Effects of Octagonal Aperture in Downstream Door of the Target Spectrometer

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- Radial Field Asymmetry in the Downstream Door of the TS
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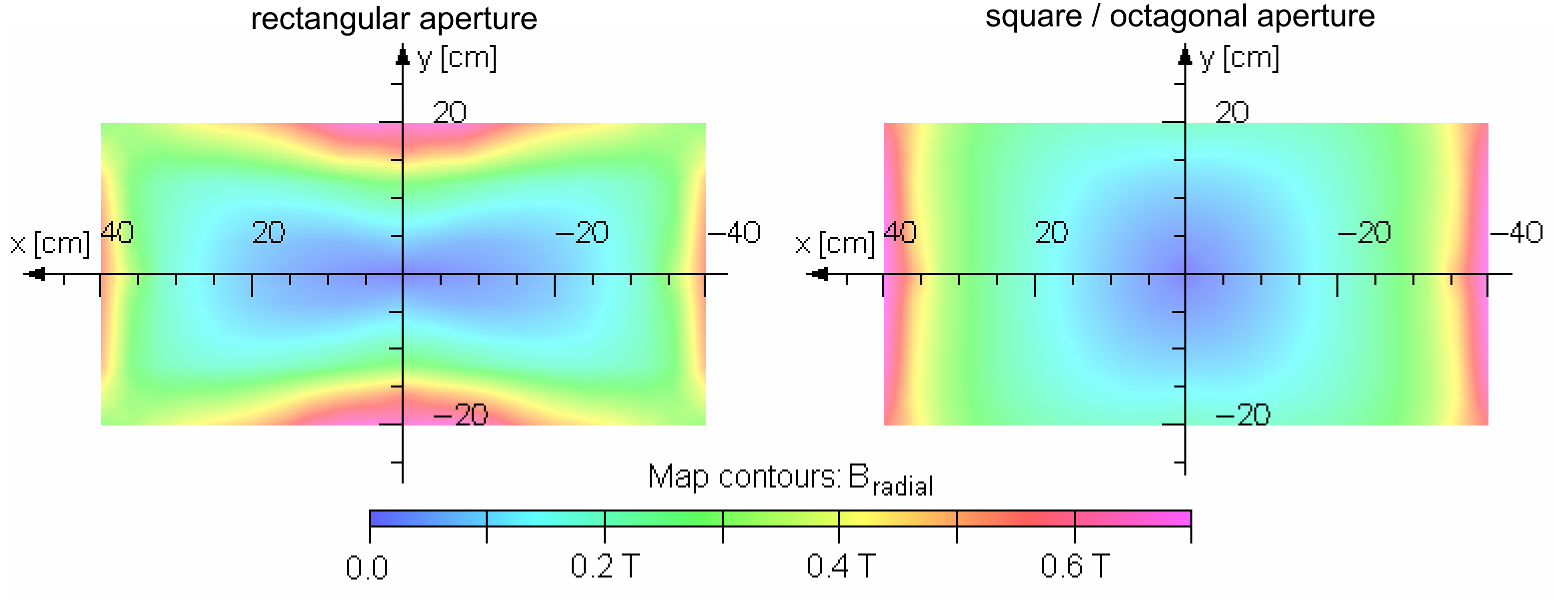
Radial Field Asymmetry in the Downstream Door of the Target Spectrometer

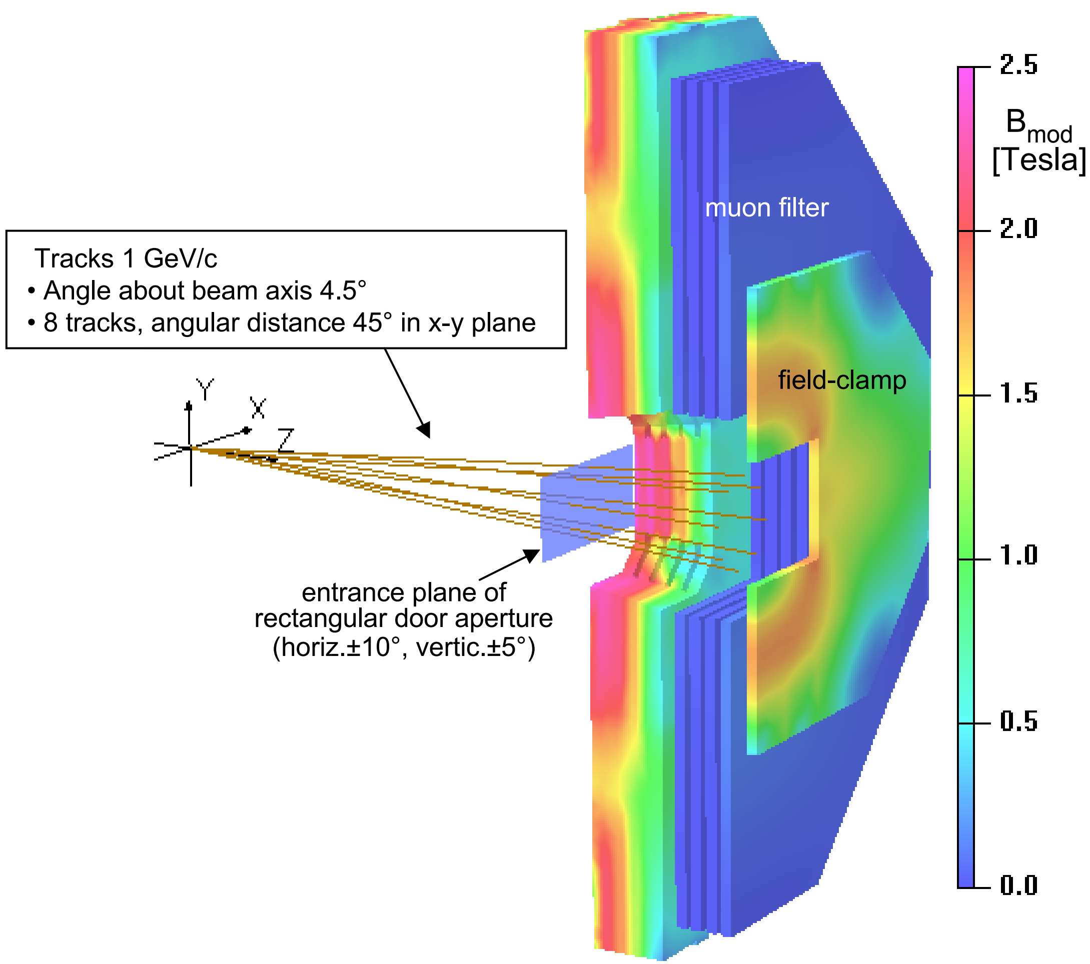
The aperture of the Downstream Door of the Target Spectrometer is assumed to be rectangular (angles ±10° horizontally, ±5° vertically).

This geometry implies an asymmetry of the radial field component (see left contour plot, radial field at entrance plane of DS-door, z=248.5cm). Particles which are moving - for instance - 1cm above or below the beam axis are subjected to a higher transversal field than particles which are moving 1cm aside of the beam axis.



If the aperture would be square or octagonal (see right contour plot) the radial field would increase at the same rate in horizontal and in vertical direction, respectively.

Tracks of 1 GeV/c Pions from IP up to Entrance Field-Clamp of Dipole

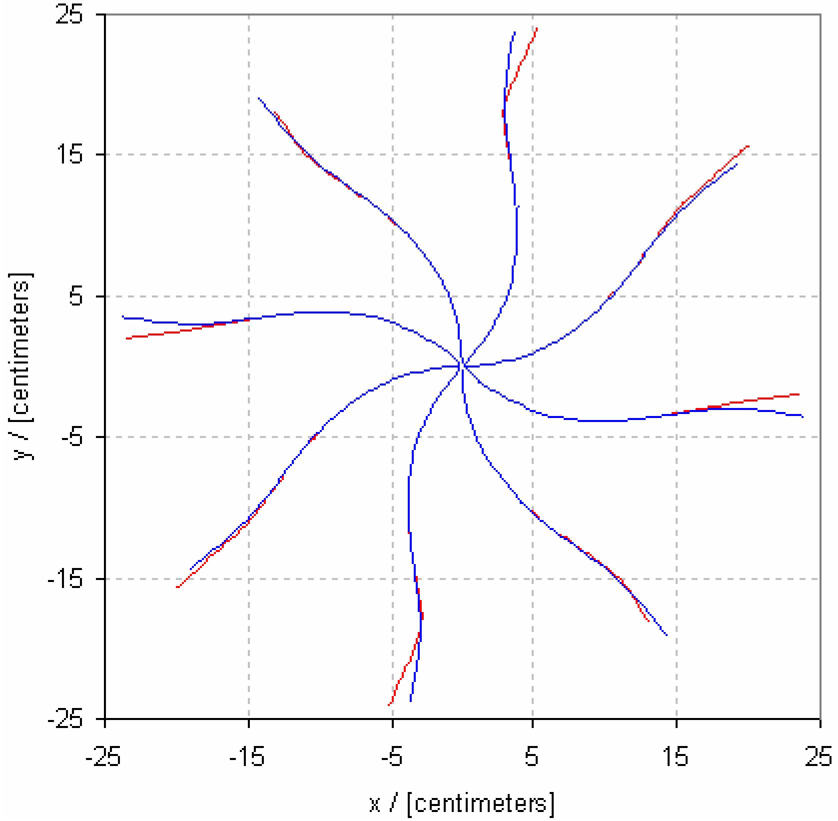


The aperture of the DS-door shown above is assumed to be octagonal. The original rectangular aperture is indicated by a blue plane (the red color in the DS-door, by the way, indicates regions of high iron saturation).

On the following pages there is shown a comparison of tracks for the cases of a rectangular aperture and an octagonal aperture, respectively.

Trajectory Projection of 1 GeV/c Pions in x-y Plane

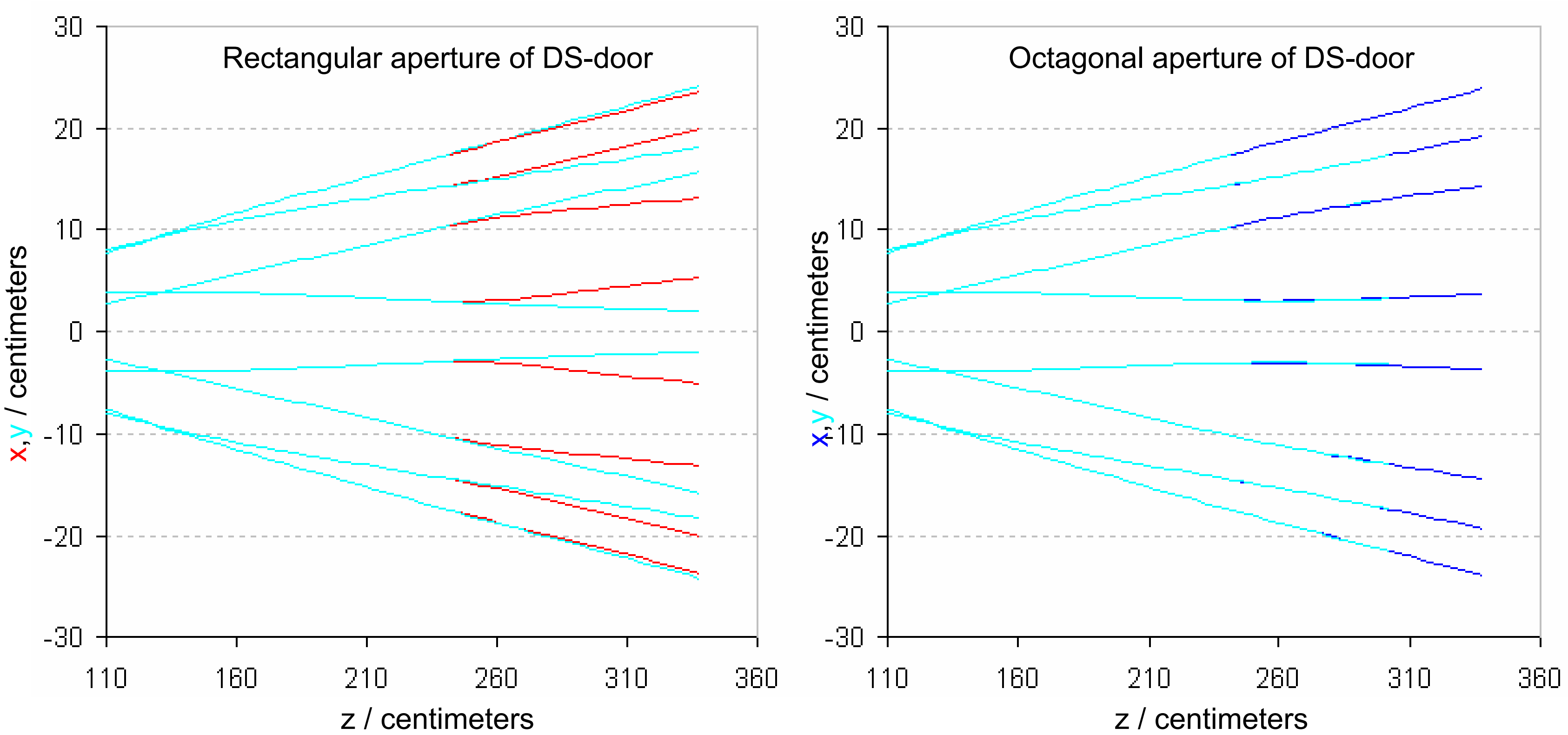
reference s. previous page, solenoid and dipole both at 100% nominal current



Red tracks: Rectangular aperture of DS-door (±5° vertical, ±10° horizontal)
Blue tracks: Octagonal aperture of DS-door (±10° vertical, ±10° horizontal)

The blue trajectories are rotational symmetric, the red ones are not.

Trajectory Projection in z-x Plane and z-y Plane, resp.



Turquoise tracks: projection in z-y plane

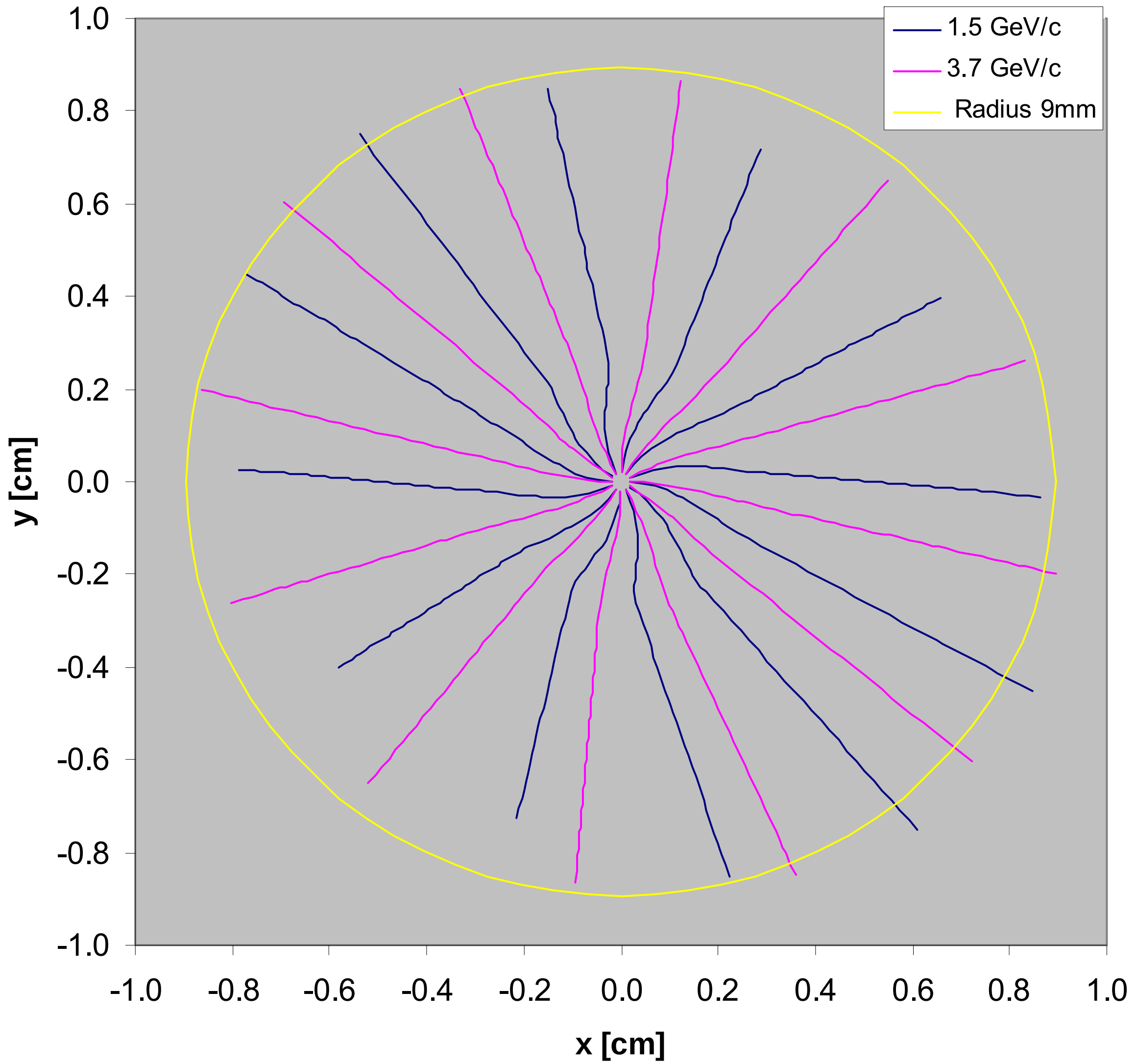
Red / blue tracks: projection in z-x plane

With octagonal aperture, the projections of trajectories in both planes are nearly congruent.

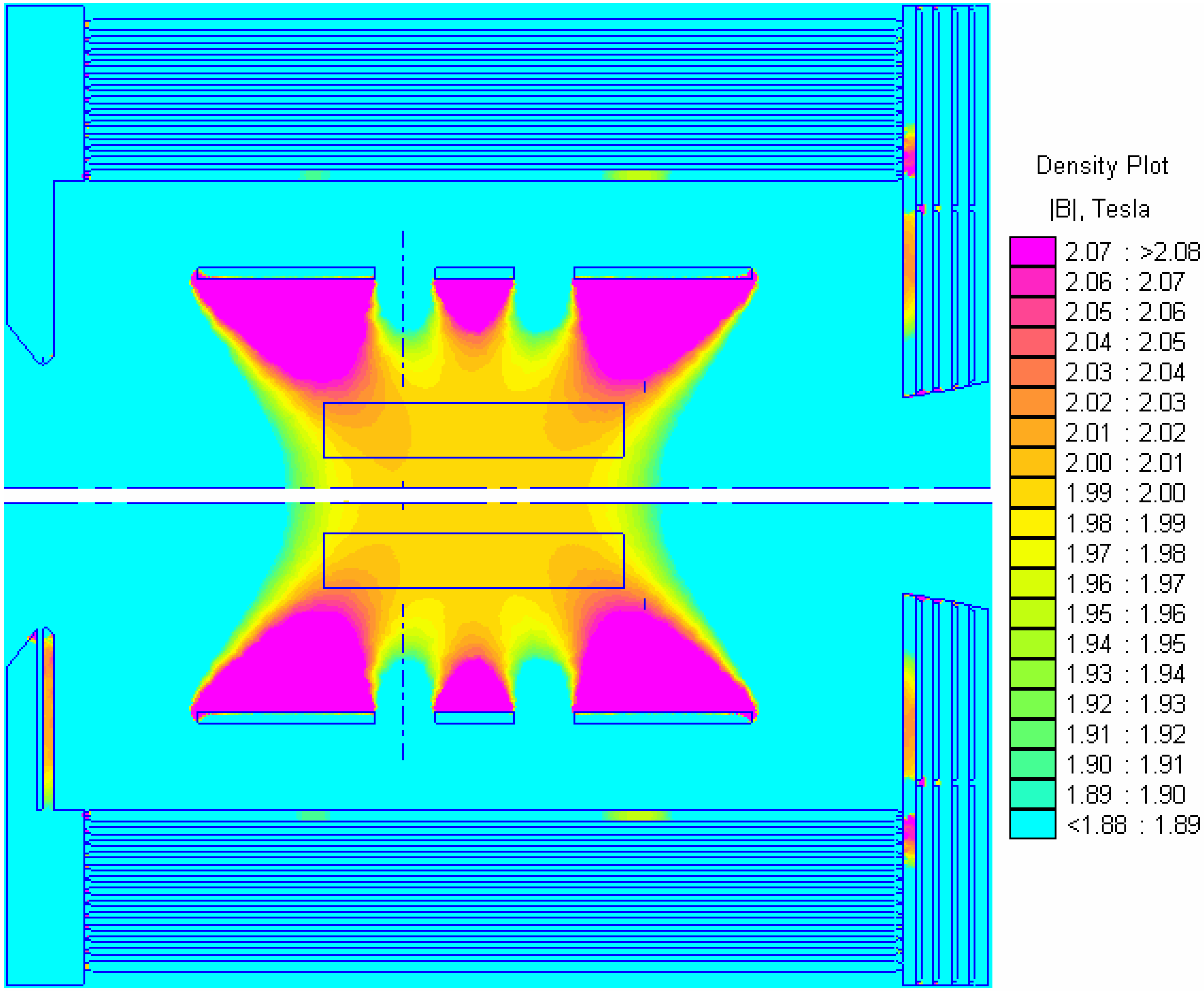
The integral of the radial field along trajectories between z = 306 cm and z = 338 cm (maximum range of Forward Trackers) is less than 0.004 T*m (0.2 % of nominal dipole integral).

Deviation of 1 GeV/c trajectories from straight line in this region is 0.1 mm at most.

trajectories in x-y (from IP up to z=895cm, θ=1mrad)

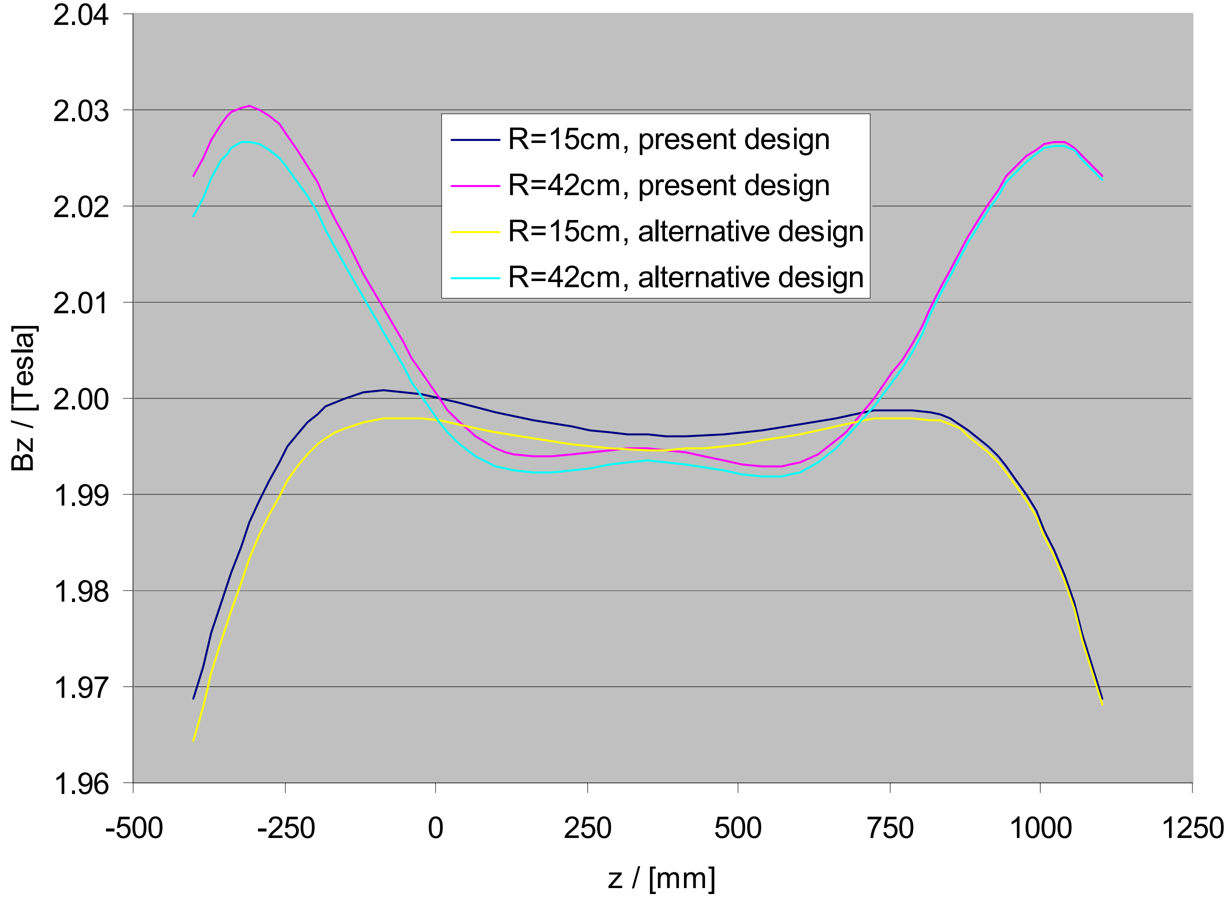


Saturation and Forces in the Solenoid

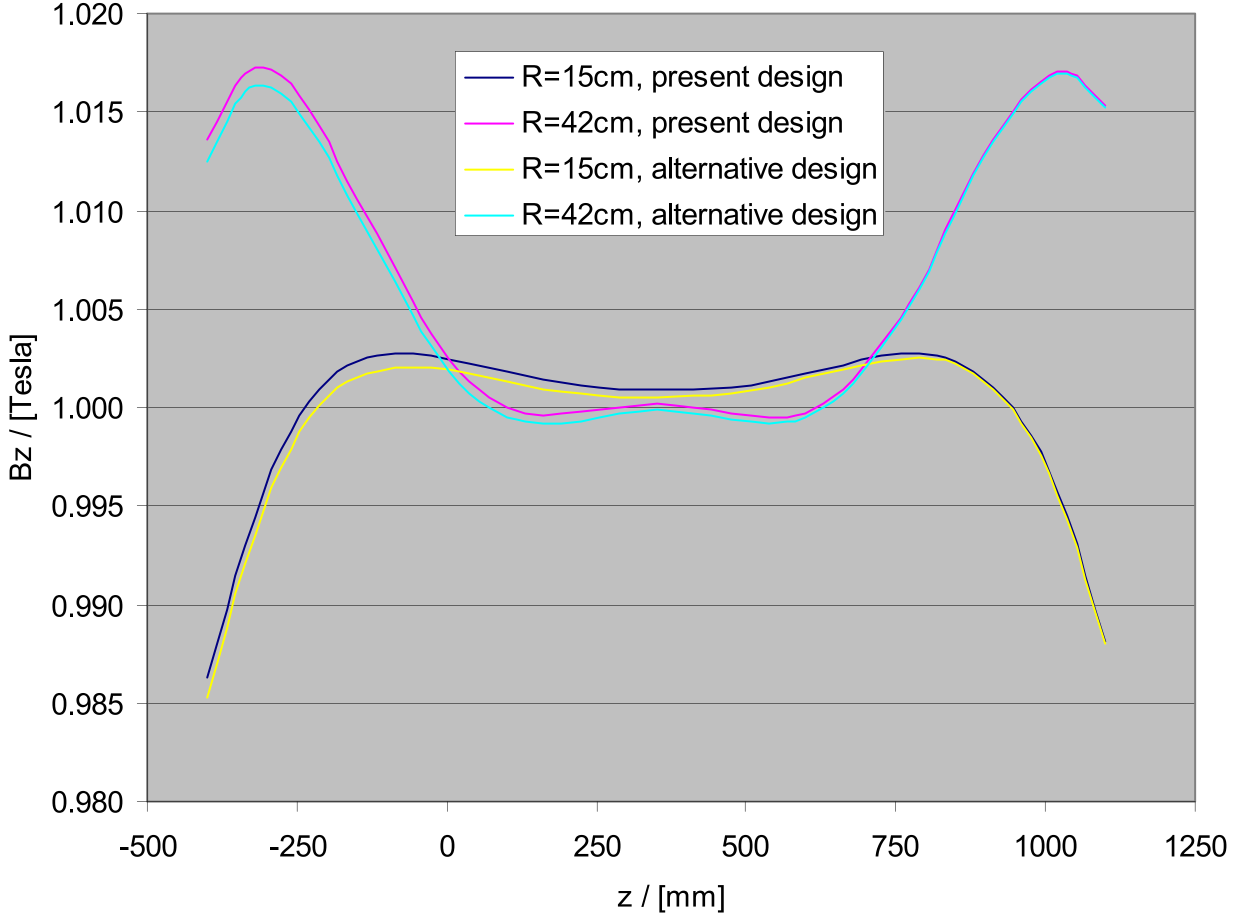


Magnetic flux density at full current
Upper half: present design
Lower half: alternative design with intentional gap in the upstream end-cap.

Field in Central Tracker Area at Full Current



Field in Central Tracker Area at Half the Nominal Current



Axial Force vs. Current