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Fast computation of magnetic shimming in high field environment

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During the development of the new S2C2 at IBA, it was found that the axial field harmonics may have an impcat on the machine performance. Due to the compactness of the machine, outside elements such as magnetic shielding (for cryo-coolers and rotco), the external beam line, and the yoke-lifting system, have an influence on the median plane field inside the synchrocyclotron itself. This is detailed in another communication. Shimming may be necessary to adjust these errors.
In this communication a simulation method for shimming a first harmonic in a cyclotron is described. The shimming is done with multiple iron shims with rectangular or sector shape in the pole gap. It is assumed that these iron shims are completely and uniformly saturated by the external magnetic field. Analytical expressions are given for the magnetic field produced by a single shim. A program is described that calculates the magnetic field produced by multiple shims. As an example, the method is applied for shimming of the first harmonic field error due to the extraction system. The calculations are very fast and allow a quick convergence to a good final solution. Good agreement was found with OPERA3D.

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poster

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