HE-LHC IR energy deposition simulations

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Thanks to J. Keintzel (CERN), F. Cerutti, M. Varasteh (CERN FLUKA team)

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EuroCirCol
A key to New Physics

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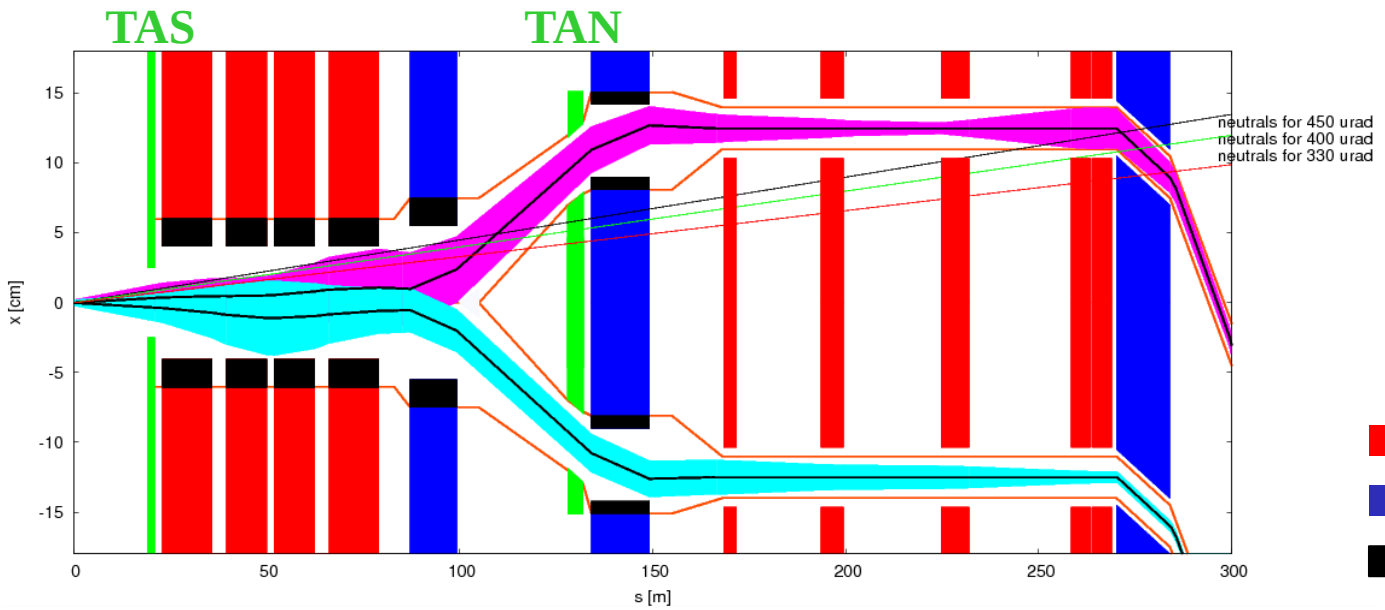
- Triplet quadrupoles
- Separation Dipoles: D1, D2
- TAN
- Full ring modelling

HE-LHC IR, horizontal



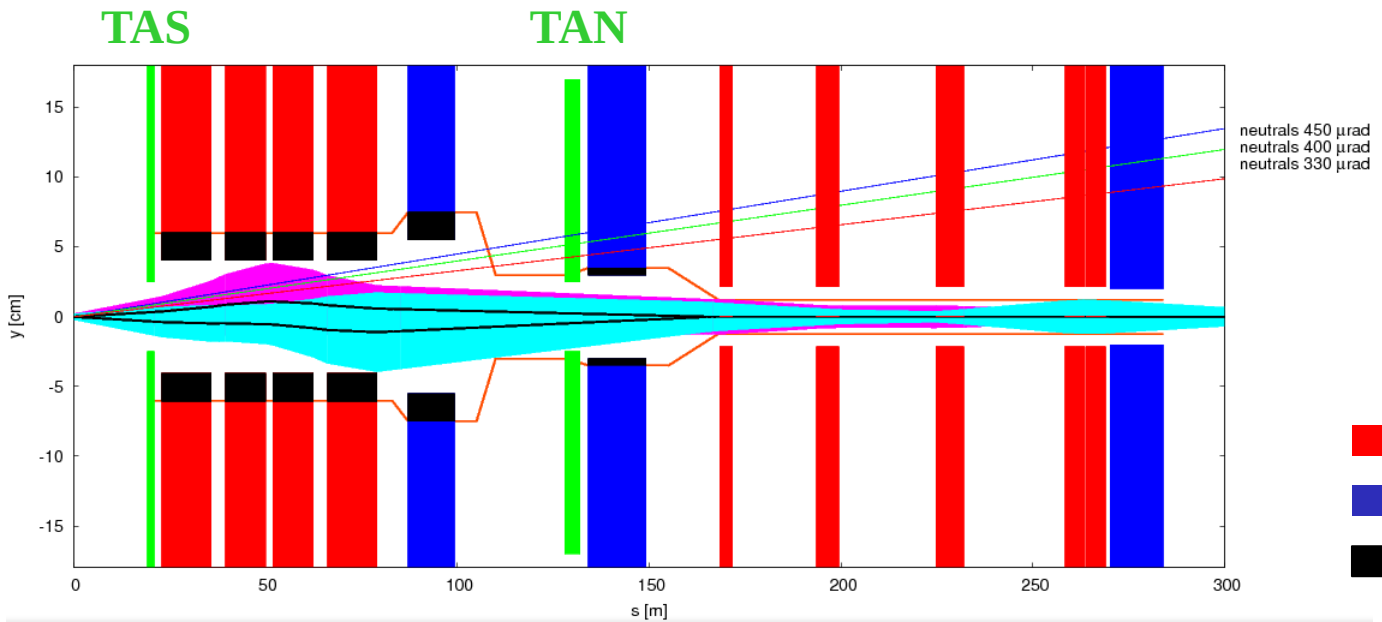
Beam envelopes (18σ)

quadrupoles
dipoles
shielding

- Complete IR design: quadrupoles, separation dipoles.
- Beam separation 250 mm.
- Beta*=0.45 m.

‘Alternative IR for FCC-hh and HE-LHC IR’, Leon Van Riesen Haupt

HE-LHC IR, vertical



Beam envelopes (18σ)

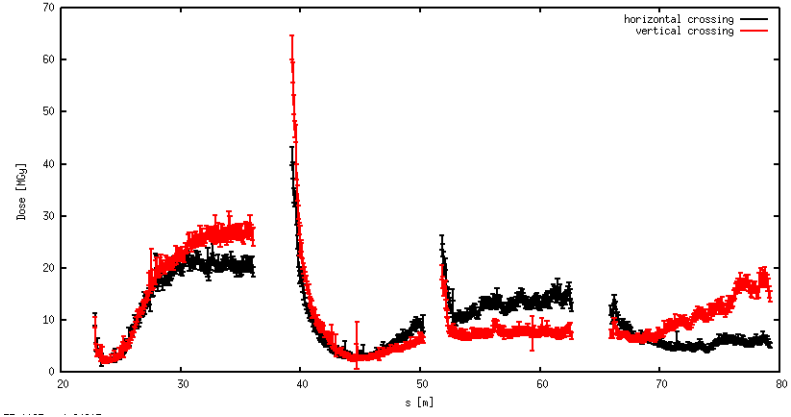
quadrupoles
dipoles
shielding

Triplet quads

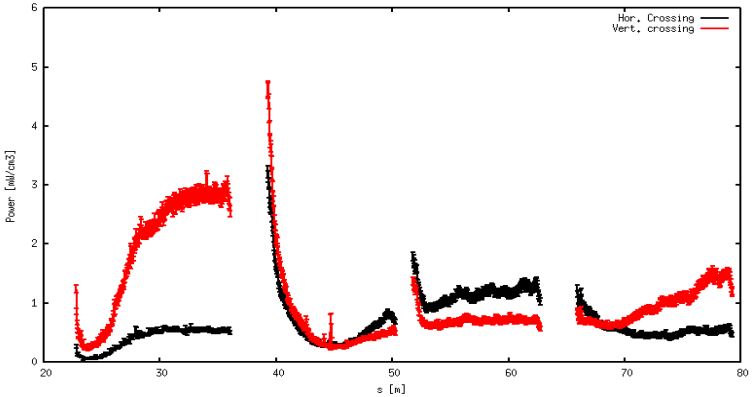
See Eurocircol 17 (Amsterdam) : ‘IR1/5 radiation shielding’, J.L. Abelleira

Updated plots for beta*=0.45 m:

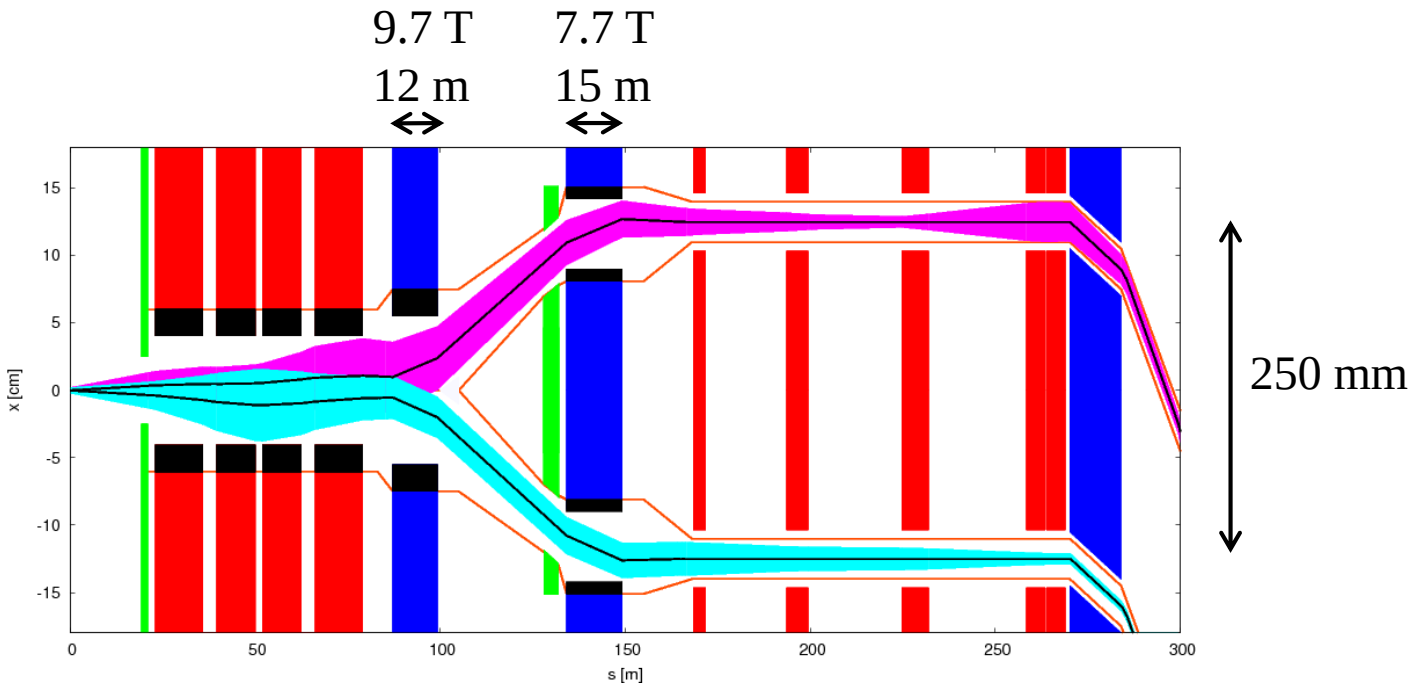
Dose



Power

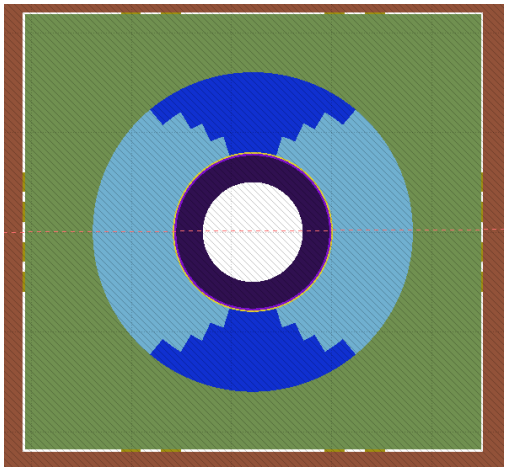


Separation dipoles

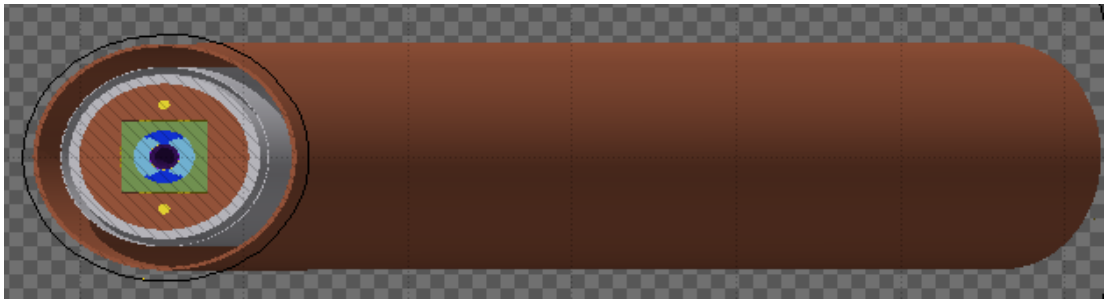


- Strong bending required: SC and long magnets

Separation dipoles: D1

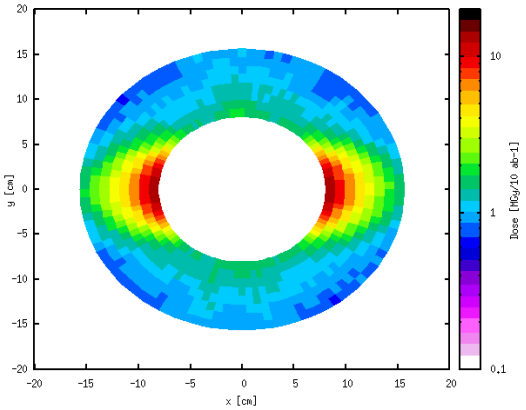


- FLUKA model based on FCC arc dipole, valid for the purpose of calculating peak dose.
- Coil radius: 8 cm.
- B=9.7 T.
- 2.15 cm of shielding.

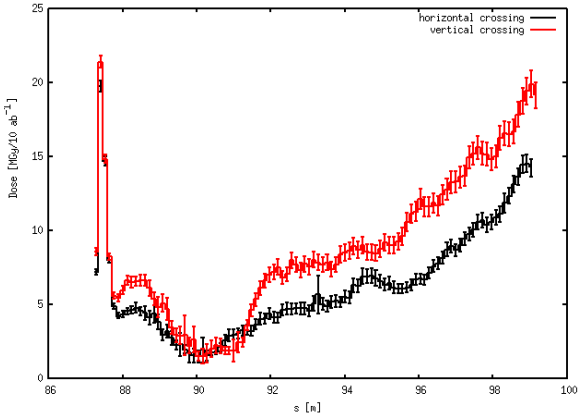


Separation dipoles: D1

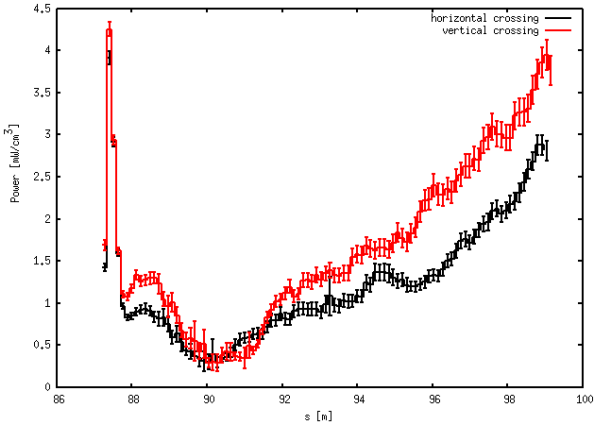
Dose in the coils



Integrated peak dose



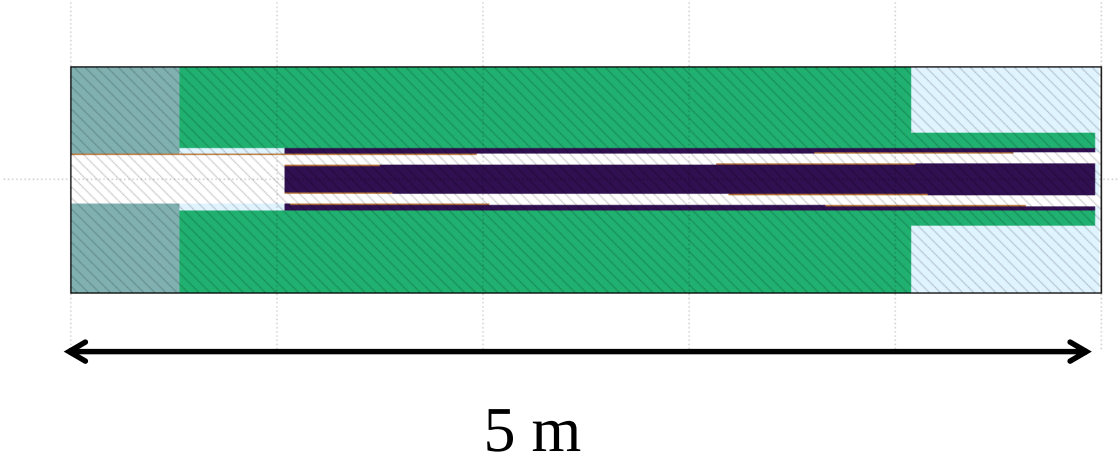
Peak power

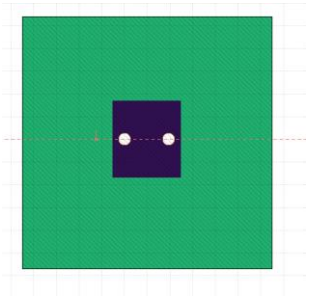


- Shielding needed to protect the coils (2.15 cm).
- Peak dose reduced from 100 MGy (0.5 cm shielding).

TAN

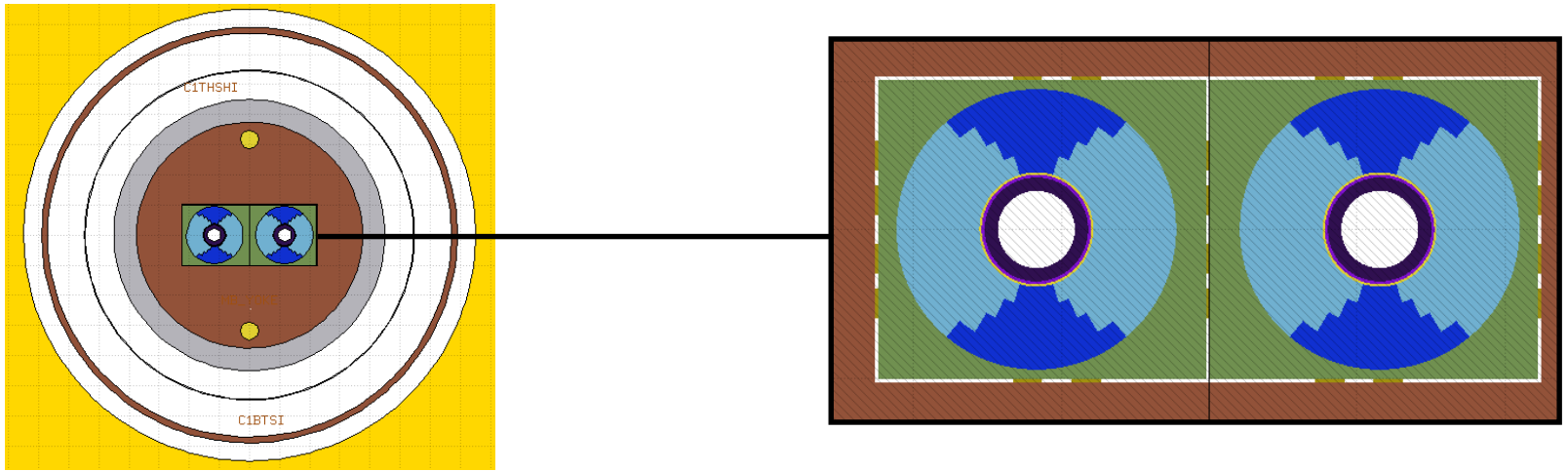
- FLUKA TAN model modified from the FCC-hh.
- Adapted to the 25-cm beam separation.



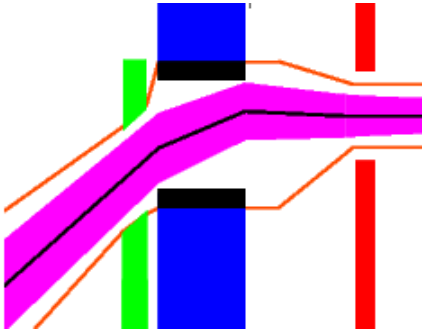


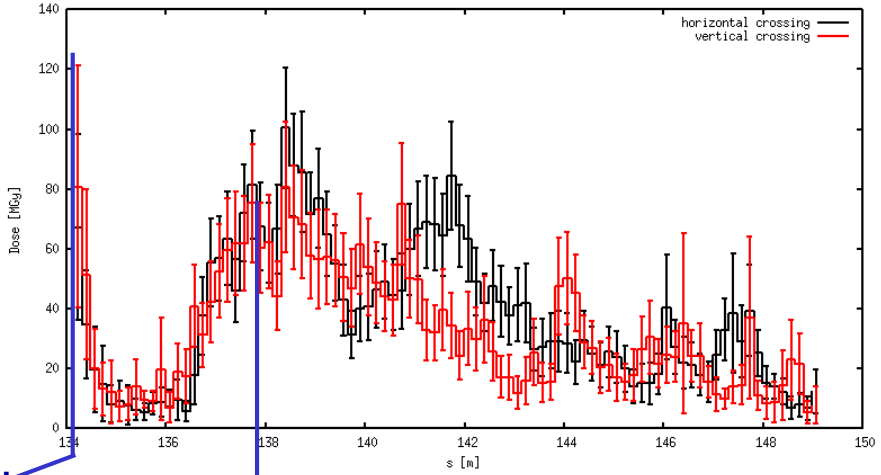
Separation dipoles: D2

- FLUKA model based on the FCC-hh arc dipole (straight).
- Coil radius: 3.85 cm.
- Magnetic field: 7.7 T.

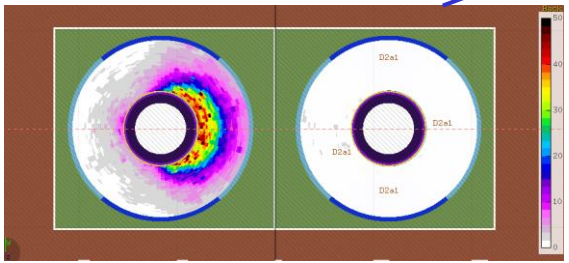


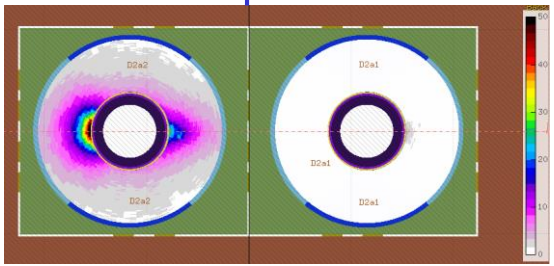
Separation dipoles: D2





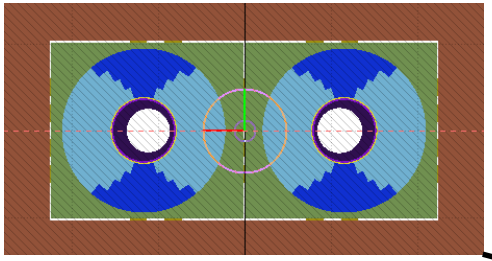
- Excessive dose.
- More shielding? not with this scheme.
- Another solution needed.

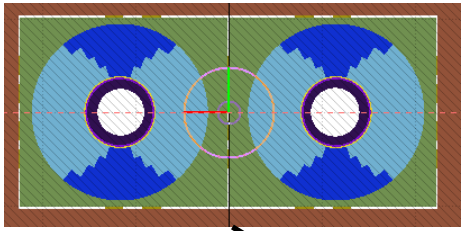


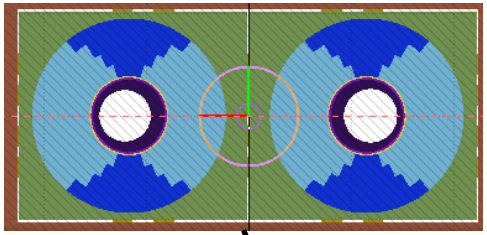


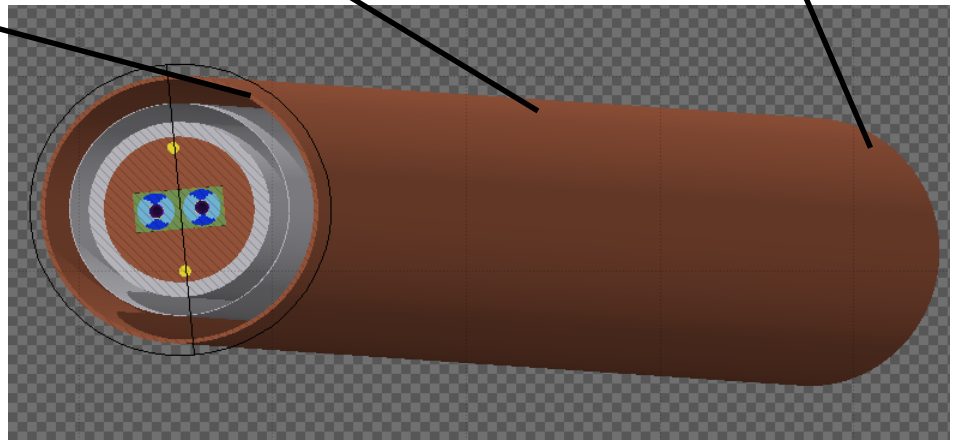
Separation dipoles: D2

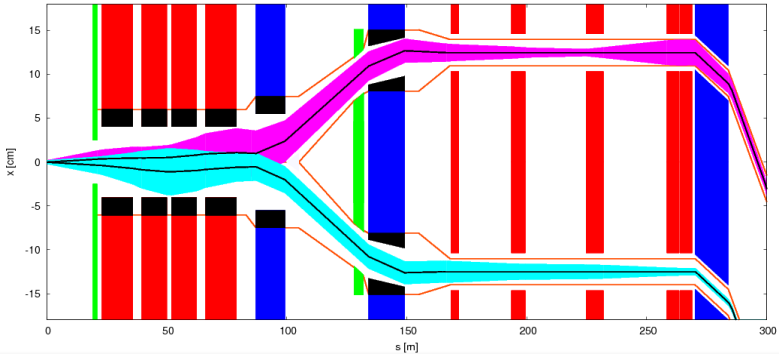
- Solution 1: Eccentric shielding





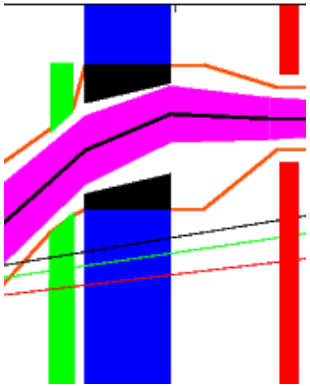


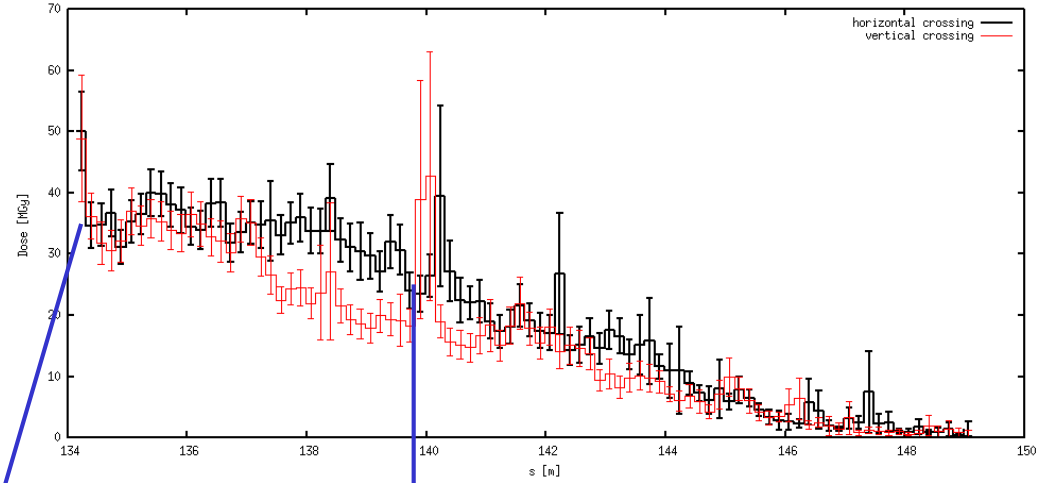


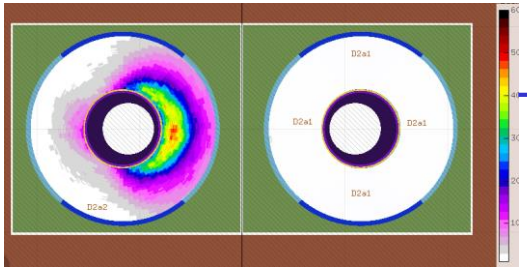


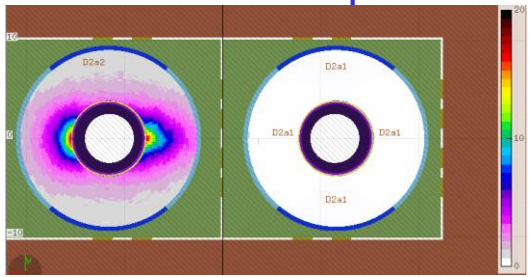
Separation dipoles: D2

- Solution 1: Eccentric shielding





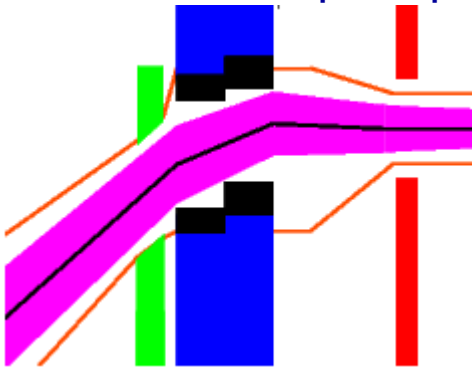


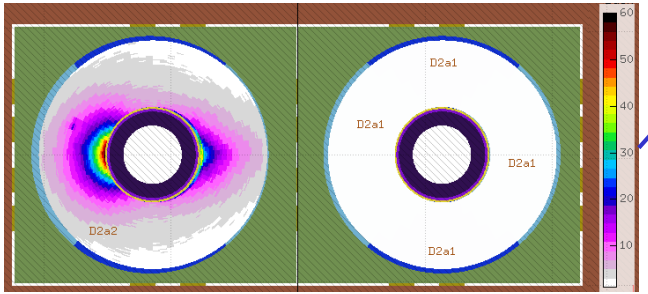


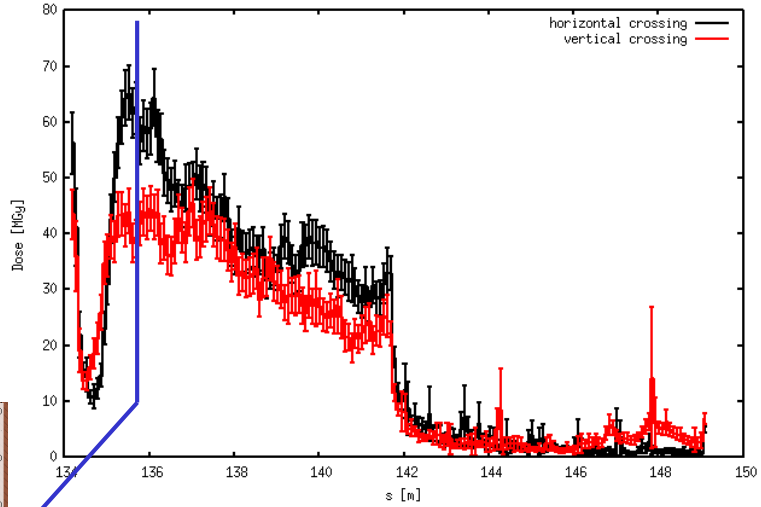
- Peak dose reduced with this shielding.

Separation dipoles: D2

- Solution 2: Split dipole with different beam separations

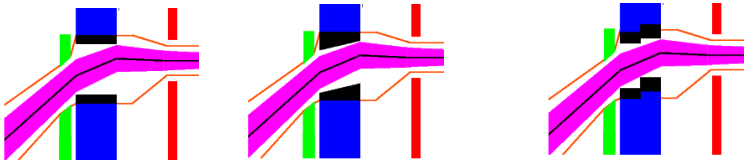






- Not as good solution as the eccentric dipole

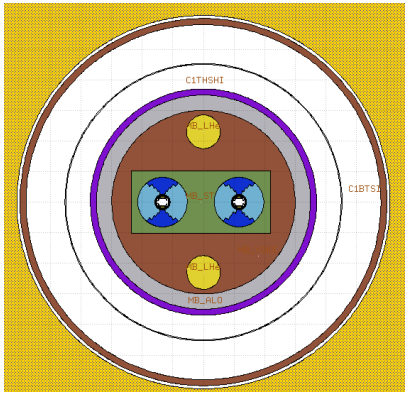
Separation dipoles: D2



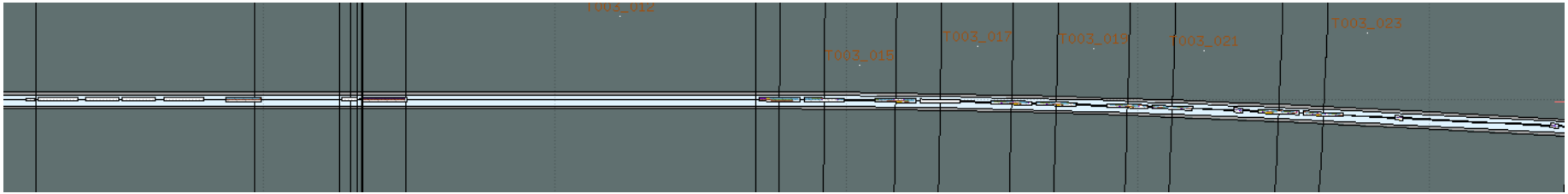
	simple	eccentric	split	
Coil r [cm]	3.85	3.85	3.75	3.75
Center position[cm]	11.6	11.6	11.4	12.2
Shielding [cm]	0.9	0.9/1.8	1.1	1.4
Inner r [cm]	2.6	2.5	2.3	2.0
Peak dose [MGy]	100	40	70	

Full ring model

- Line from IP to DS being modelled with line builder to simulate energy deposition from diffractive proton losses.
- Twiss files already provided (J. Keintzel).
- Arc dipoles: SBEND with 25-cm beam separation.
- Quadrupoles need to be adapted to the new optics.



SBEND (M. Varasteh, CERN FLUKA team)



Conclusions

- Full design of the HE-LHC presented: quads, dipole separators, TAN.
- Dipole separator parameters are presented, seem feasible (t.b.c. by magnet group).
- Energy deposition studies for D1 indicate that shielding is required.
- Simulations indicate that shielding is required for D2, with an eccentric shielding.
- Arc dipole ready, quadrupole model required to finish the line from IP to DS for diffractive proton losses in the DS.