, build and test an HTS demonstrator coil for a toroidal spectrometer magnet.

3.1 Conductor specification

3.2 Coil design

3.3 Mechanical structure

3.4 Project status

4. Conclusion

References

[1]

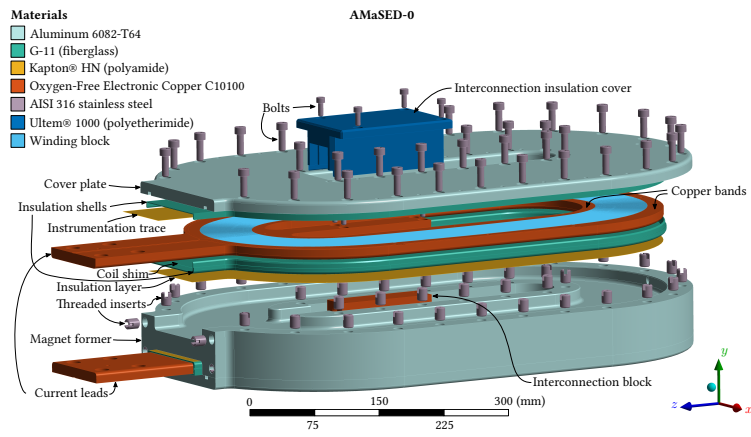


Figure 1: An exploded view of the components of the dummy coil, AMaSED-0.