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Characterization of a soldered metal insulation HTS ReBCO demonstrator coil 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 at an operating temperature of 20 K. The toroid consists of twelve HTS coils, where each coil contains two winding layers. 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 built and tested a small-scale demonstrator coil for the toroidal magnet system. The demonstrator coil consists of two individually built racetrack-shaped soldered metal insulation HTS ReBCO winding layers. The finite electrical resistance between winding turns enables self-protection against quenches. The winding layers are surrounded by copper bands functioning as current leads and layer jumps. The coil is supported by a lightweight mechanical structure made from aluminium alloy. We present an electrical characterization and magnetic measurement results for the demonstrator coil.

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