Some Additional Calculations for the PANDA Magnets

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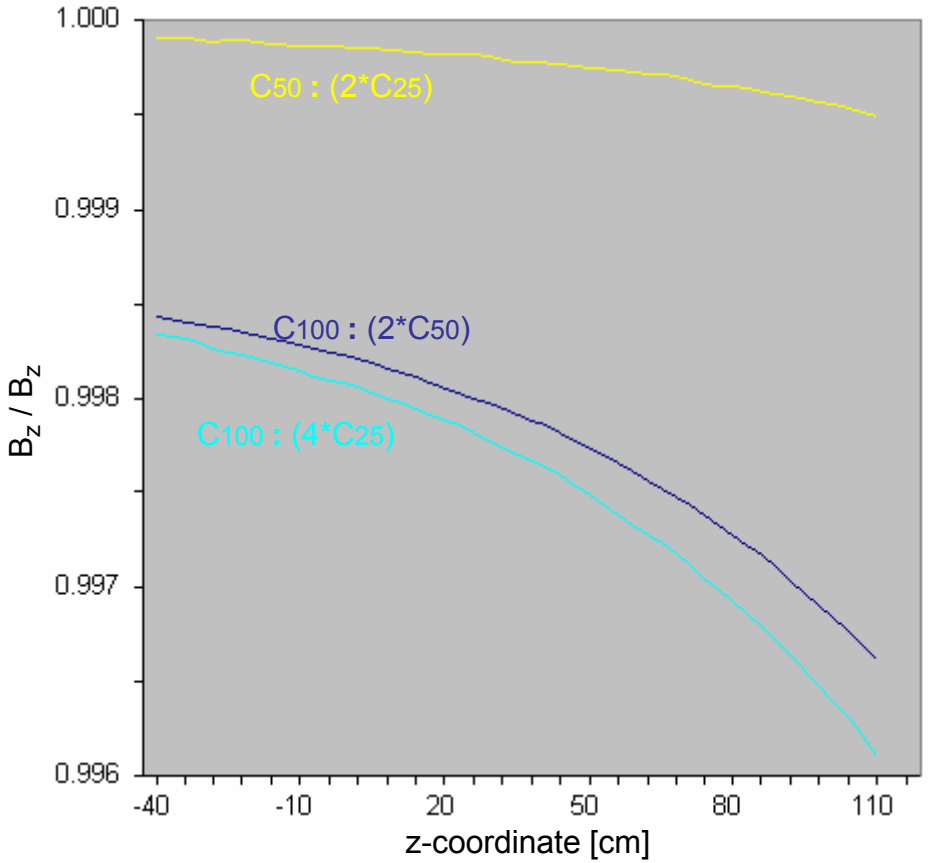
- Effect of Yoke Saturation on Central-Tracker Area
- Dipole Field-Clamp Update
- Radial Field Asymmetry in the Downstream Door of the TS
- Trajectories in the Region of the Forward Trackers FT1 & FT2

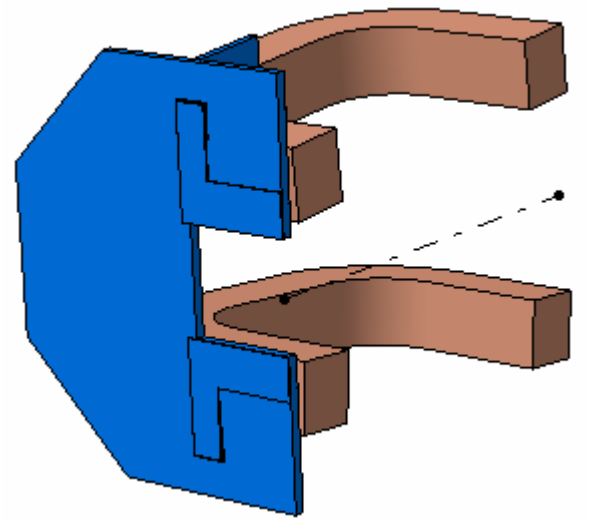
Effect of Yoke Saturation on Central-Tracker Area



Normalized ratios of axial fields at radius 15 cm for different solenoid currents, labels C100 (full nominal current), C50 (50% nominal current), C25 (25% nominal current)

The lower ratios at the downstream end of the Central Tracker (z=110cm) indicate that the saturation of the downstream door of the iron yoke is bigger than the saturation of the upstream door.

Dipole Field-Clamp Update



Half of Dipole field-clamp (blue color), fixed to the yoke (which is not shown)

Purpose of field-clamp: reduction of magnetic force on Muon Filter, reduction of stray field for Forward Trackers

Full dimensions: width ±1.9m, height ±1.2m, thickness 60mm

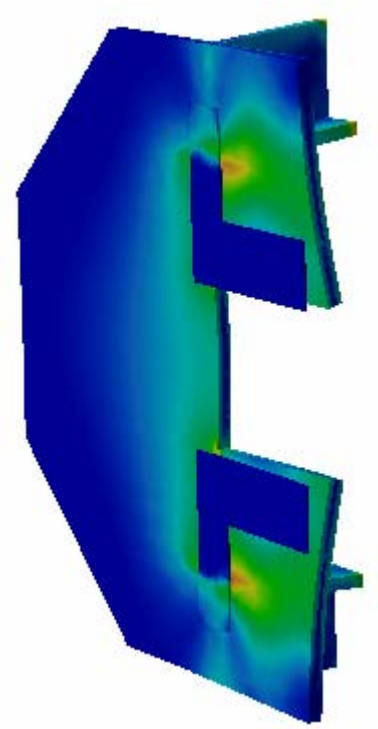
Aperture: width ±0.64m, height ±0.32m

Extension in beam direction 3.40m<z<3.46m

Total weight 3.5 tons

Total magnetic force at full current ~90kN (~9 t).

Force left on Muon Filter < 1kN



Magnetic force acts mainly at the aperture. There the deflections go up to 0.5mm in z-direction (if no direct mechanical connection to the coils is provided).

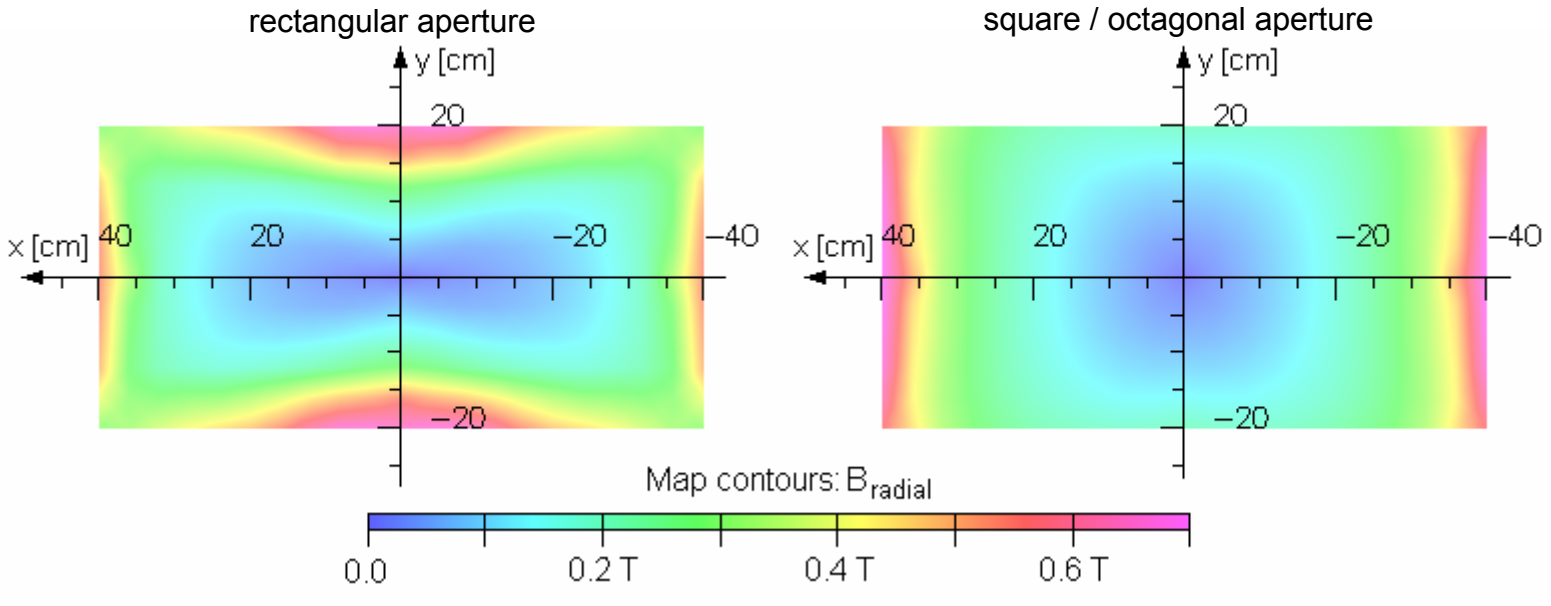
Stresses (indicated by colors) are far below the material strength.

The L-shaped parts in front of the field-clamp are supposed to be some kind of attachments for detectors, made of non-magnetic steel. When fixed to the field-clamp at the position where the field clamp is fixed to the yoke, there is hardly any deflection of the attachments at full current ($\Delta z<0.1$mm) .

Radial Field Asymmetry in the Downstream Door of the Target Spectrometer

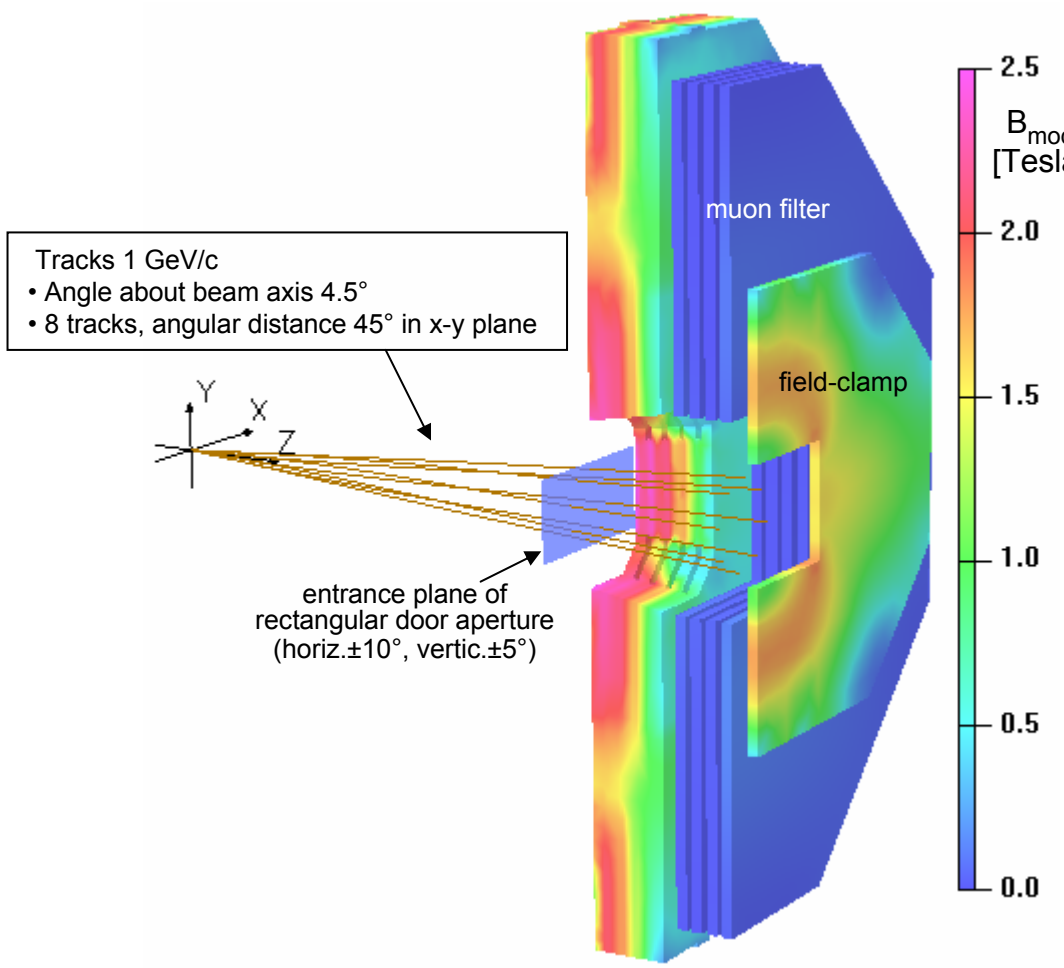
The aperture of the Downstream Door of the Target Spectrometer is assumed to be rectangular (angles ±10° horizontally, ±5° vertically).

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). So 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

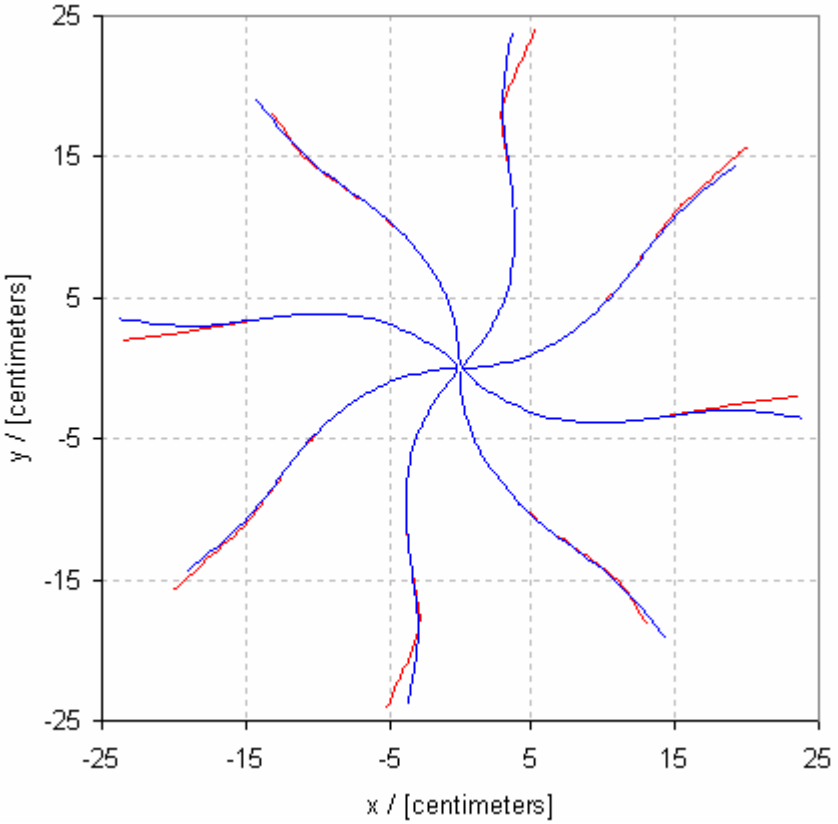


The aperture of the DS-door shown above is assumed to be octagonal. The original rectangular aperture is indicated by a blue plane (the red color in the DS-door, by the way, indicates regions of high iron saturation).

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

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

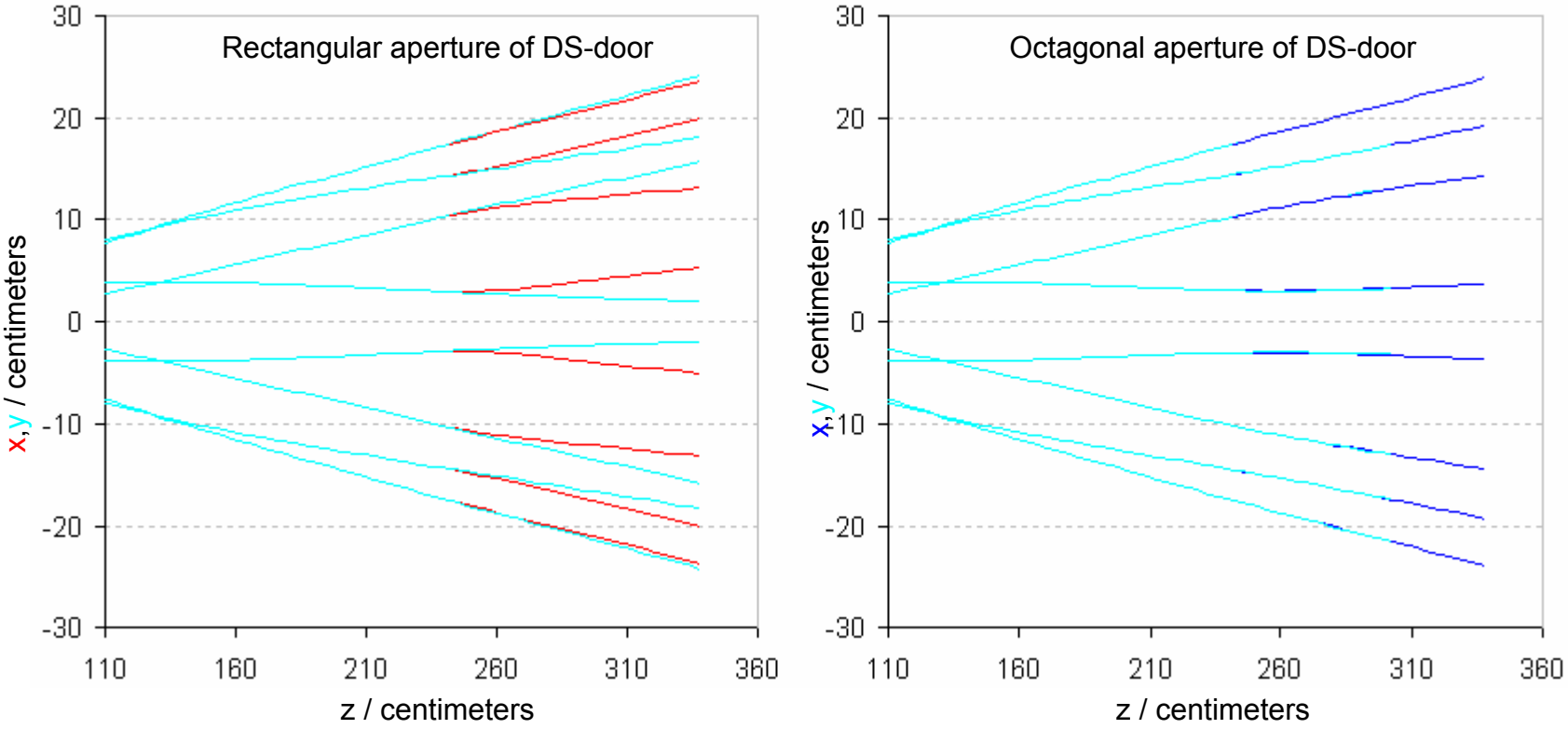
reference s. previous page, solenoid and dipole both at 100% nominal current



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.