Report from Vienna

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Talk Outline

- The (happy?) end of a Saga:
  - pairs production rate comparison
  - measurement made with Belle at KEKB
- The rest of the background picture in Belle-II
  - Radiative Bhabha
  - Touschek
- Conclusions

Pairs Production Rate Issue

Estimates for expected QED rates

background tracks per event:

BDK: $N_{\mathrm{tr}}^{\mathrm{bg}} = 2630$

KW: $N_{\mathrm{tr}}^{\mathrm{bg}} = 2519$

Naive estimate of occupancy:

Nr of pixels: $250 \times 1600 \times 8 = 3.2 \times 10^6$

(assume each track lights up 3 pixels)

$0.24\ \%$ ⟷ $1.3\ \%$

Our number

„SuperB“ number

Expectation from SuperB MC:

$N_{\mathrm{tr}}^{\mathrm{bg}} = 13800$

These numbers from SuperB include the multiple hits produced by each track

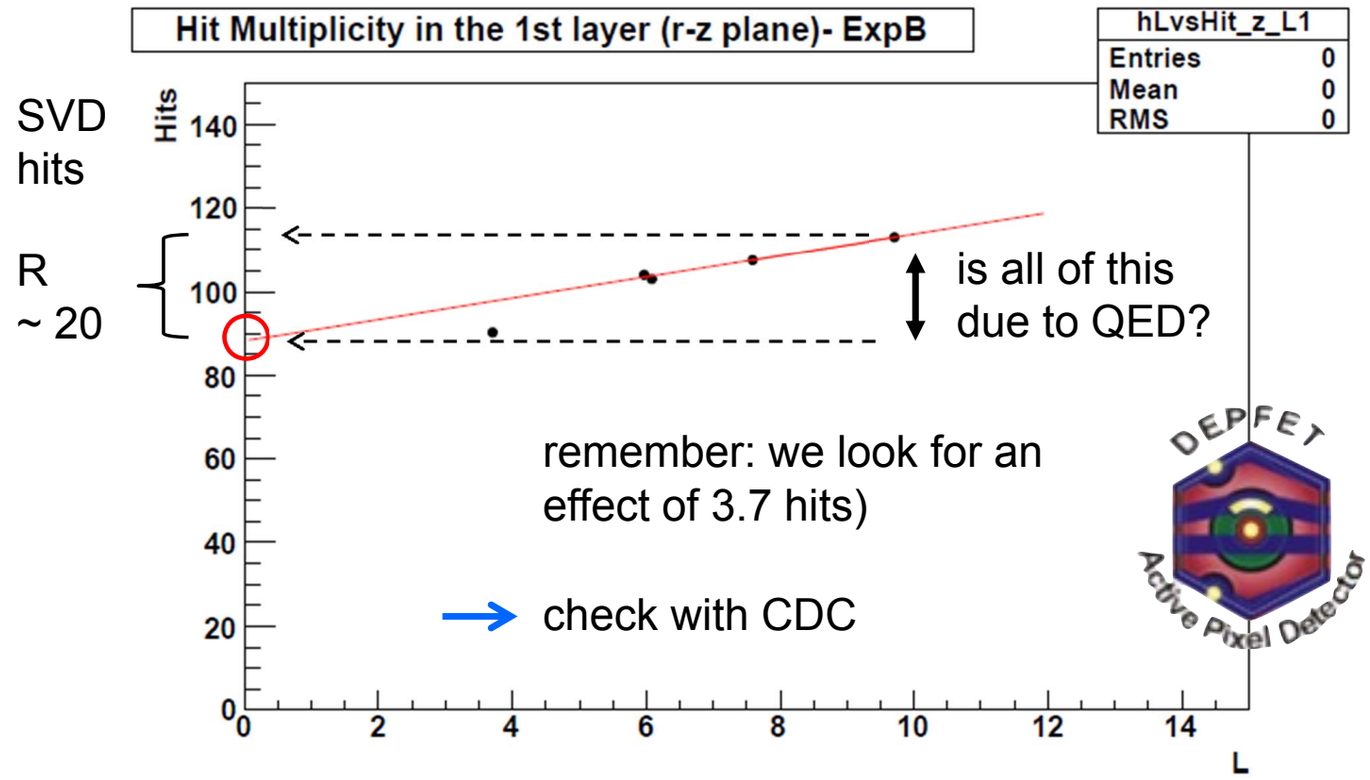
This is a factor 5.5 more !!!

Measurement With Belle

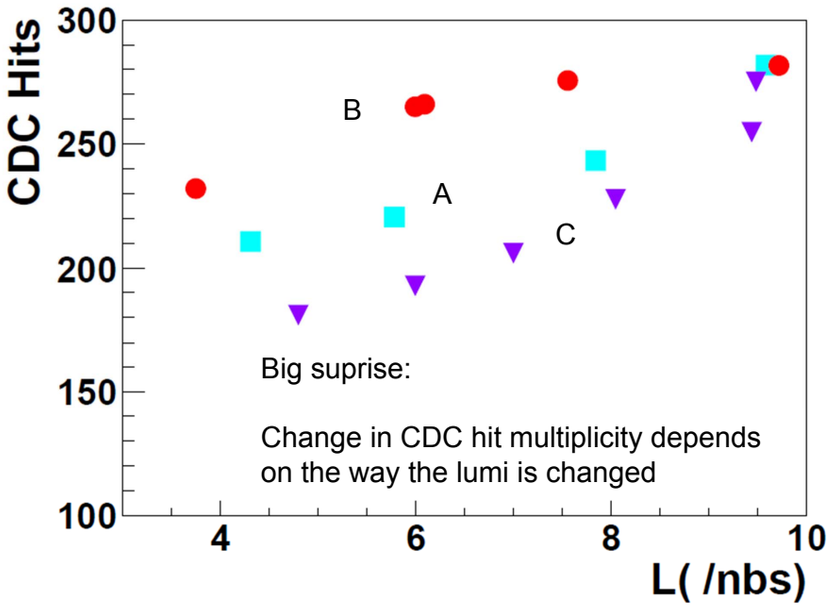
Most of the pairs are too soft to be detected as tracks.

Measure the SVD occupancy as a function of Lumi.

L ~ 10 / nb s
Integration time = 2 μs



- Exp. A: separate the beams vertically
- Exp. B: increase the beam vertical size
- Exp. C: decrease bunch charge



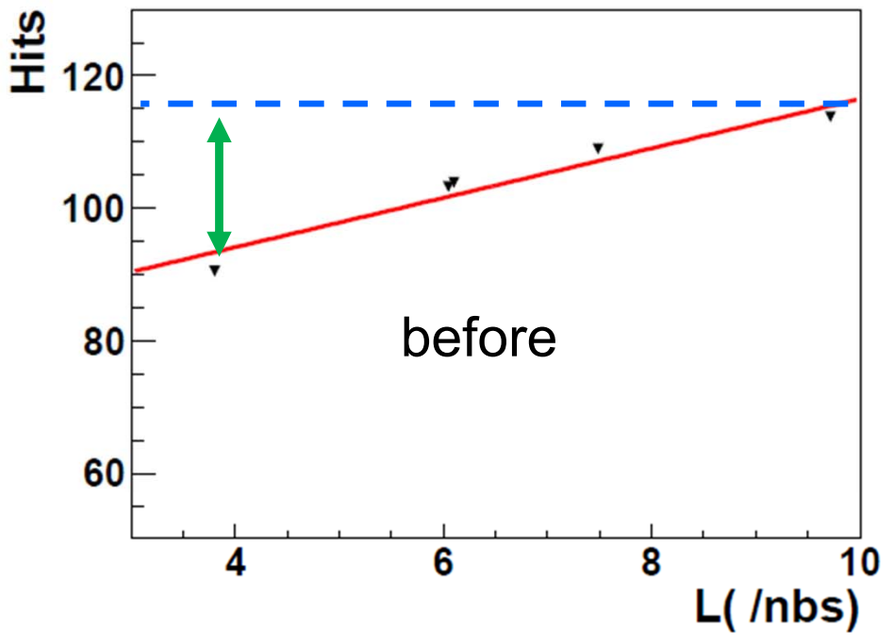
How to Disentangle QED from Lumi?

Background Correction

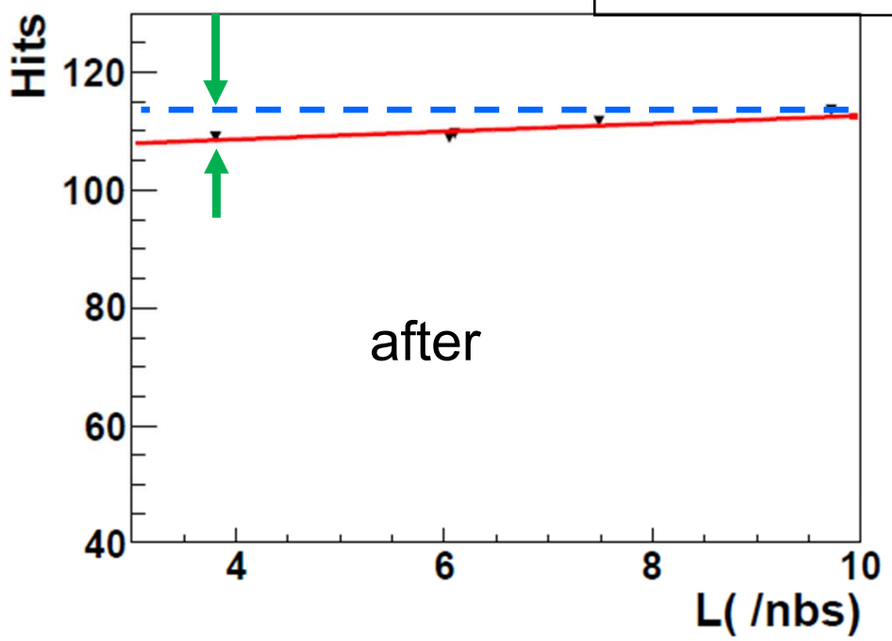
For each experiment, each data point:

$$N^{SVD}_{hits\_corr}(L_i) = N^{SVD}(L_i) \times \frac{N^{CDC}(L_{max})}{N^{CDC}(L_i)}$$

Results are consistents using CDC corrections at different radii and among different experiments!



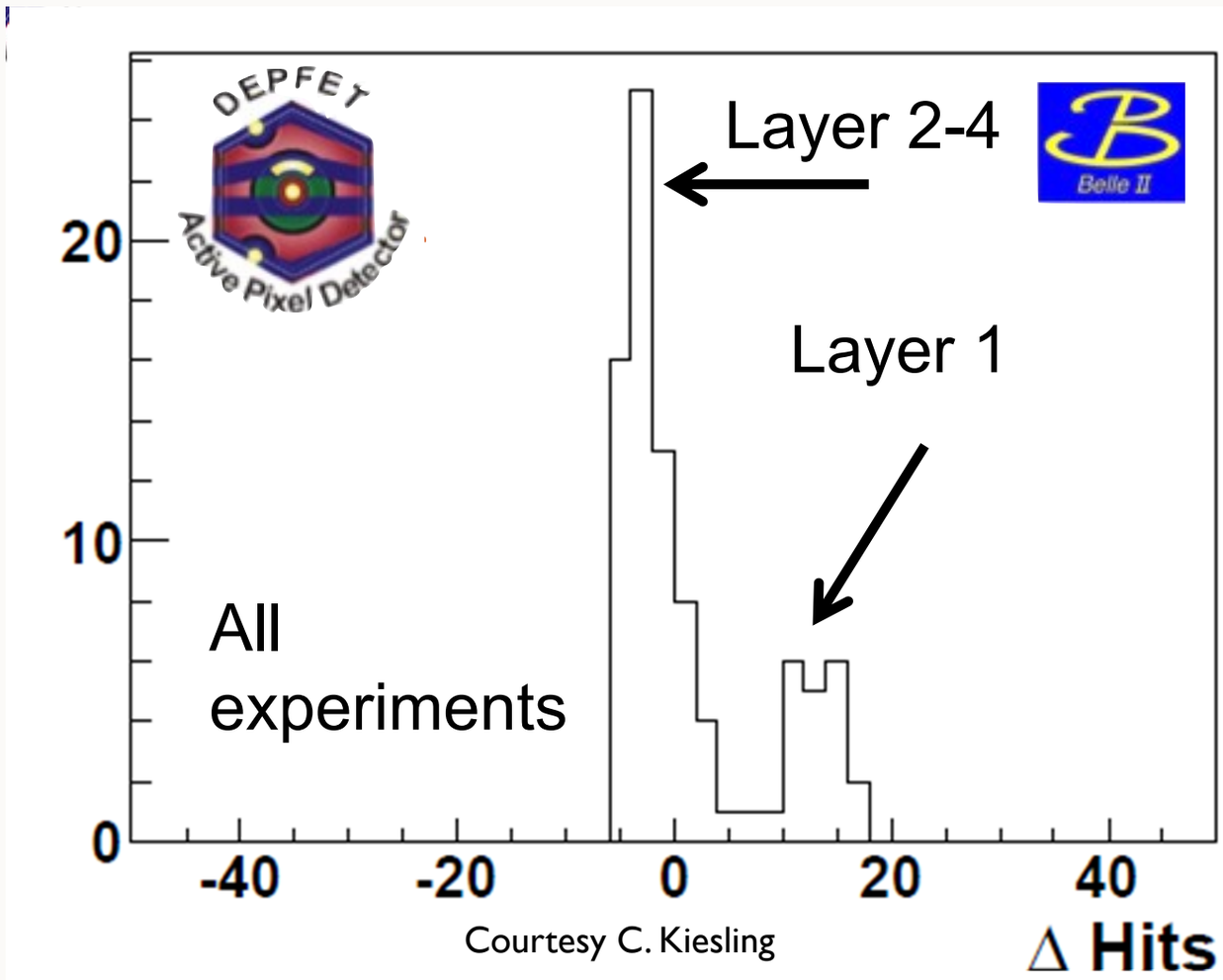
(a) exp.(B)



(b) exp.(B)

C. Kiesling, Joint Belle II & SuperB Background-Meeting, Vienna, Feb. 9-10, 2012

RESULTS



1st layer hit hardest,

higher layers much less

consistent with full Monte Carlo simulation

Full Monte-Carlo simulation: 3 x naive expectation: **curlers !**

Experiment	SVD layers	Hits	QED hits	KoralW	SuperB(BDK)
Belle	1	~ 100	13.3 ± 2.6	11.31	62.2
	2 - 4	~ 45	-2.9 ± 2.1	2.38	13.1
Belle II	Occupancy (1st PXD)			0.7%	4.0%

11.7

By Giuliana

accurate rescaling

Table 6.1: Comparison between data and Monte Carlo

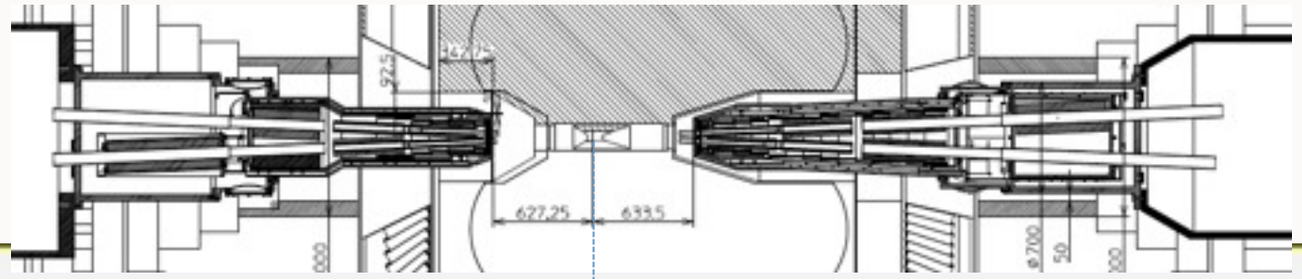
Pairs Rate Conclusions

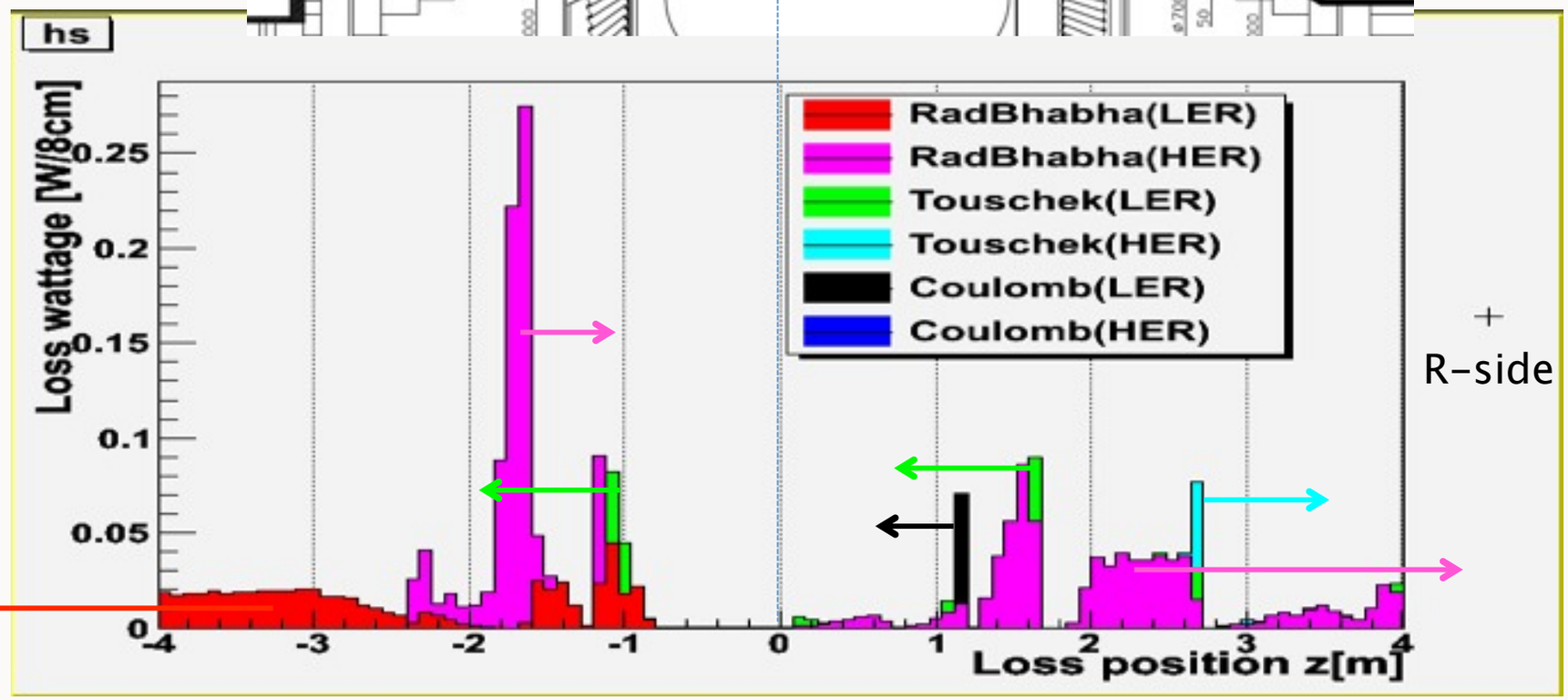
- *The Very Clever Measurements Made by our Friendly Competitors at Belle are not Contradicting our Predictions*

- *Friendly Communication Channel Established*

  Let us Hope it will last…

The Belle Background Picture





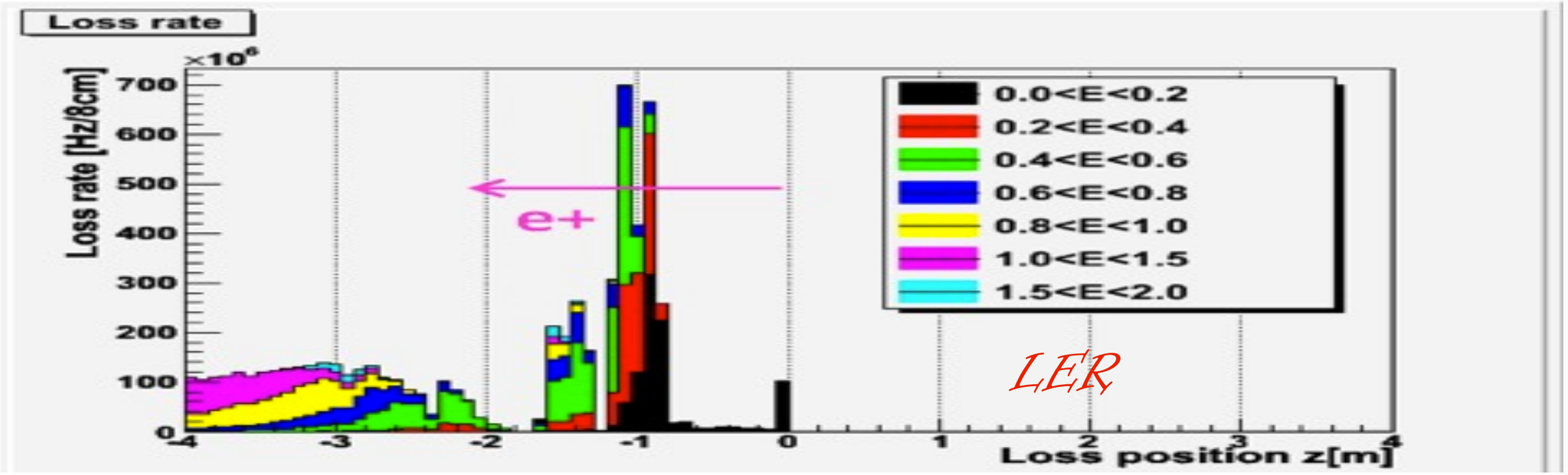
L-side

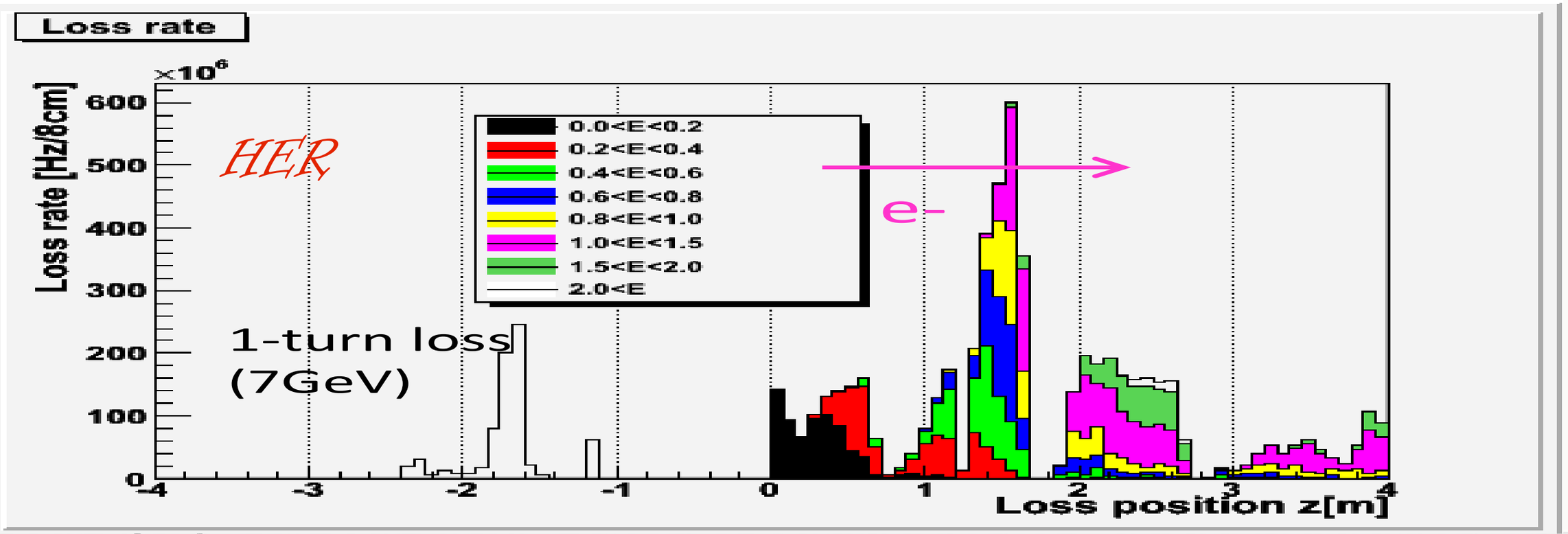
R-side

	LER (4GeV e+)	HER (7GeV e-)
Rad. Bhabha	0.55 W (eff. 0.9GHz)	1.60W (eff. 1.4GHz)
Touschek	0.10 W (0.16GHz)	0.05 W (0.05GHz)
Coulomb	0.06 W (0.09GHz)	0.001W (0.001GHz)

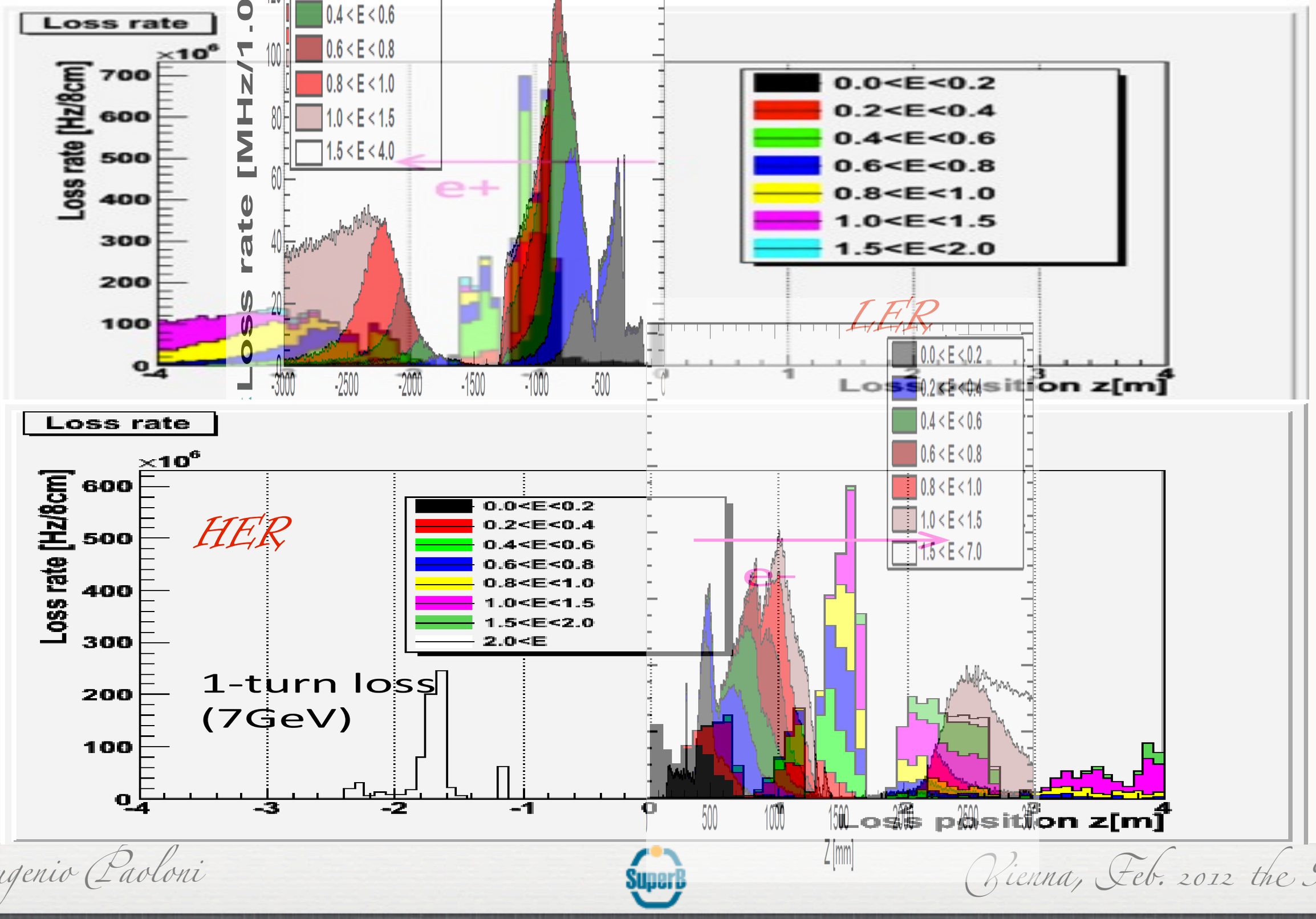
1GeV ,1GHz
= 0.16W

RADIATIVE BHABHA



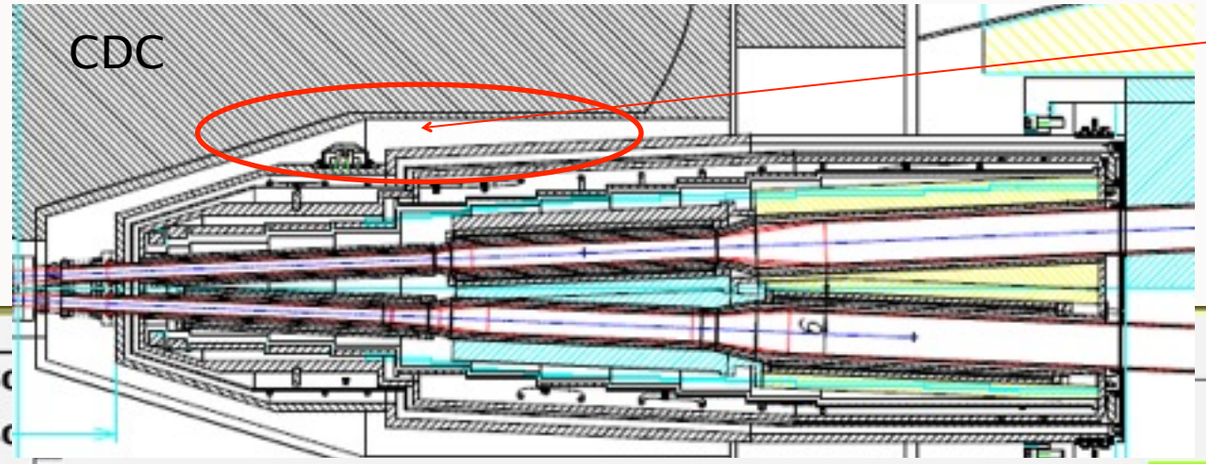


RADIATIVE BHABHA COMPARIS.

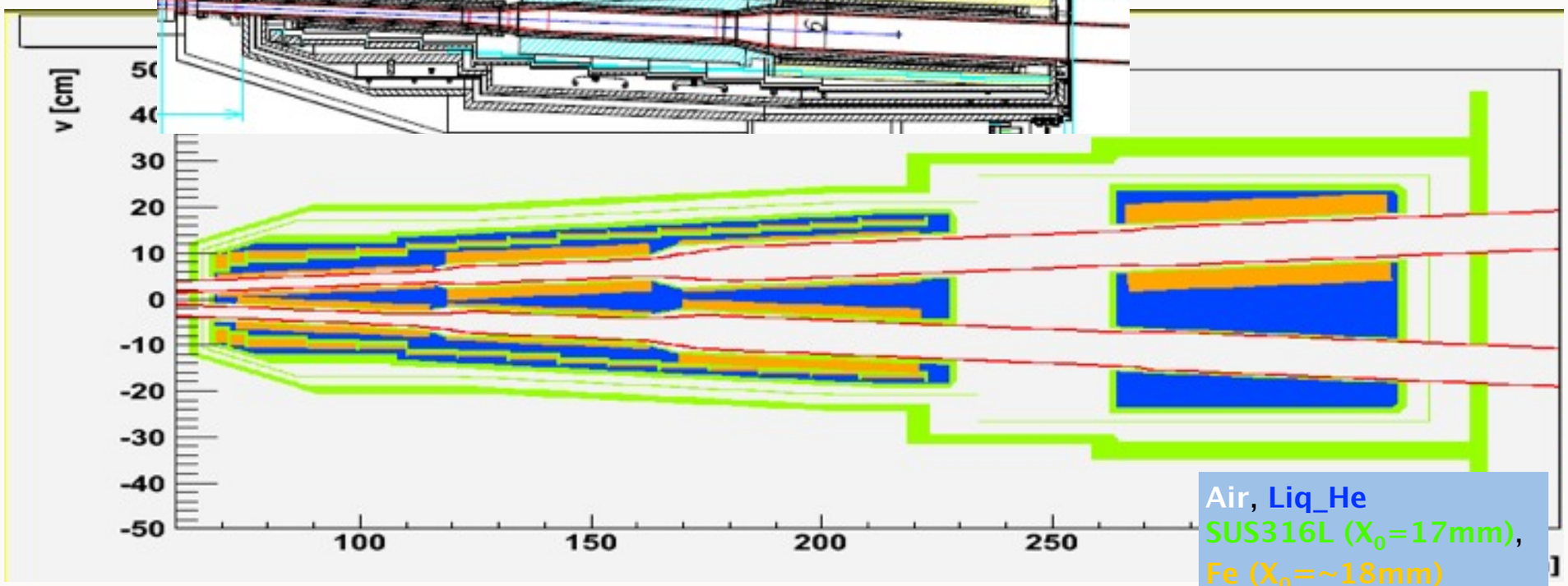


BELLE II LAYOUT

QCS cryostat



Space limited!
– cables, pipes should sit here
Additional shield for RBB?
(not shield here in current GEANT4)

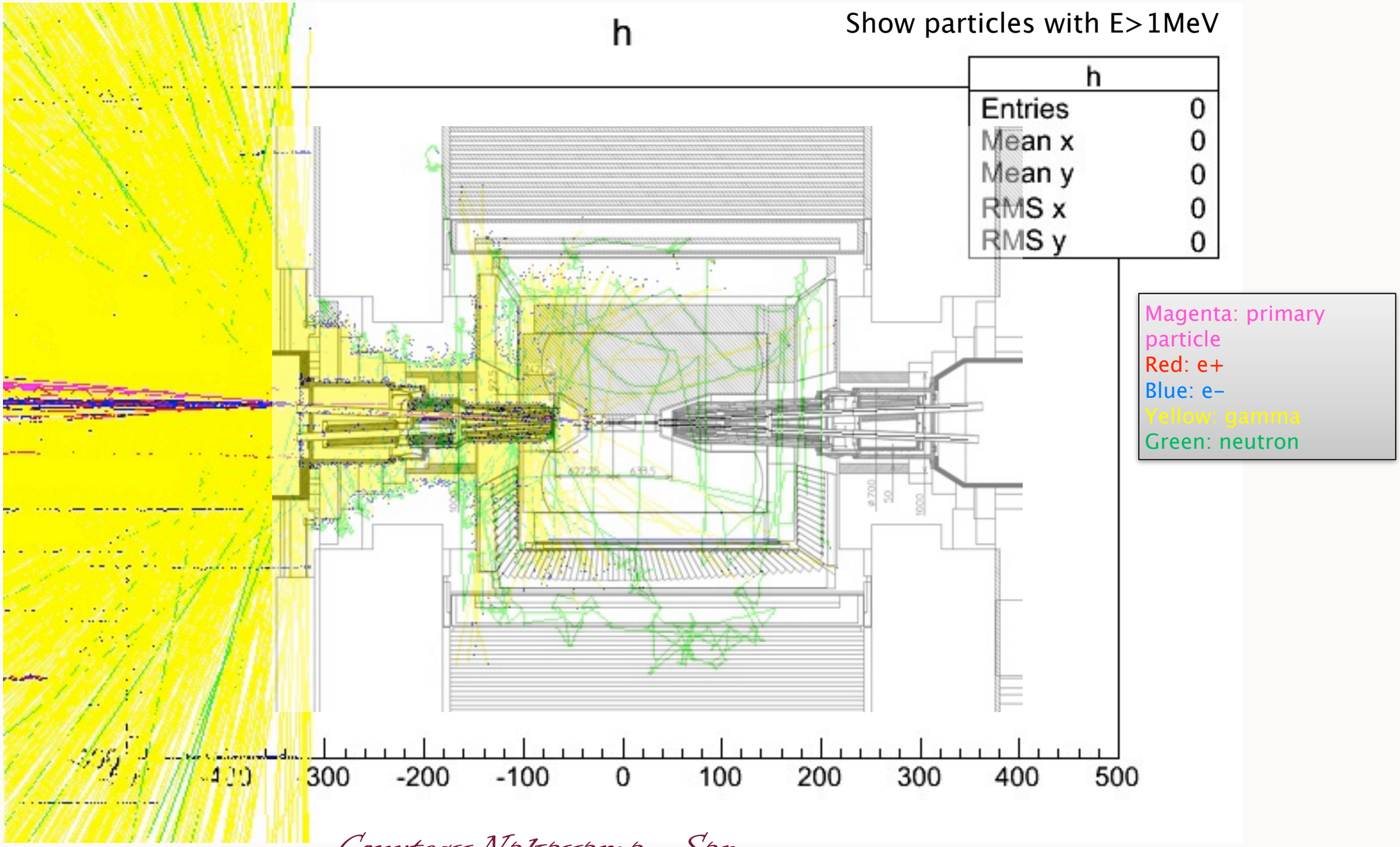


Air, Liq_He
SUS316L (X_0=17mm),
Fe (X_0=~18mm)
SC_COIL(X_0=~16mm),
Ta (X_0=4.3mm)

4mm of Ta beam pipe ($1X_0$), few cm of iron+coil (~$2X_0$) ,
and few cm of SUS structure(~$2X_0$)

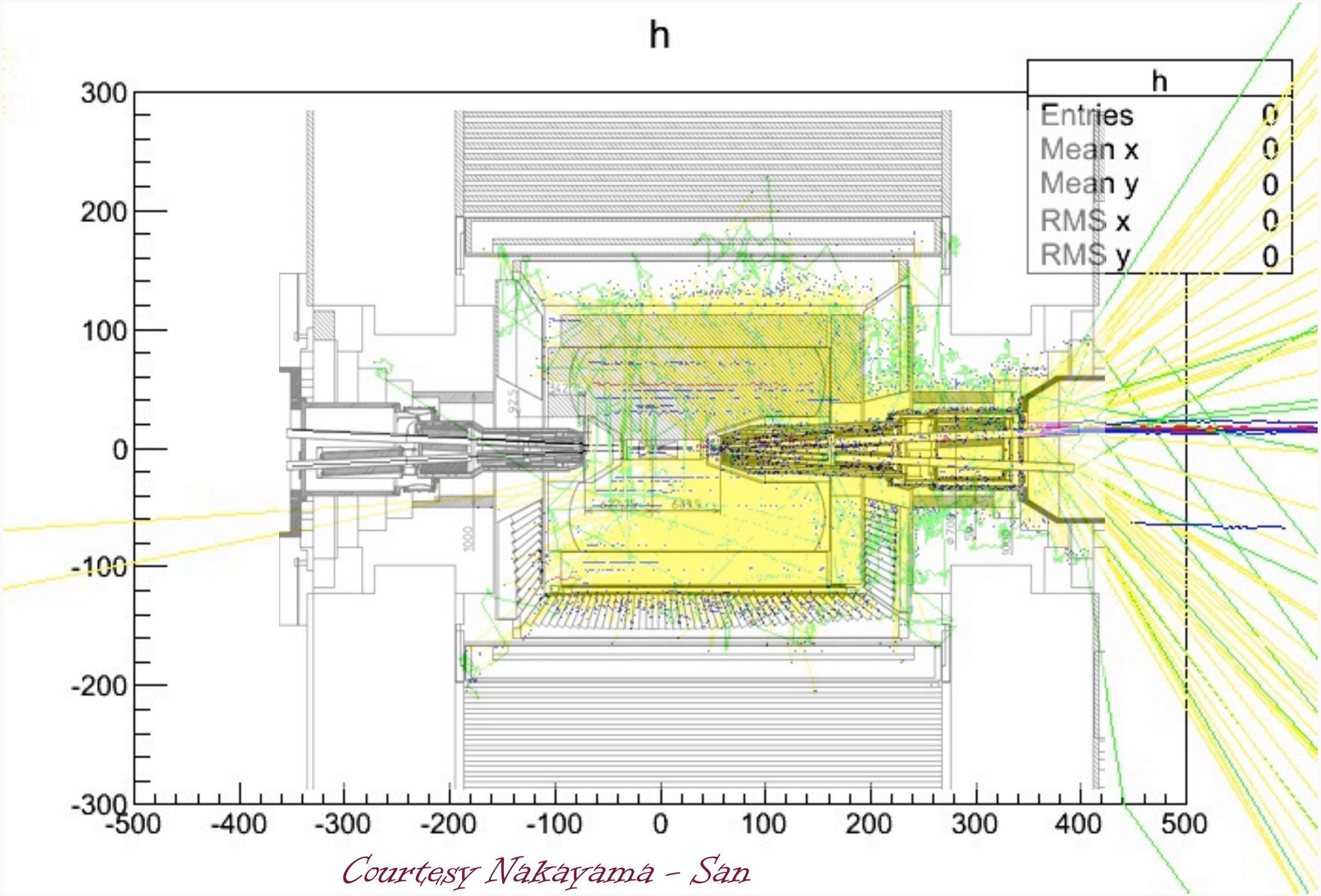
Courtesy Nakayama – San

LER Rad Bhabha in 100ns



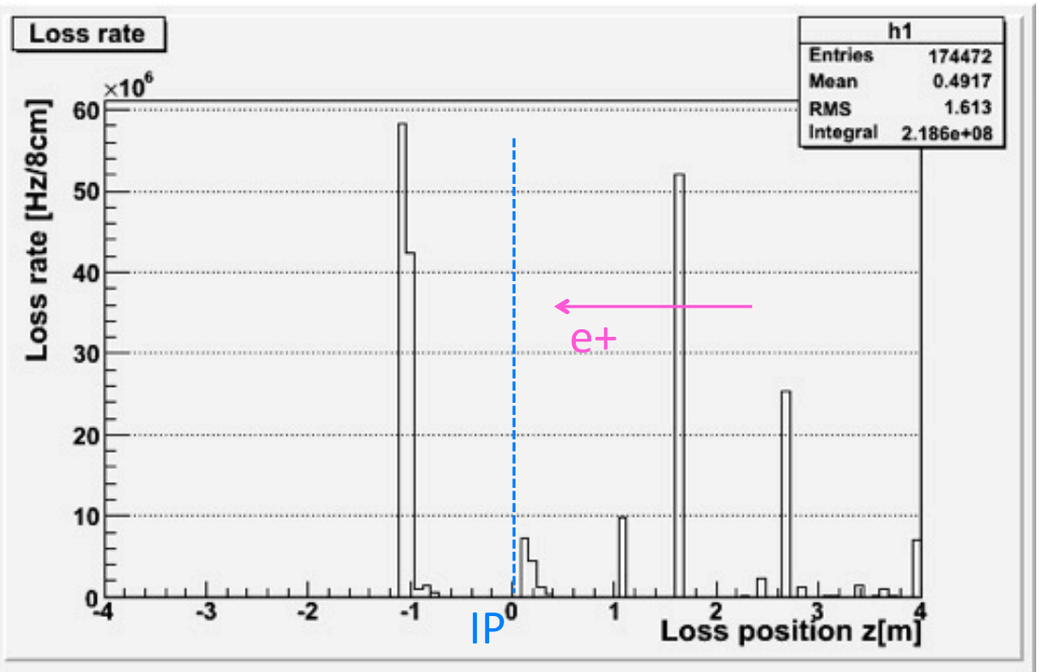
Courtesy Nakayama - San

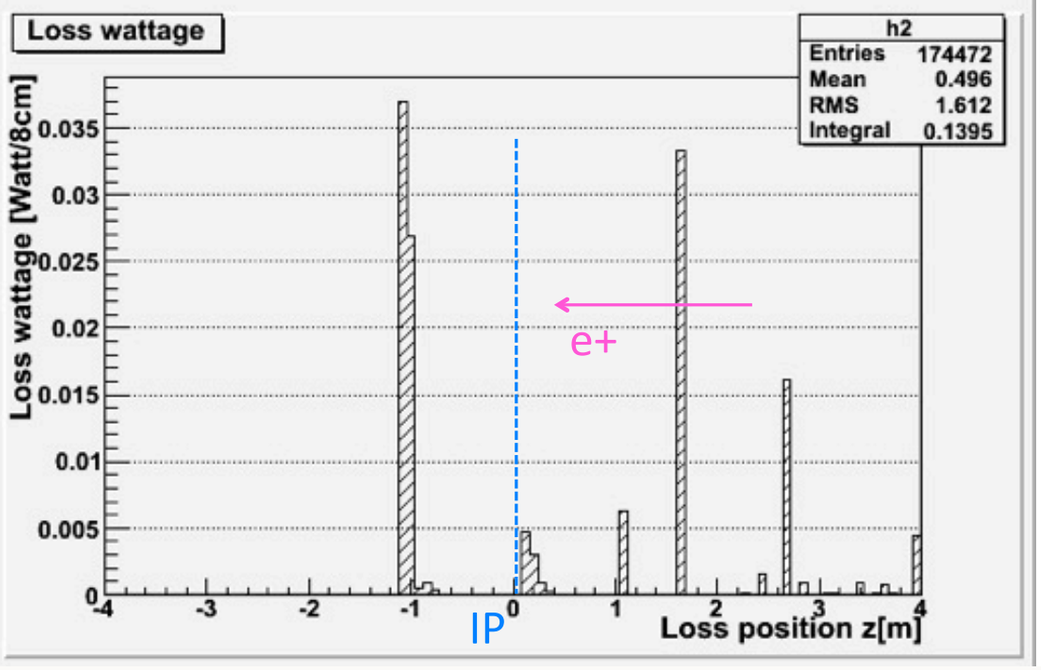
HER Rad Bhabha in 100ns

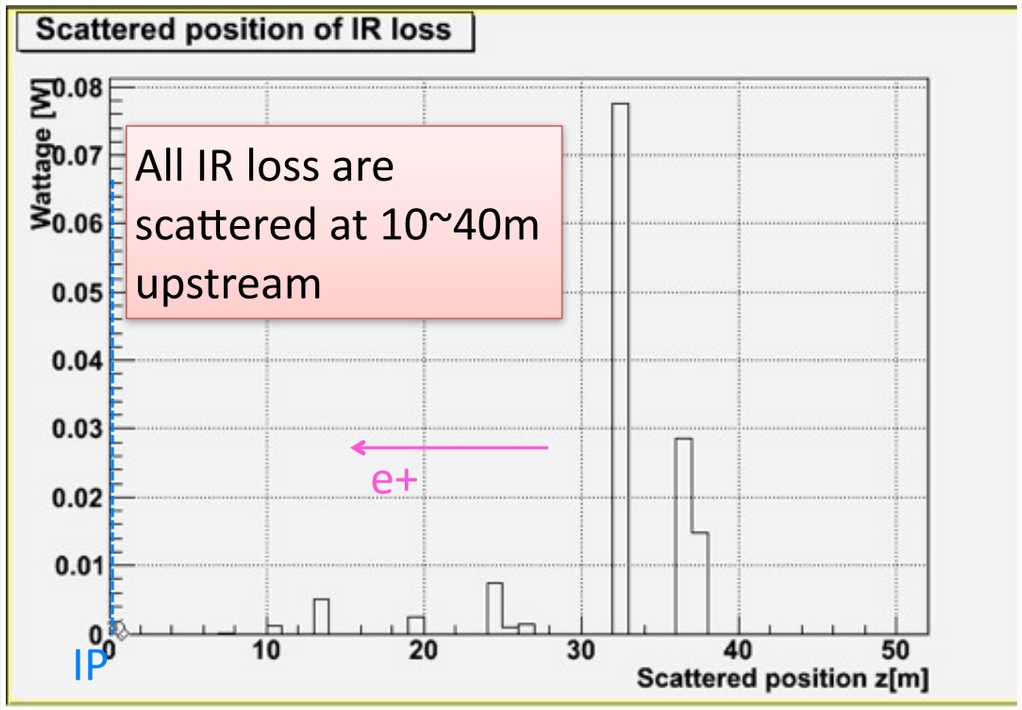


Courtesy Nakayama - San

LER Touschek







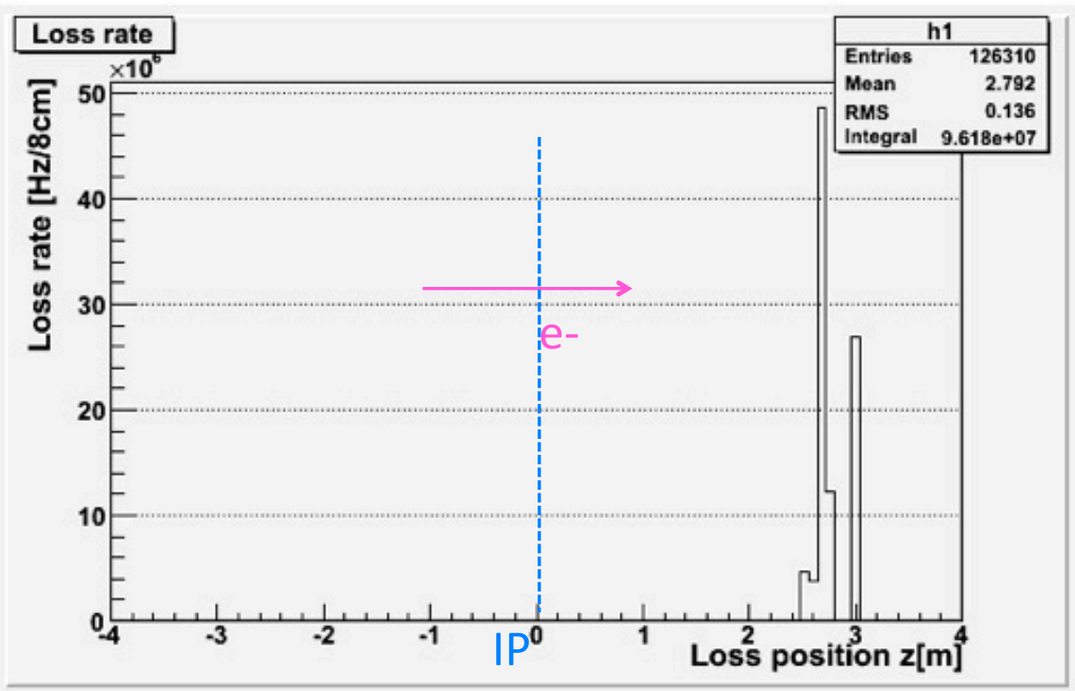
Within |z|<4m,
- loss rate: 0.22 GHz
- loss wattage: 0.14 W

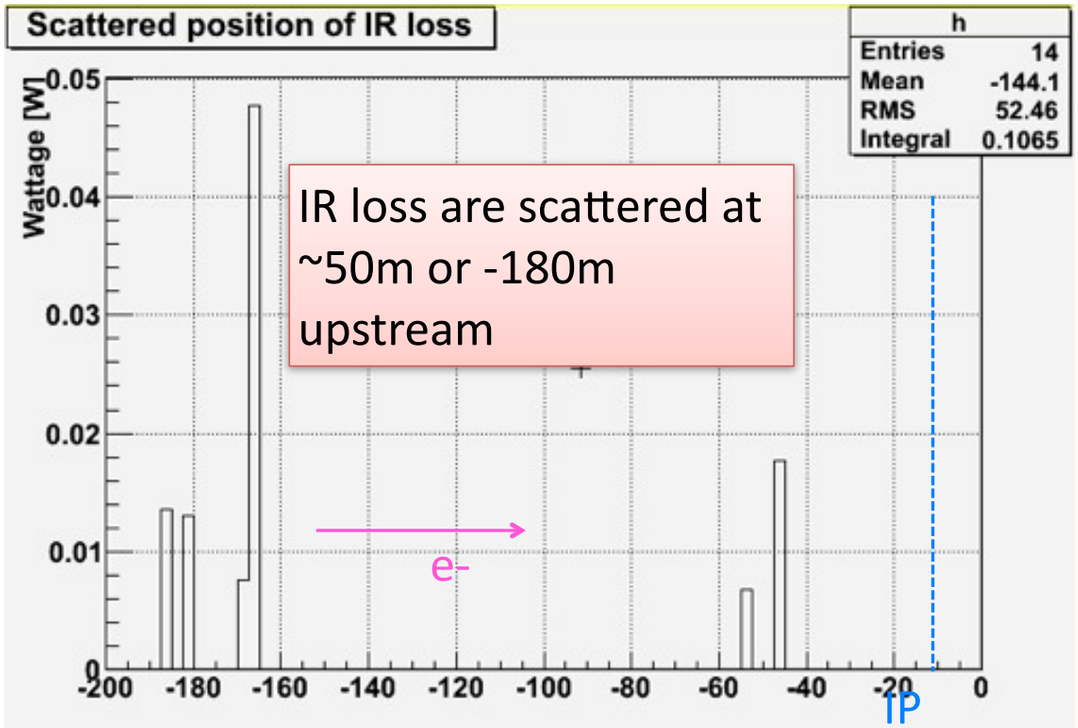
Loss wattage: we assume all energy of beam particle is deposited at the loss position.

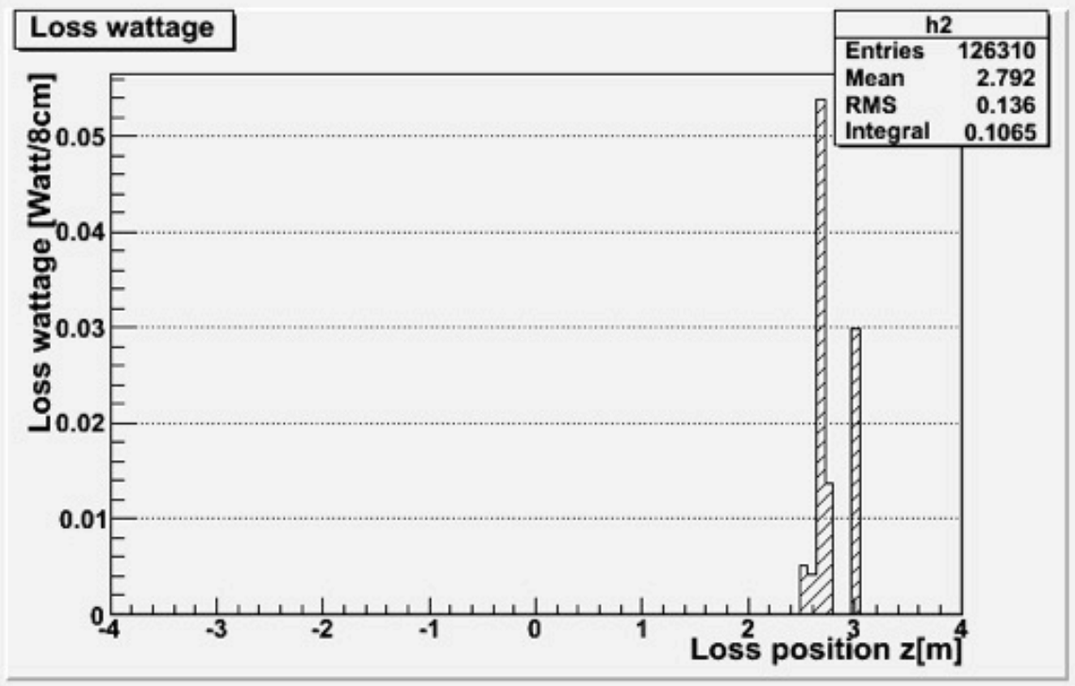
Courtesy Ohnishi-San

To be compared with our 90 MHz/beam

HER TOUSCHEK







Courtesy Ohnishi-San

Within |z|<4m,
- loss rate: 0.10 GHz
- loss wattage: 0.10 W

Loss wattage: we assume all energy of beam particle is deposited at the loss position.

To be compared with our 6.8 MHz/beam

Conclusions

- The Vienna meeting was a very nice occasion to establish a fruitful communication channel with our friendly competitors
- We gained confidence in our background predictions (especially pairs)
- We learned about multi turn Rad Bhabha

Thank you

for your Attention

Lifetime and Injection Power

unit in sec	LER	HER
Touschek lifetime	562	623
Luminosity lifetime	1800	1300
Beam-Gas lifetime	2240	3260
Total lifetime	360	373
Injection limit (25 Hz)*	181	104

*Injection efficiency is assumed to be 100 %

Background Cross Sections

	Scattering Cross section	#Evt / crossing	**Scattering** Rate	
Beam Strahlung	~340 mbarn (Eγ/Ebeam > 1%)	~1400	0.34 THz	Luminosity lifetime driving term
Beam Strahlung	~150 mbarn (Eγ/Ebeam > 10%)	~630	0.15 THz	Losses "near" the IP
e^+e^- production	~7.3 mbarn	~31	7.3 GHz	
e^+e^- production (seen by L0 @ 1.4 cm coverage 300 mRad)	~ 80 μbarn	~0.34	80 MHz	Main SVT L0 Background
Elastic Bhabha	O(10^{-4}) mbarn (Det. acceptance)	~420/Million	100 KHz	~L1 Trigger rate
$\Upsilon(4S)$	O(10^{-6}) mbarn	~4.2/Million	1 KHz	Physics

Definitions

Event rate:

$$\mathcal{R} = \mathcal{L}\,\sigma$$

track rate:

$$\mathcal{R}_{\text{trk}} = \mathcal{R}\,\langle \#trk \rangle_{evt}$$

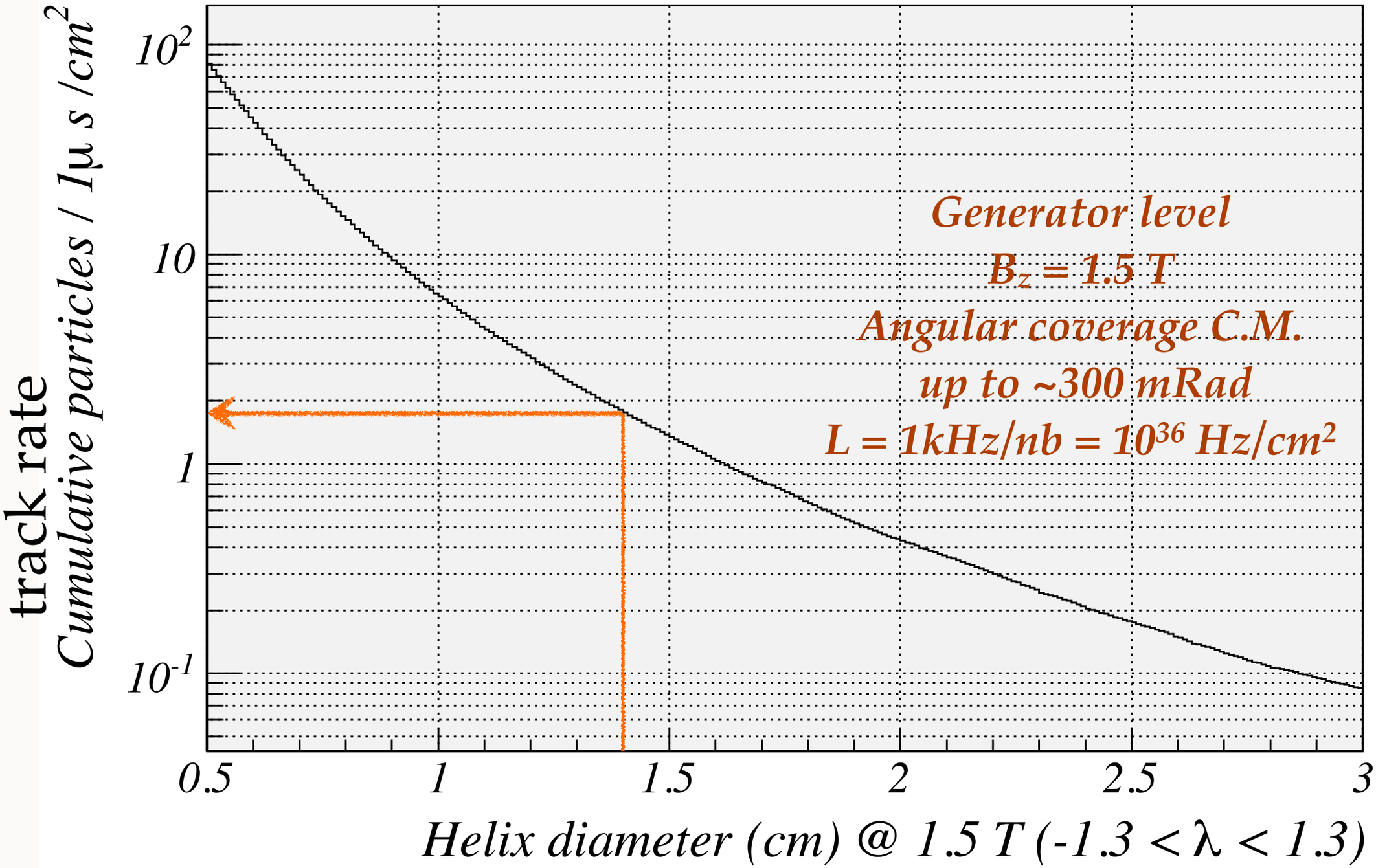
cluster rate:

$$\mathcal{R}_{\text{clus}} = \mathcal{R}_{\text{trk}} \langle \#clus \rangle_{trk}$$

hit rate:

$$\mathcal{R}_{\text{hits}} = \mathcal{R}_{\text{clus}} \langle \#hits \rangle_{clus}$$

DIAG36 TRACK RATE EVALUATION



Bruno Evaluation Example