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# Thu-Af-Or23-07: Magnetic design of superconducting toroidal gantry for hadron therapy

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Hadron and proton therapy are cutting edge techniques for cancer treatment and a great development of specialized medical centers and research facilities is foreseen in the next decades. One of the main obstacles to the penetration of the use of charged particles for therapy is the construction of complex and expensive accelerating structures and rotating transfer lines, i.e. gantries, able to bend and focus the beam down to the patient.
GaToroid is a novel concept of fixed toroidal gantry, able to deliver the dose at discrete angles in the whole range of treatment energies in steady-state configuration. The absence of magnetic field and current variations is an appealing feature, implying simplified demands on stability, powering, mechanics and cooling, as well as for the clinical prospective, allowing rapid variations of beam energy and treatment angle.
In this work, we present the magnetic design of the toroidal coils composing GaToroid, focusing the analysis on an option for a proton machine with energy range of 70 MeV to 250 MeV. To create a proper magnetic field distribution, the coils have been designed with peculiar asymmetric shape and the conductors have been graded. An initial winding geometry was obtained with an optimization aiming at maximum energy acceptance of the Gantry. We are now progressing to the detailed engineering design.
We describe here the coil and conductor layout (LTS and HTS options), and mechanical studies involving the general torus structure and the analysis of the stress on the coils. Quench protection is evaluated for LTS (Nb-Ti) configuration, as well as more innovative HTS (REBCO) options. Finally, we present the design and the construction of a scaled-down demonstrator, intended as the proof of principle of winding procedure and mechanical coil structure.
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