New ALICE Beam Pipe: Injection Protection

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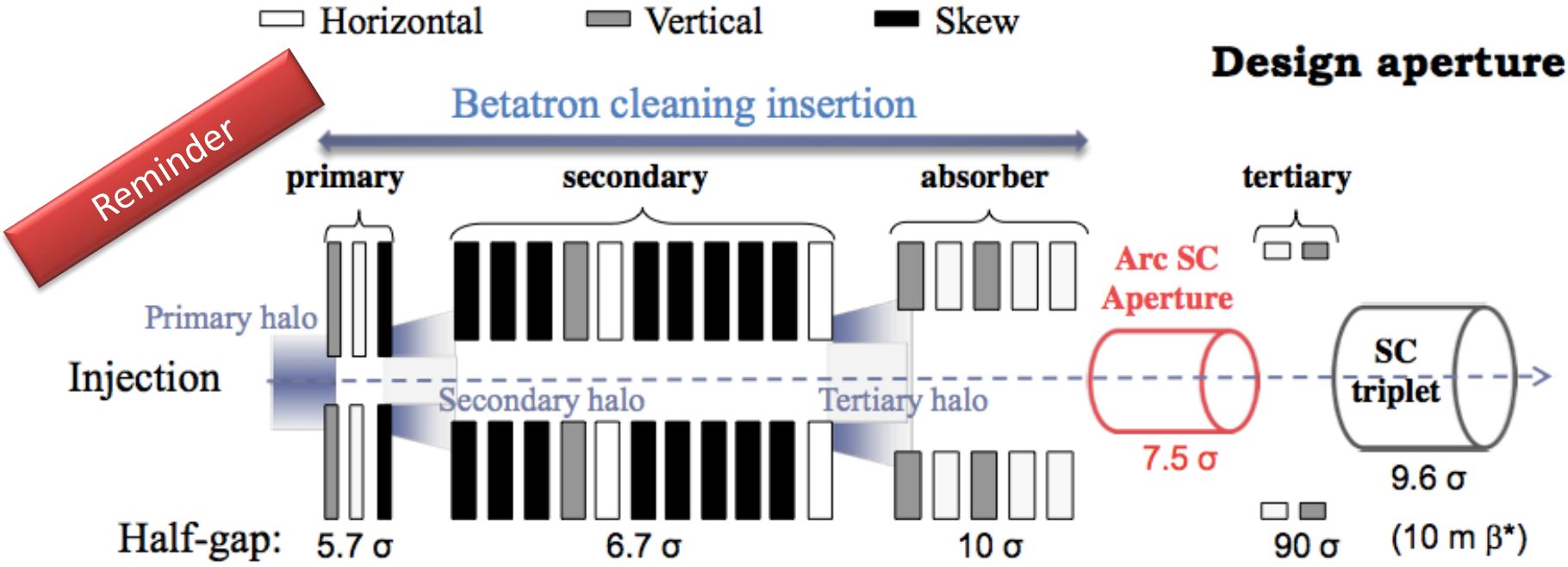
Acknowledgment: M. Giovannozzi

Outlines

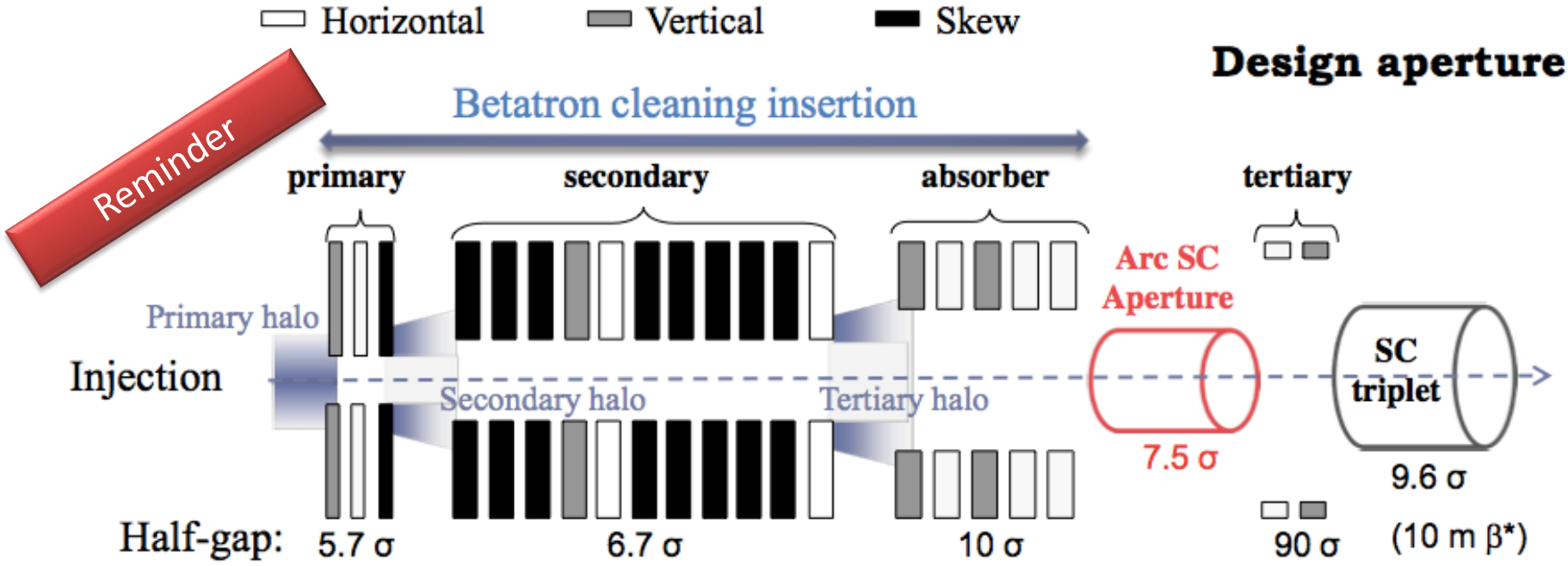
- Reminder
- Assumptions
- Aperture and beam envelope:
  - Nominal injection
  - Grazing event (MKI failure)
  - Mis-injection
- Conclusions

Collimation Hierarchy at Injection



- The protection elements must always be set to an aperture $\mathbf{a_{prot} < n_1}$.
- For secondary collimators the condition $\mathbf{a_{sec} < a_{prot}}$ must always be satisfied.
- The primary collimators must be the closest element to the beam and $\mathbf{a_{prim} < a_{sec}}$ has to be valid. Primary collimators do not have to intercept the beam core (3 σ)!!

Collimation Hierarchy at Injection



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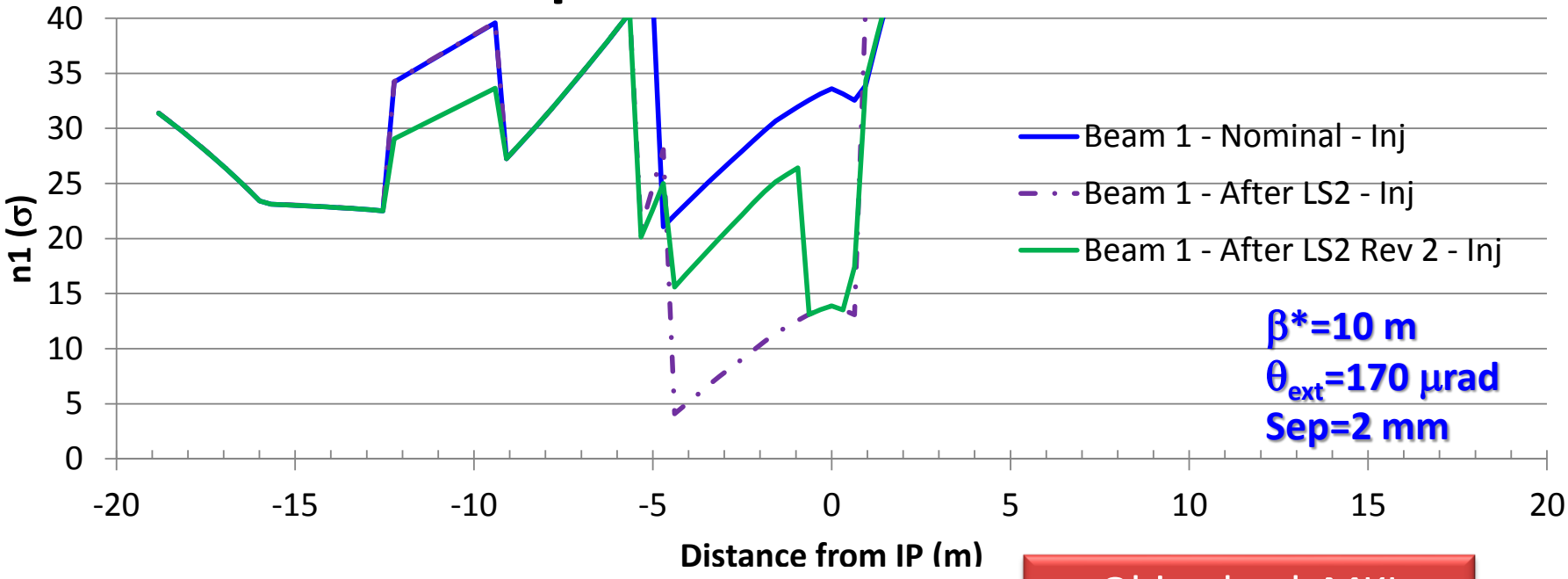
- For secondary collimators the condition satisfied.
- The primary collimators must be the cl $a_{prim} < a_{sec}$ has to be valid. Primary collin the beam core (3 σ)!!

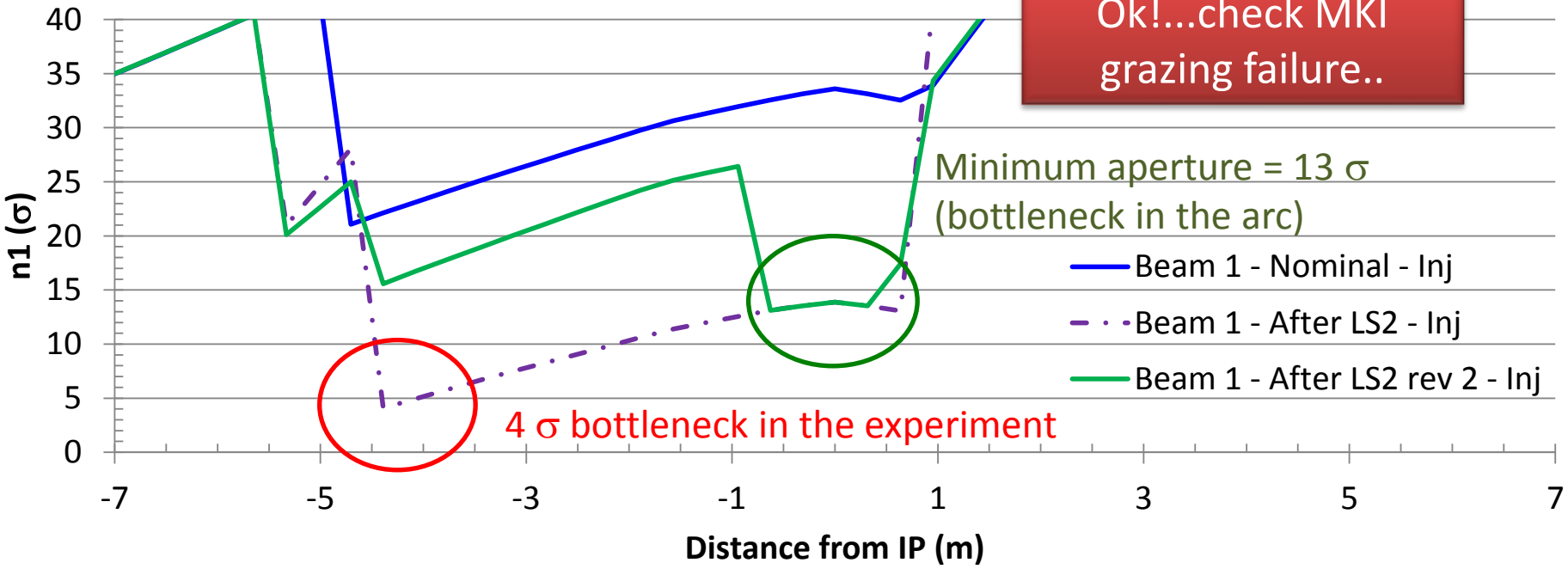
To protect the LHC aperture at injection (bottleneck in the arc) and respect the collimation hierarchy:

- LHC injection protection collimators (TDI, TCLIA and TCLIB) ar at 6.8 σ
- TCDI (in the TL) are at 4.5 – 5 σ

M. Giovannozzi

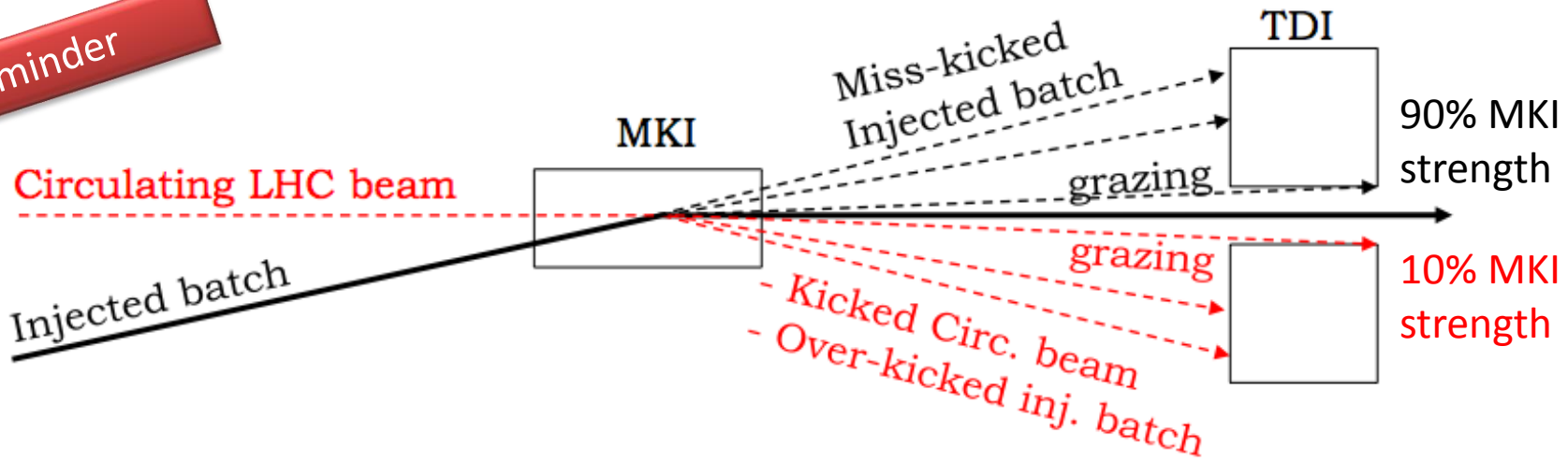
Alice aperture: results - I





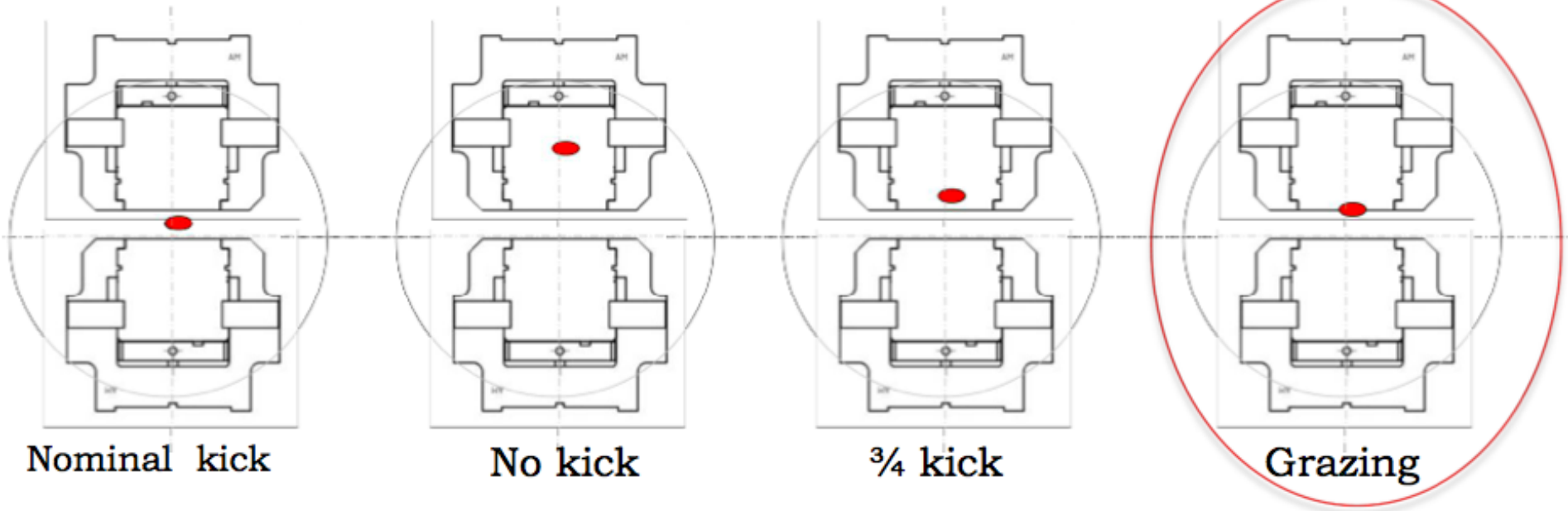
MKI Failures

Reminder



Most critical

Injected beam:



Assumptions

- Normalised emittance of 3.5 mm mrad also for postLS2 case
- Optics for protons (minimum n1):β^* = 10 m,
  crossing angle = 170 μrad , separation =2 mm
- Beam envelope: 6.8 σ_β (what can go through TCDIs and TDI) + 20% beta-beating
- Aperture: Mech.aperture* – Mech.tol.* – Orbit** – Disp.offset***

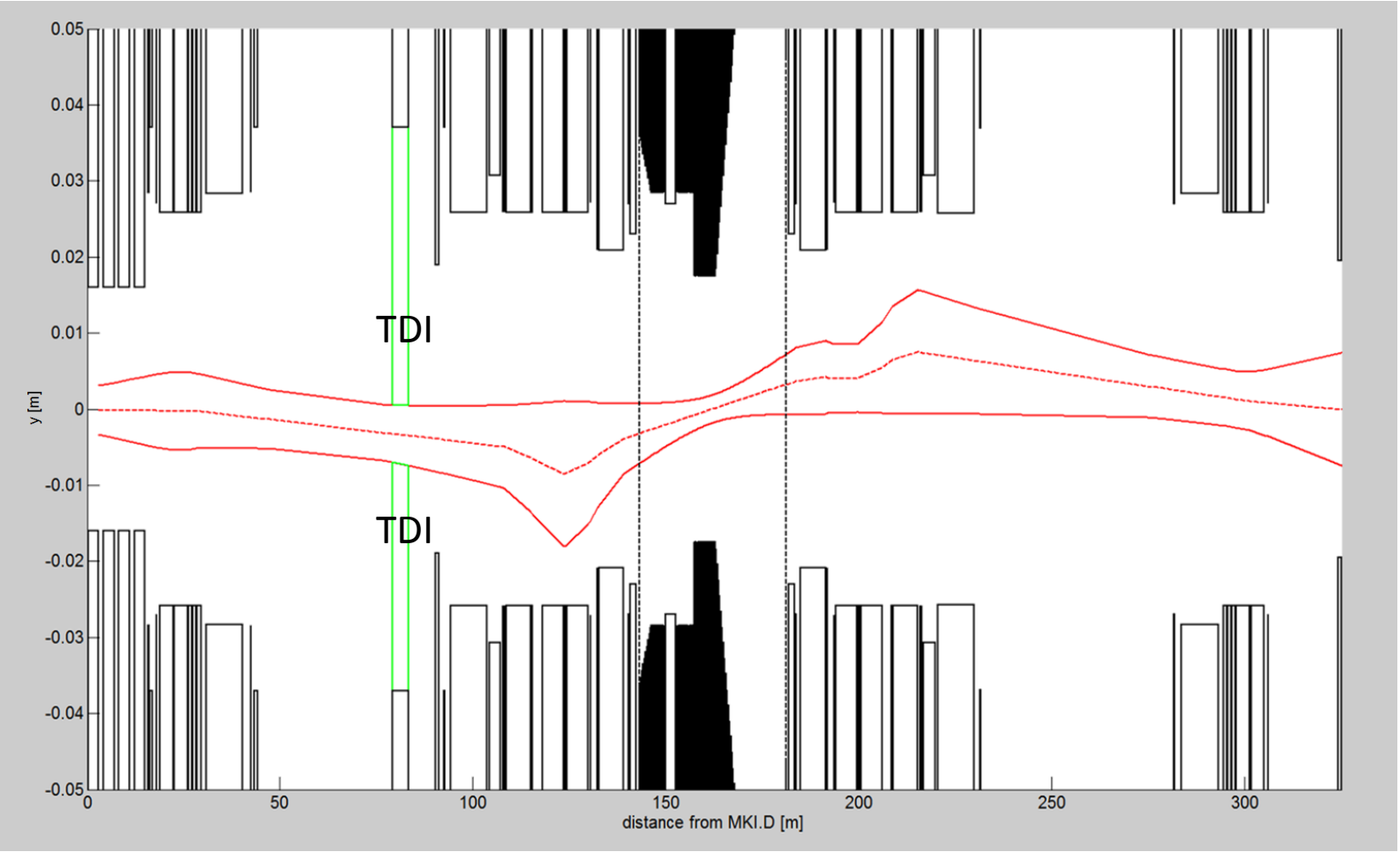
* Data from ALICE and Massimo

** 4 mm *sqrt(β/max(β))

*** Dy*3e-4

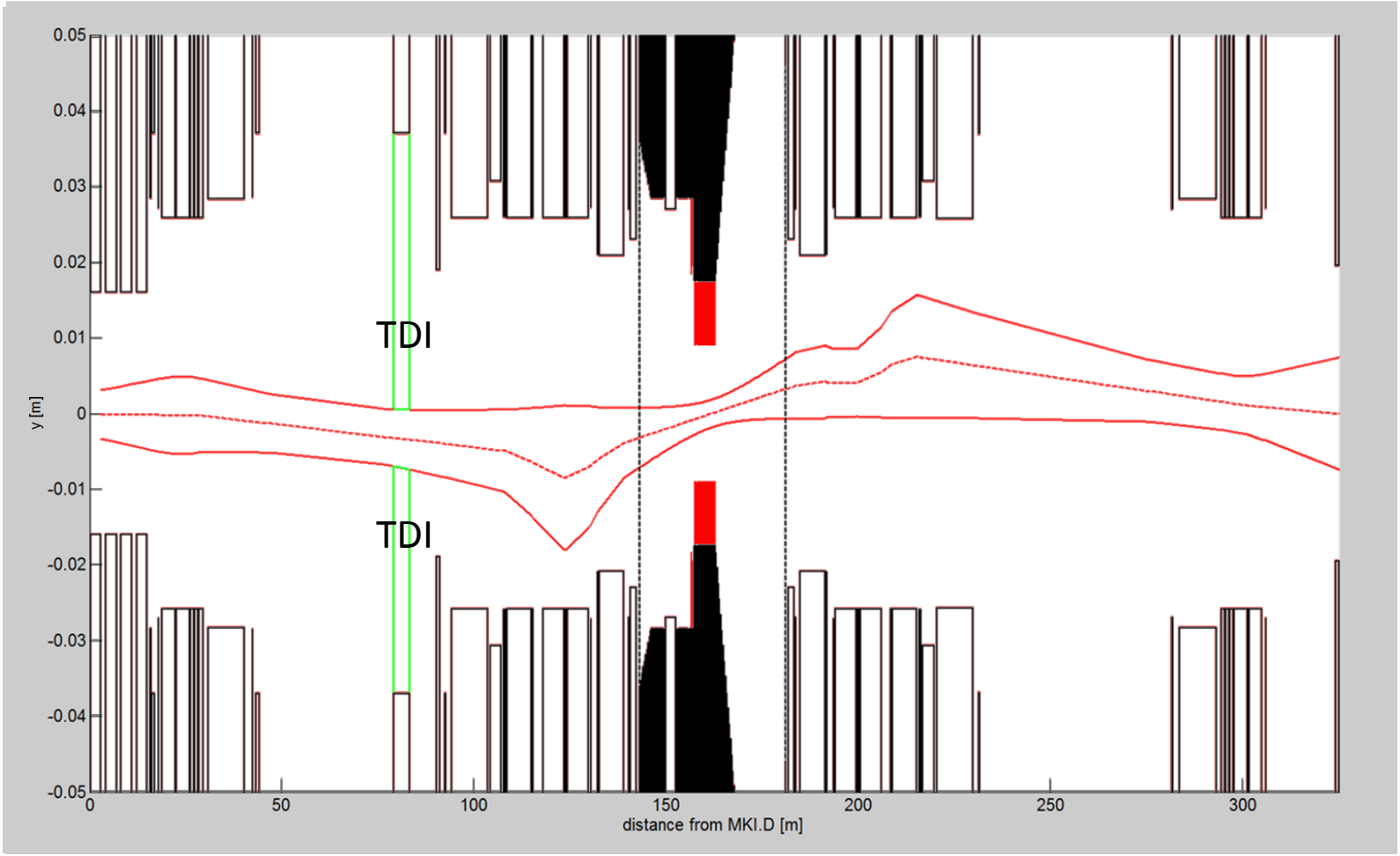
Aperture and Beam Envelope PreLS2

Nominal kick

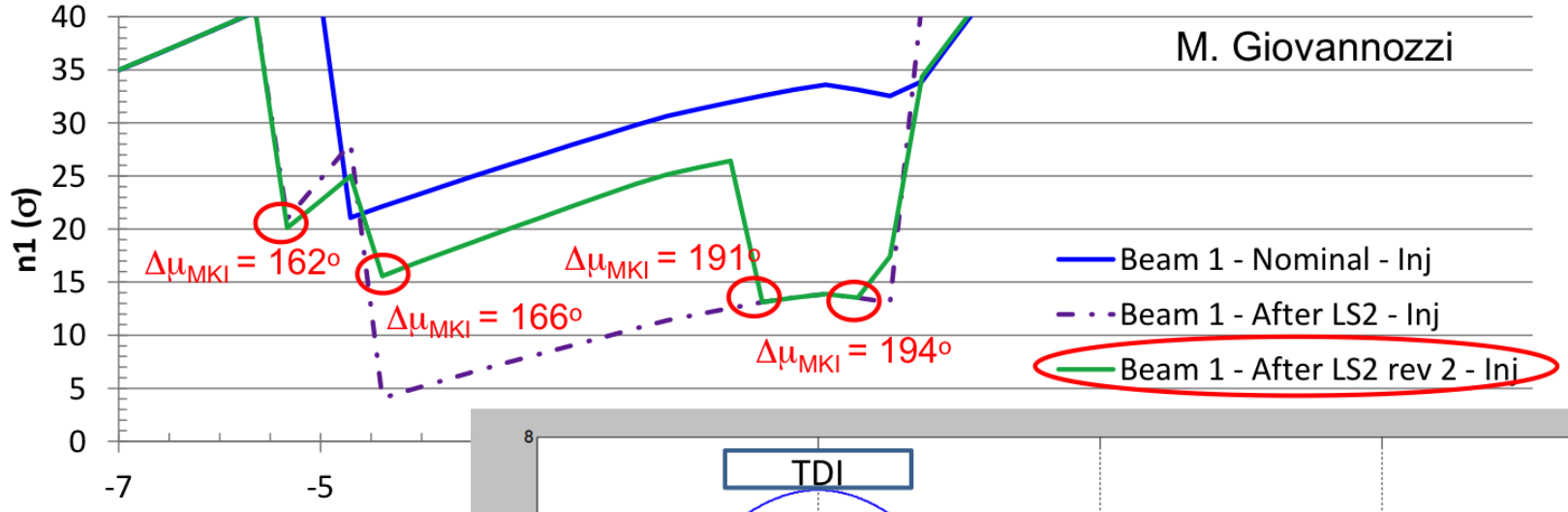


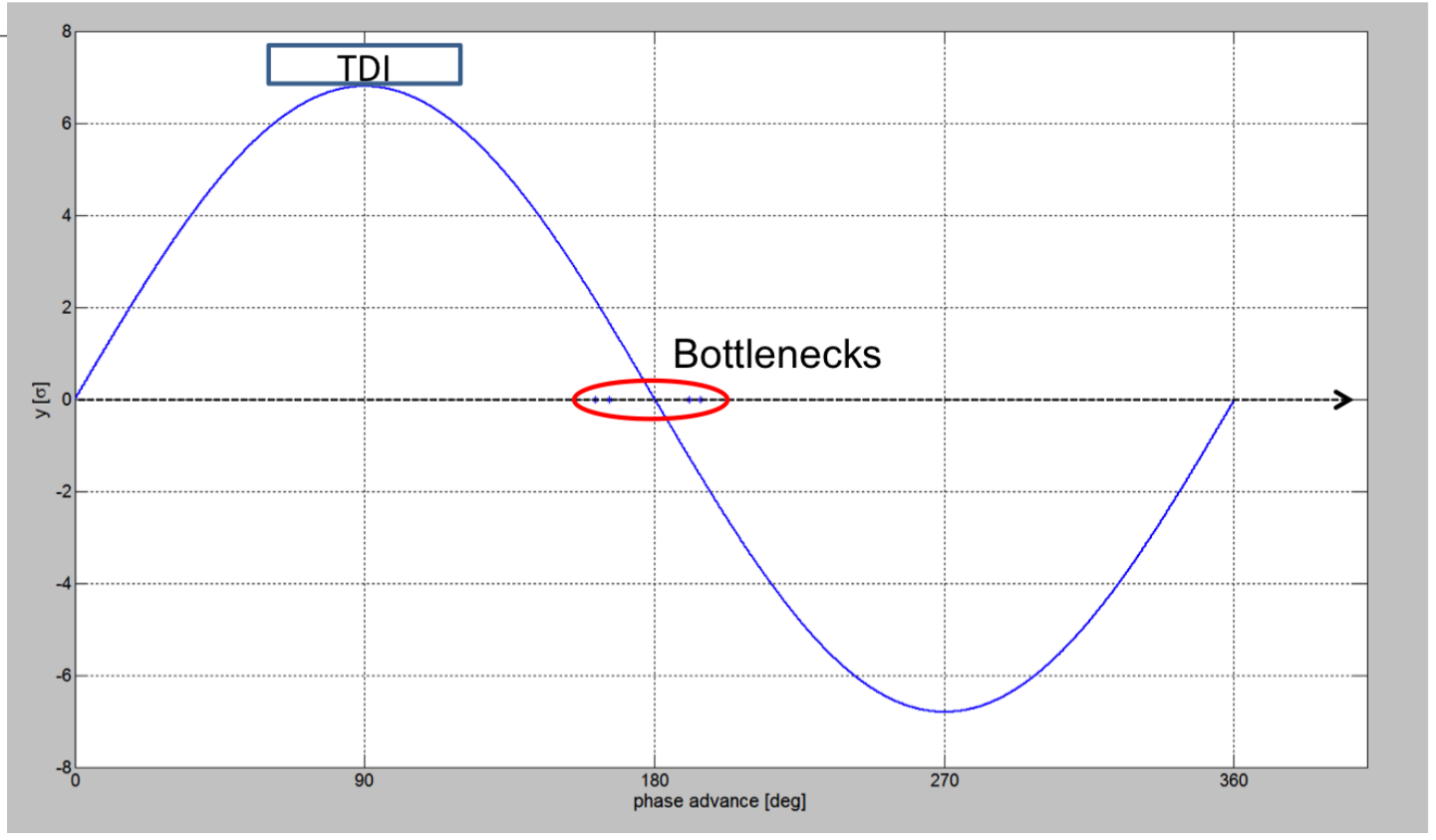
Aperture and Beam Envelope PostLS2

Nominal kick

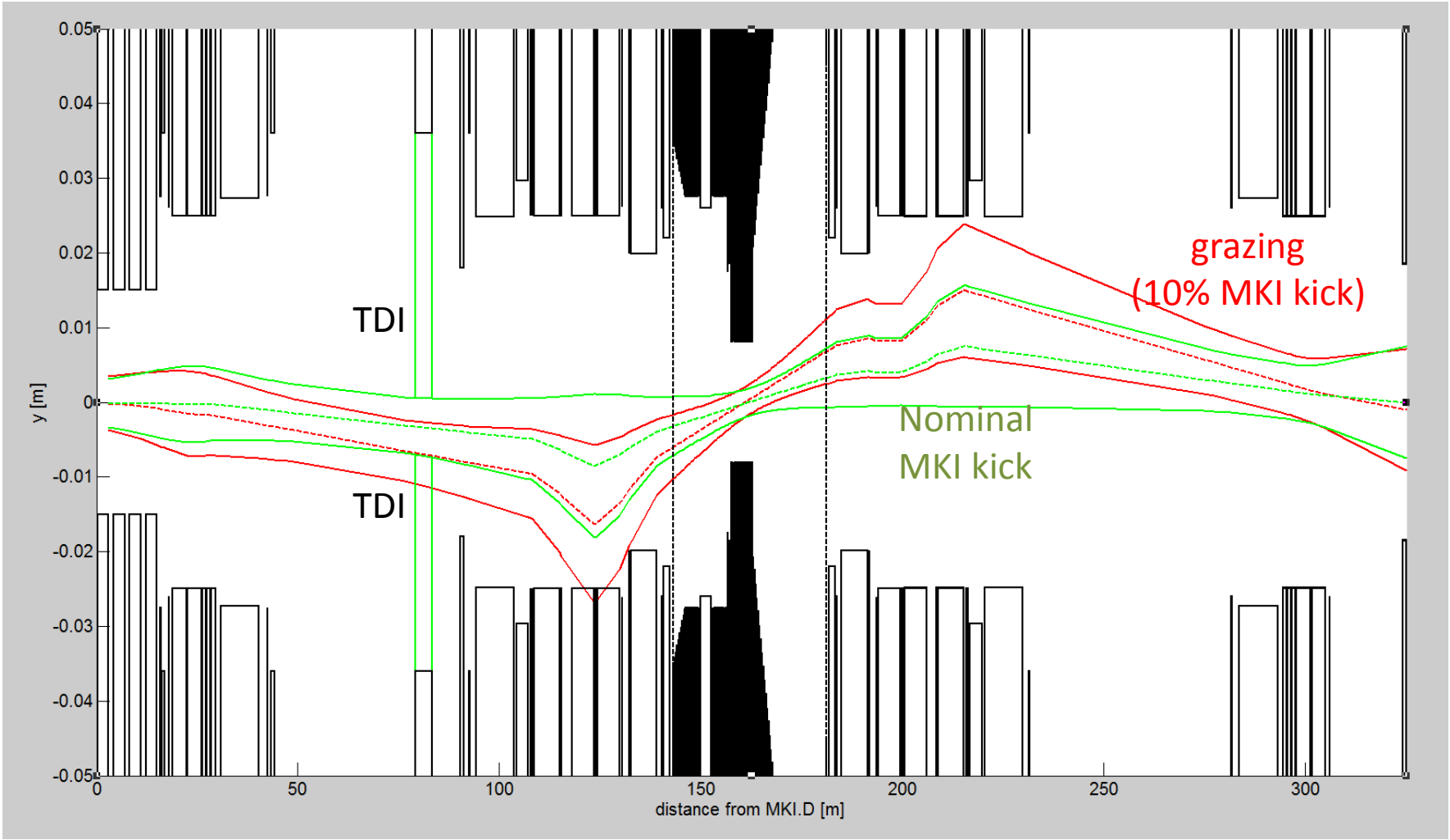


Phase Advance Min. Aperture- MKI

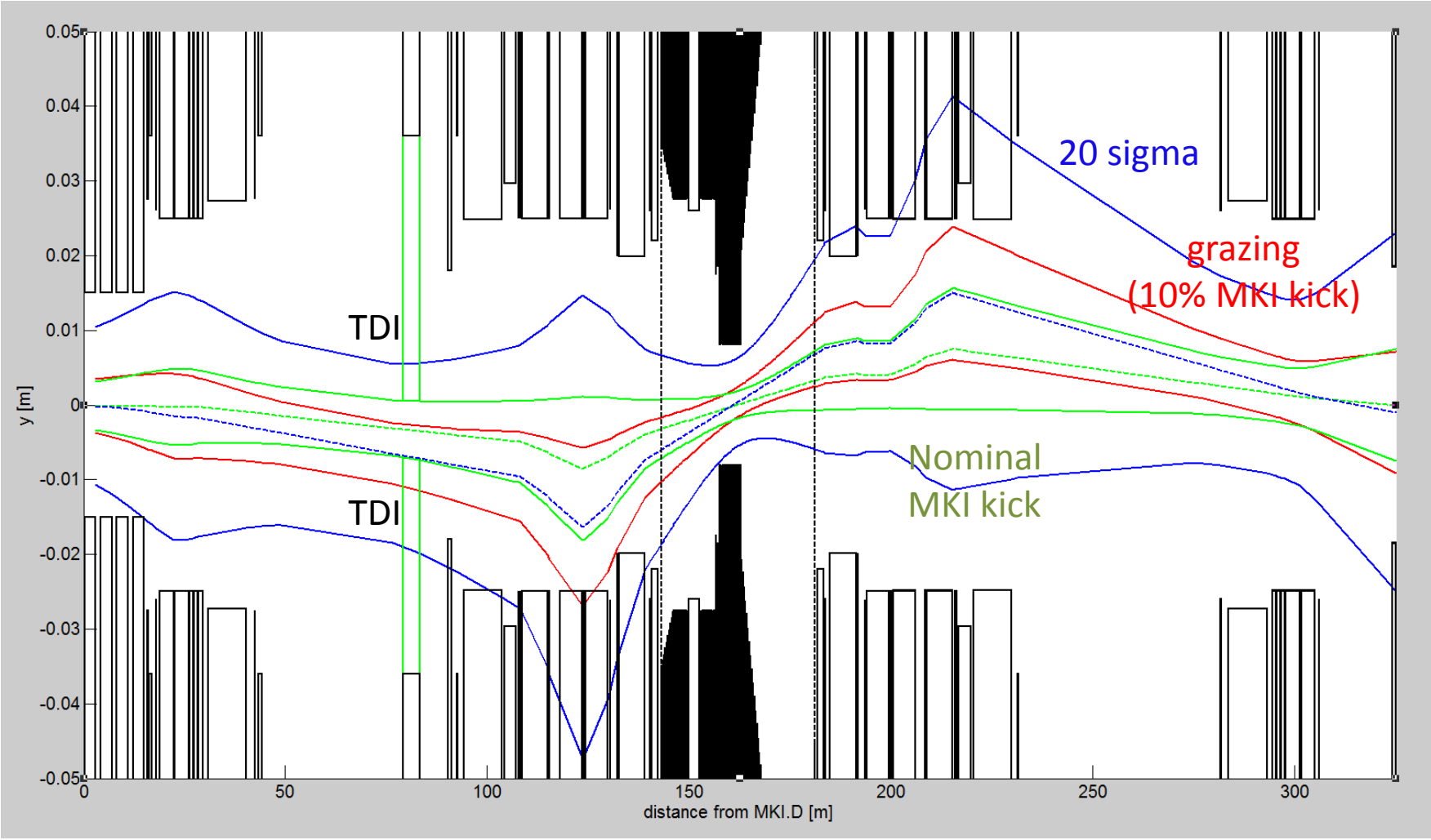




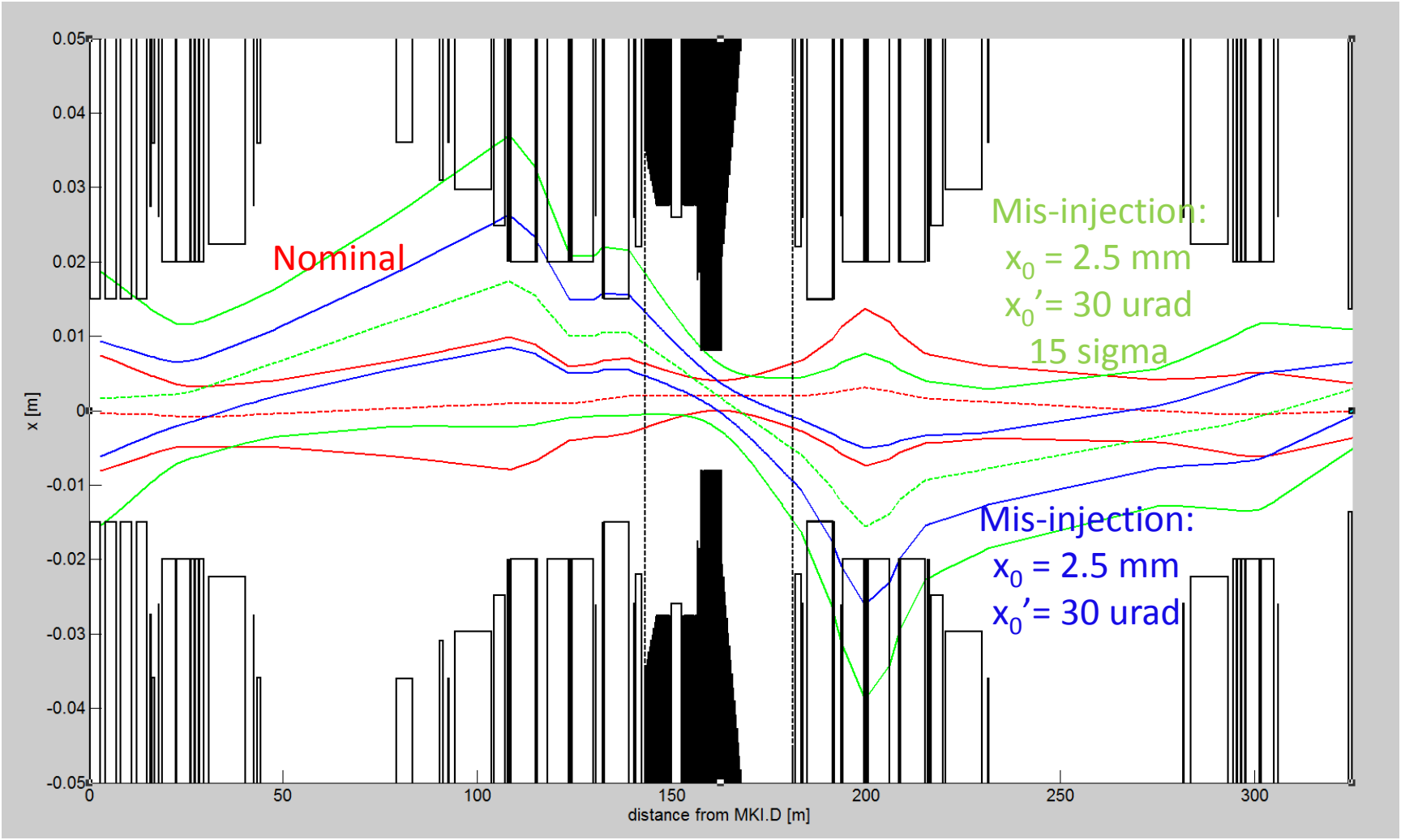
Grazing Event (Vertical)



Grazing Event (Vertical)



Mis-injection (Horizontal)



Conclusions

- The new proposed aperture fulfills the n1 requirements of collimation hierarchy: bottleneck kept in the arc and > 7.5 σ
- No direct beam impact on the new aperture is expected also in case of the most critical MKI failure (grazing event) or mis-injection