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Physical design study of the main magnet for the CIAE 75 MeV cyclotron

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A 75 MeV cyclotron is currently under development at the China Institute of Atomic Energy (CIAE). This machine is designed to extract a beam with a rated power exceeding 60 kW for the production of medical radioisotopes, such as ^{68}Ge, ^{223}Ra, and ^{225}Ac, aiming to meet the growing domestic demand for diagnostic and therapeutic radionuclides. This paper addresses key challenges and solutions in the design and computational analysis of the main magnet. The magnet poles adopt a structural design scheme featuring integrated straight-edged sectors with a slight spiral angle at the trailing edges. The isochronous magnetic field distribution is achieved through an axial shimming method. Magnetic field optimization was performed using the numerical simulation software OPERA-3D, thereby enhancing the acceleration efficiency of the cyclotron. Furthermore, deformation simulation and mechanical structural optimization were carried out for the main magnet. Under the premise of ensuring overall performance, the deformation of the main magnet, which has a diameter of 4.4 meters and a weight of 130 tons, was controlled within acceptable engineering tolerances.

Footnotes

Funding Agency

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