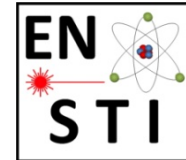

RADIATION IN THE FINAL TRIPLETS

M.I. Besana, F. Cerutti, L.S. Esposito, A. Ferrari



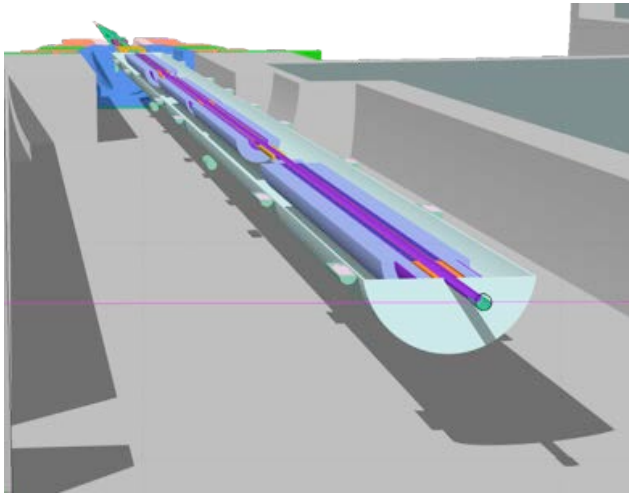
input and advice by R. Martin, D. Schulte, E. Todesco, R. Tomás

FCChh General Design Meeting

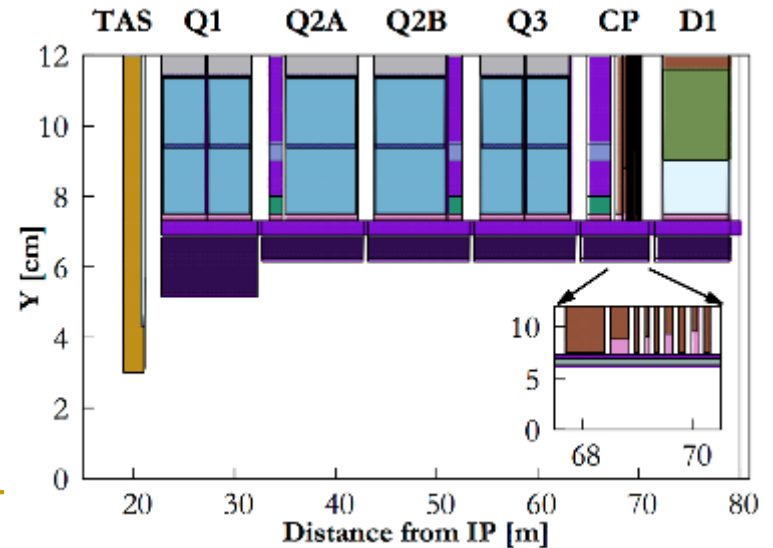
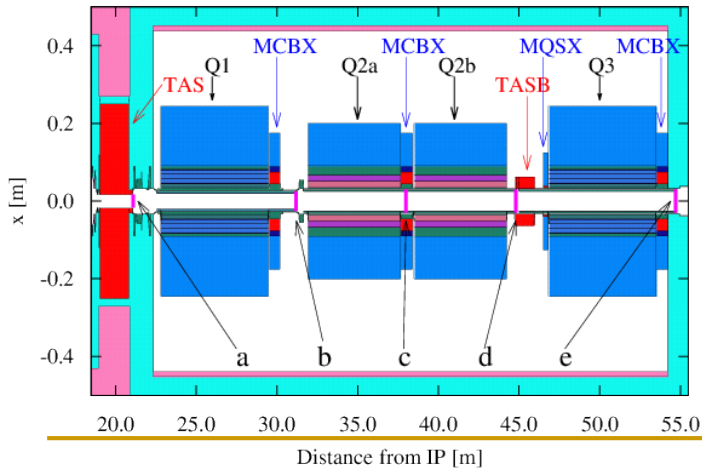
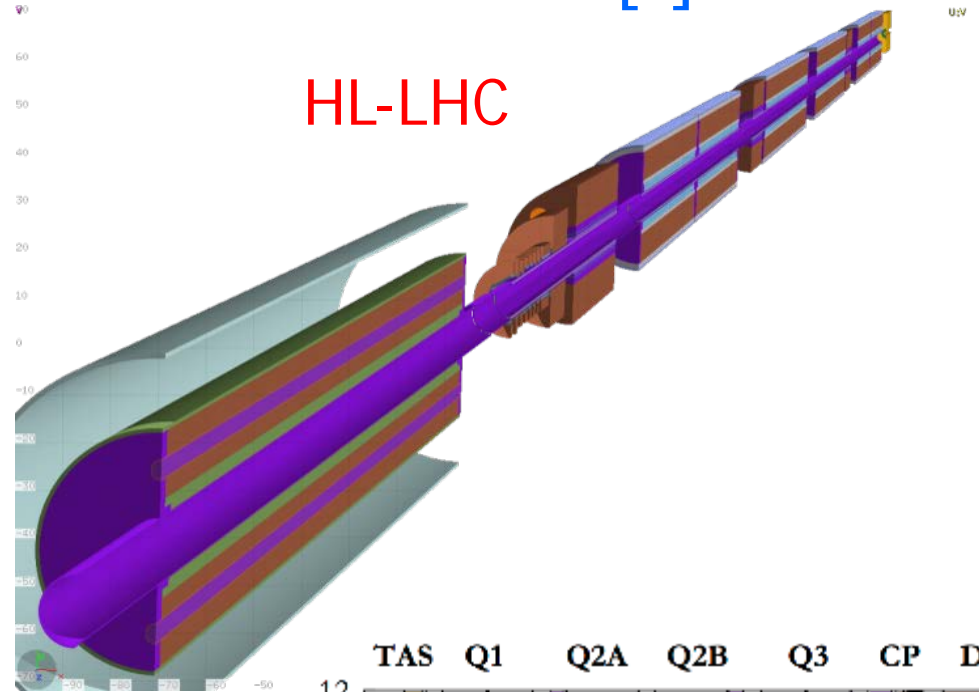
Oct 16, 2014

PRESENT AND "NEAR" FUTURE [I]

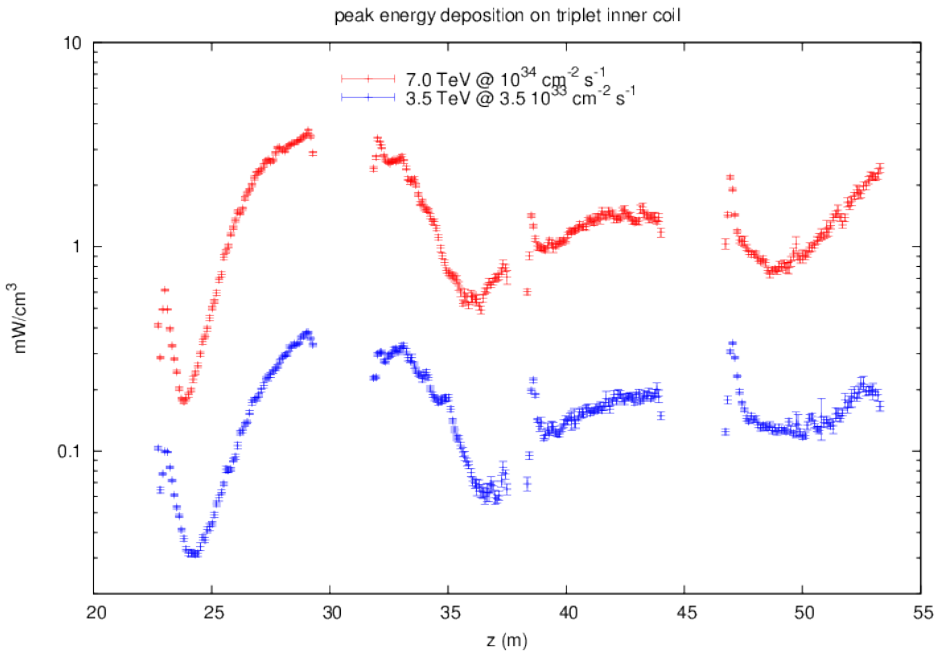
LHC



HL-LHC

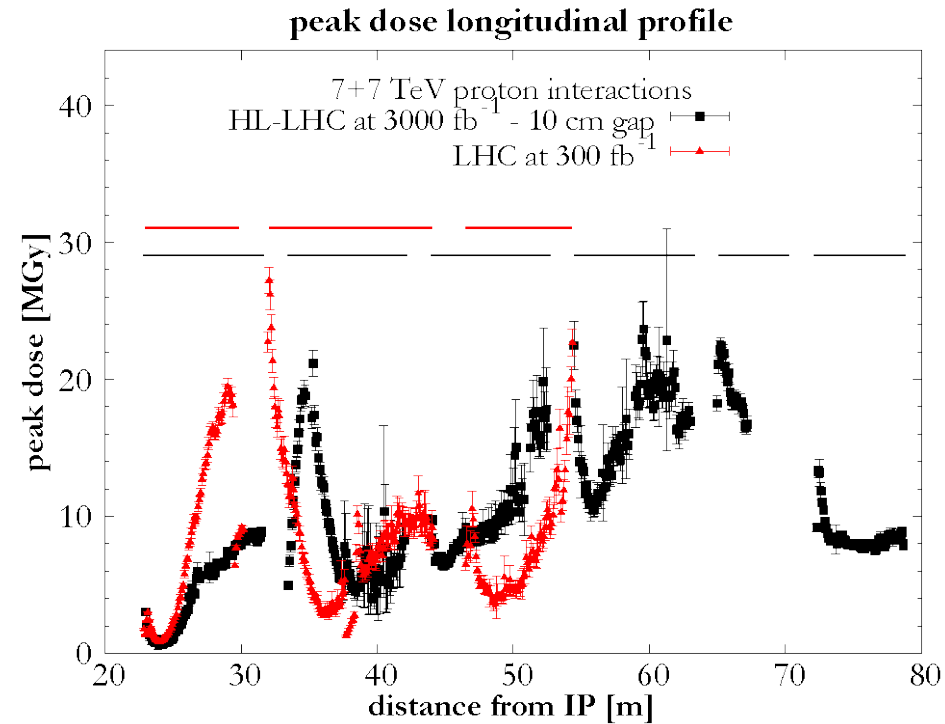


PRESENT AND "NEAR" FUTURE [II]



$\sim 4 \text{ mW/cm}^3$

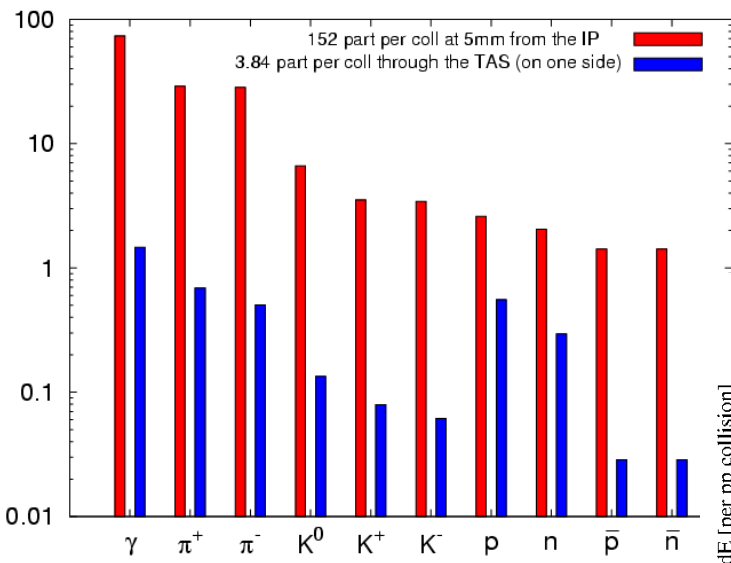
at nominal energy and luminosity



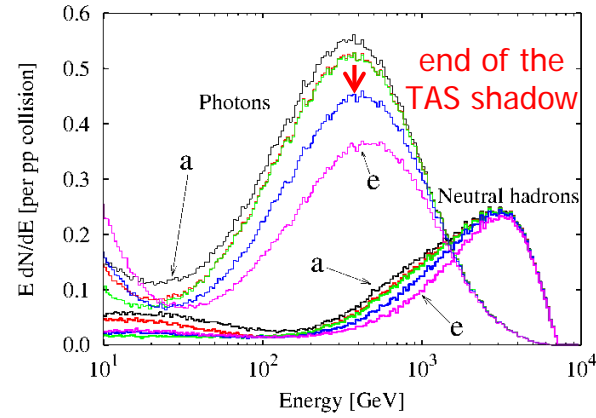
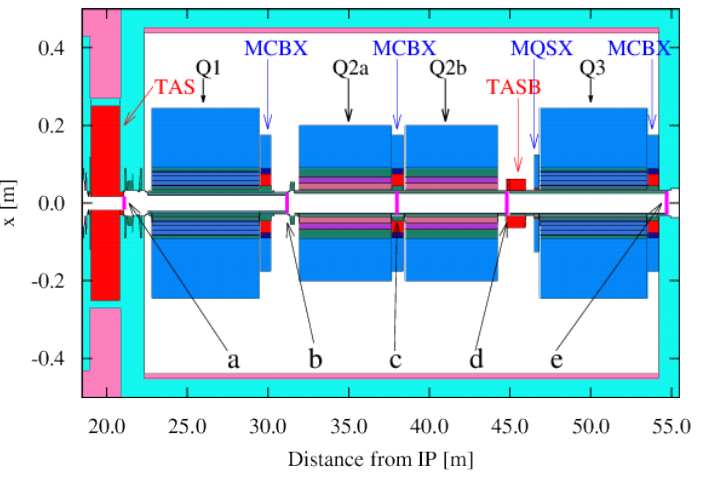
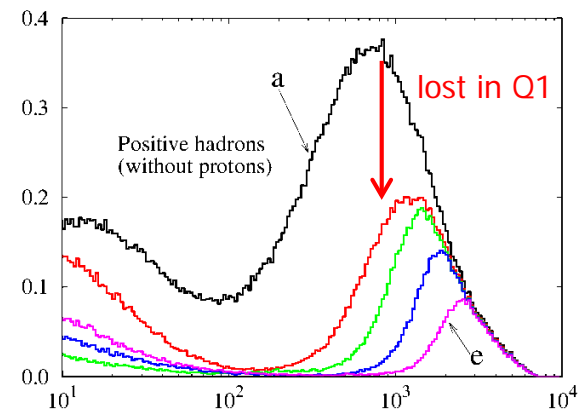
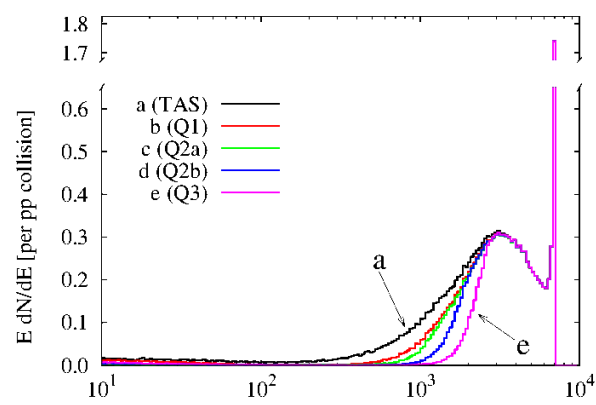
$\sim 30 \text{ MGy}$

after the target integrated luminosity

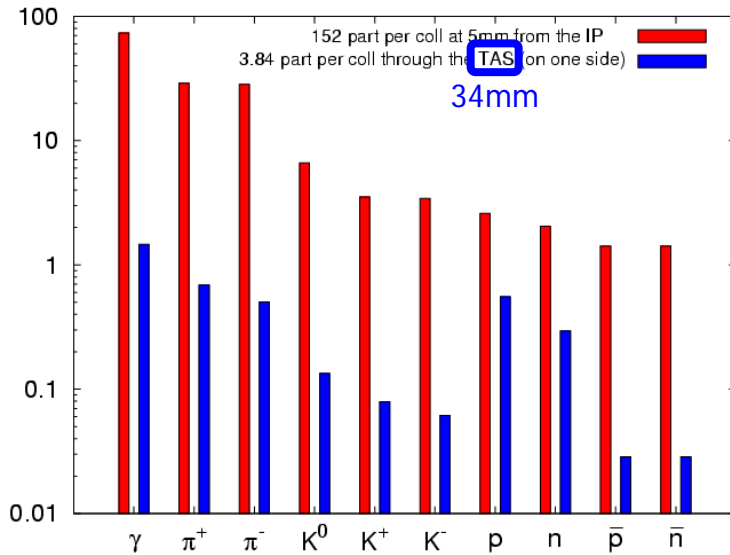
THE RADIATION SOURCE [I]



7 TeV p + 7 TeV p



THE RADIATION SOURCE [II]

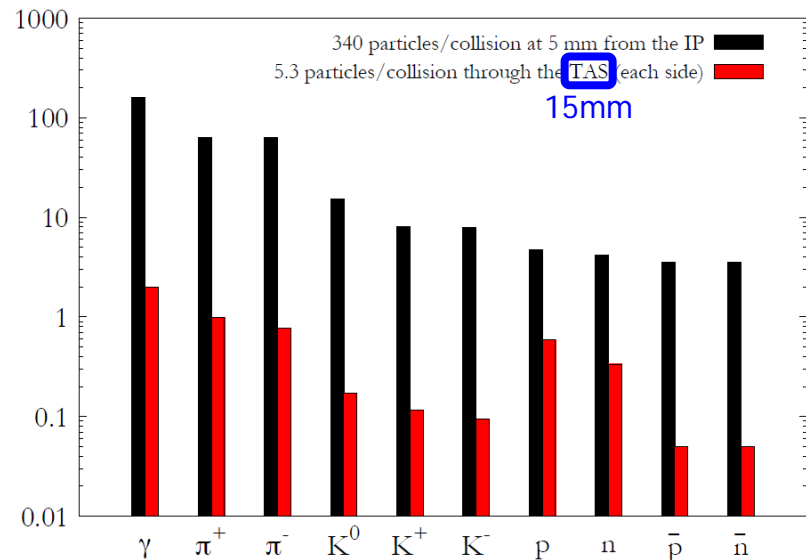


7 TeV p + 7 TeV p (85mb)

@ $L_0 = 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$

yields 1 kW

towards each (L&R) side



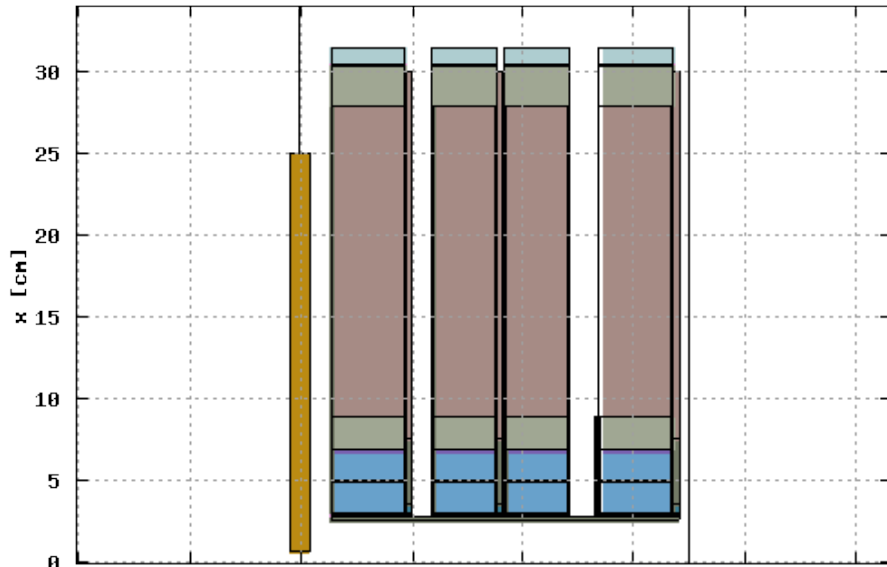
50 TeV p + 50 TeV p (108mb)

@ $L_0 = 5 \cdot 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$

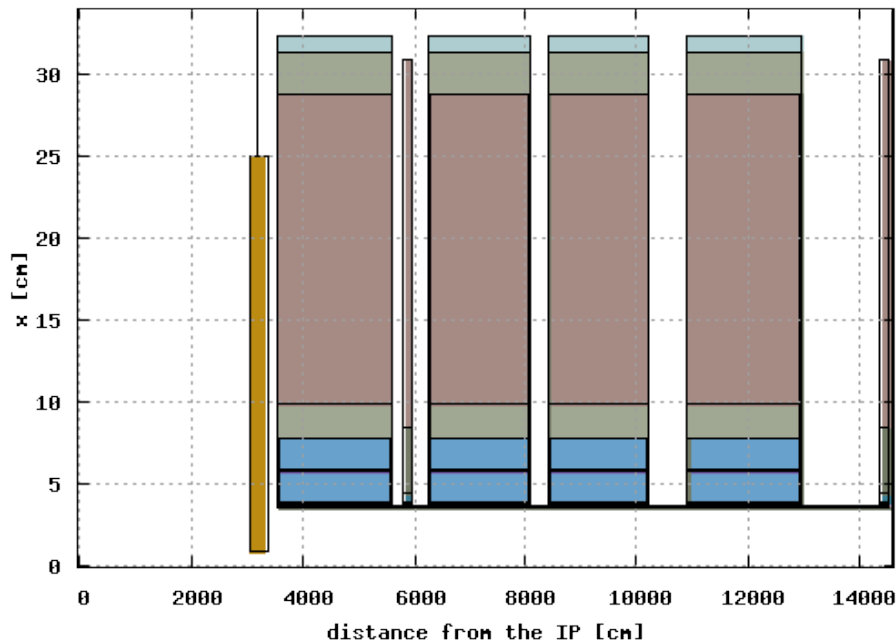
yields 43 kW

towards each (L&R) side

STUDY CASES



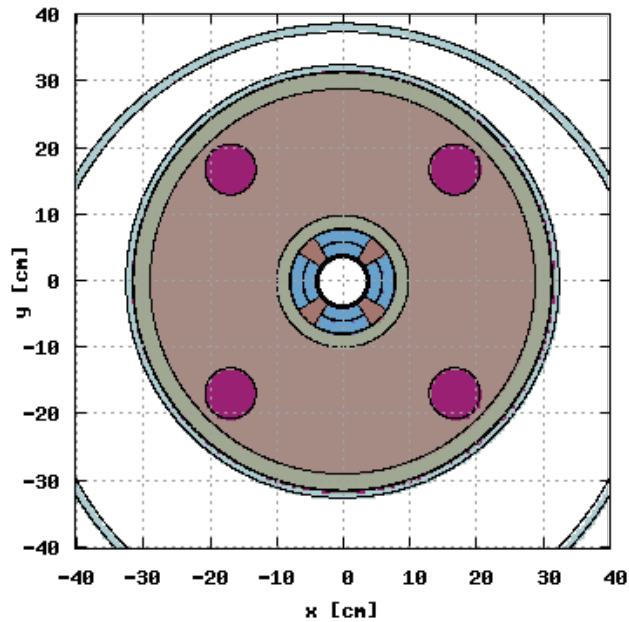
365 T/m
 62mm coil aperture
 12.74m (Q1&3) and 11m (Q2a&b) magnetic lengths
 TAS: 15mm aperture and 3.6m length
43urad half horizontal crossing angle



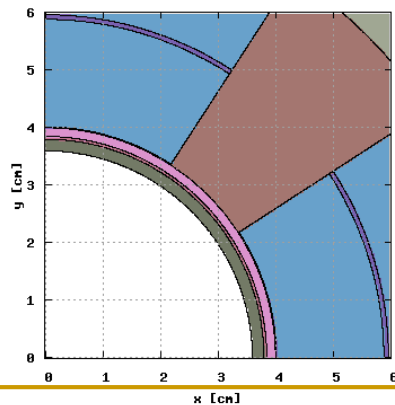
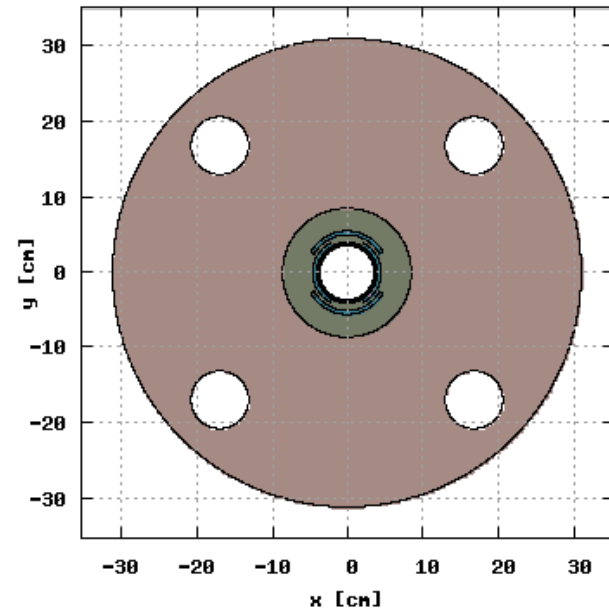
220 T/m (Q1) and 190 T/m (Q2&3)
 80mm coil aperture
 20m (Q1&3) and 17.5m (Q2a&b) magnetic lengths
 TAS: 20mm aperture and 3m length
70urad half vertical crossing angle

MAGNET MODELS

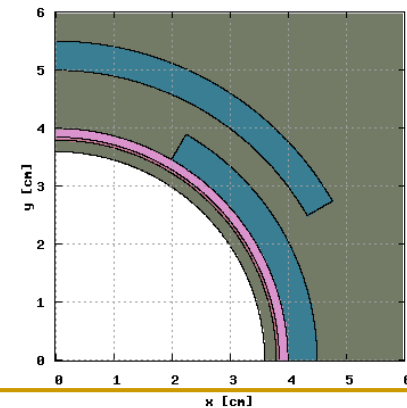
final focus quadrupole Nb₃Sn



orbit corrector NbTi



2mm thick Cold Bore
0.5mm Kapton insulator
1.5mm LHe
no beam screen

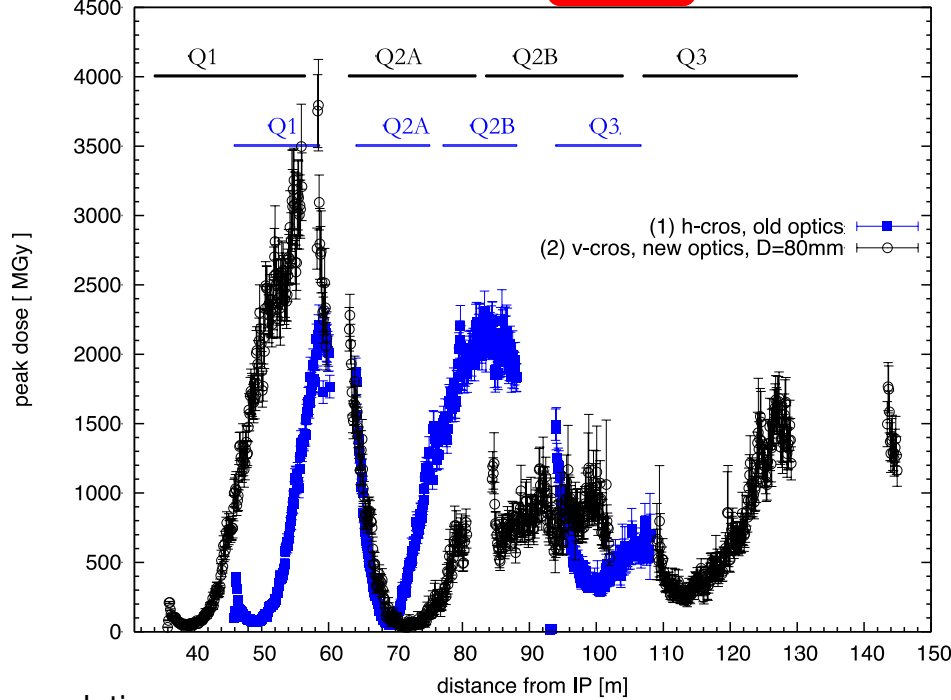
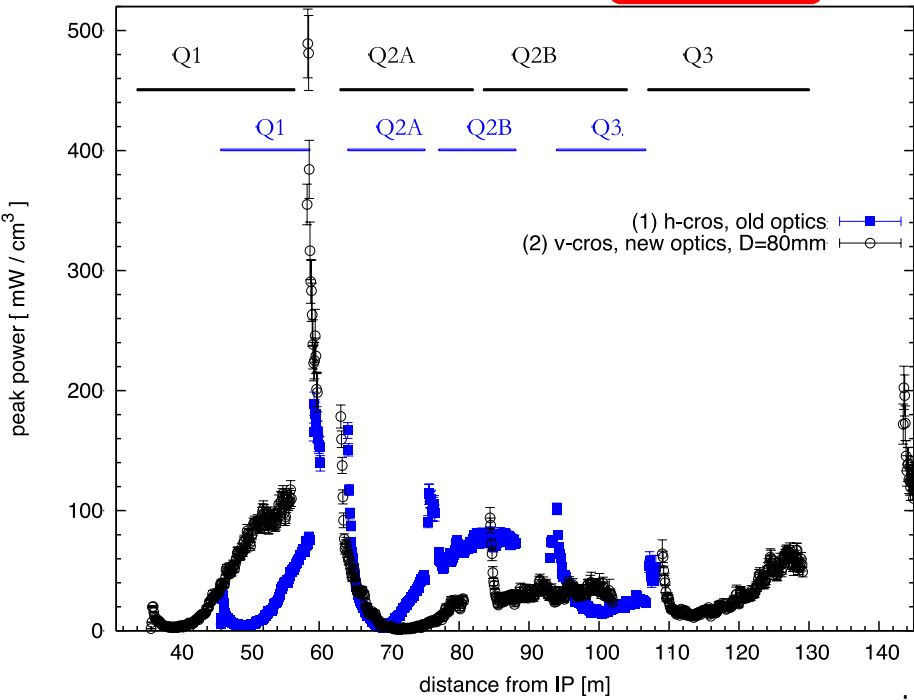


PEAK POWER DENSITY AND DOSE PROFILES

no shielding

peak power profile on the inner coil layer @ $5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$

peak dose profile per 3000 fb^{-1}



scoring resolution

$\Delta r = \text{coil thickness}$

$\Delta z = 10 \text{ cm}$ $\Delta \phi = 2^\circ$

$\Delta r = 2 \div 3 \text{ mm}$ (innermost strands)

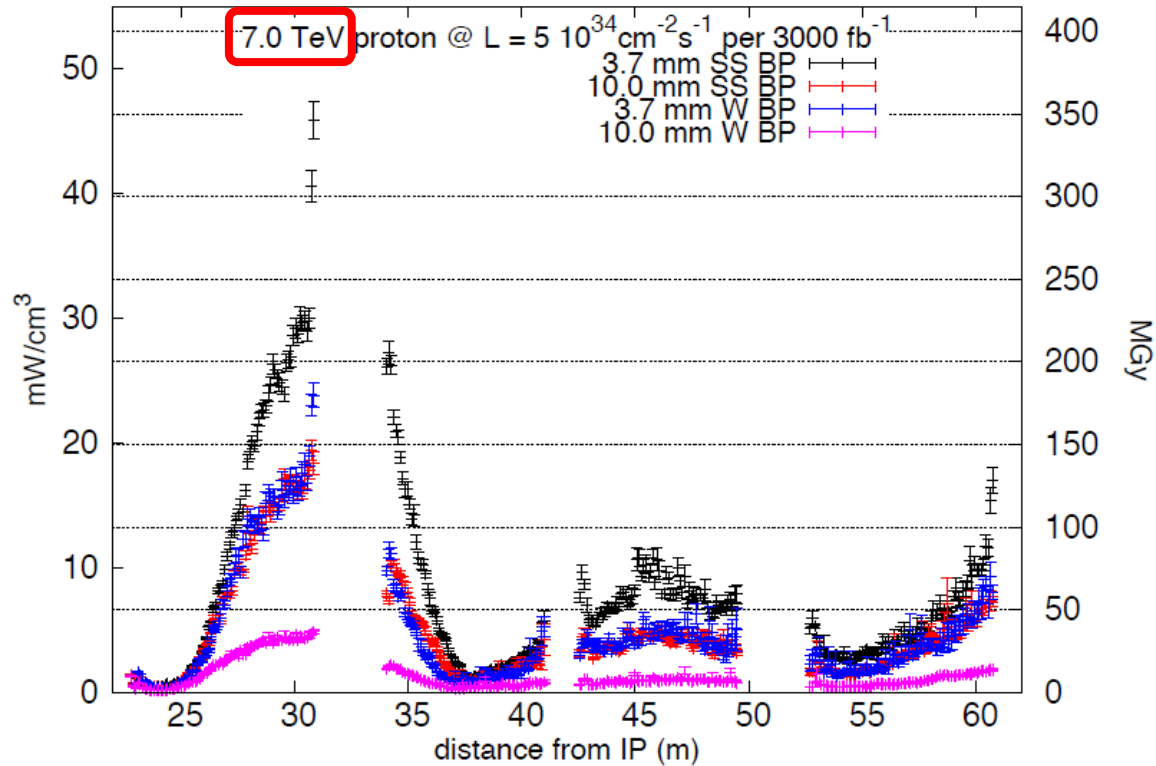
REQUIREMENTS FOR THE CRYOSYSTEM

Total power [W] @ $5 \cdot 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$		
component\layout	62mm	80mm
TAS	8851	7029
Q1	843	1868
C1	223	502
Q2a	1063	1010
Q2b	1608 + 245* * orbit corrector + Qs	1907
Q3	1531	2107
C3	110	552
	5620	7950

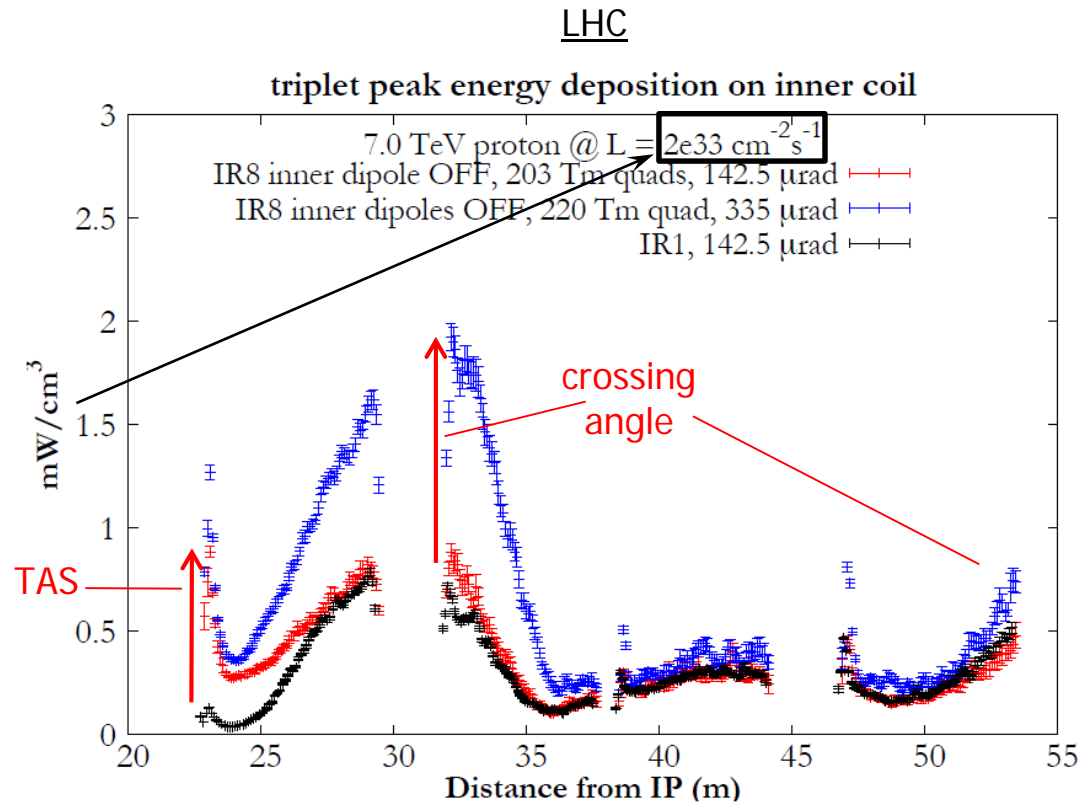
SHIELDING EFFECTIVENESS

140mm coil aperture

triplet peak energy deposition on innermost 3 mm



TAS AND CROSSING ANGLE ROLE

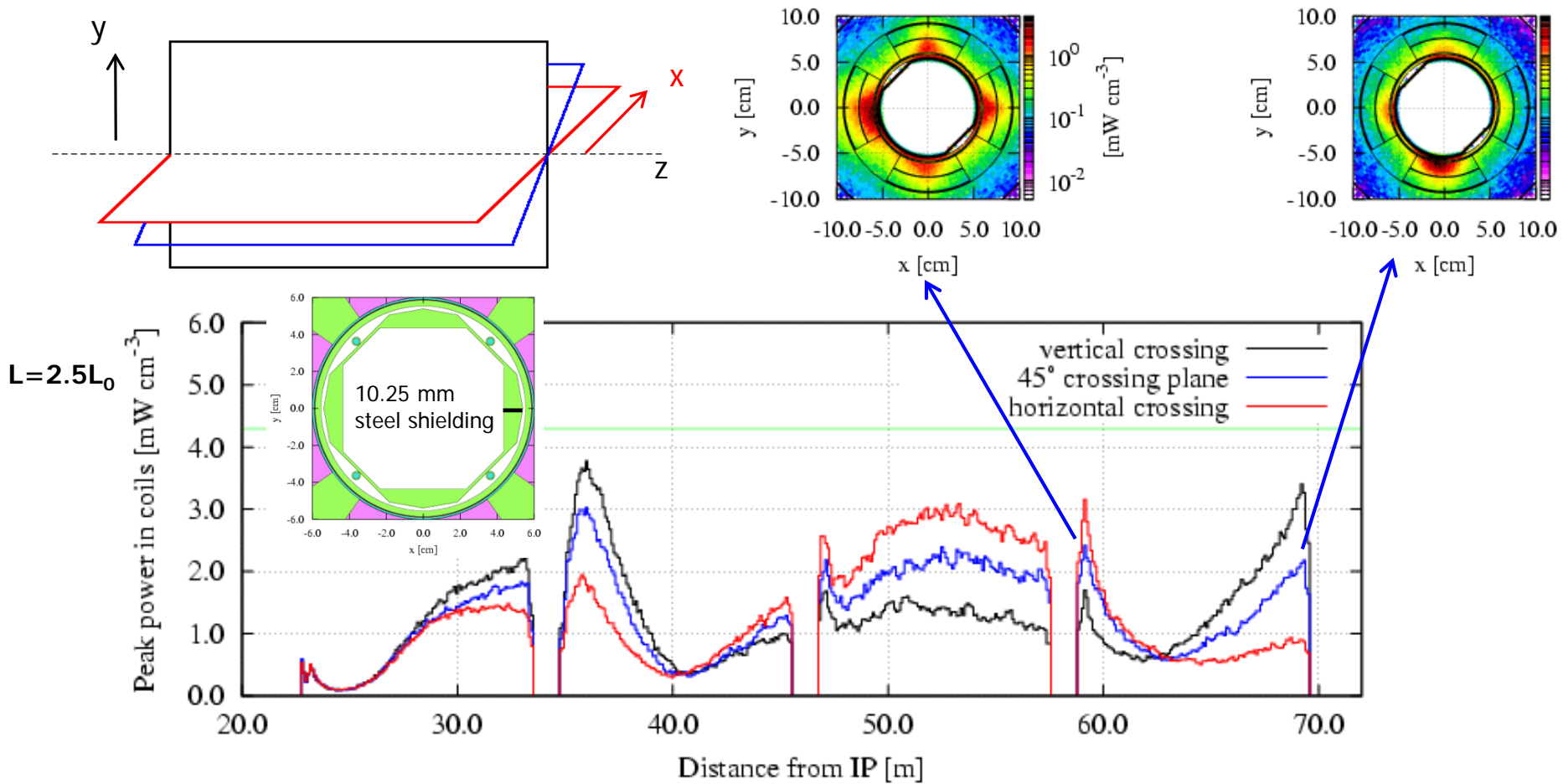


CROSSING PLANE ROLE

7 TeV

120mm coil aperture

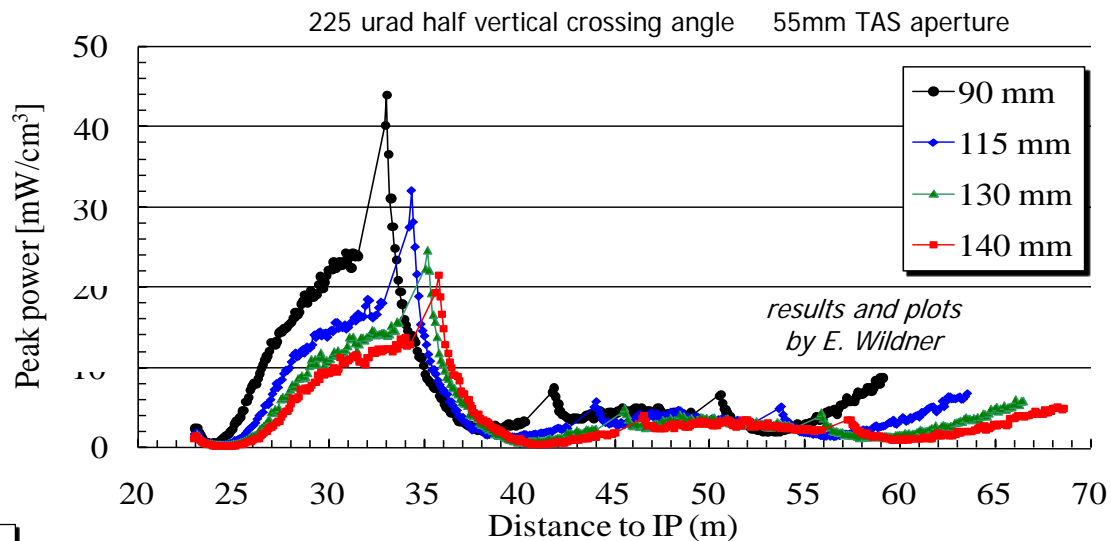
225 urad half crossing angle



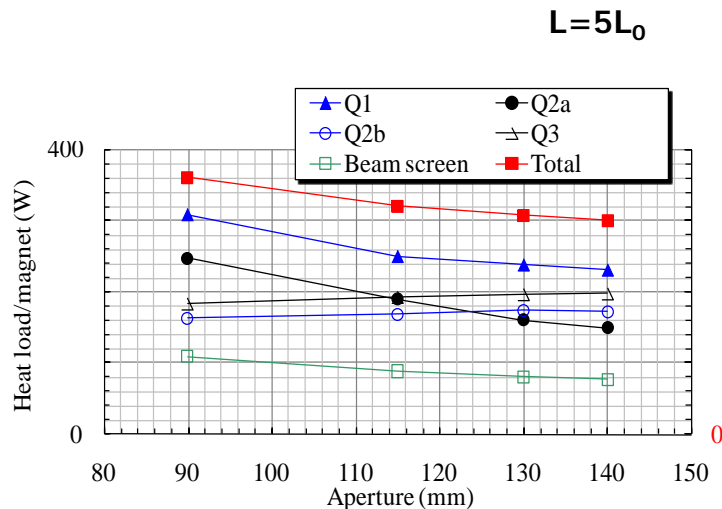
PARAMETRIC STUDY

Total length (m)	Gradient (T/m)	Aperture (mm)
36.2	156	90
40.7	125	115
43.6	112	130
45.7	104	140

idea and numbers by E. Todesco



the longer, the better

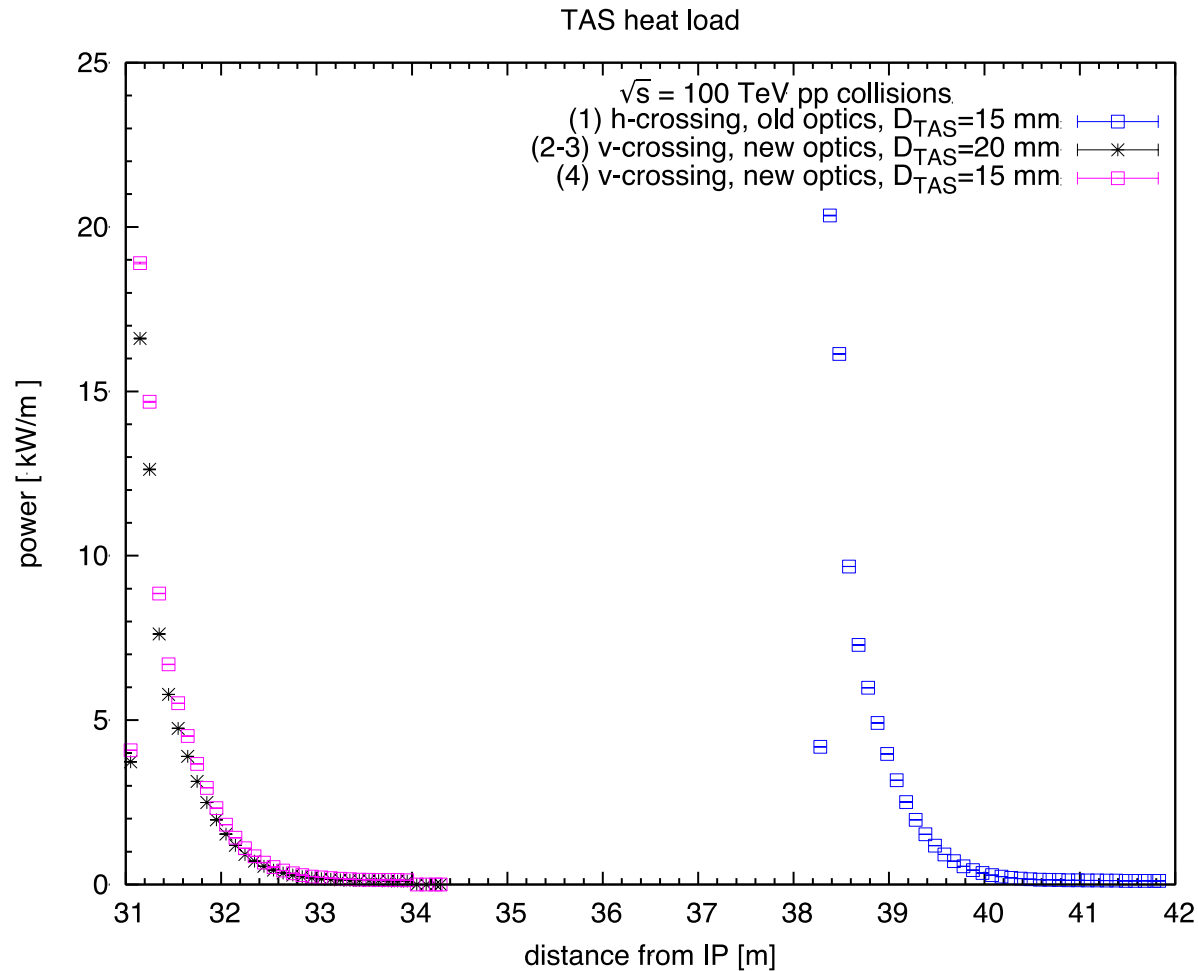


PERSPECTIVES

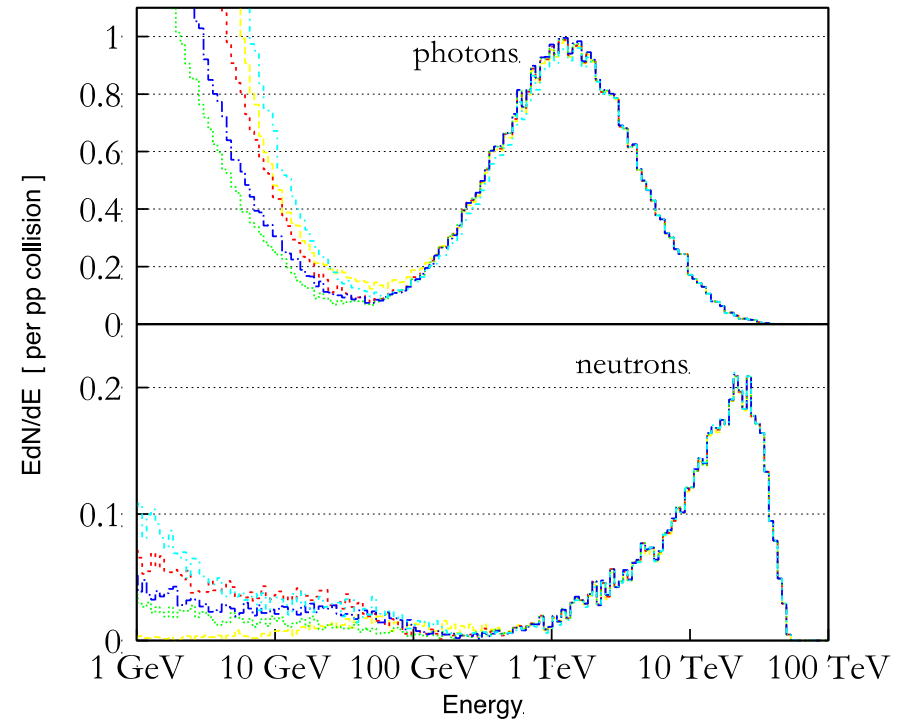
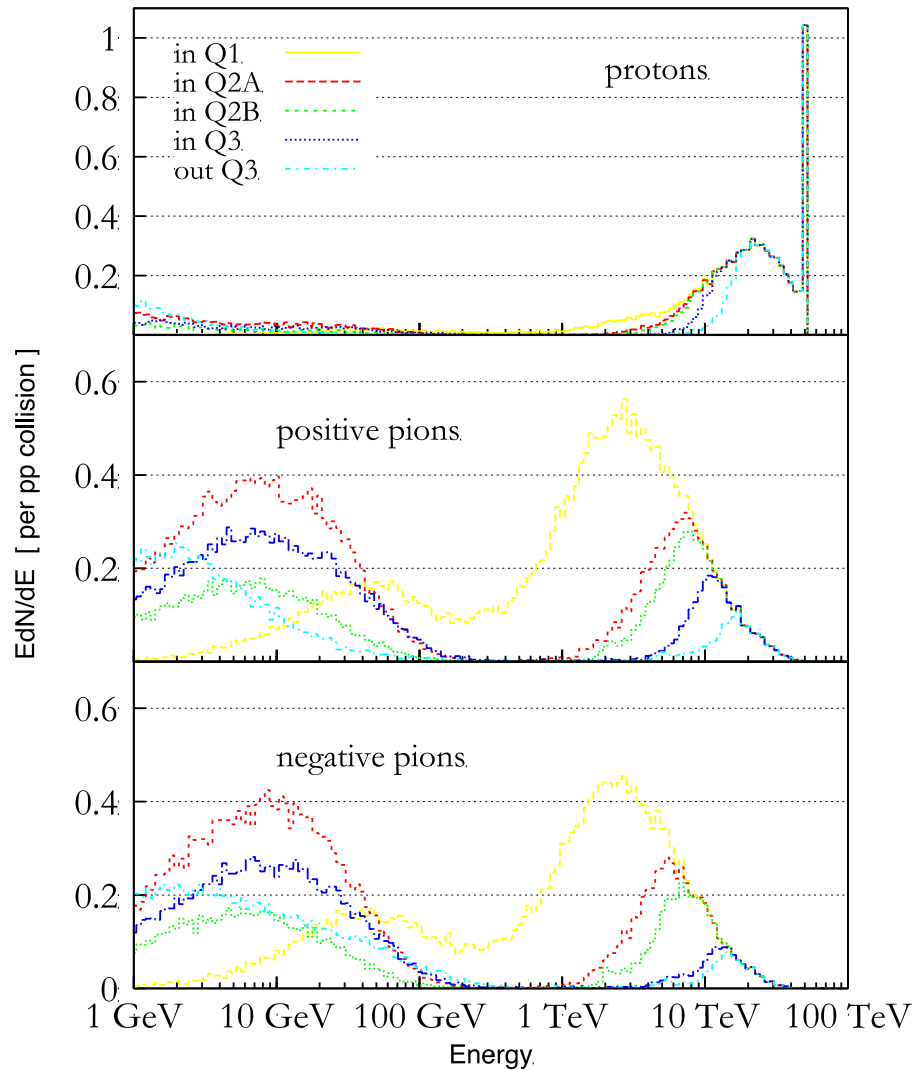
Evaluate the improvement by basic shielding options (continuous INERMET liner)

Explore the design parameter space with respect to the impacting energy by charged pions

TAS COOLING



DEBRIS PROPAGATION



AZIMUTHAL MAP IN THE COLD BORE

