

Toroidal Bending Magnets for Hadron Therapy Gantries

Technology #17367

Applications

Toroidal bending magnets which are suspended in gantries in proton and carbon beam therapies.

Problem Addressed

Several designs exist for proton and carbon beam therapy; however, because of stray field, either a large amount of external ferromagnetic shielding is required (such as iron), or a second set of coils with a reversed field are needed to reduce or eliminate the magnetic fields from the dipole. In either case the weight of the magnets is high, and means to reduce the weight and size of the system are desired. The advantage of the toroidal magnet is that there is no need for magnetic shielding, thereby substantially decreasing the weight of the system.

Technology

Multiple plates resting against a bucking cylinder are used in the toroidal bending magnet. There are gaps between the plates, and one of them is used for beam bending. The rest of the plates contribute to the field in the gap used for bending, and to reduce the stray magnetic field. The additional magnet plates are not otherwise used directly, and no beam passes through the gaps between them. Adjusting the spacing of the plates creates changes in the magnetic field that can be used to adjust the path of the hadron beam. Additionally, the Bragg peak can be scanned in all three dimensions: ordinate and coordinate (within the treatment plane at fixed beam energy) and in depth (varying the location of the treatment plane within the body) with the inclusion of achromatic magnets. Achromatic magnets have two conventional dipoles separated by one or more quadrupole (focusing) magnets and allow variation in the beam energy. The quadrupole magnets compensate for dispersion and shift in beam direction because of the variation in beam energy. Achromatic magnets can be made by combining two toroidal bending magnets. The simple geometry may also allow the use of higher fields, making it attractive for carbon therapy, as well as proton therapy.

Advantages

- Decreases weight
- Decreases stray field
- Allows higher fields

Categories For This Invention:

Life Sciences

Clinical Applications

Radiology

Intellectual Property:

Toroidal bending magnets for hadron therapy gantries
PCT
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External Links:

Plasma Science and Fusion Center
<https://www.psfc.mit.edu/>

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