D0 design and beam-beam effect

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CERN AT-MCS-MA

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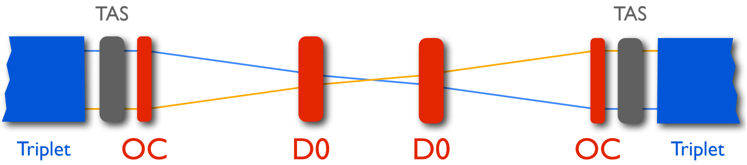
Outline

1. How is the D0 evolving since Valencia?
   - Initial scheme
   - The impact of the leveling with angle
   - Can the D0 work at 50 ns?
2. D0 and beam-beam effect
   - The D0 position and strength
   - Results and limitations of RHIC and SPS's experiments



In the initial scheme...

- 1 dipole (D0) inside the detector ($3-4$ m from the IP)
- 1 orbit corrector (OC) in front of the triplet, before the TAS
- 4 LRs encounters at 5σ in LHC
- static crossing angle during the run

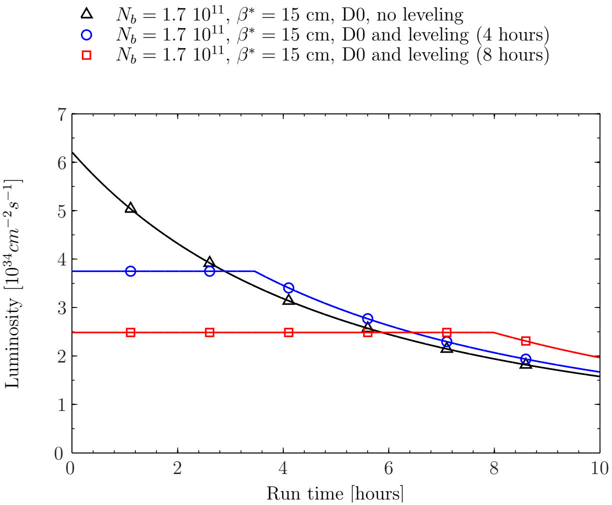
The impact of the leveling with angle

A natural evolution: to level with angle

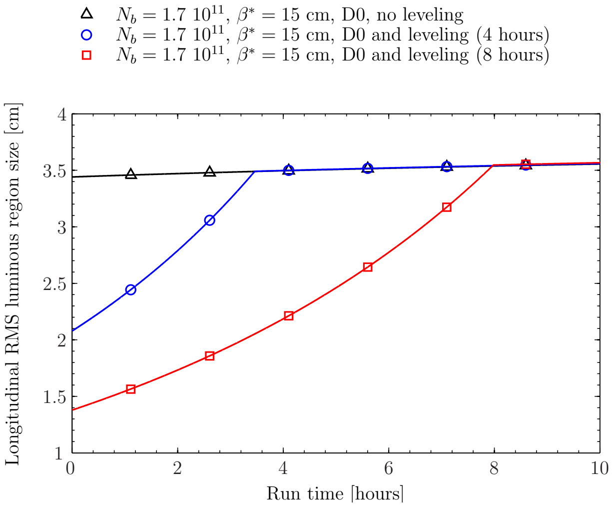
It impacts (apart from the luminosity)...

- the luminous region length
- the HO tune shift: more beam current allowed
- the BB effect
- the D0 field: D0 has to switch polarity during the run

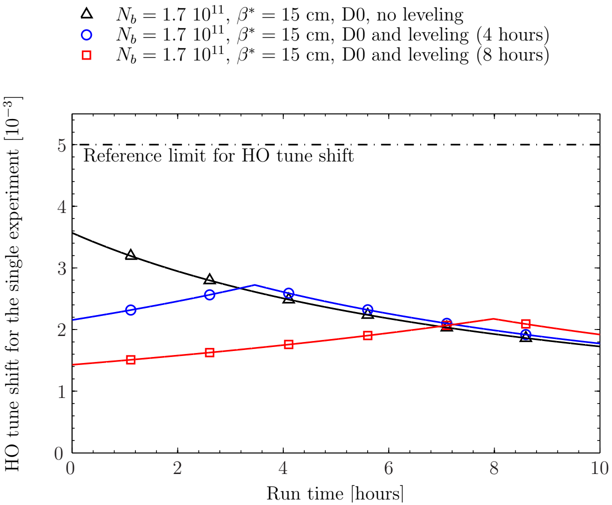
The leveling with angle...



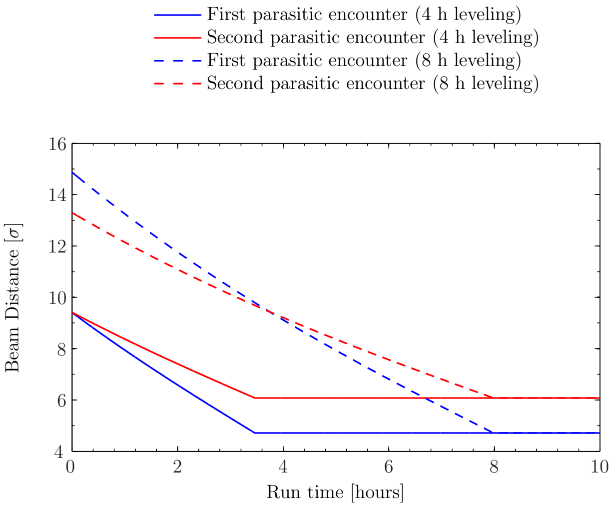
The luminous region changes its length...



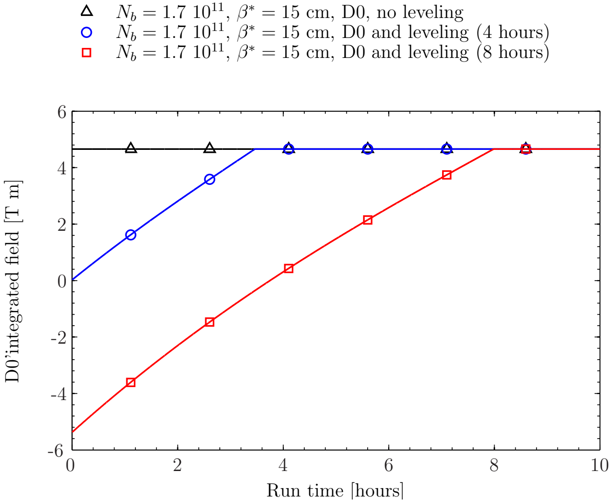
The HO tune shift reduces: more beam current?



The beam separation varies during leveling...



The D0 field changes polarity...



Can the D0 work at 50 ns?

YES, we can use the Early Separation Scheme at 50ns.

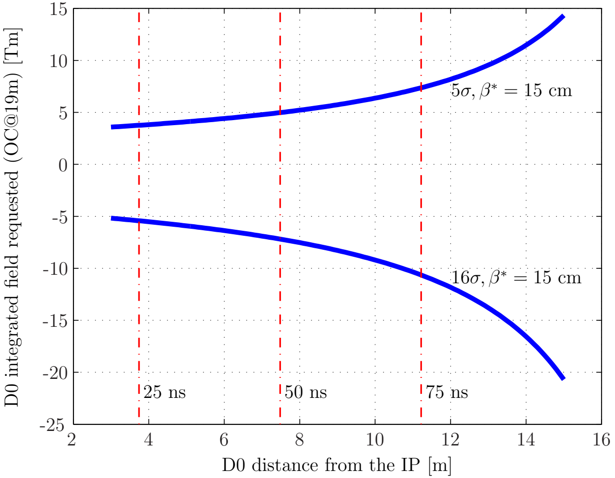
Advantages

- to solve the HO tune shift without having longitudinally flat profile
- (therefore) leveling with angle
- increasing the beam separation in the triplets from 8.5 σ to 9.5 σ (or more)

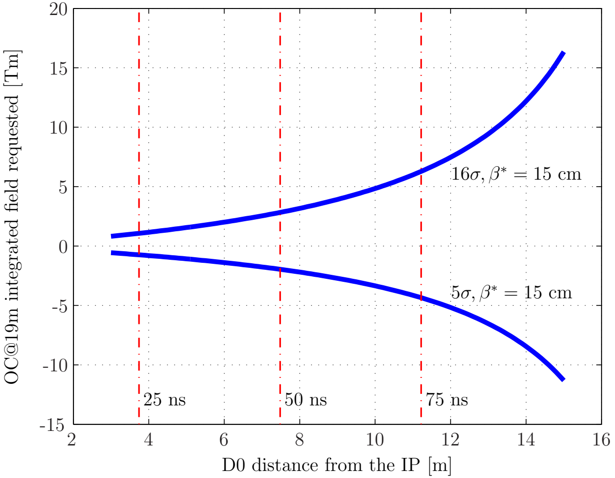
Drawbacks

- All D0 problems...

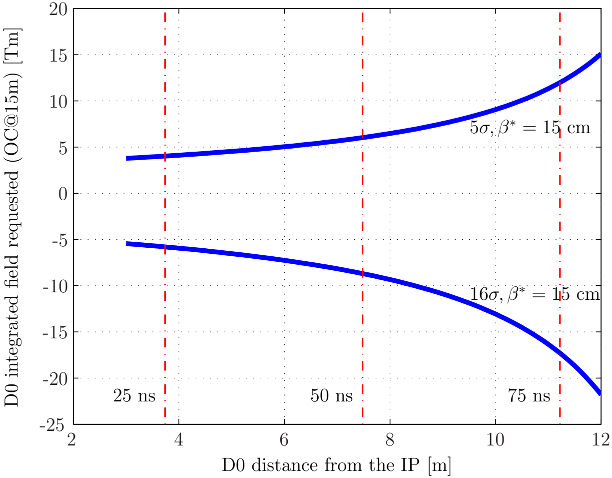
D0 integrated field with OC at 19 m from the IP



OC integrated field with OC at 19 m from the IP



D0 integrated field with OC at 15 m from the IP



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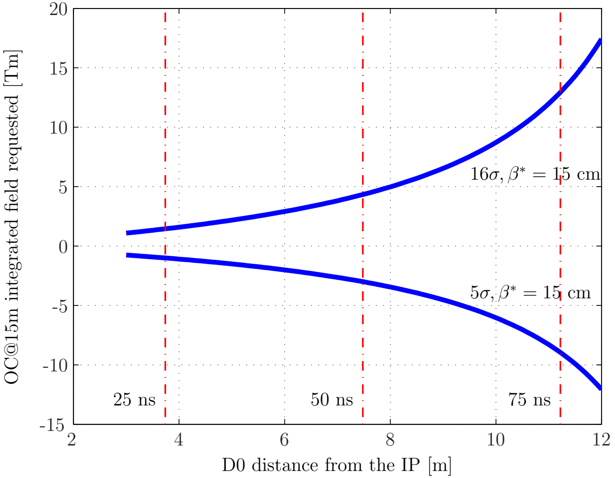
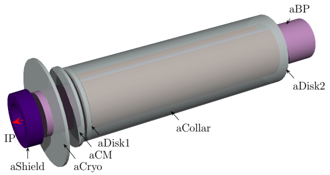
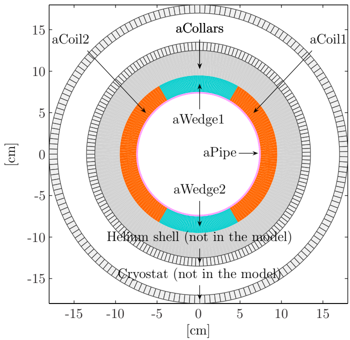


How a weak D0 looks like (1 m long, NbTi, 3 Tm).

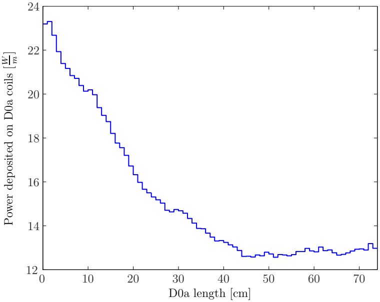


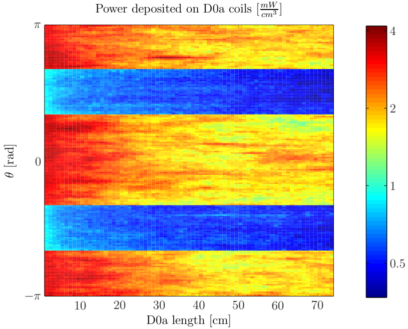


Very large apertures (15 – 30 cm)!

Thanks to D. Tommasini

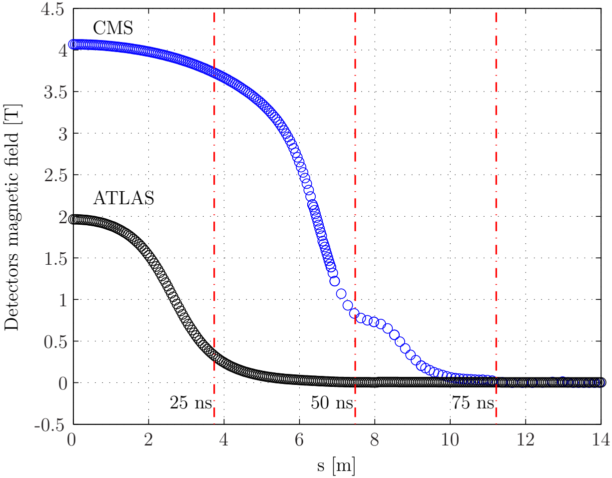
Energy deposition studies ($L = 10^{35}$ cm^{-2} s^{-1})





Thanks to E. Wildner and C. Hoa

The position at 50ns from the IP...



The position at 50ns ($7 - 9$ m) from the IP...

Advantages...

- good trade-off between position and integrated field
- CMS solenoidals field significantly lower
- connections, cryolines, maintainability less critical

Difficult questions to answer...

- Does D0 blind the detectors? (see detectors talks)
- Does 8 LRs at 5σ unacceptably spoil the beam ($N_b = 1.7\ 10^{11}$ ppb, $\epsilon_n = 3.75$ mm mrad)?

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Can we get a clear answer to that question?

Only LHC can give a complete answer...

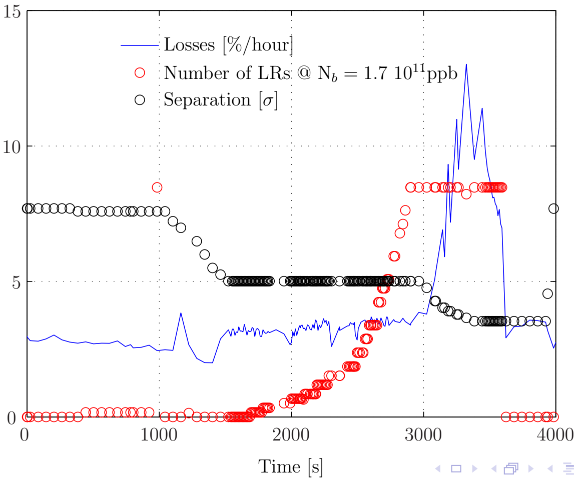
- we do not consider coupling we HO collisions, other LRs, other lattice non linearities
- we approximate the beam field at 5σ with the wire field at 5σ
- we approximate the interaction in the weak-strong regime.

In which machines?

- RHIC (wire), SPS (wire), Tevatron (collider with similar bunch current but very different collision scheme)
- all these machines have circunferences from 4 to 6 times shorter than LHC, does it play a role?

20 June 2007: RHIC experiment

N. Abreu, G. Robert-Demolaize, U. Dorda, W. Fischer, J.-P. Koutchouk, G. Sterbini, F. Zimmermann



24 July 2007: SPS experiment

G. Burtin, R. Calaga, **U. Dorda**, J.-P. Koutchouk, G. Sterbini, R. Tomás, **J. Wenninger**, F. Zimmermann

. . . among other results. . .

- The effect of 1 wire (1.2 m long, at $\beta \approx 50$ m) at 30 A with a distance of $4.3\sigma (= 6$ mm) from the SPS 37 GeV/c beam has not an observable effect (during the poor beamlife of the SPS beam!).
- This is equivalent to 9 parasitic encounters at 4.3σ for the LHC ultimate current with LHC nominal normalized emittance in the SPS circunference.

Conclusions

- The D0 is compatible with leveling, 25ns and 50ns.
- IF 8 LRs at $N_b = 1.7\ 10^{11}$ can be tolerated, the position between $7-8$ m from IP seems very promising for the engineering point of view: are we daring to much? can experiments live together with it?
- There are efforts to look for further MD time: even if partial, the experimental results are ruther encouraging and consistent.
- To preserve the opportunity of slot $4-6$ m until clearer results: RHIC's long beam lifetime would be ideal.

Thank you.