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Development of a small-aperture cos-theta dipole insert coil based on Bi2212 Rutherford cable and stress management structure

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The U.S. Magnet Development Program (US-MDP) aims at developing high-field accelerator magnets with magnetic fields beyond the limits of Nb3Sn technology. Recent progress with composite wires and Rutherford cables based on high temperature superconductor Bi2Sr2CaCu2O8-x (Bi2212) allows considering them for this purpose. However, Bi2212 wires and cables are sensitive to transverse stresses and strains, which are substantial in high-field accelerator magnets. To prevent large degradation of the Bi2212 coils and achieve the required field quality, an innovative design which provides turn positioning during coil fabrication and operation and manage azimuthal and radial strains/stresses in the coil has been proposed at Fermilab. This paper describes the development and fabrication of a small-aperture two-layer Bi2212 dipole inserts with stress management. The design and main parameters of the superconducting wire and Rutherford cable, the coil stress management structure design and the coil FEA in the dipole mirror and dipole test configurations are presented and discussed. The key Bi2212 coil fabrication steps, its instrumentation and assembly in a dipole mirror configuration inside an Nb3Sn outsert coil are also reported in the paper.

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