Design and Simulation of Cyclotron Magnet Using COMSOL Multiphysics®

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Abstract

Medical accelerators, in particular Cyclotrons, are used to accelerate charged particles to tens of Mega electron Volts (MeV) of energies. These high energy particles then used to produce isotopes for medical application such the system located at king Faisal Specialist Hospital and Research Centre (KFSHRC).

The old CS30 Cyclotron at KFSHRC suffers from low output beam current. This problem could not be linked to a broken component or lack of maintenance. However, it is linked to the effect of magnetic field and its component in the accelerated area inside the cyclotron. And it is not always possible to perform a magnetic mapping to study variation in a cyclotron's magnetic field due to the amount of work needed to prepare the equipment, such as removing many components, including the dees, from the extracted area. Hence, simulation is helpful in determining the effect on particles under the influence of magnetic and electrical fields.
Therefore, a 3D model of the CS30 Cyclotron magnet was designed and imported into the COMSOL Multiphysics®. The components of the model of the CS30 cyclotron had the same dimensions as the real cyclotron's parameters. Moreover, two modules were operated within the COMSOL environment: the AC/DC (to generate magnetic field) and Particle Tracing modules. The former generates the required field by energizing the coils with the same electrical current of 350 Amp, while the particle tracing module accelerates the particles to their final energy of 26.5 MeV.

Results show that the difference between actual and simulated values was less than 10%. The obtained value will allow tracing of the particles orbits while changing the magnetic force around a critical region such as the electrostatic deflector. Results are reported in this work.

Figures used in the abstract

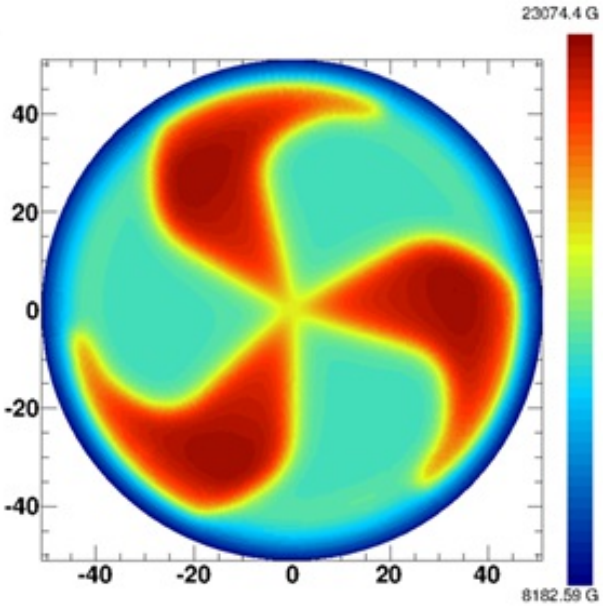

Figure 1: Simulated Magnetic field obtained for the CS-30 Cyclotron.