D0 and its integrability

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'Towards a Roadmap for the Upgrade of the LHC and GSI Complex'
IFIC, Valencia, Spain, 16-20 October 2006

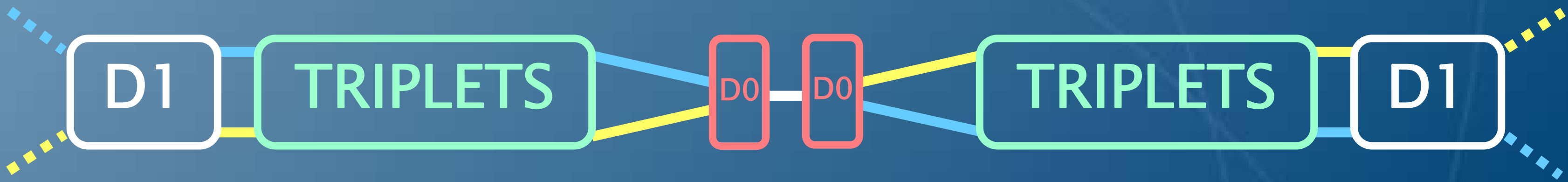
Outline

1. Introduction
2. Potential of peak luminosity increase
3. Possible implementations
   - D0's strength
   - D0's position
4. The main challenges
   - Beam-beam effect
   - Energy deposition
   - Magnet design
5. Conclusion and plans.

1- Introduction I

- The nominal $\beta^*=0.55$ m was selected for LHC since the gain in reducing it was small due the higher Xing angle
- **BUT** the lattice sextupoles and the matching sections were sized to open the possibility of $\beta^*=0.25$ m
- To cope with the Xing angle two solutions were presented
  1. to halve σ_s: new RF system & impact all around the LHC
  2. to use crab cavities: a completely new approach
- In CARE 05 was presented a new scheme:
  3. to use an early separation scheme.

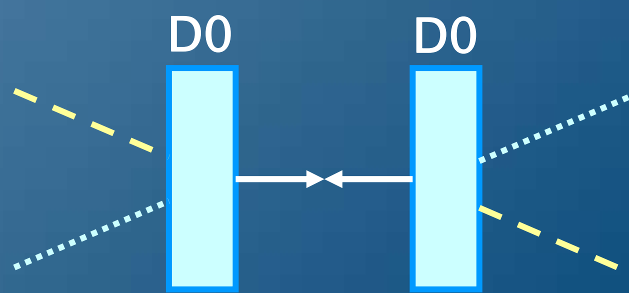
1- Introduction II



- Allow a vanishing crossing angle at the IP using a dipole on each sides of the IP: the D0
- PROS
  - simple, cheap, local change, transparent to the rest of the machine.
- CONS
  - intrusion of magnetic element in the detectors
- Two possible implementations
  - the Full Early Separation scheme (FES)
  - the Partial Early Separation scheme (PES).

1- Introduction III

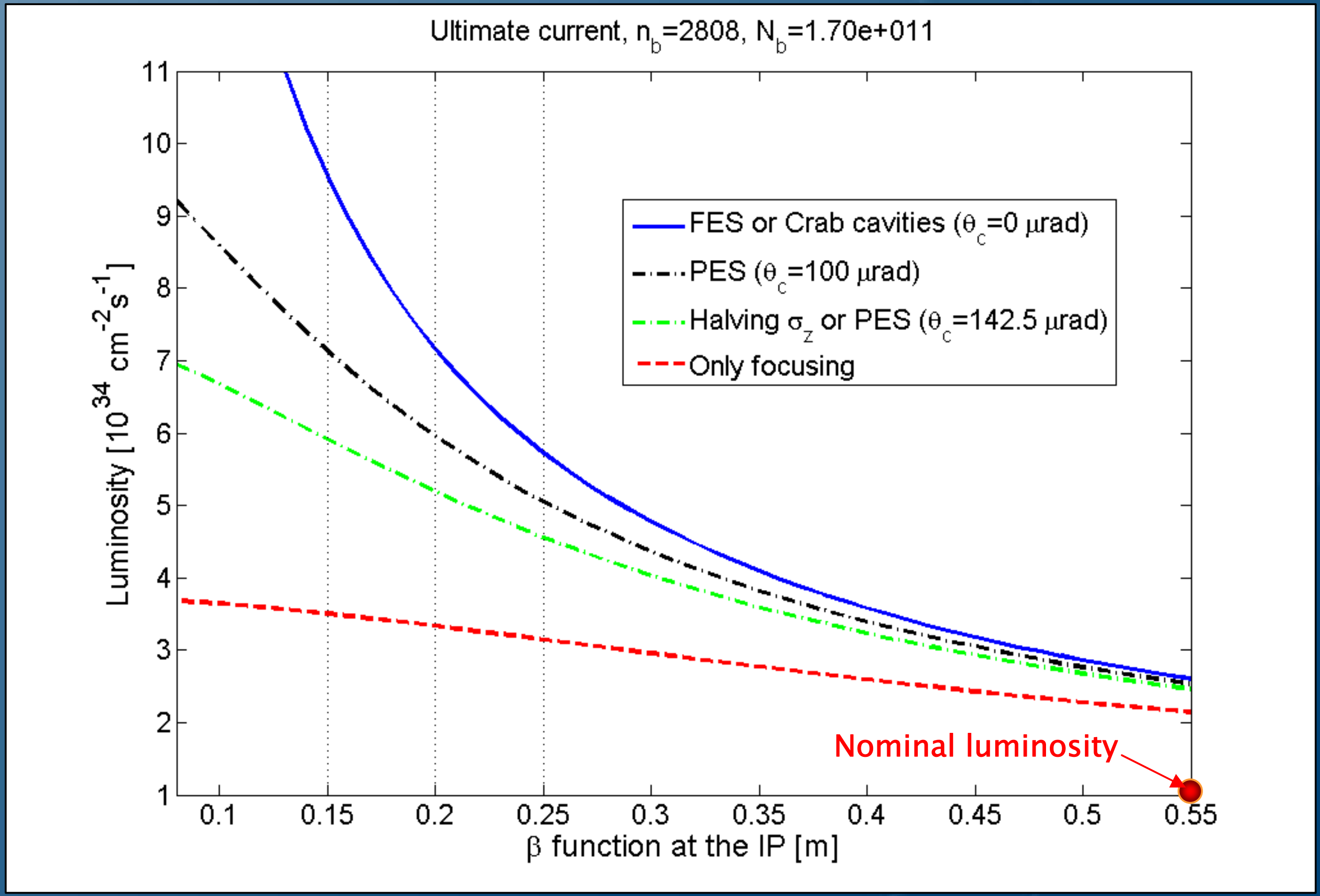
The Full Early Separation scheme (FES)



The Partial Early Separation scheme (PES)

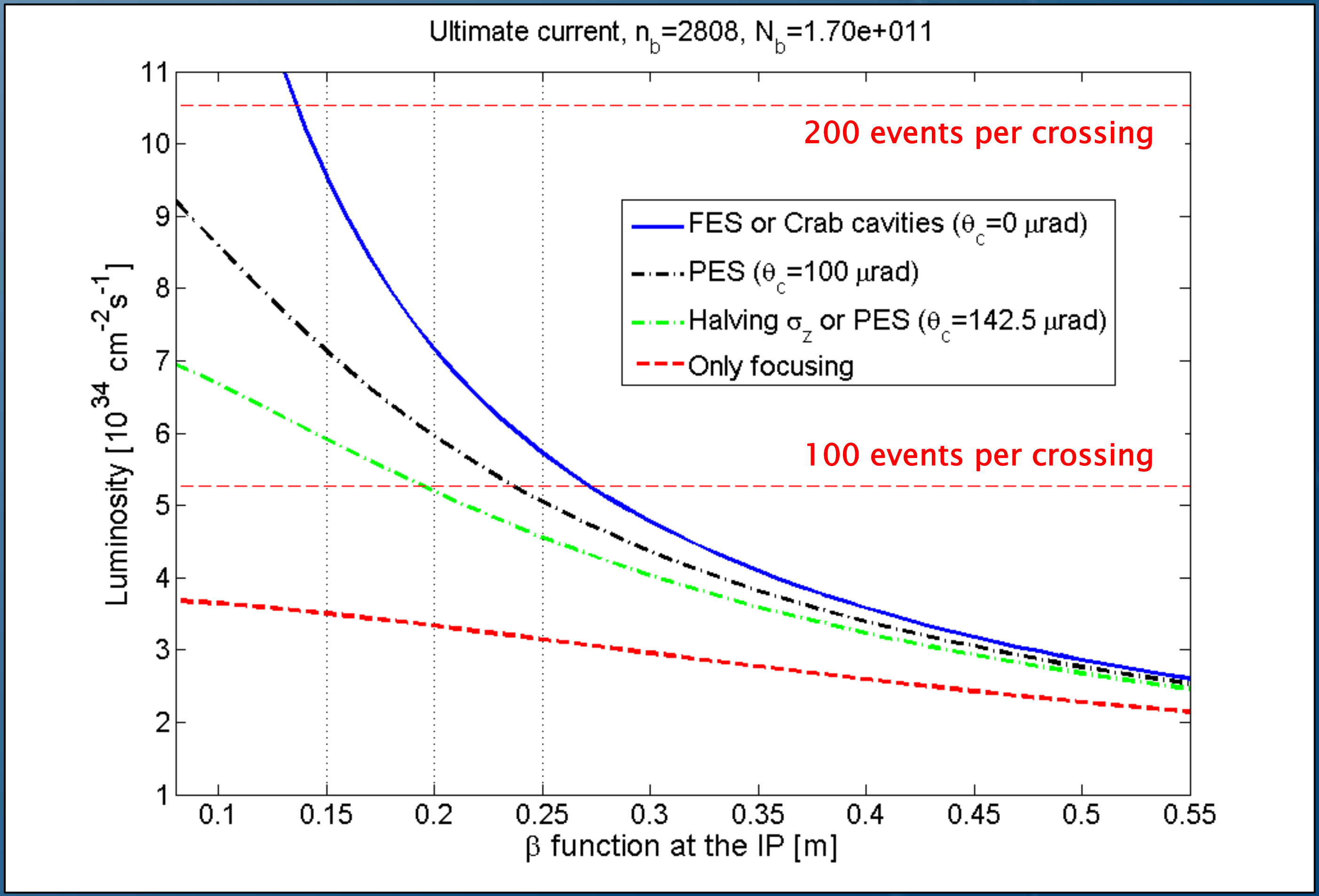
We need a residual crossing angle

2- Potential in peak luminosity increase



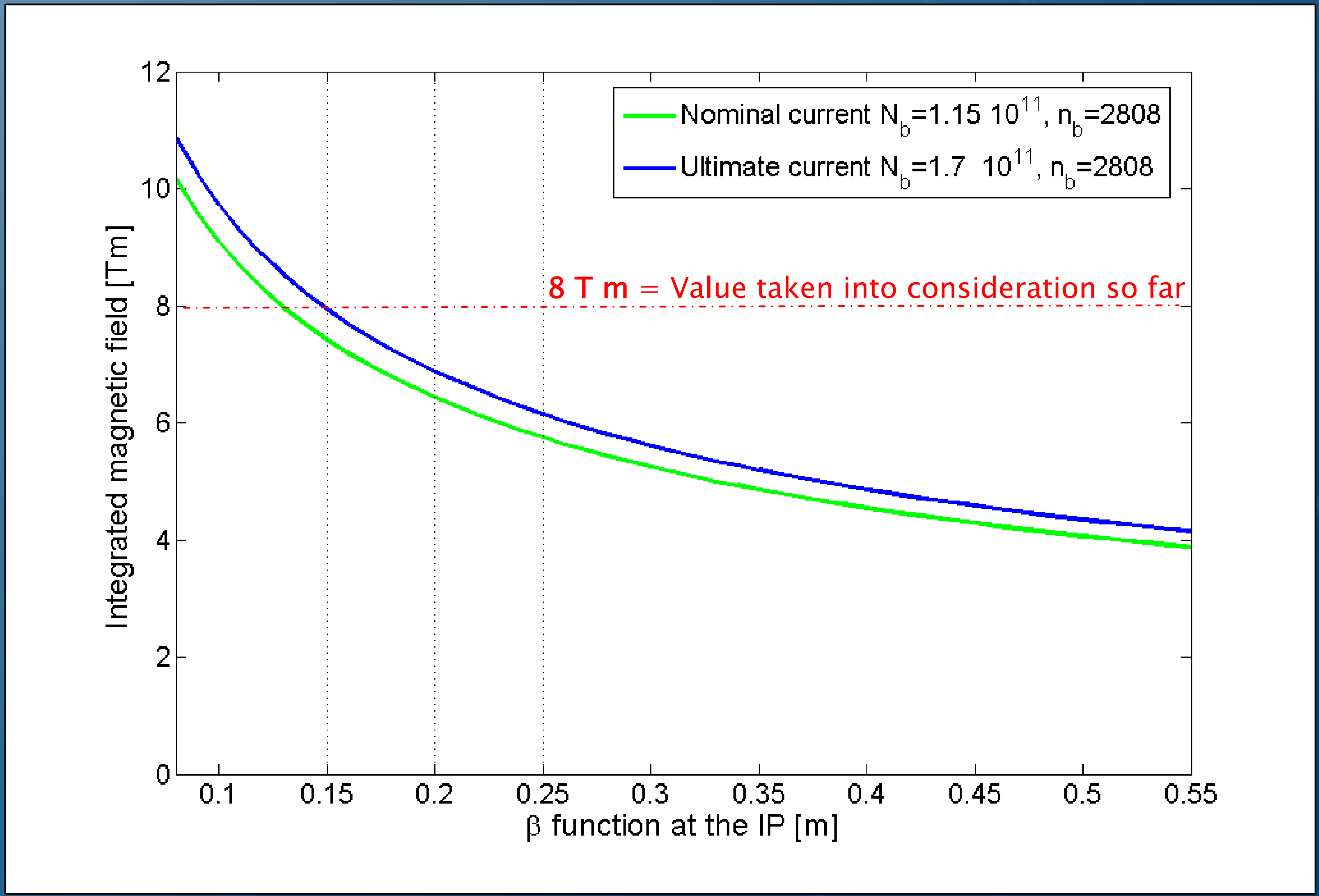
The D0 gives the opportunity of gaining in luminosity with a lower increase in the beam current by modifying the geometry of the collision to take full (or almost full) advantage of the decrease of the β^*.

2- Potential in peak luminosity increase



The D0 gives the opportunity of gaining in luminosity with a lower increase in the beam current by modifying the geometry of the collision to take full (or almost full) advantage of the decrease of the β*.

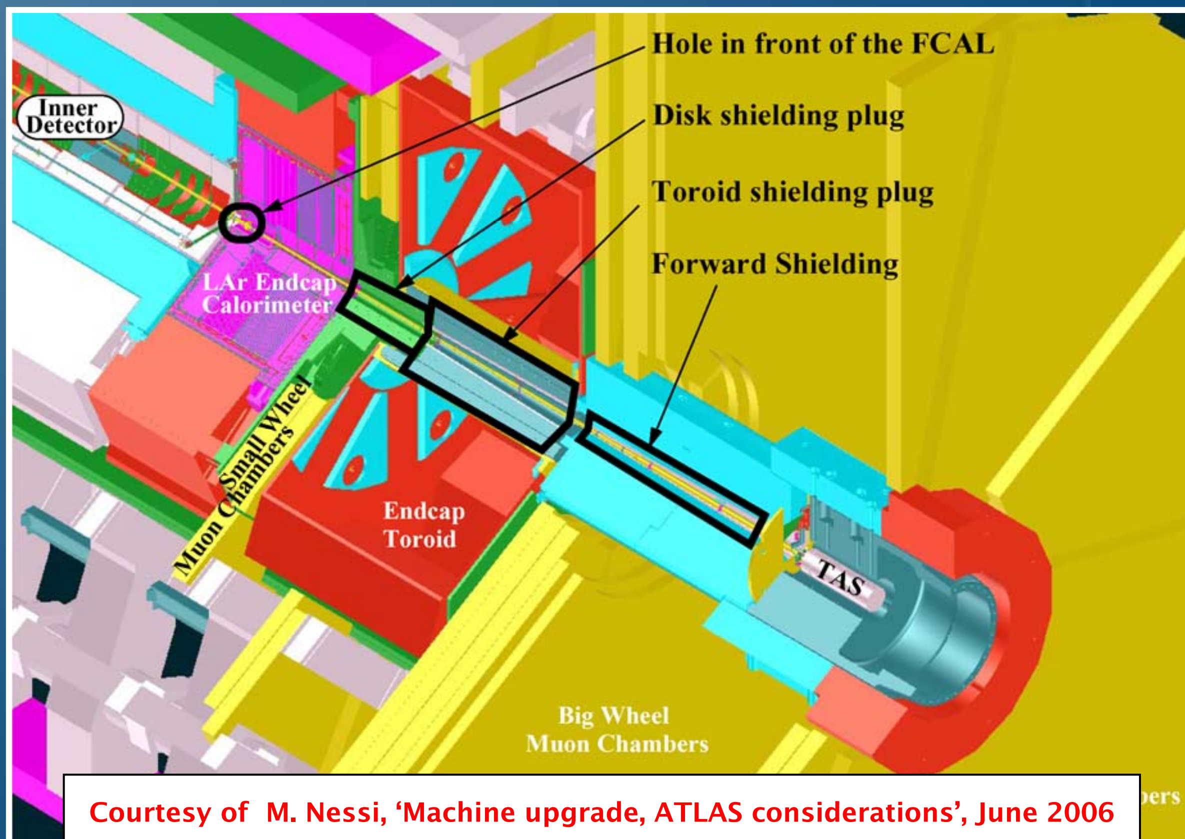
3.1– Which field do we need?



We consider a D0's kick of 160 μrad and the value of 8 Tm is our reference value.

3.2- Are there slots for a D0?

- We cannot put the D0 in the inner detector which excludes the FES for 25 ns.
- BUT there are potential slots starting at 3.5 m and 6.8 m (ATLAS) that are the starting points for our study of a PES.



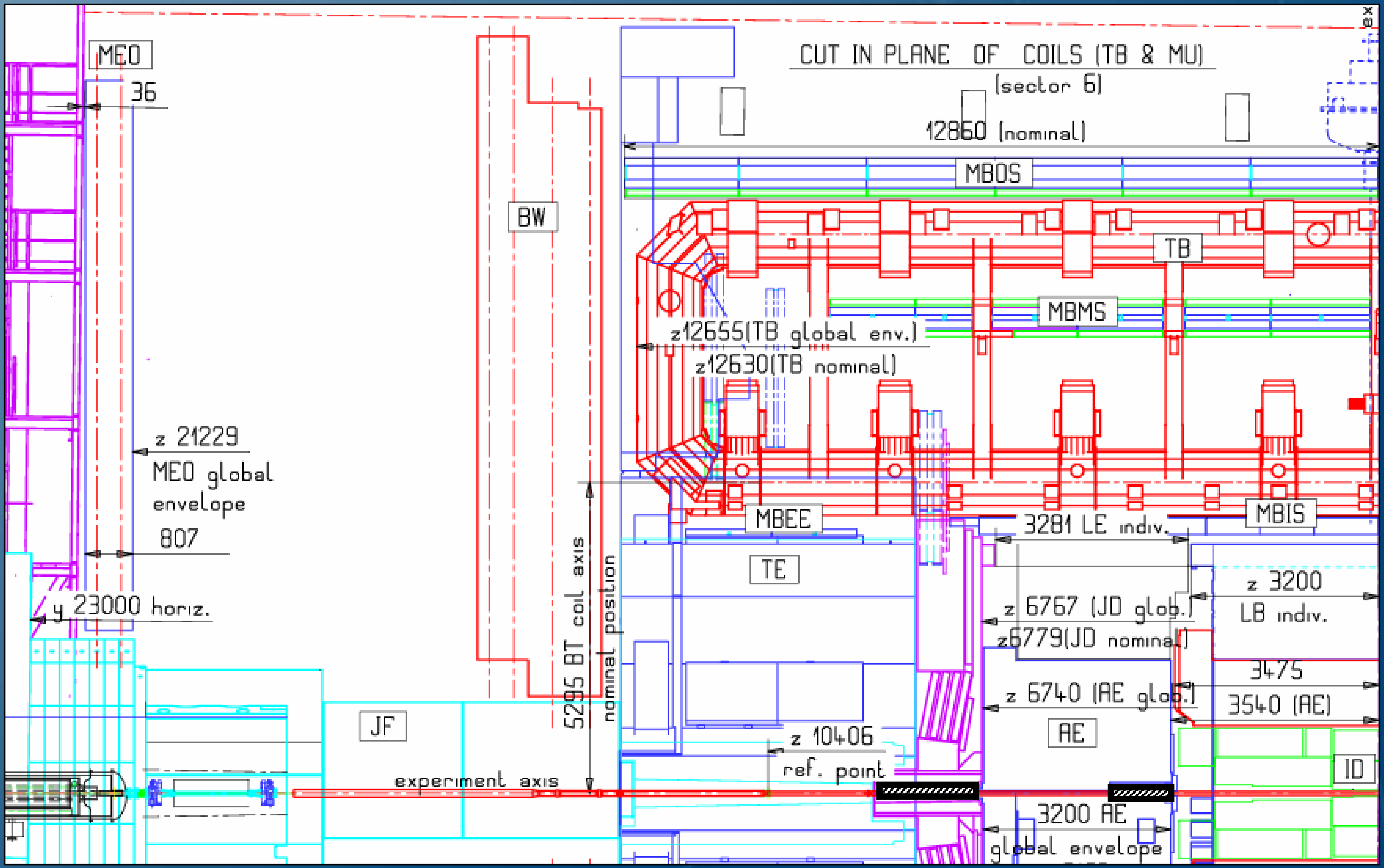
Courtesy of M. Nessi, ‘Machine upgrade, ATLAS considerations’, June 2006

3.3- Strategy for implementation

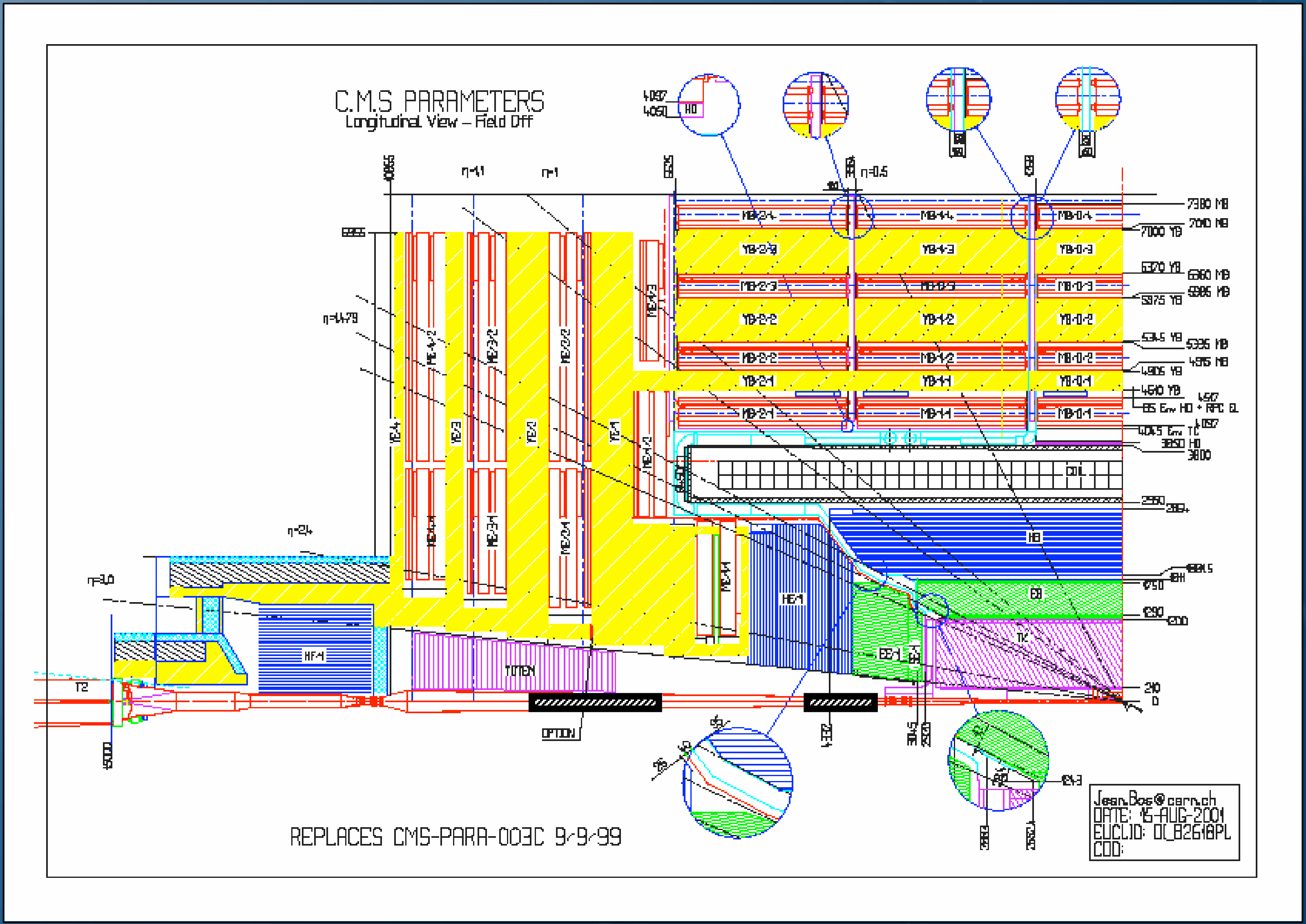
- We can consider the first two ATLAS slots:
  - Slot1 starting at 3.49 m from IP with a total length of 1.09 m
  - Slot2 starting at 6.80 m from IP with a total length of 1.86 m

- We can obtain the 8 Tm splitting the dipole into two:
  - a 4 T D0a in Slot1 (it should be transparent)
  - a 4 T D0b in Slot2 (it should be massive)

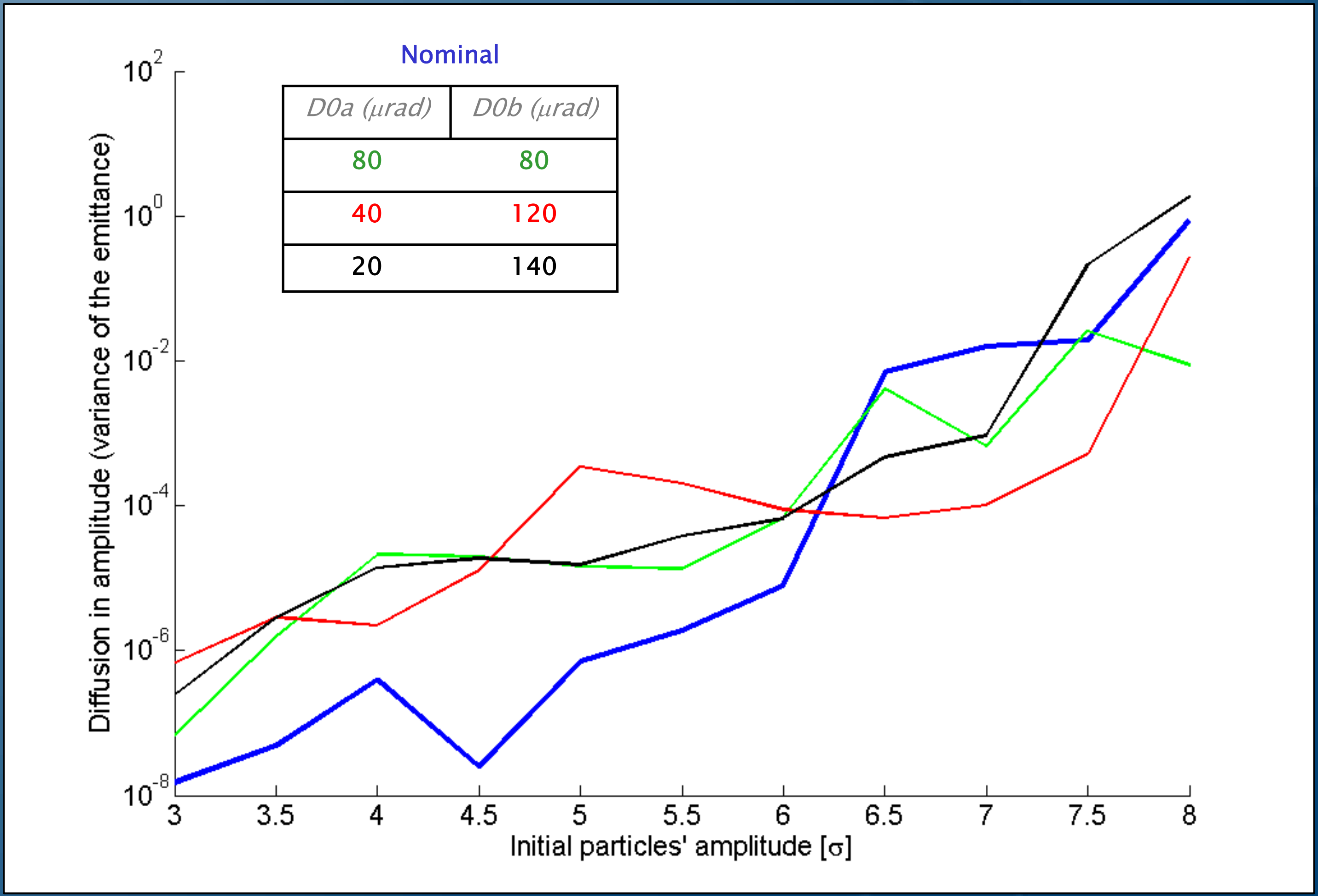
3.3- Where would we put the D0 in ATLAS?



3.3- The same strategy in CMS



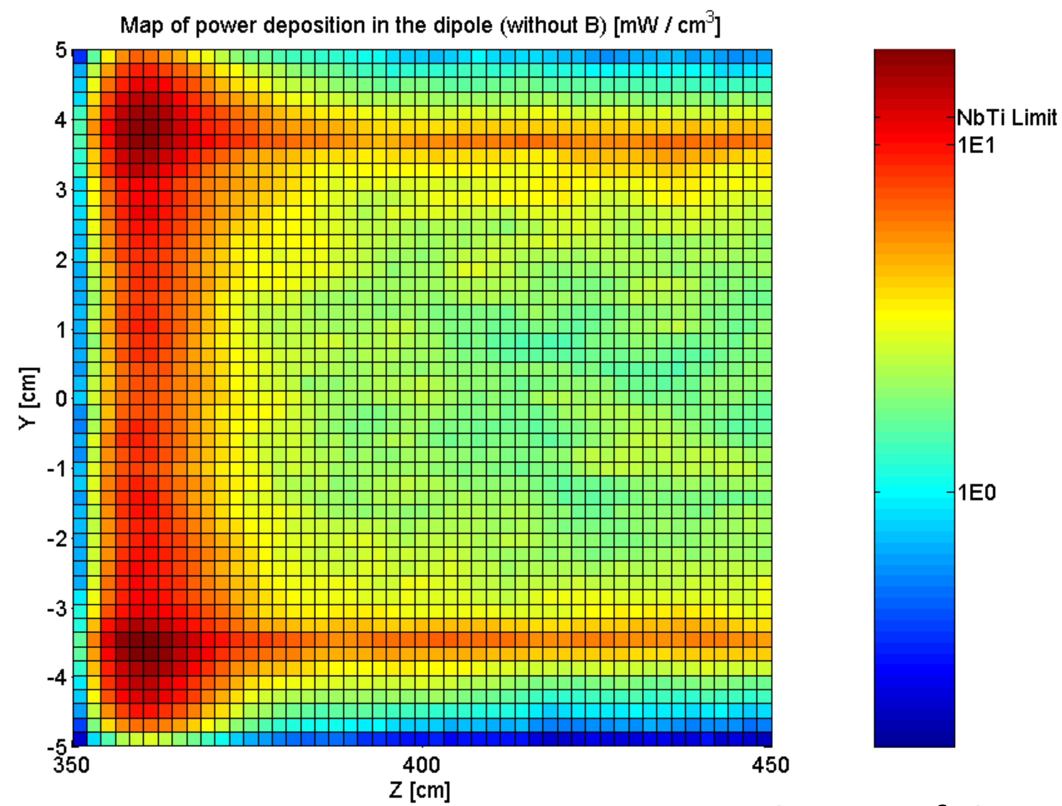
4.1- Diffusion due to the beam-beam effect



Thanks to U. Dorda and F. Zimmermann for their active collaboration

The beam dynamic's behavior of D0 seems not to depend on the different distribution of kick's angle between D0a and D0b.

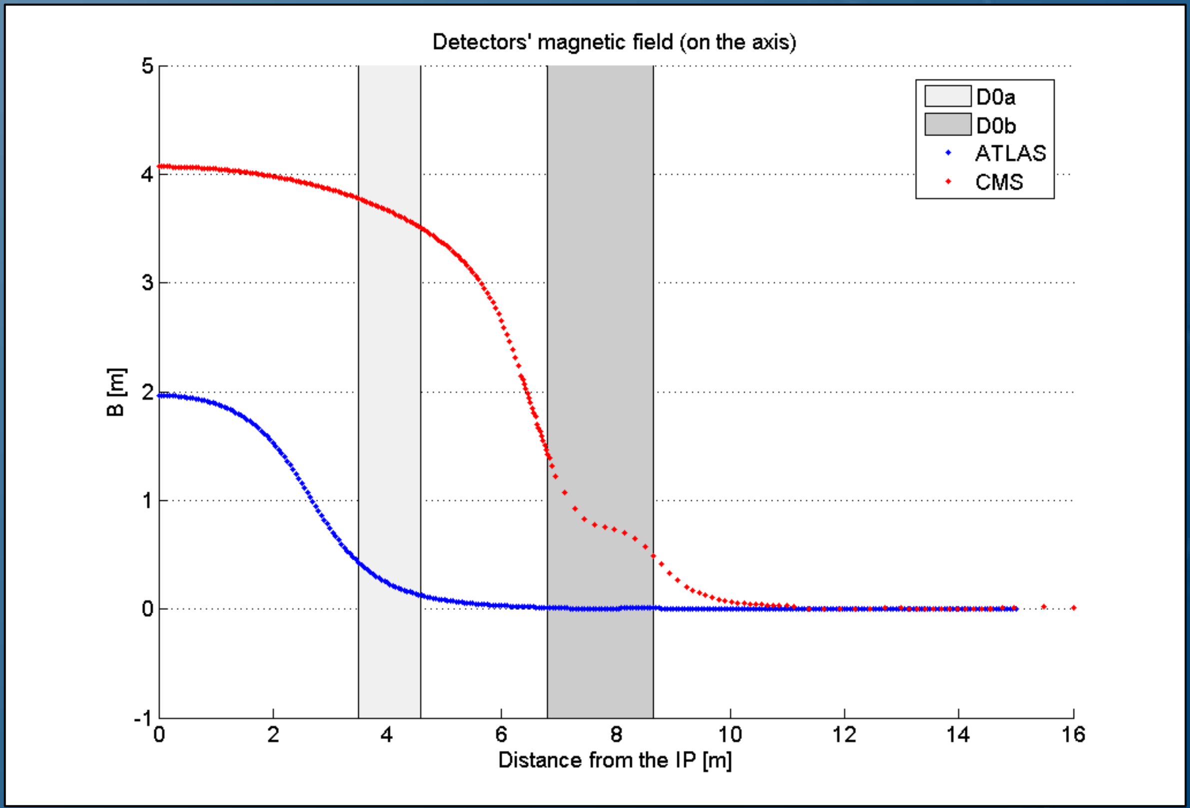
4.2- Energy deposition



Courtesy of C. Hoa

The energy deposition in the D0a appears to lie between 34 W and 90 W depending on simulations. These studies require to be cross-checked and active efforts are made in this direction. Thanks to F. Broggi, C. Hoa and E. Wildner for sharing their results.

4.3- Other important issues to study



- Mechanical aspects (forces and torques)
- Magnetic interference and backscattering
- Compatibility with detector's maintenance
- Room for services' routing.

5- Conclusions

- The D0 boosts significantly the luminosity with only a local change of the machine. It further allows reaching the 10^{35} $cm^{-2}s^{-1}$ with a lower beam current.

- So far, the initial studies and discussions with experimental physicists showed no show-stoppers but many issues.

- Plan of action:
  - To clarify the beam separation requirements
  - To study the integration and energy deposition
  - To choose the magnet technology accordingly and to design the D0a and D0b.