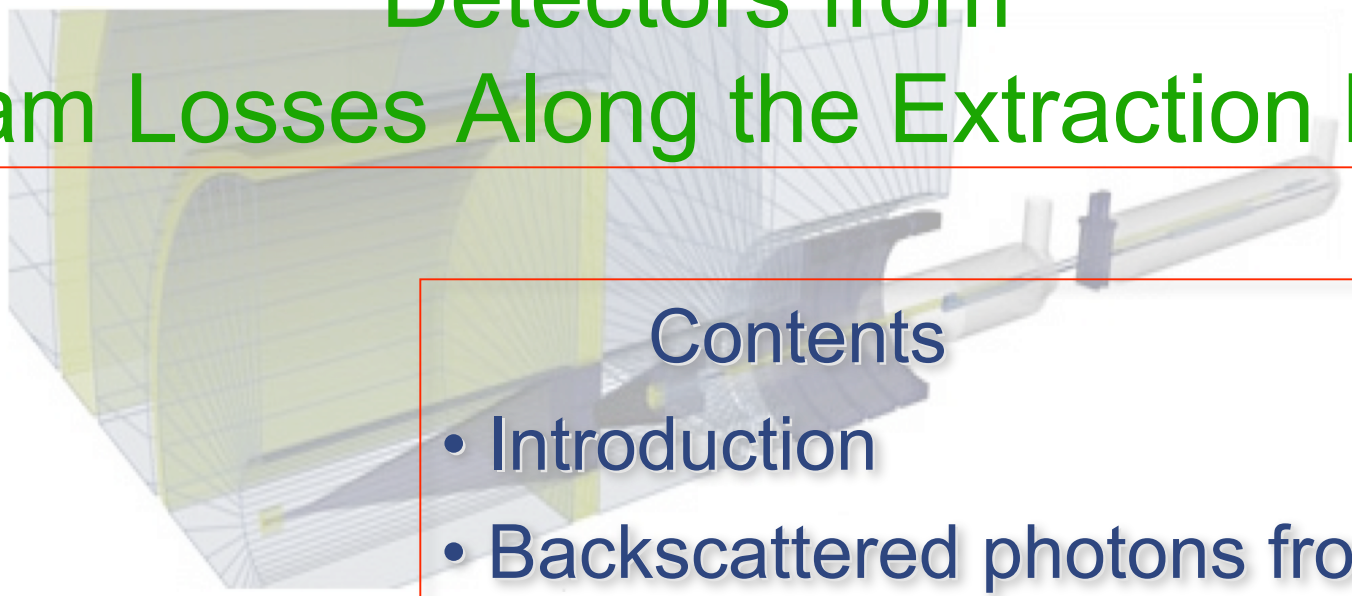
Backscattering of photons into the ILC Detectors from Beam Losses Along the Extraction Lines



IRENG07
Olivier Dadoun
dadoun@lal.in2p3.fr
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Introduction

- In spite of all the attention put in the design, the extraction will be the place of secondary particles generation
- Several origins:
  - **Disrupted beam particles**
  - **Synchrotron radiation**
  - **(beamstrahlung, e^+e^- pairs, radiative Bhabhas)**
- Several locations
  - **BeamCal mask**
  - **Beam pipe**
  - **Collimator …**
  - **Beam dump**
- We would like to quantify the number of backscattered particles* which can reach the detector in order to predict the hits they can induce

* for the different extraction lines and different detectors concept

Aim

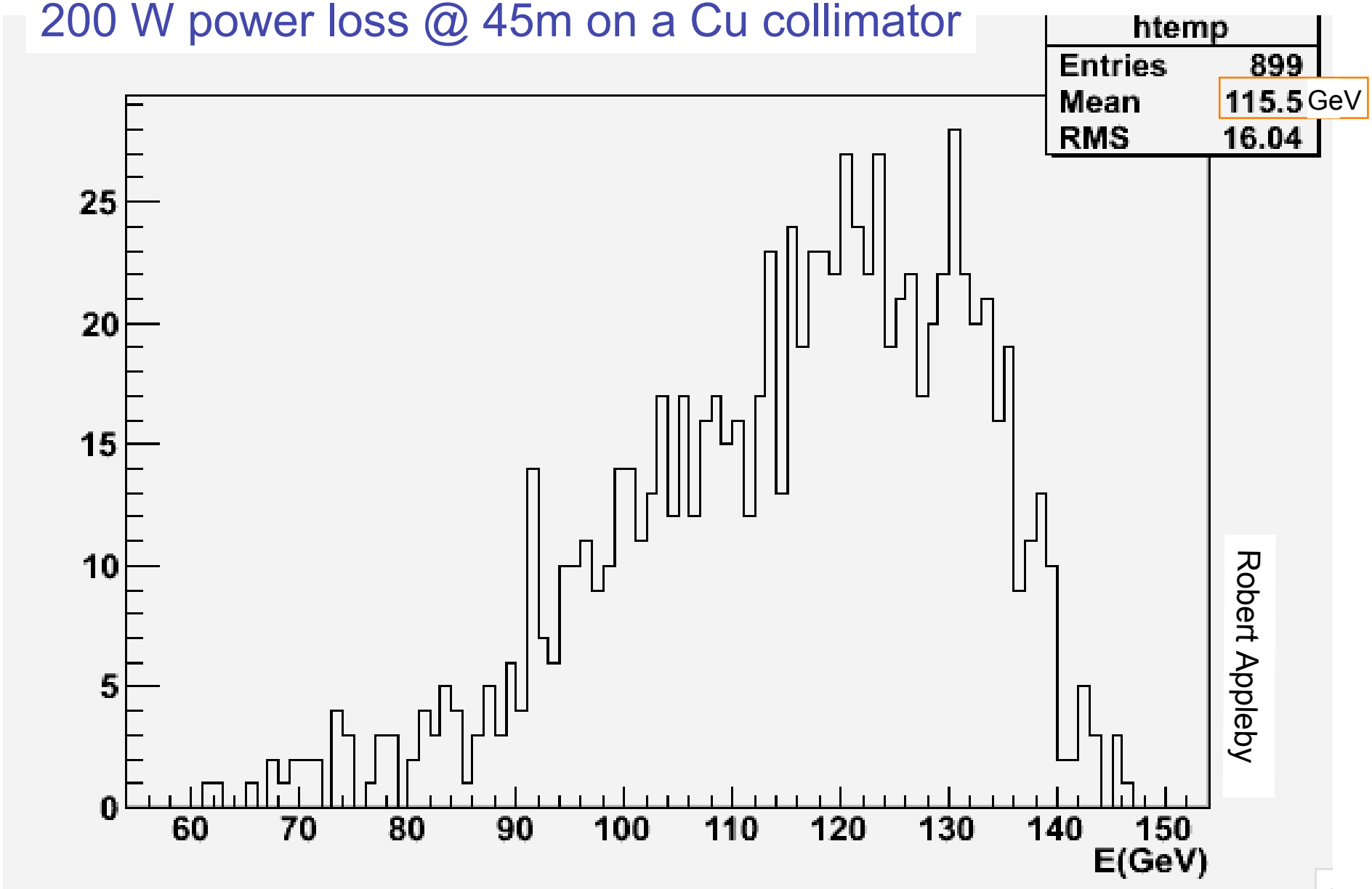
- How many hits will be induced by backscattered photons in the detectors ?

- How many backscattered photons can pass through the smallest aperture in the extraction line, i.e the BeamCal (with a radius to protect the VD), and still create background in the detector?

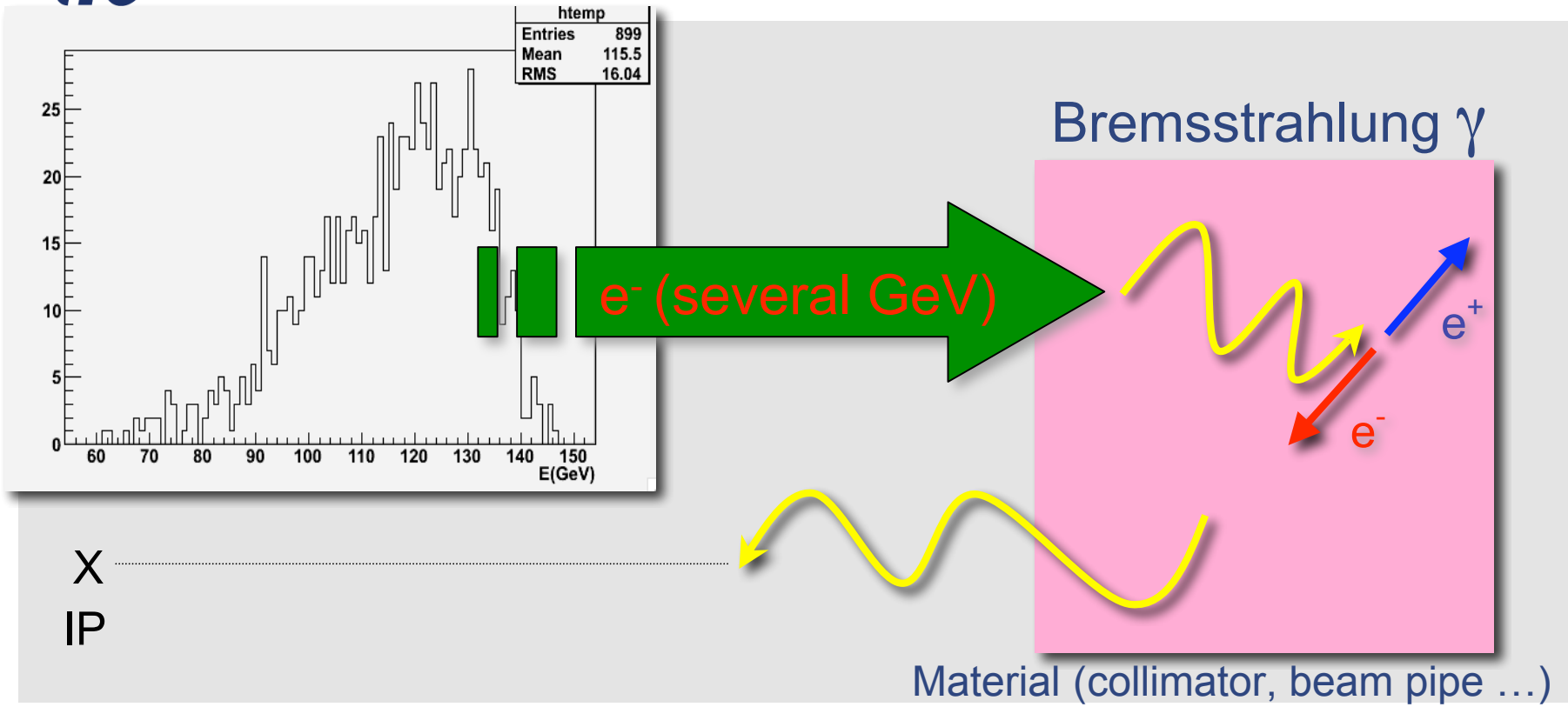
- Illustration using the disrupted beam losses in the 2mrad extraction line, but arguments and methods are general (Robert talk's)

2mrad disrupted beam losses (QEX1COLL)

200 W power loss @ 45m on a Cu collimator



Main processes for backscattered γ

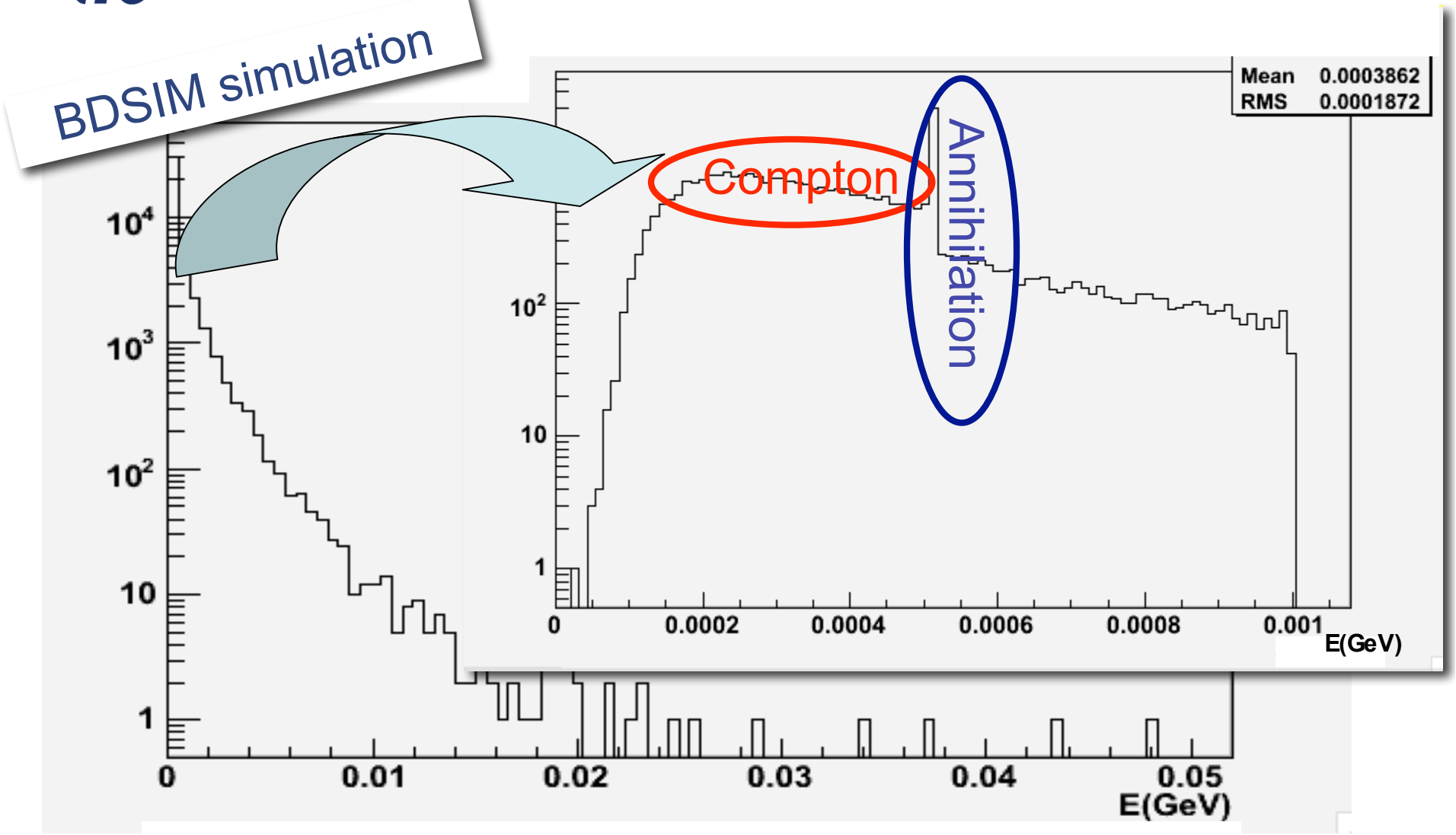


Backscattered g from cascades of processes:

- Bremsstrahlung
- Compton
- if e+, annihilation
- Xray emission

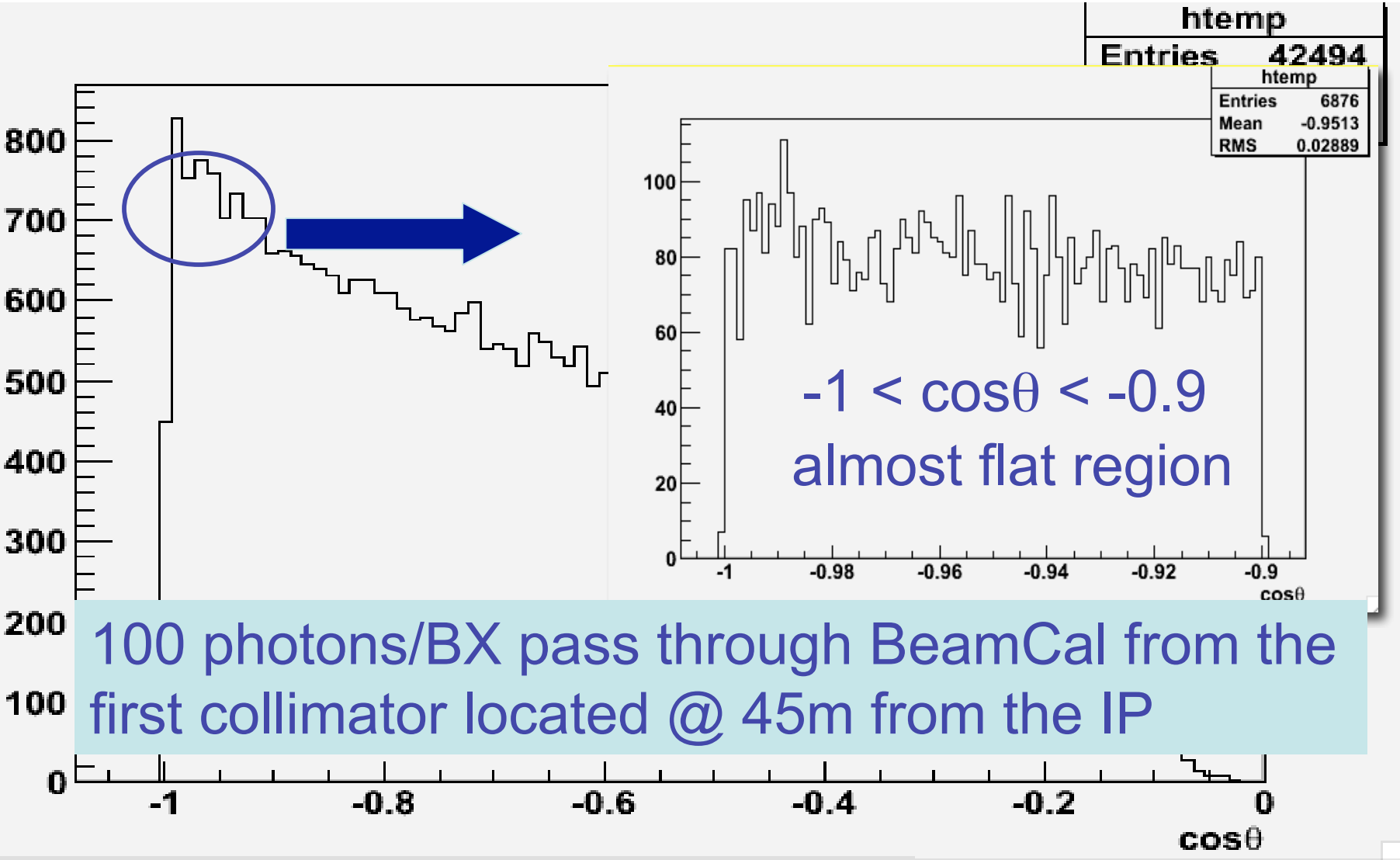
(can not be seen here due to our energy threshold)

Backscattered γ spectrum



How many γ can pass through the 1.2 cm BeamCal radius (with θ~1.2cm/45m) ?

Extrapolation using flatness of cosθ distribution



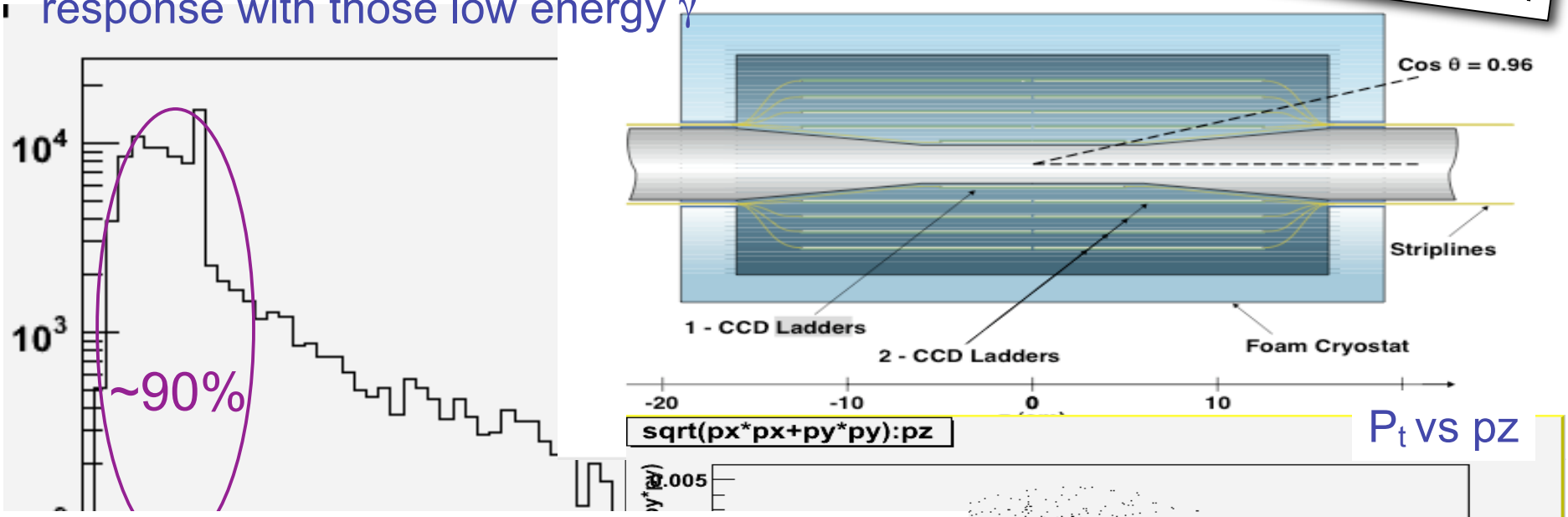
How many hits they will produce in the VD ?

Mokka Simulation & Marlin reco.(1)

γ generated at the IP

Study more simple case to see the detector response with those low energy γ

VD description



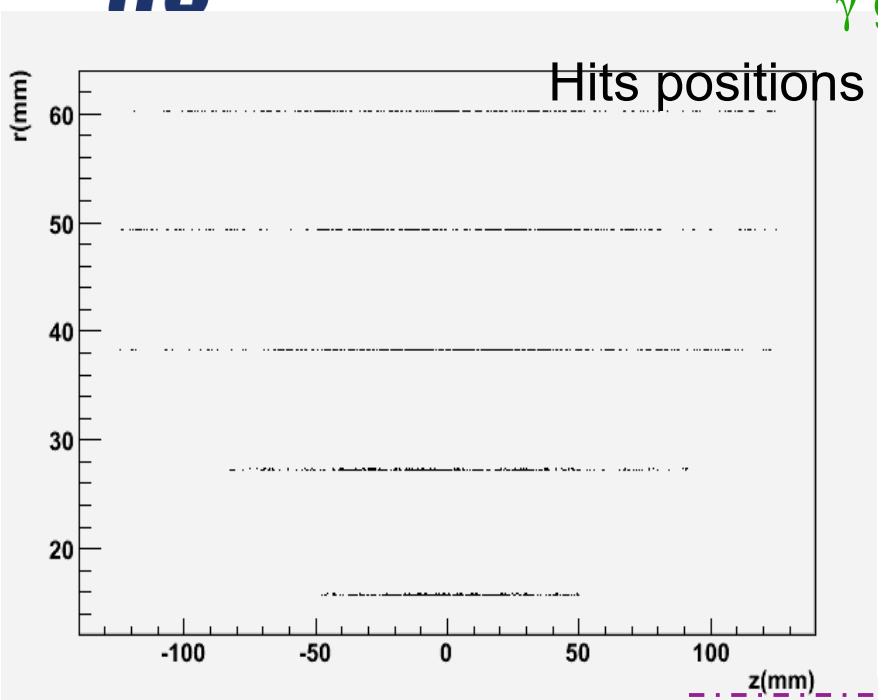
P_t vs pz

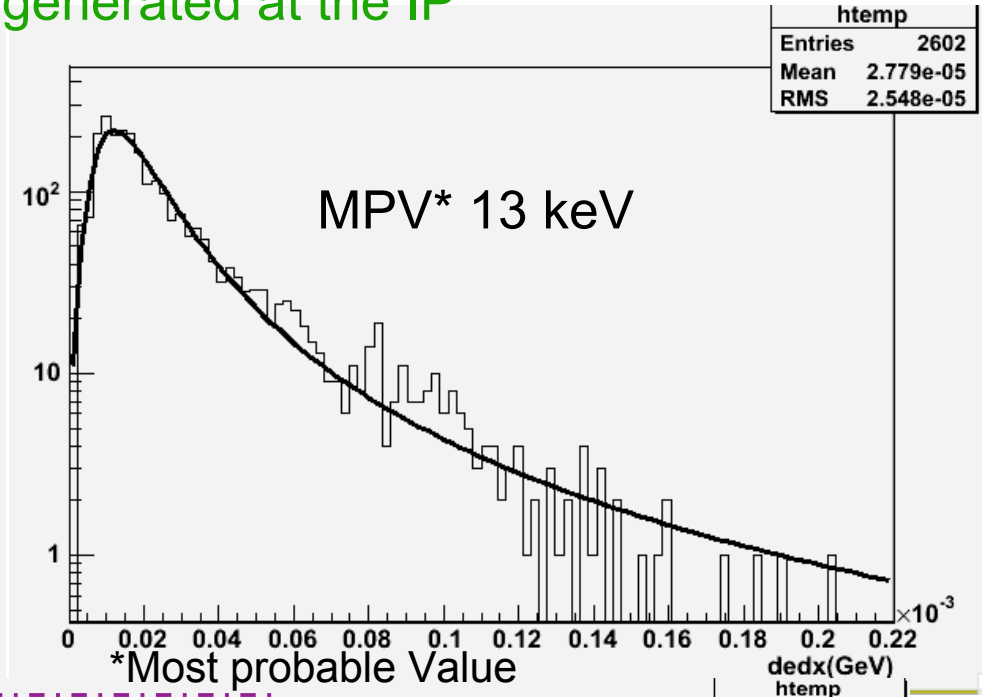
Generate photons at the IP

X(0,0,0), $\varphi \in [0,2\pi]$, $\cos\theta \in [-0.96,0.96]$

Mokka Simulation & Marlin reco.(1)

γ generated at the IP



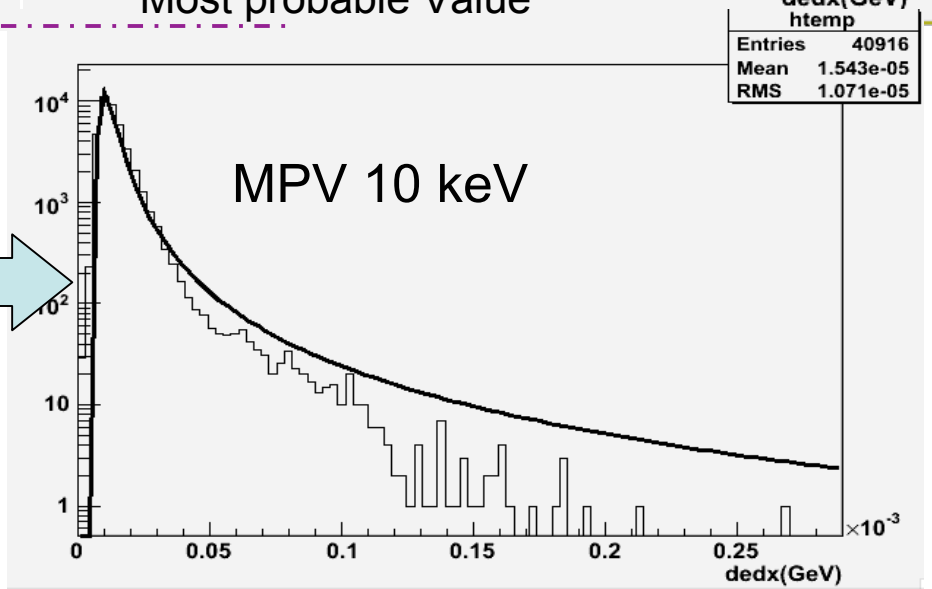


*Most probable Value

To calibrate we use:
10 GeV μ^- same spatial dist.

- Active Si 37 μm
- ρ=2.33 g/cm^3
- $(dE/dx)_{min}$=1.664 MeV/(g/cm^2)

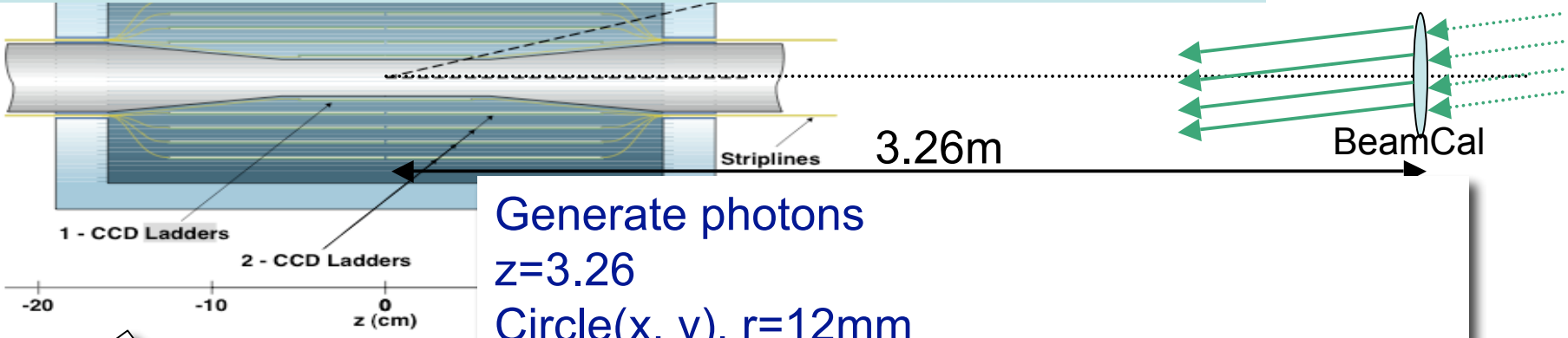
(for Si E_{MPV} ~0.7*E_{mean})



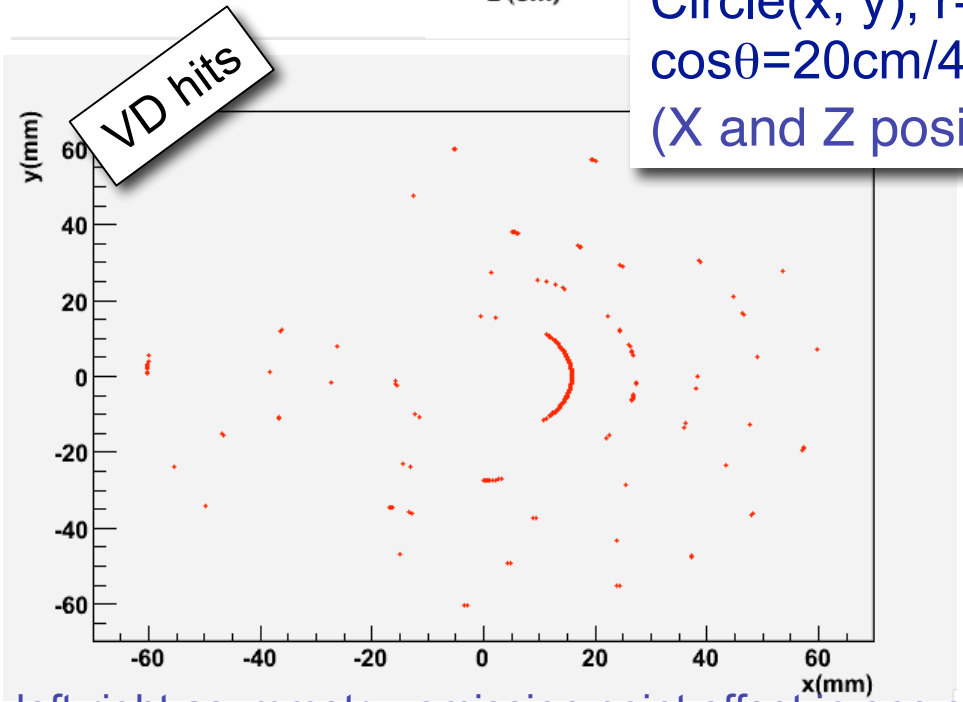
Mokka Simulation & Marlin reco.(2)

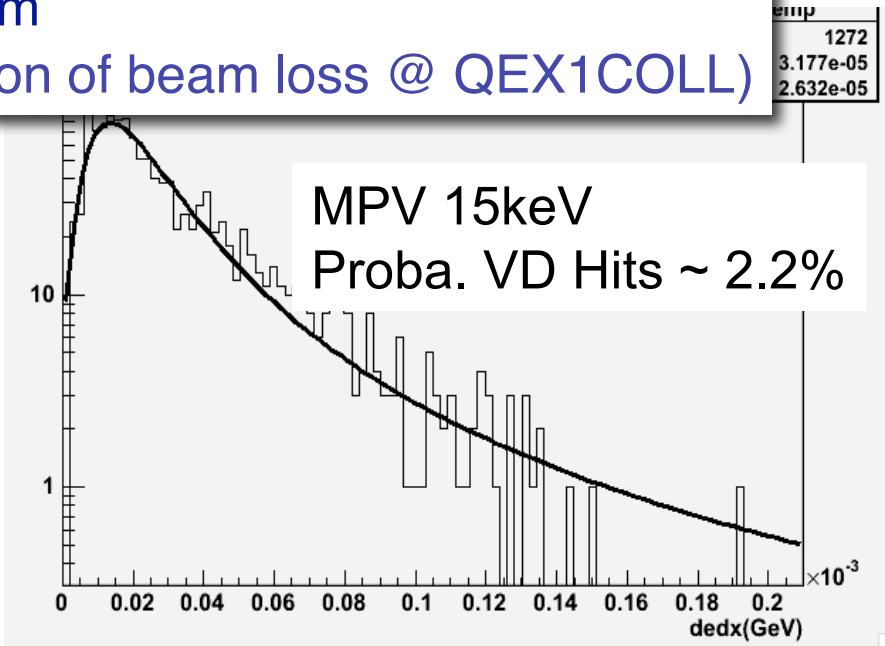
γ generated with very small angle

Study the direct lines of sight passing through the BeamCal



Generate photons
z=3.26
Circle(x, y), r=12mm
cosθ=20cm/45m
(X and Z position of beam loss @ QEX1COLL)





MPV 15keV
Proba. VD Hits ~ 2.2%

left-right asymmetry, emission point offset in one side

VD Hits in the minimal 2mrad

Assuming the same energy spectrum for the beam particles lost on collimators, the fraction of VD hits from other backscattered γ emission sources will be the same: ~ 2.2%

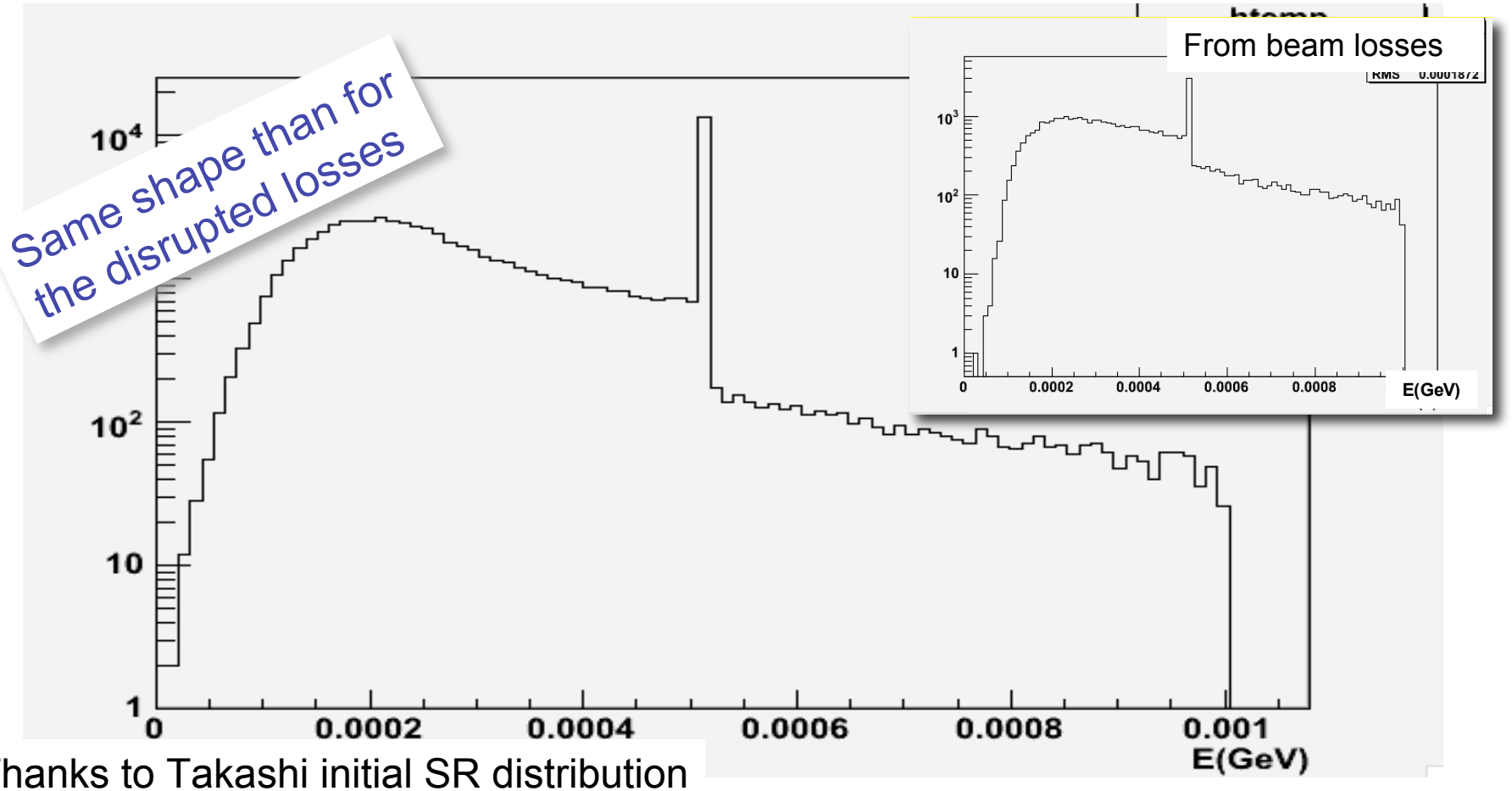
	D[m]	X[cm]	P[kW]	#γs/BX	VD hits/BX
QEX1COLL	45	20	0.2	1.3	0.02
QE2COLL	53	-	0	0	0
BHEX1COLL	76	41	0.1	0.2	0.004
COLL1	131	85	52.3	40	0.8
COLL2	183	115	207.5	82	1.8
COLL3	286	-	0	0	0

Conclusion & prospects

- Back-scattered photons due to disrupted beam losses in the 2mrad produce negligible effects in the VD
- Further studies planned include a more complete analysis of all photon emission sources (synchrotron radiation from QD0 for example)

Comment :

Backscattered γ energy from QD0 SR (Cu for the septum material @ 90 m)



Thanks to Takashi initial SR distribution

2200 γ/BX at the IP * 2.2% ~ 50 VD hits/BX < 300 direct hits from incoherent pairs

Conclusion & prospects

- Back-scattered photons due to disrupted beam losses in the 2mrad produce negligible effects in the VD
- Further studies planned include a more complete analysis of all photon emission sources (synchrotron radiation from QD0 for example)
- Further studies planned include other backscattered particles (neutron)
- Study the other IR geometries under consideration including backscattering from the main beam dump and taking into account multiple reflections on the beam pipe