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[Invited] Design of the HTS based, high power proton Cyclotron CYCIAE-100B

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The cyclotron CYCIAE-100, the driving accelerator of the Beijing Radioactive Ion-beam Facility (BRIF), was completed successfully to provide up to 52 kW proton beams with energy range from 70 to 100MeV continuously for researches of nuclear physics, material and life science, also for medical isotope production in 2014. Although the design is 'compact', the total weight of CYCIAE-100 is still up to 435 ton, which limits the further applications. In order to reduce the weight significantly of high power cyclotrons, an ironless superconducting cyclotron CYCIAE-100B is proposed by China Institute of Atomic Energy (CIAE). To improve thermal stability and simplify the cryogenic system, 2G HTS tapes are used to wind the sector coils, shimming coils and main coils, and the first two of which are the replacement of iron poles. The operating temperature is below 30K. The practical production of the field with complicated distribution for beam dynamics had been explored. In order to obtain the isochronous field with strong focusing, a peak-valley staggered arrangement for sector coils and trim coils, and the corresponding mechanical structure are designed. Due to the limitation on the minimum bending radius of the HTS coil and the difficulty of precise positioning of the coils, we have to use few iron in the design: 1) an iron central plug to produce a field bump for the lack of flutter in the center region; 2) a H-shaped iron scheme for magnetic shimming at the room temperature side, which is particularly beneficial for the shimming quality and efficiency. The 110 MHz waveguide cavity and its induced magnetic field, cryogenic and vacuum system, quench protection and power supply system will be also presented in this paper.

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