5th Joint HiLumi LHC - LARP Annual Meeting

Oct 29, 2015

ENERGY DEPOSITION ASPECTS FOR LHCb REQUEST

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WP10 Energy Deposition & Absorber

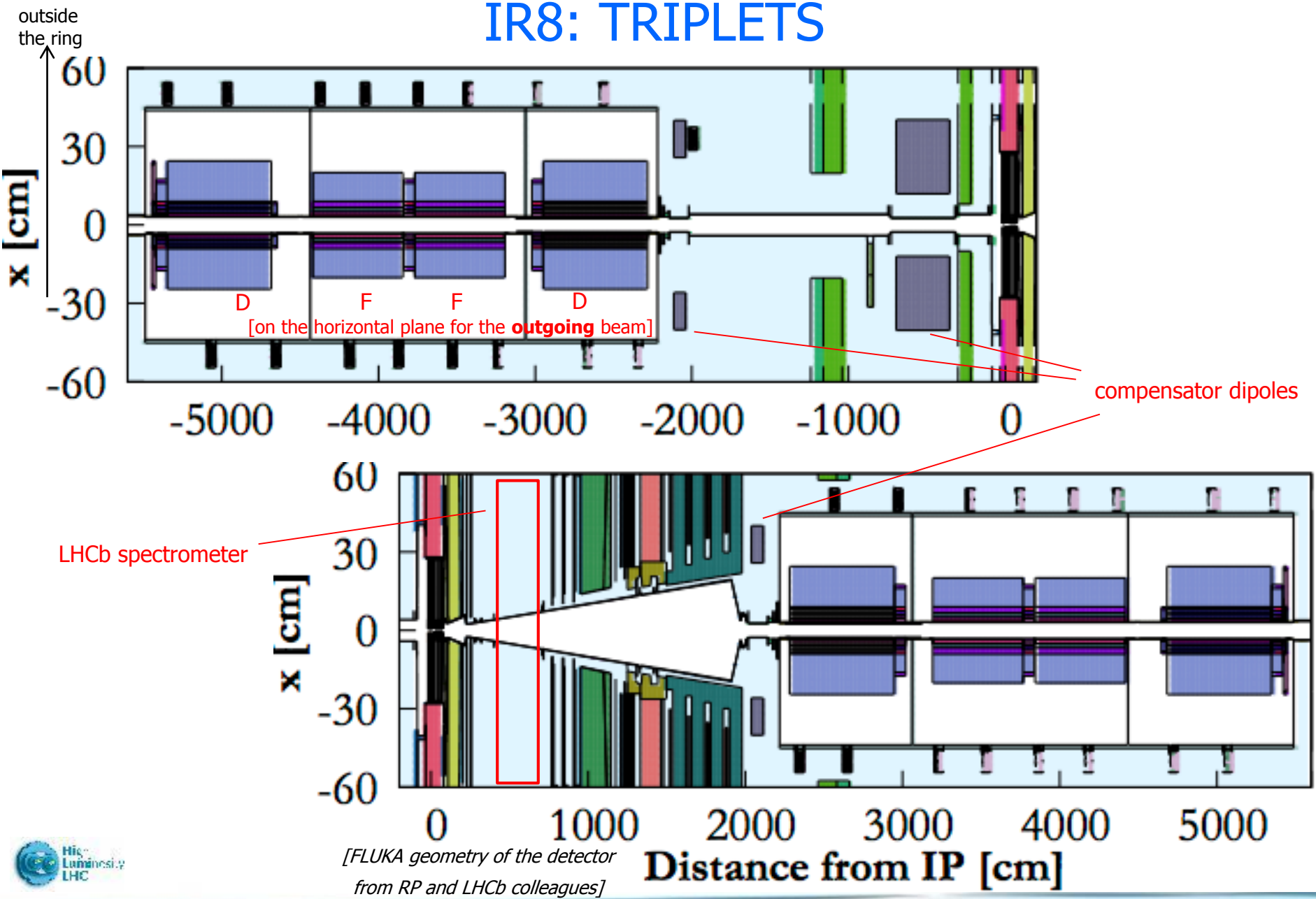
through L.S. Esposito's work and essential discussions with G. Arduini, M. Brugger, H. Burkhardt, R. De Maria, B. Di Girolamo, I. Efthymiopoulos, S. Fartoukh, M. Giovannozzi, S. Redaelli, S. Roesler, L. Rossi, A. Santamaria, B. Schmidt, …

SCOPE

proton-proton collision debris impact on

- warm dipoles (MBXWS.1R8)
- muon chambers (neutron background)
- triplet-D1
- D2
- <matching section>
- electronics
- QRL
- [access, activation] ⟹ RP

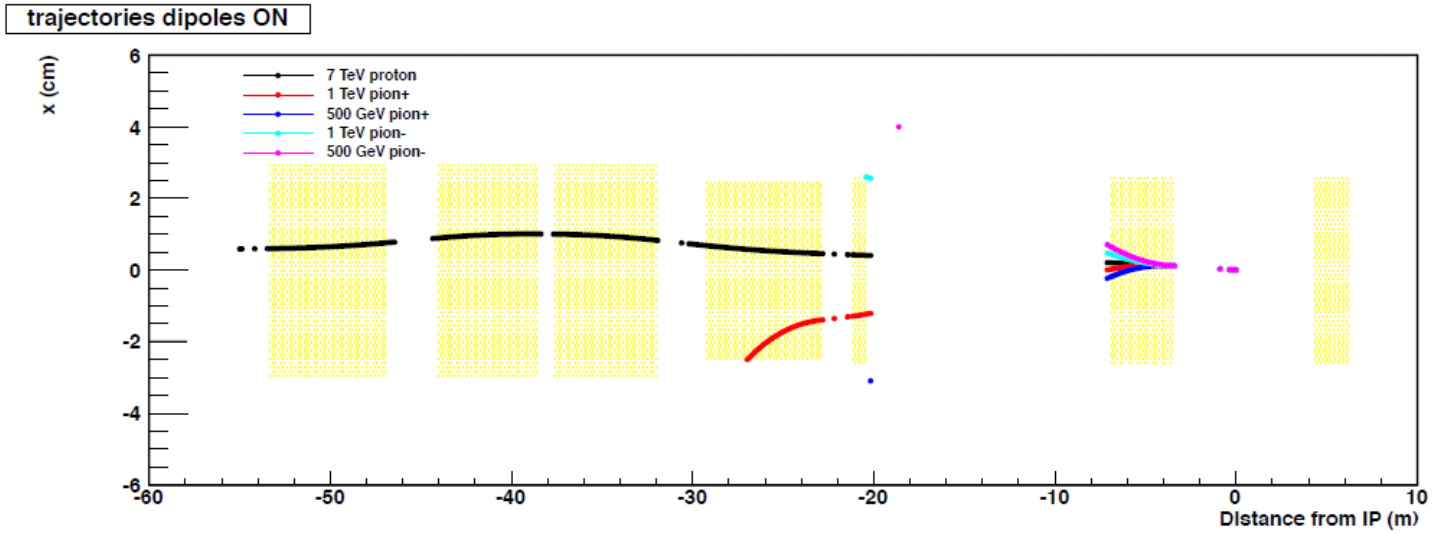
IR8: TRIPLETS



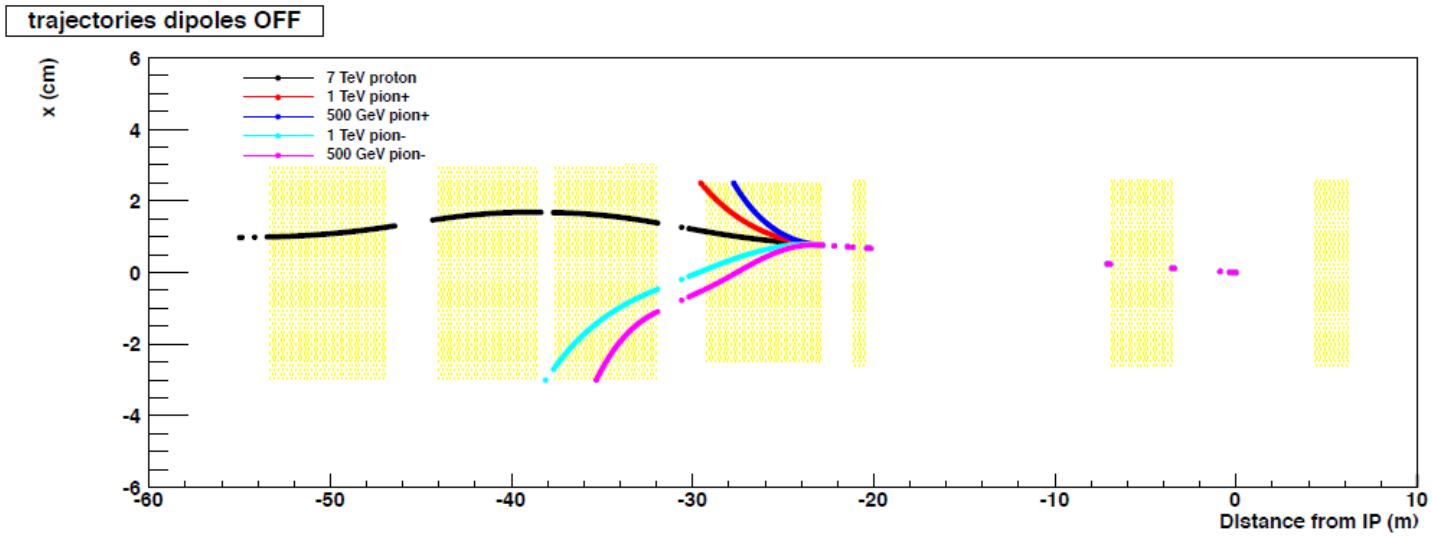
[FLUKA geometry of the detector from RP and LHCb colleagues]

SPECTROMETER EFFECT

ON



OFF



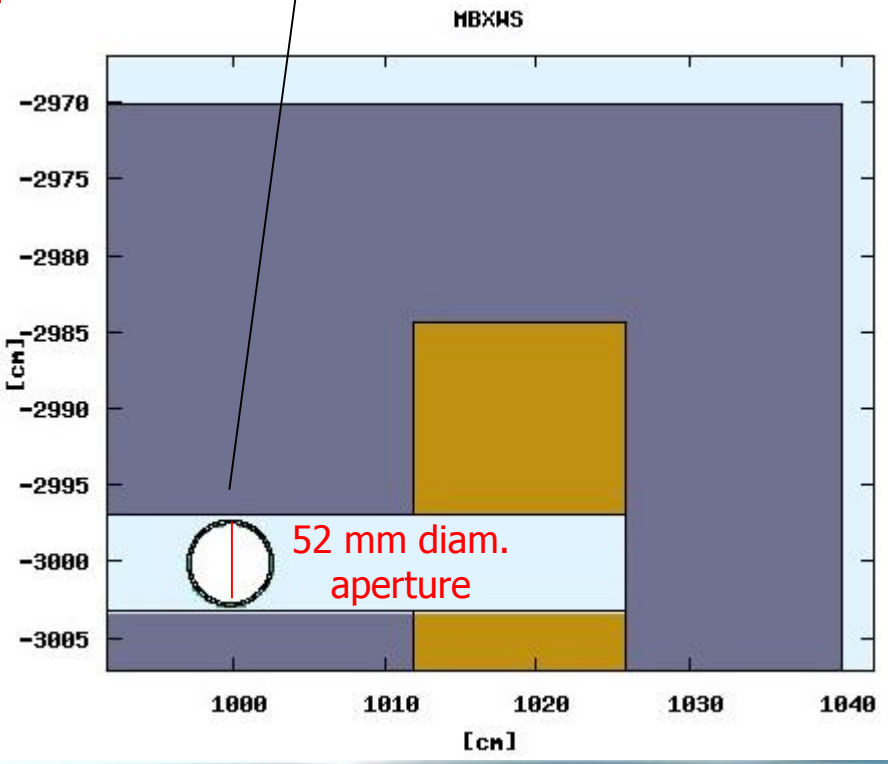
MBXWS

70 W @ 10^{34} cm^{-2} s^{-1}

30 MGy after 100 fb^{-1}

in the IP side return coils

(to be protected in the front)



filling the air gap with tungsten

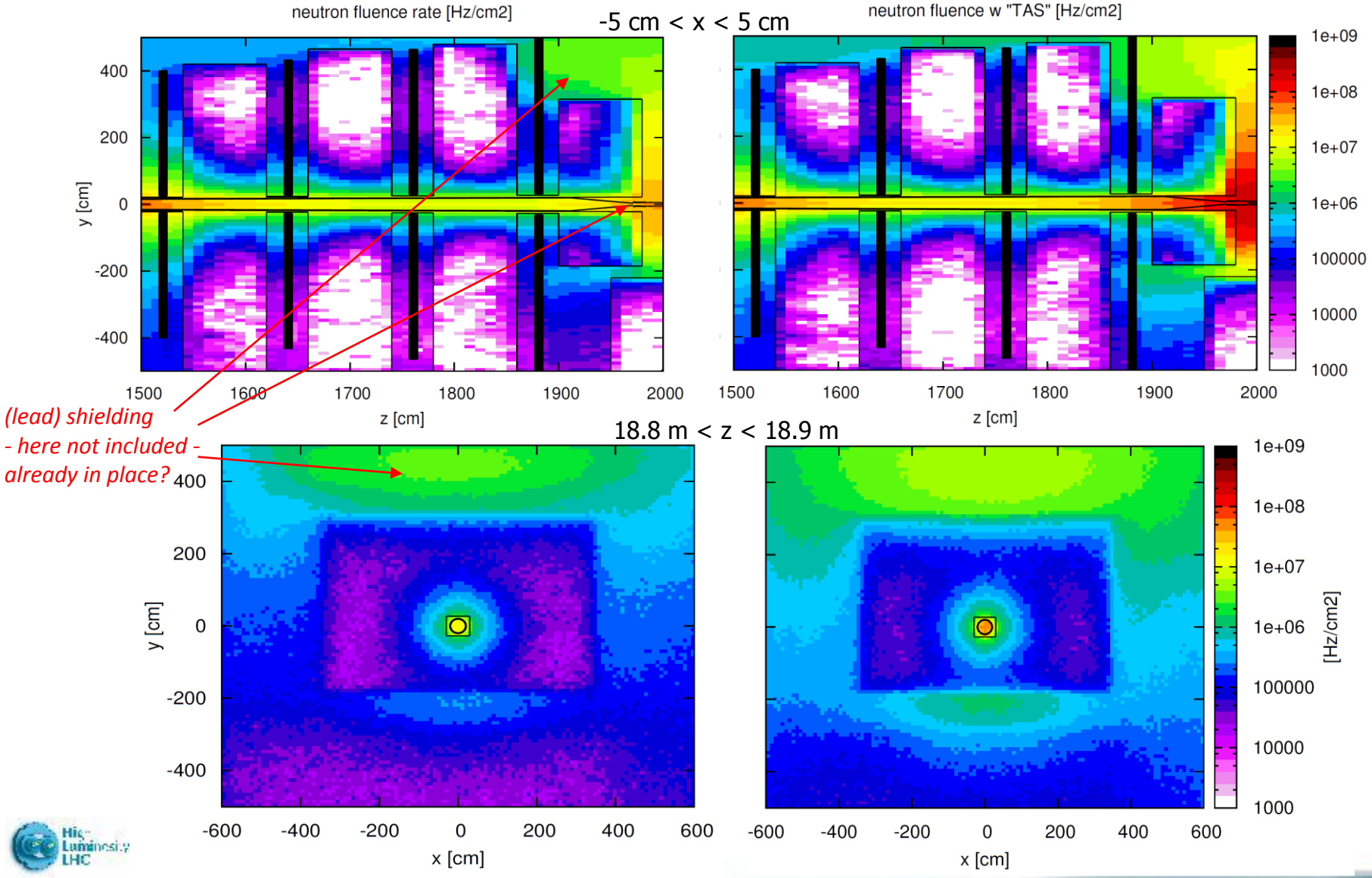
(to use it as a 1m long "TAS")

one collects 115 W more

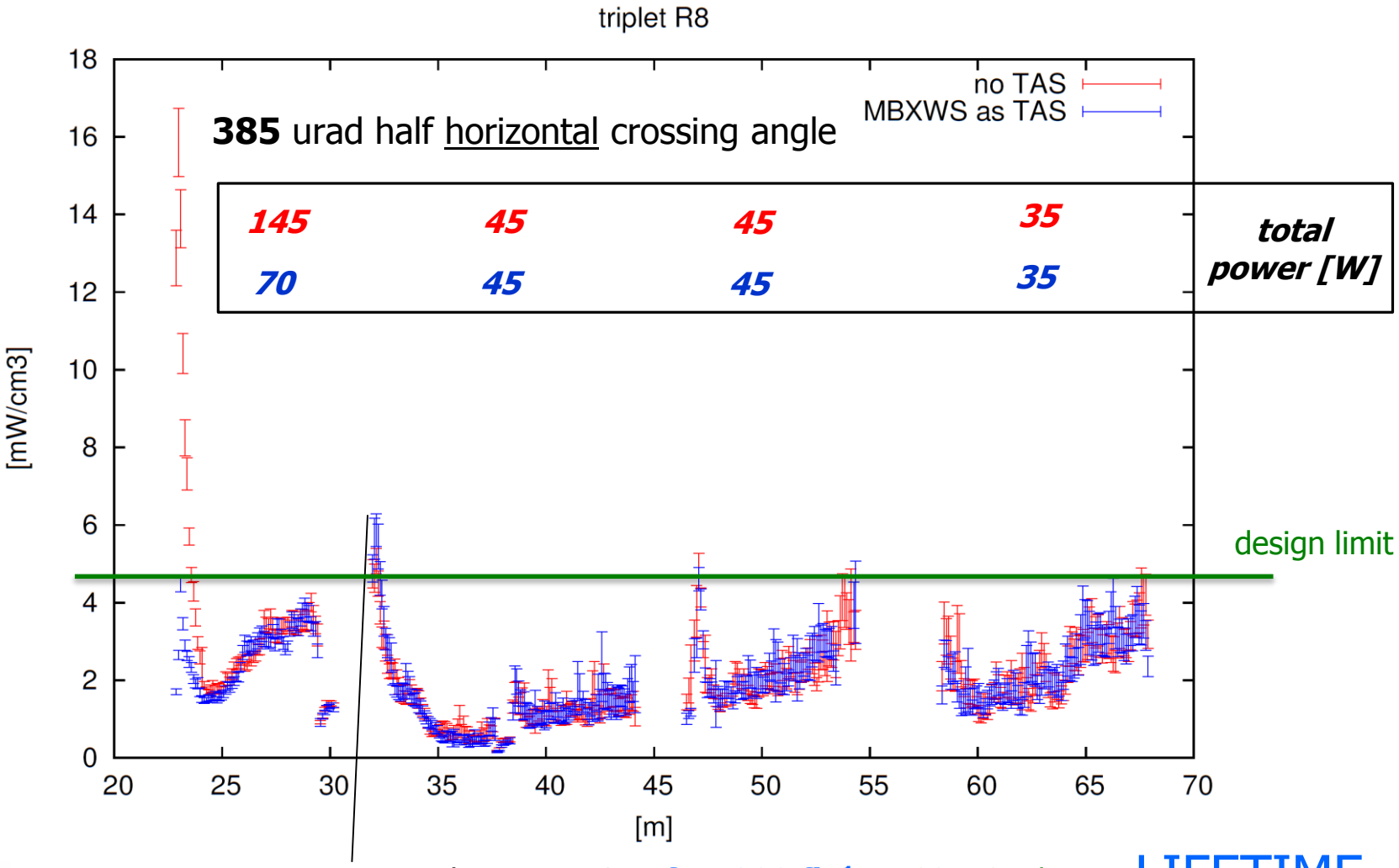
calculations for **385** urad half horizontal crossing angle

NEUTRON BACKGROUND @ 10^{34} cm^{-2} s^{-1}

with tungsten filling inside MBXWS

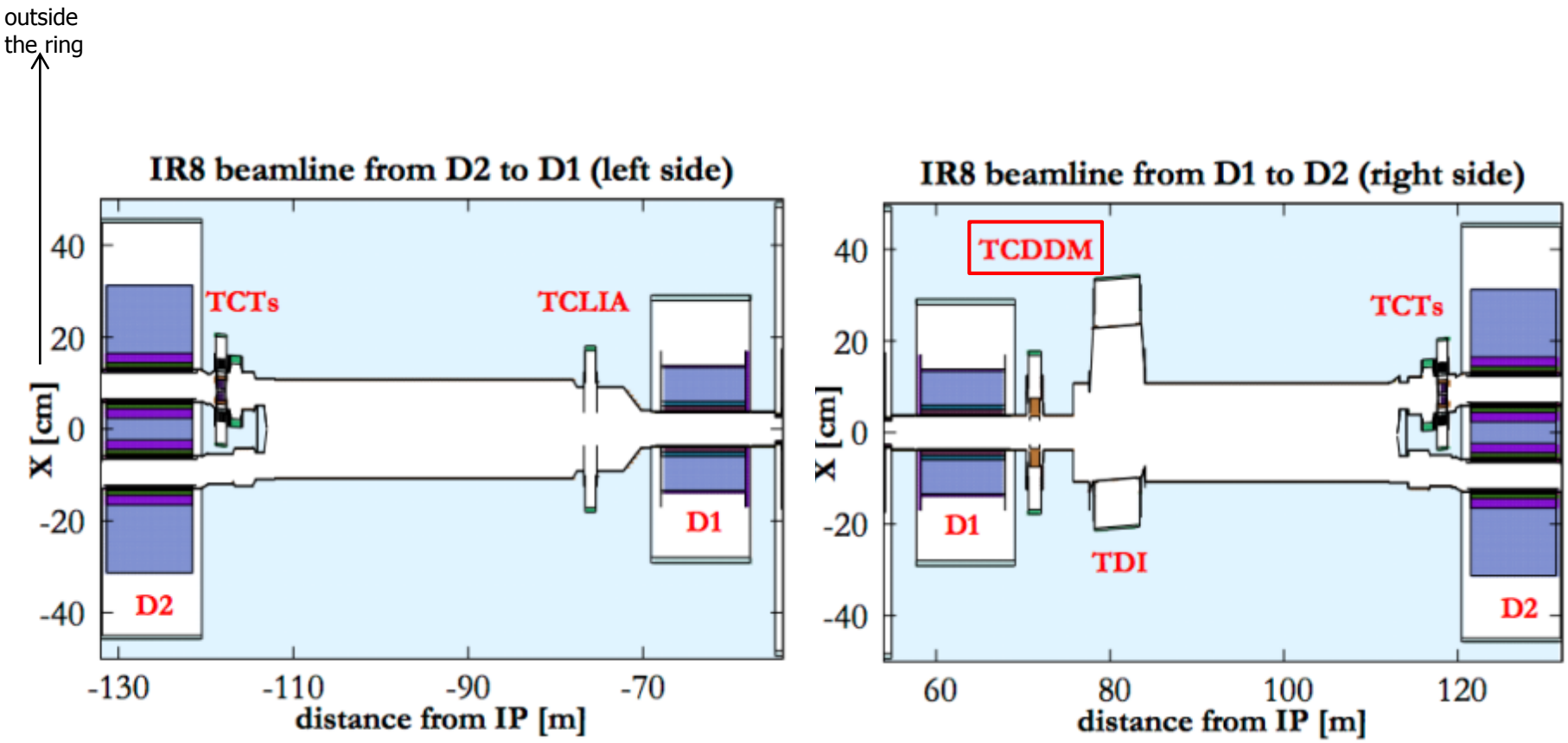


MARGIN TO QUENCH & CRYOLOAD @ 10^{34} cm^{-2} s^{-1}

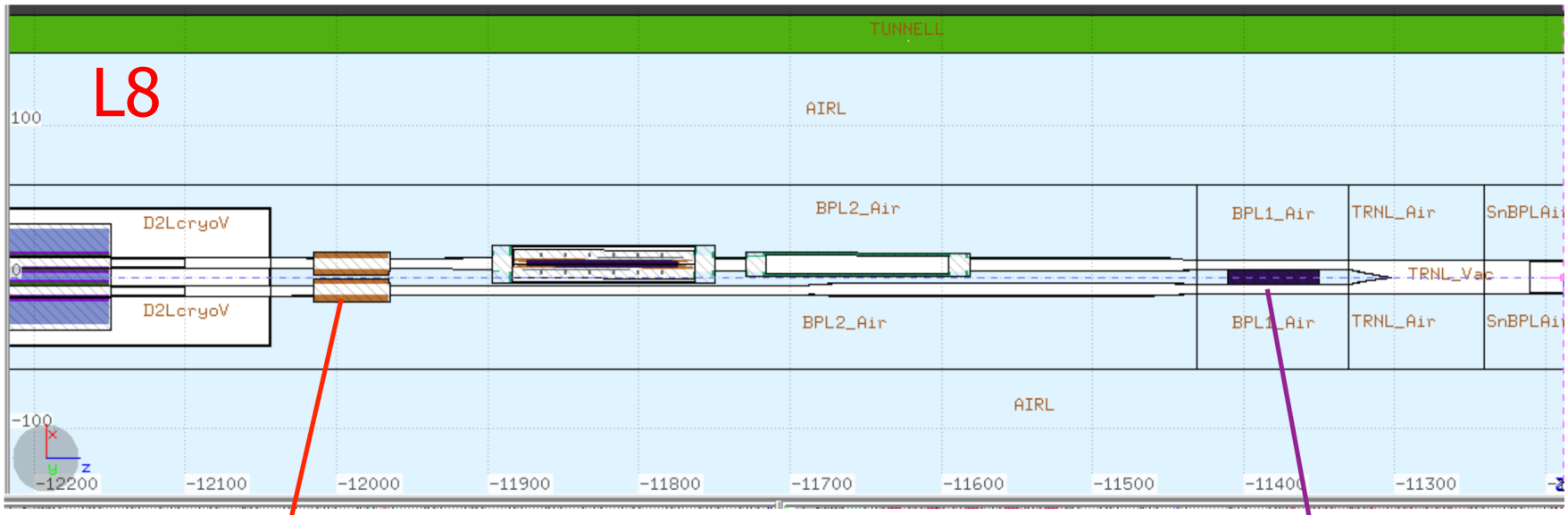


corresponds to **45 MGy** **after 300 fb^{-1}** vs. 30 MGy design LIFETIME

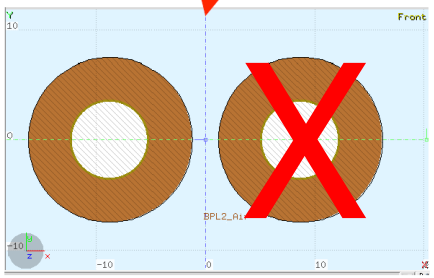
IR8: D1 AND D2


outside the ring
IR8 beamline from D2 to D1 (left side)
TCTs
TCLIA
D1
D2
X [cm]
40
20
0
-20
-40
-130
-110
-90
-70
distance from IP [m]
IR8 beamline from D1 to D2 (right side)
TCDDM
TCTs
D1
TDI
D2
X [cm]
40
20
0
-20
-40
60
80
100
120
distance from IP [m]

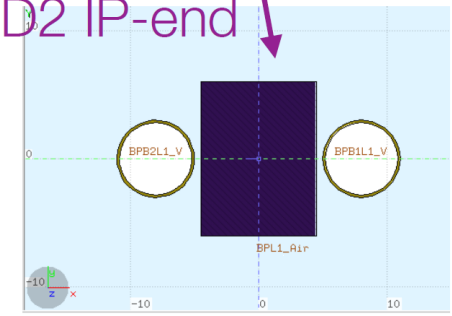
TWO PROTECTION ELEMENTS FOR LS2



50 cm Cu masks
at ~1.35 m
from D2 IP-end



9 × 12 × 60 cm3
Inermet180 absorber at
~ 7.5 m from D2 IP-end

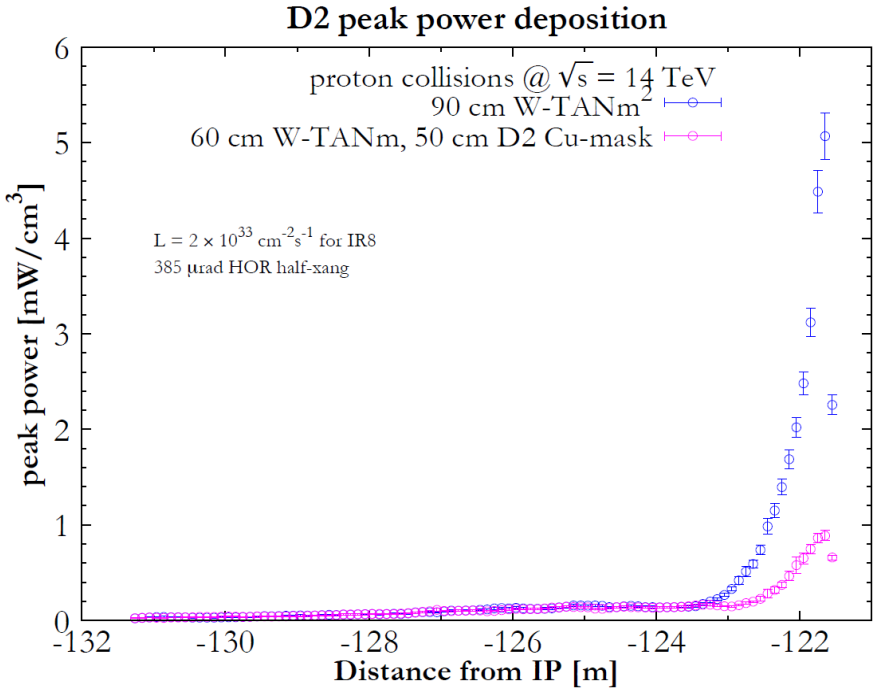


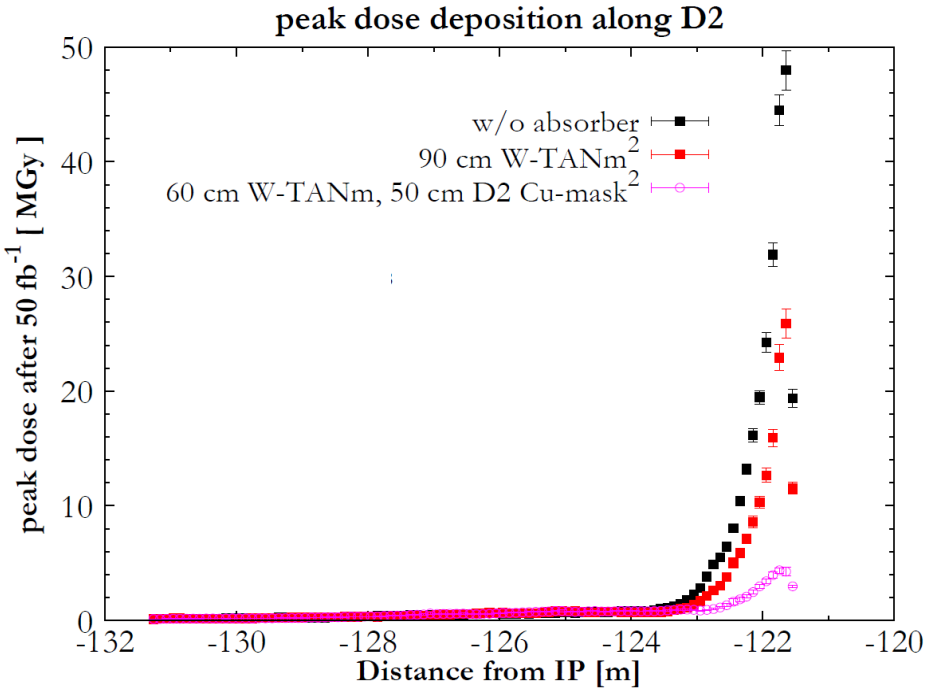
i.e. mini-TAN

MASK EFFECTIVENESS [I]

@ 2 10^{33} cm^{-2} s^{-1} (power), 50 fb^{-1} (dose)

385 urad half horizontal crossing angle





factor 5 reduction in peak power density/dose
in addition to the factor 2 provided by mini-TAN

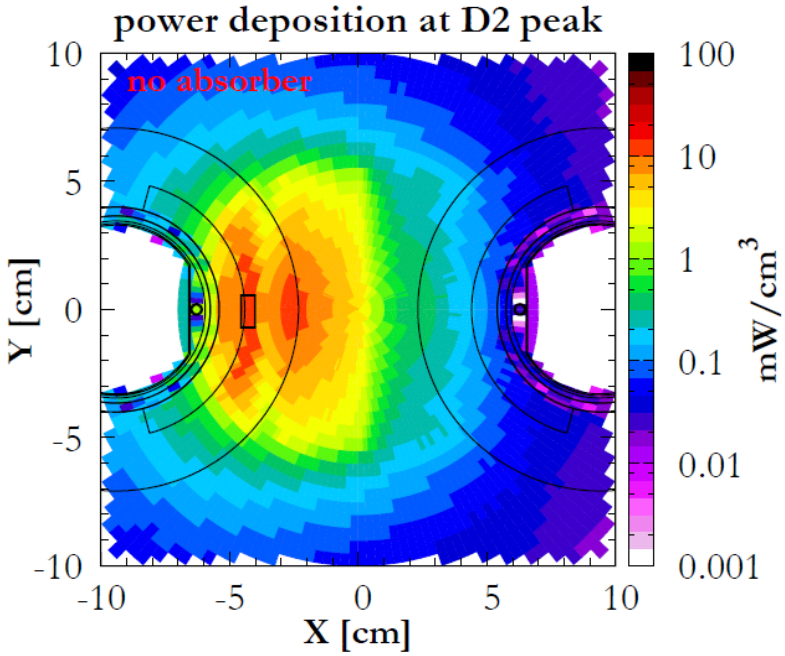
@ 10^{34} cm^{-2} s^{-1}

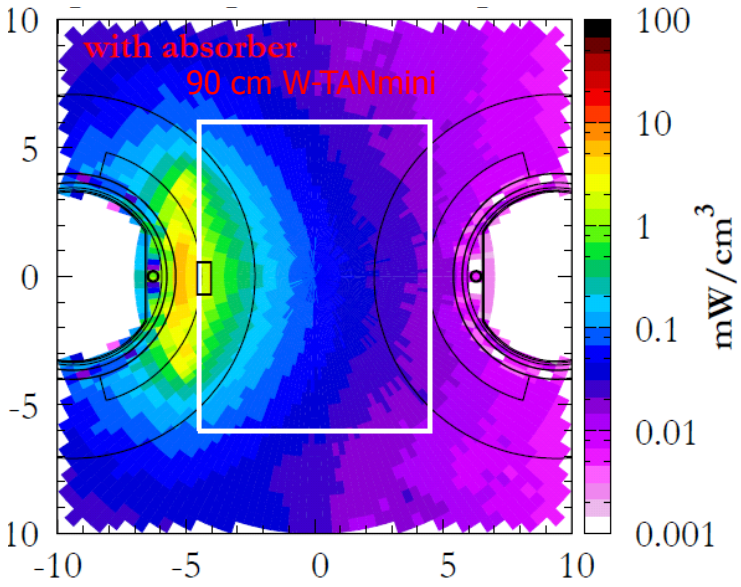
30 W in the D2 cold mass

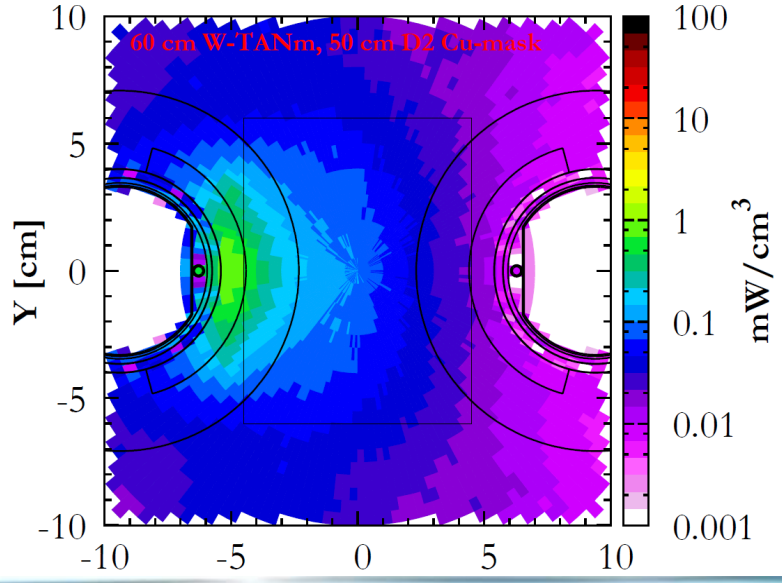
5 mW/cm^3 peak in D2 coils

i.e. 30 MGy after 300 fb^{-1}

MASK EFFECTIVENESS [II]







UPGRADE TO 2 10^{33} cm^{-2} s^{-1} AND 50 fb^{-1} (POST LS2)

L.S. Esposito, talk at the 4th HL-LHC Coordination Group Meeting, 14.01.13

F. Cerutti, talk at the LHC Machine Committee, 27.03.13

L.S. Esposito, F. Cerutti, A. Lechner, A. Mereghetti, V. Vlachoudis, A. Patapenka
CERN-ACC-2013-0285 (IPAC 2013)

A. Santamaria, L.S. Esposito, R. Alemany, H. Burkhardt, F. Cerutti, N.V. Shetty
CERN-ACC-2014-0142 (IPAC 2014)

F. Cerutti, talks at the WP8 Bi-weekly Meetings, 04.11.14 and 23.06.2015

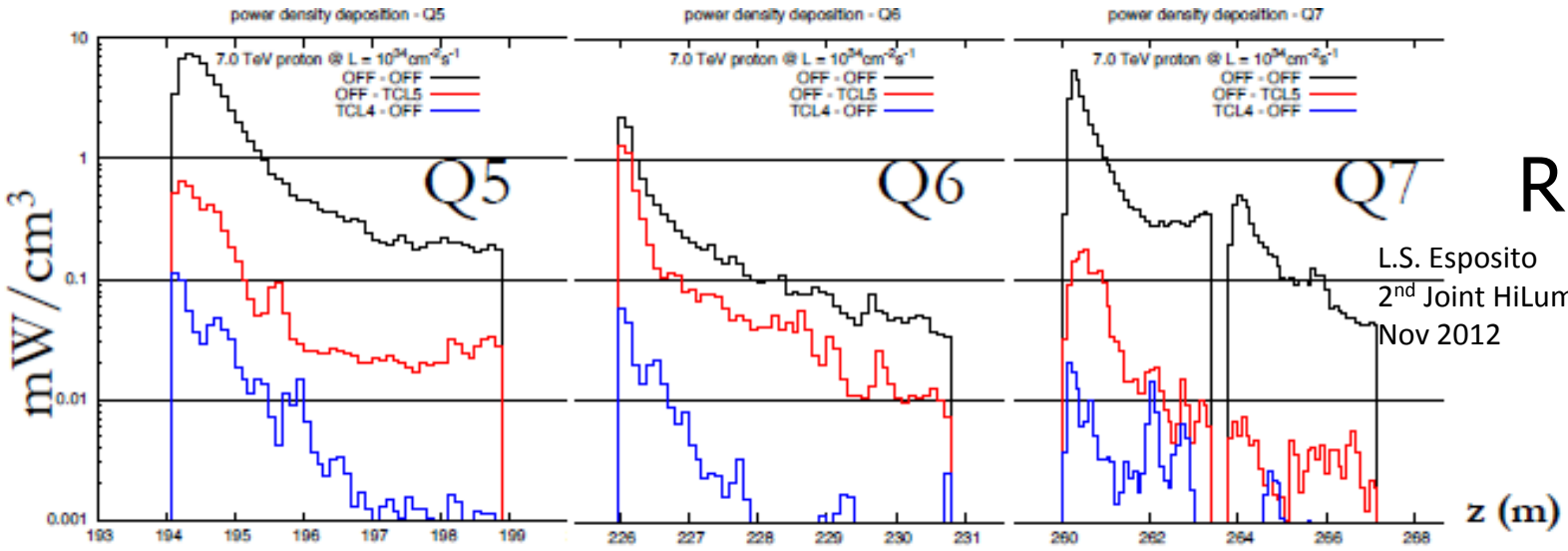
no need for a TAS (values not exceeding IR1 and IR5 at L_0)

D2 (L&R) protection required: 50cm Cu mask (in addition to a 60cm W absorber at the beam chamber separation)

MATCHING SECTION

need for designing a collimator (**TCL**) protection system

Looking for reference at Point 1&5 @ 10^{34} cm^{-2} s^{-1}



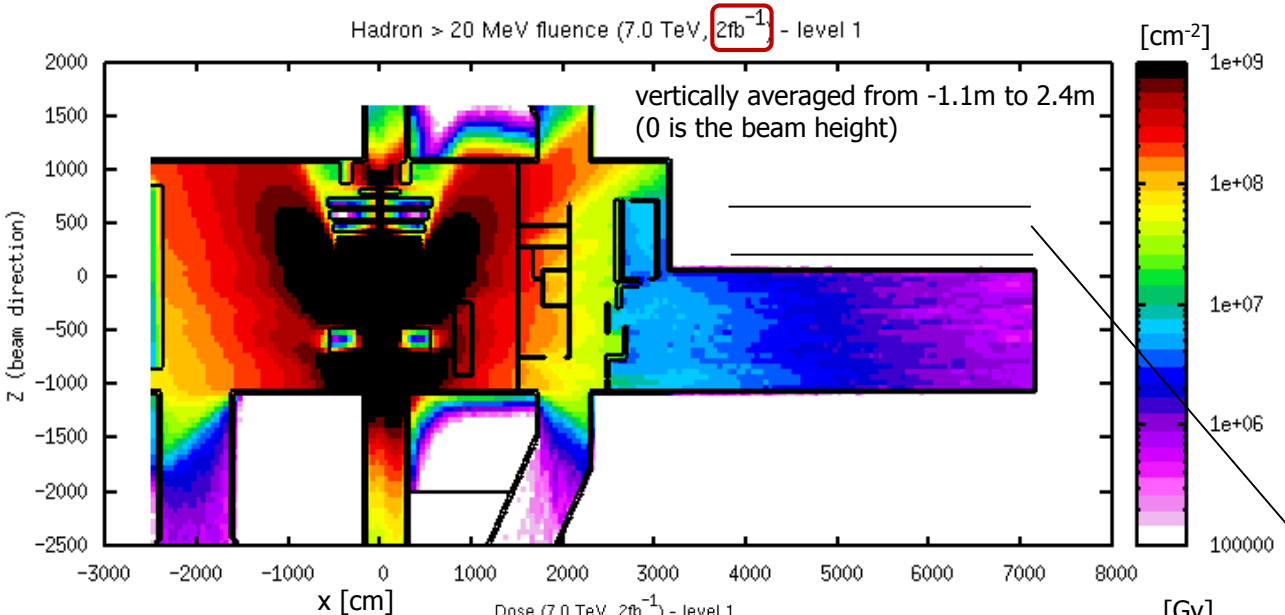
R5 (CMS)

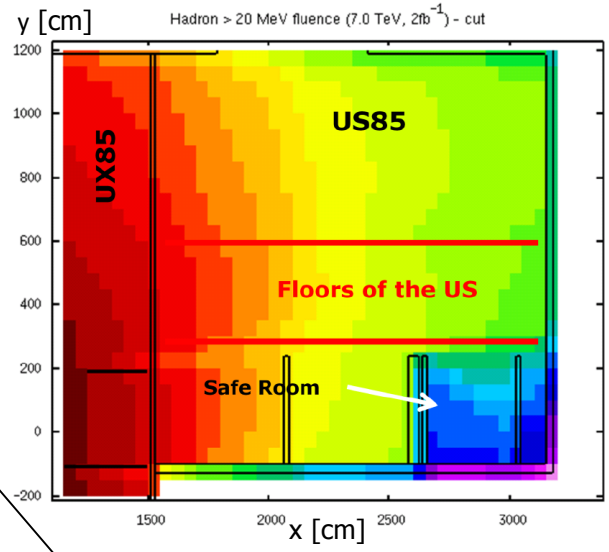
L.S. Esposito
2nd Joint HiLumi LHC - LARP Ann. Meet.
Nov 2012

major role played by TCL4/TCL5

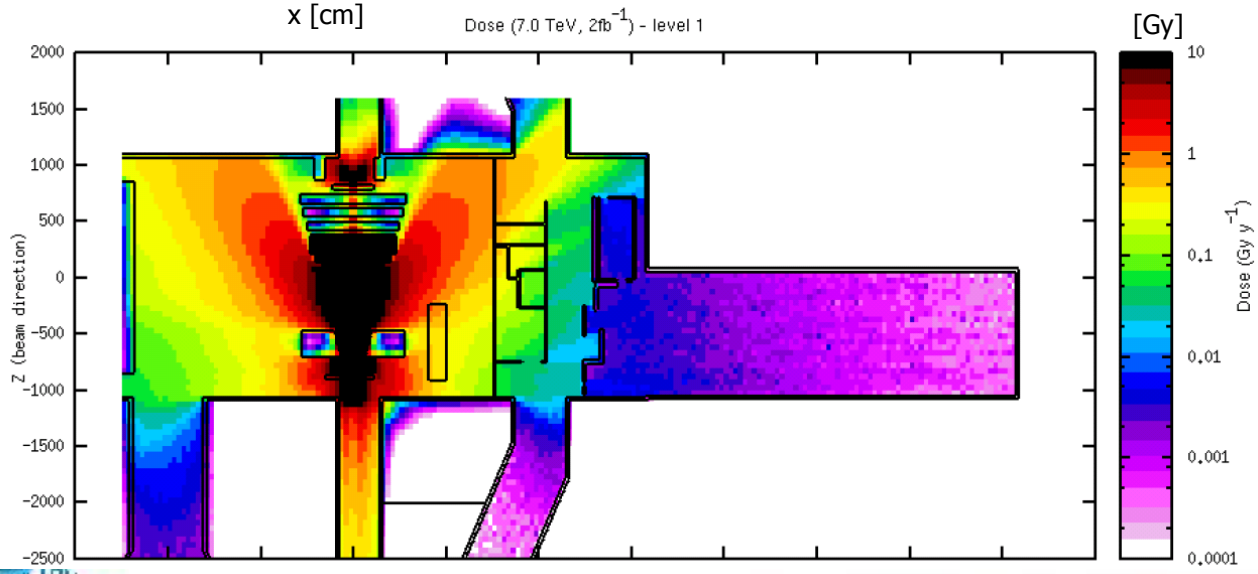
Point 8 specificities: different crossing angle, different TAN,
injection kickers and septa around Q5*R*

SINGLE EVENT EFFECT RISK



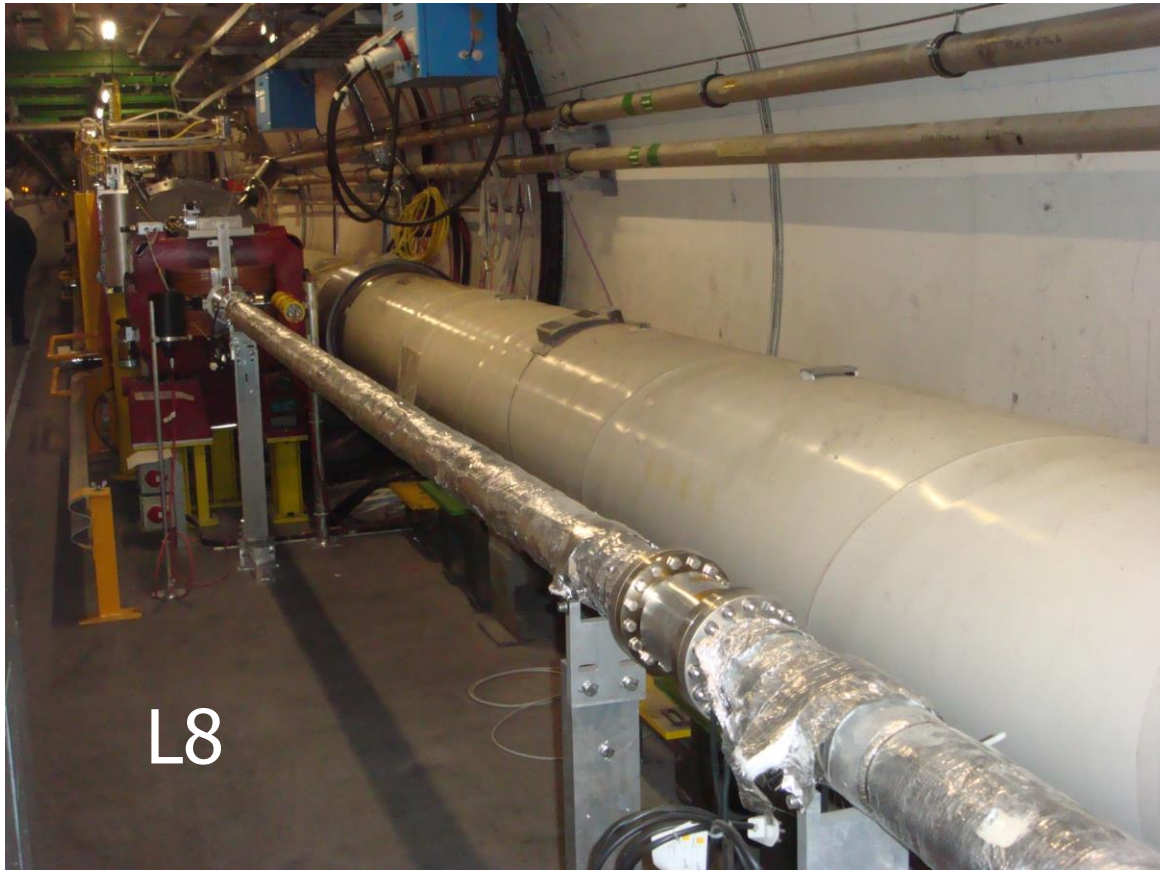


longitudinally averaged over 4m
(from 2m to 6m, 0 is the cavern center)



limit of 10^7 cm^{-2} per year
to be kept facing a
2 to ~100 fb^{-1} lumi increase

QRL



assuming there 1 kGy per 100 fb^{-1}

one gets 0.1 mW/kg @ 10^{34} cm^{-2} s^{-1}

TOWARDS 10^{34} cm^{-2} s^{-1} AND BEYOND

MBXWS as TAS is a promising option, importance dependence on the crossing angle.

Impact of IP displacement and additional dipole to be evaluated.

Background from backscattering to be evaluated with the actual shielding configuration (neutron fluence rate in the unshielded muon chamber above the forward iron block up to several MHz/cm^2)

LS2 mini-TAN+D2 mask solution to be optimized: real TAN?

TCLs for the matching section quadrupole protection

Electronics shielding (US85 safe room)