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Second generation HTS quadrupole for FRIB

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Abstract: This paper will describe the design and R&D plan of a High Temperature Superconductor (HTS) quadrupole for the establishment of the Facility for Rare Isotope Beams (FRIB). Quadrupoles in the fragment separator region of this facility will be subjected to intense level of radiation (>106 Gy per year) and heat loads (over 200 Watts in the coils of first 0.6 meter long magnet itself). The use of HTS is attractive as it can remove these high heat loads at elevated 30-50 K rather than at 4-10 K, needed for conventional low temperature superconductors. Earlier, in the first phase of HTS magnet R&D for Rare Isotope Accelerator (RIA), we had successfully designed, built and tested a 10 T/m, 290 mm aperture quadrupole with ~ 4 mm wide first generation BSCCO2223 tape operated at 30 K. The second generation magnet design requires a higher gradient (15 T/m) and is being designed with ~12 mm wide second generation YBCO tape to operate at even higher temperature, ~50 K. Higher operating temperature makes the removal of large amounts of energy even more efficient. We are developing a warm iron magnet design where the HTS coils are conduction-cooled with helium gas flowing through a support structure. The goal of this three year R&D program is to evaluate the viability of HTS magnets in a real machine with magnets in a challenging environment where HTS offers a unique advantage.
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