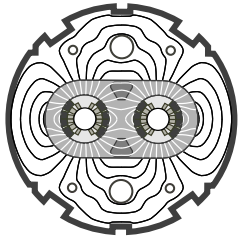
Available Aperture in Triplets IP1 and IP5

for optics version 6.500, updated aperture files

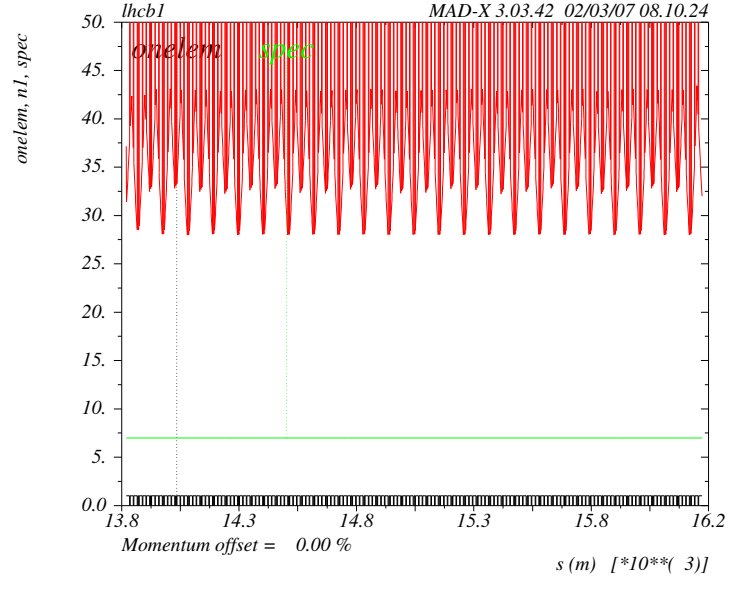
Th. Weiler, R. Assmann, C. Bracco, V. Previtali, S. Redaelli

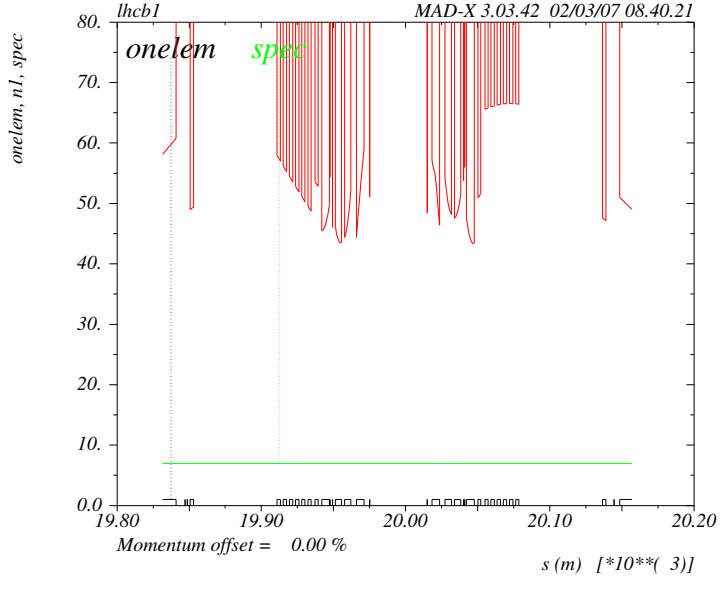
Accelerator and Beam Department, CERN



Motivation

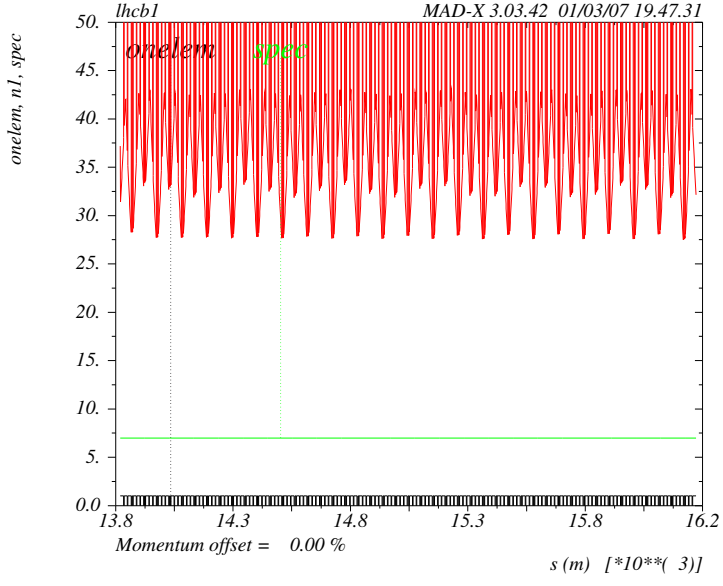
At injection and during most of the squeezing steps the aperture bottle-neck is in the arc ($\approx 27.79\sigma$), but at the end of the squeeze the triplets in the high luminosity insertion will become the aperture bottle-neck. Therefore the tertiary collimators have to be in place to limit the aperture in the triplets.

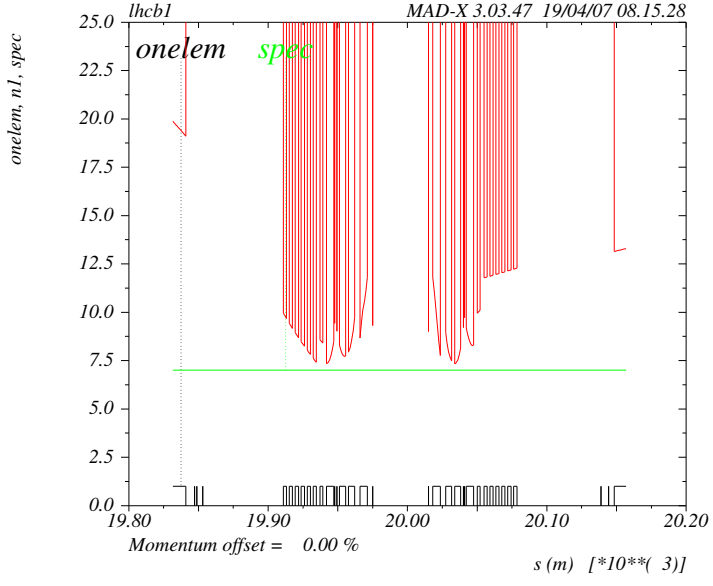




Motivation

At injection and during most of the squeezing steps the aperture bottle-neck is in the arc ($\approx 27.79\sigma$), but at the end of the squeeze the triplets in the high luminosity insertion will become the aperture bottle-neck. Therefore the tertiary collimators have to be in place to limit the aperture in the triplets.





Calculating the Available Aperture

used input:

- LHC optics V6.500
- aperture information provided

  `/afs/cern.ch/eng/lhc/optics/V6.501/aperture`

- $dp = 0.86 \cdot 10^{-3}$ (for top energy)
- radial closed orbit 3 mm

MADX command:

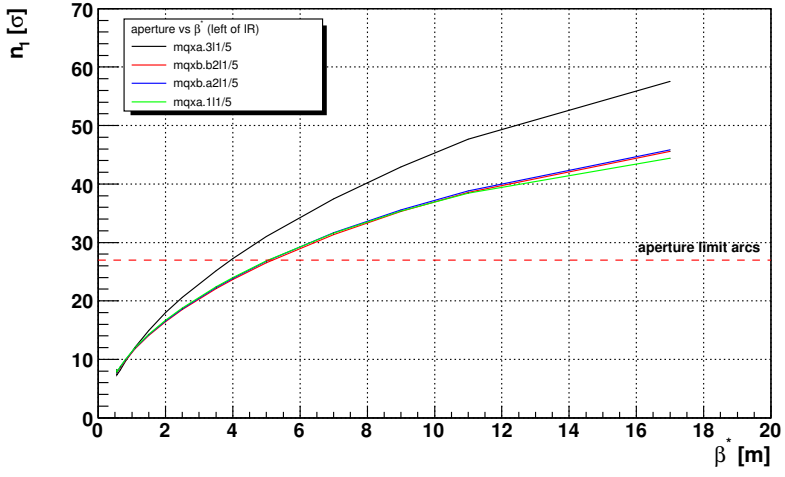
```
aperture, range=MBRC.4L1.B1/MBRC.4R1.B1,
 cor=0.003, spec=7,interval=1.0, dp=0.00086,
 file="apert_tripletIP1_b1_V6.5.data";
```

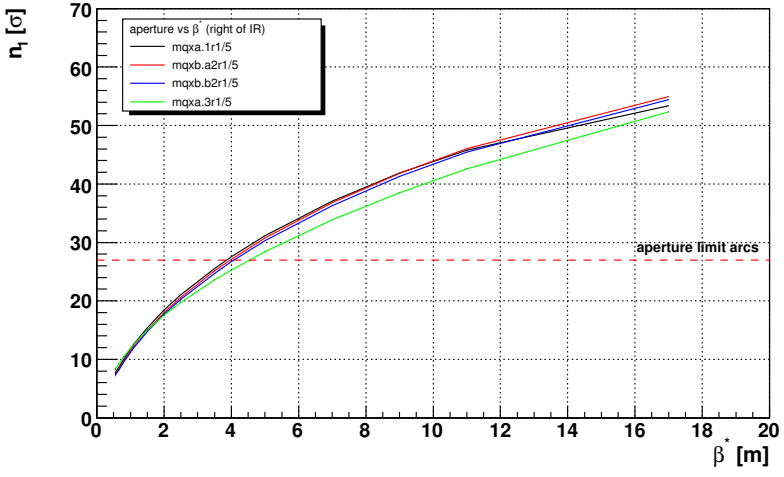
Collision Optics (IR1)

left of IR

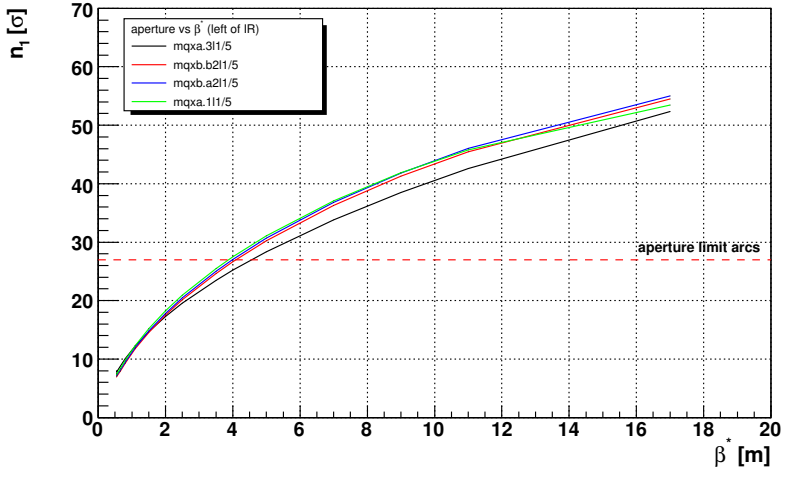
right of IR

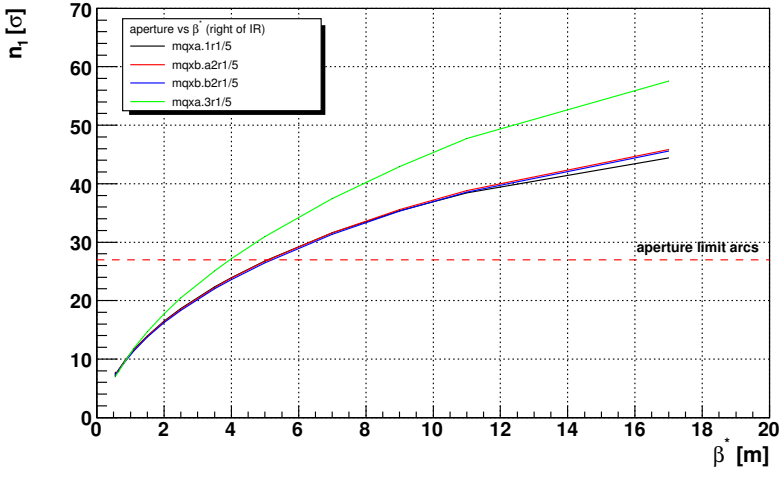
beam 1





beam 2





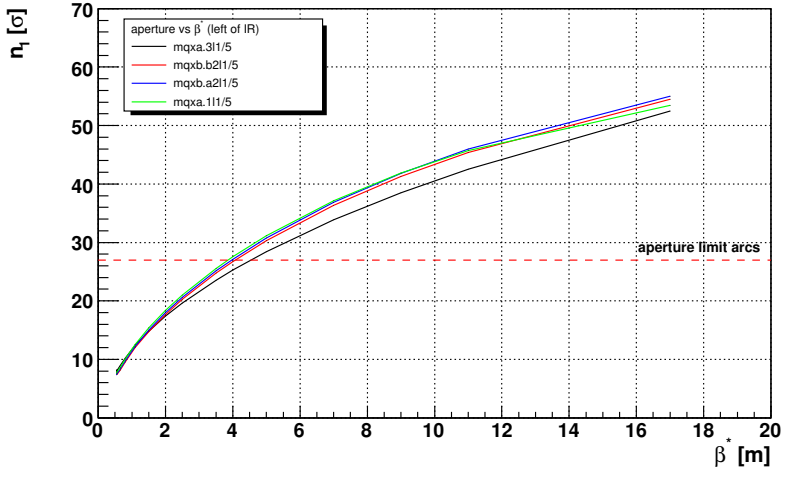
min. apeture: beam 1 $n_1 = 7.34\sigma$, beam 2 $n_1 = 7.04\sigma$

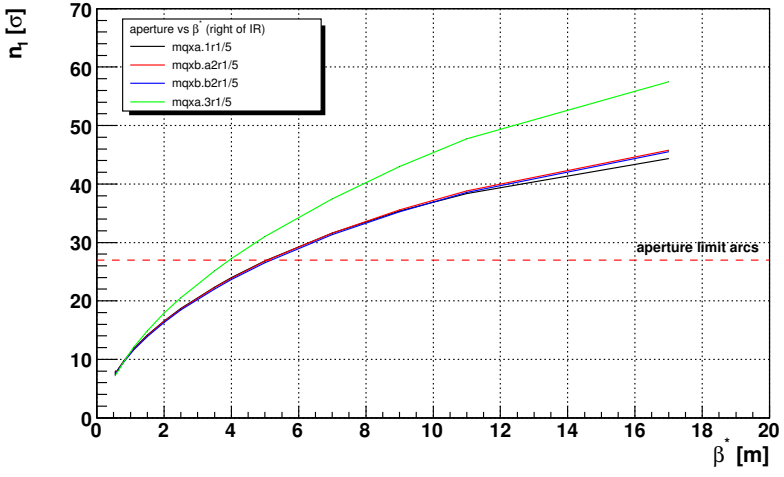
Collision Optics (IR5)

left of IR

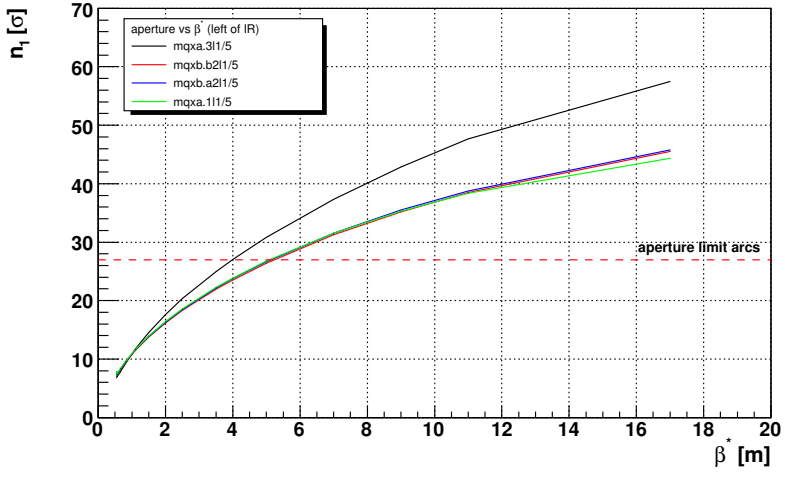
right of IR

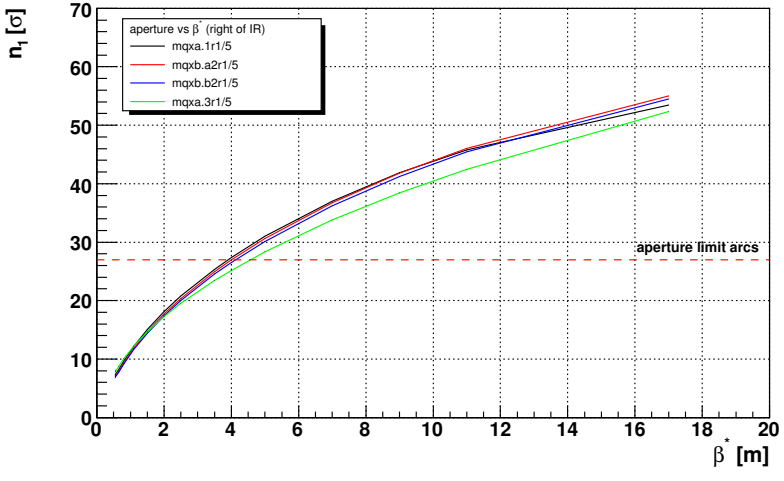
beam 1





beam 2





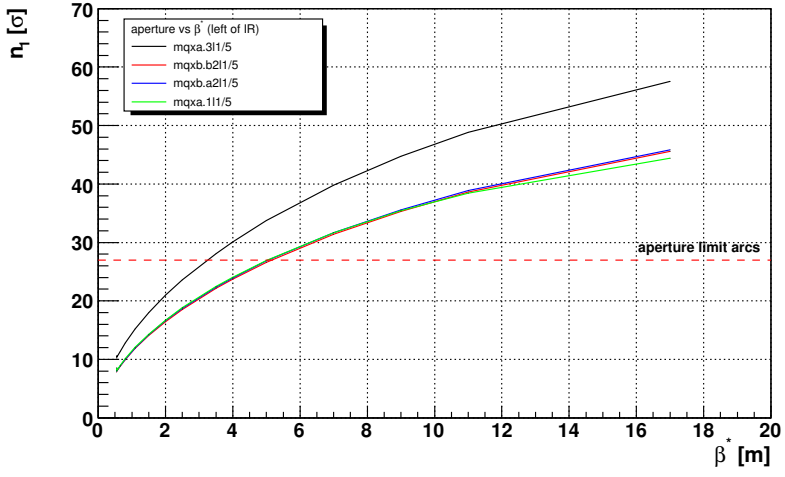
min. apeture: beam 1 $n_1 = 7.35\sigma$, beam 2 $n_1 = 6.93\sigma$

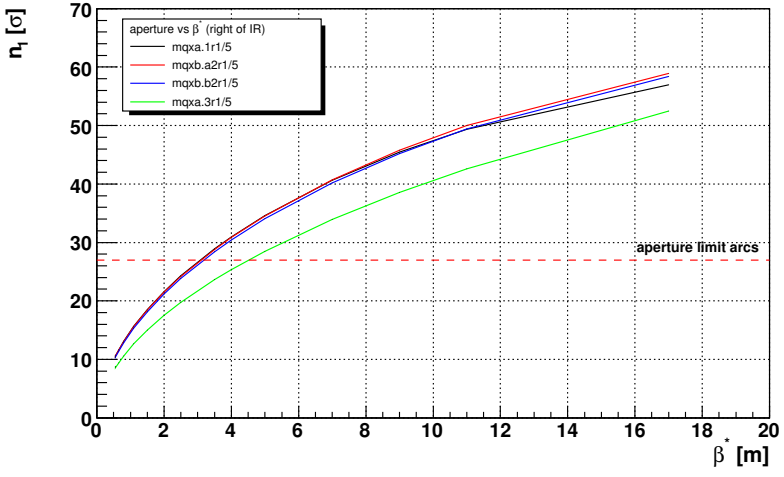
Flat Optics (IR1)

left of IR

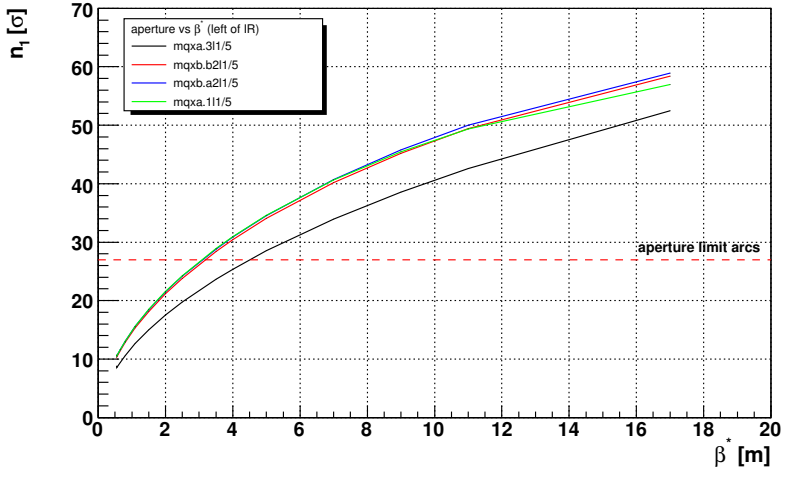
right of IR

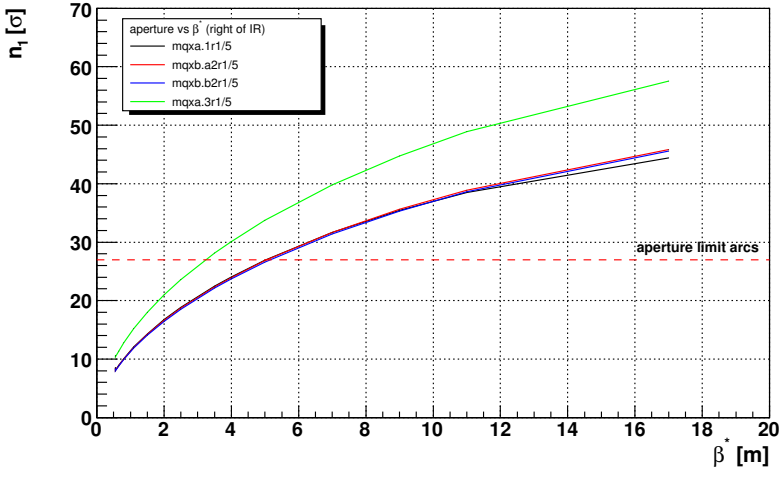
beam 1





beam 2





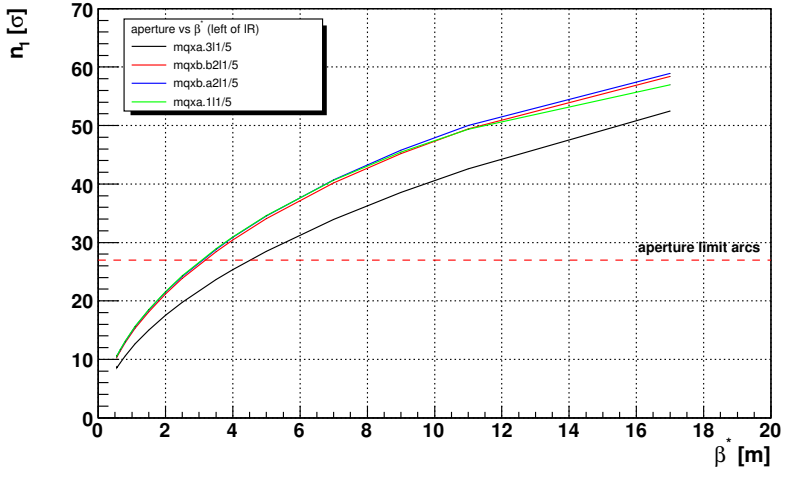
min. apeture: beam 1 $n_1 = 7.98\sigma$, beam 2 $n_1 = 7.98\sigma$

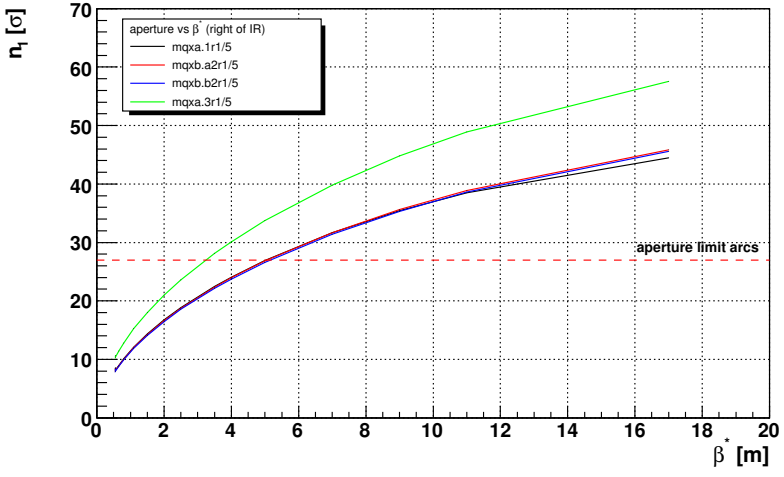
Flat Optics (IR5)

left of IR

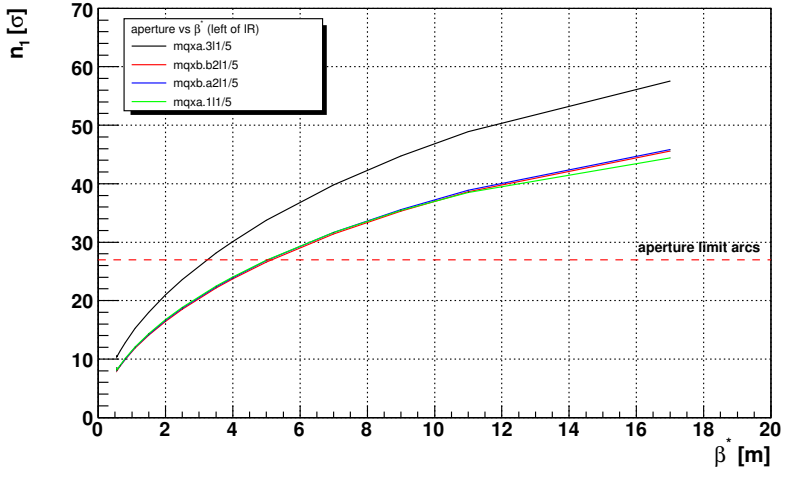
right of IR

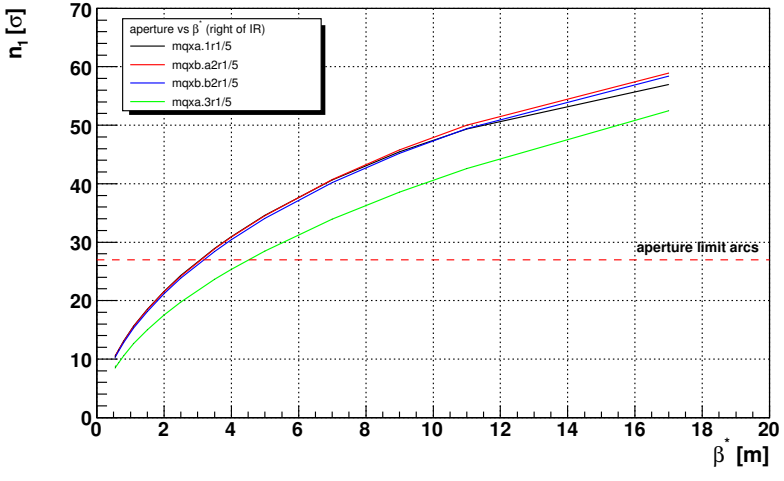
beam 1





beam 2





min. apeture: beam 1 $n_1 = 7.99\sigma$, beam 2 $n_1 = 7.99\sigma$

Summary

- flat optics
  - minimal $n_1 = 7.98\sigma$ in IP1 (beam 1 and beam 2)
  - start closing tertiary collimators at $\beta^* \approx 5\,\mathrm{m}$
- collision optics
  - minimal $n_1 = 6.92\sigma$ in IP5 (beam 2)
  - start closing tertiary collimators at $\beta^* \approx 5\,\mathrm{m}$
- difference between two beams: since layout around insertion is symmetric the available minimal optics should be the same for both beams. Difference in β-function are in the $O(\,\mathrm{cm})$ and for the orbit $O(\,\mu\mathrm{m})$ cannot explain $0.3 - 0.5\sigma$