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Preliminary study of 4 T superconducting dipoles for a light rotating gantry for ion-therapy

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A collaboration between CERN, CNAO, INFN and MedAustron has been formed with the aim at designing a light rotating gantry suitable for hadron therapy based on 430 MeV carbon ion beams. After a preliminary design based on 3 T dipole field, now the collaboration is engaging to improve the design to 4 T or more. The magnets are designed according to cosθ layout to be wound with Nb-Ti superconductor Rutherford cable. One of the main challenges of these magnet is the very small curvature radius of 1.65 m with a relatively large aperture, 90-100 mm. Another challenge is the use of cryogen-free magnets despite the cycling operation with 0.3-0.35 T/s. The design of these 4 T dipoles, to which will be superimposed a further 0.3 T of quadrupole field, is therefore very challenging. The paper will report the preliminary design at 4 T (aiming at least 20% margin in operative conditions) as well as the parameters of a 1 m long demonstrator to be manufactured at INFN-LASA in one and half year. The conductor measured characteristics, with 3 micron Nb-Ti filaments embedded in a Cu-Mn alloy matrix. The resulting gantry is very compact, and we are working on integration between gantry structure and magnets to allow reducing the rotating weight to less than 50 tons, which is a factor five gain on the present state-of-the art.

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