Estimate of photon backscattering from beam losses in the extraction line

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ATF2 meeting 16/10/2007 LAPP Annecy

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Introduction

The incoming and the outgoing beam line will be the place of secondaries particles generation

- Several origins
  - Disrupted beam particles, SR, beamstrahlung
- Several locations
  - BeamCal mask, collimator, beam pipe, … , dump

Needs (recalled during IRENG07):

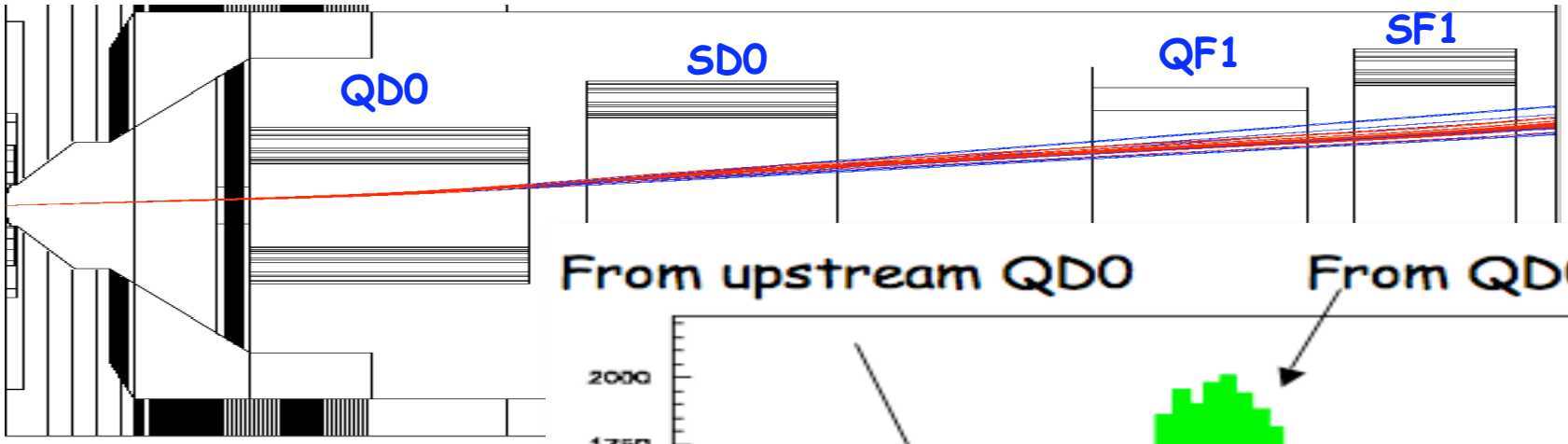
1. List of all background
   (upstream, mask and downstream sources)
2. Impact for all the (sub-)detectors concept

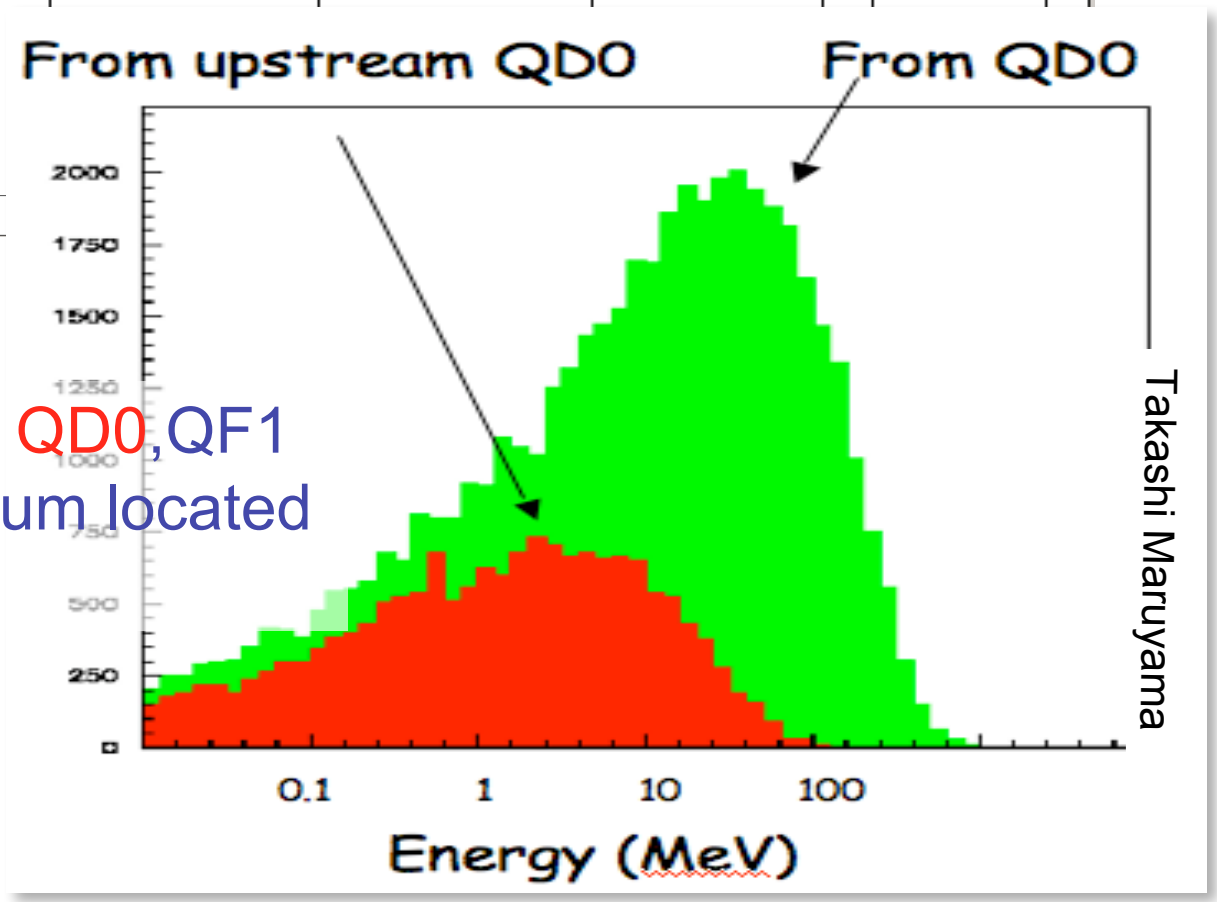
(need to run the detector simulation for such events)

Illustration using losses in the 2mrad

(see Philip's talk)

Common element between incoming and outgoing beam ~15m





Beam goes off axis in QD0,QF1

⇨ SR hit the septum located @ 90 m from the IP

Aim of this presentation

Question we want to answer :

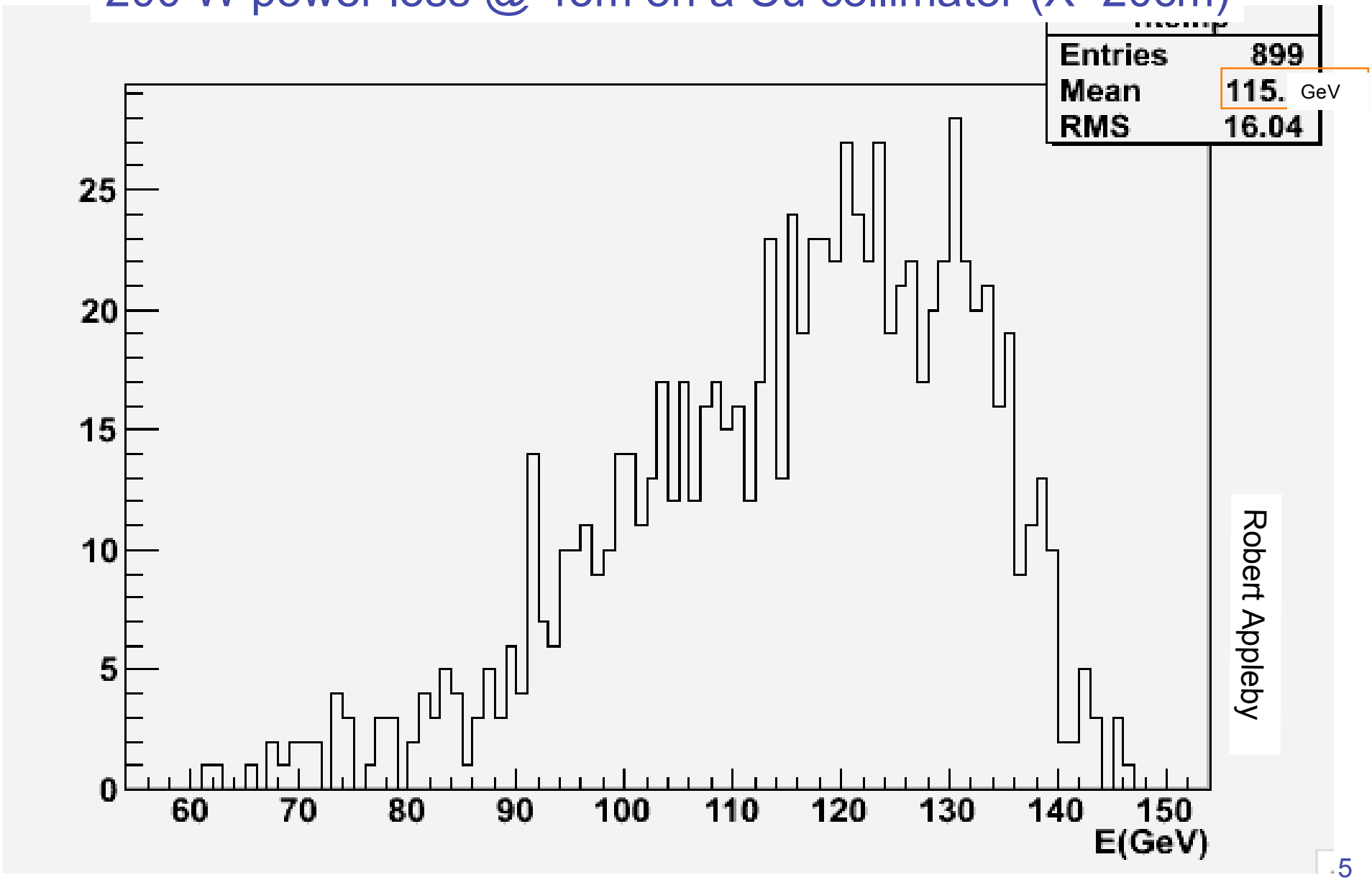
How many backscattered photons from

- Beam losses along the extraction line
- SR

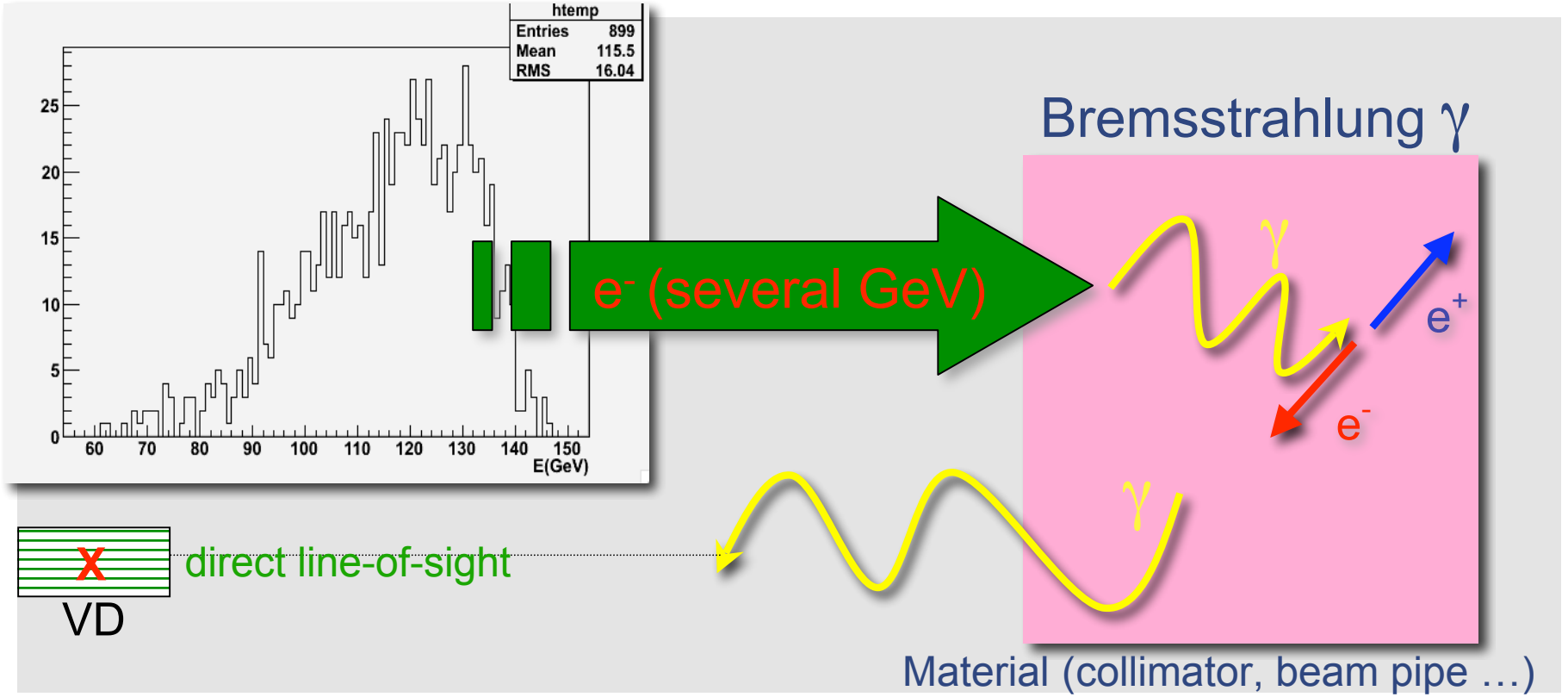
can reach the IP via direct lines of sight passing through the BeamCal aperture (which is the smallest aperture) and still create background in the VD of the LDC detector concept ?

2mrad disrupted beam losses (QEX1COLL)

200 W power loss @ 45m on a Cu collimator (X=20cm)



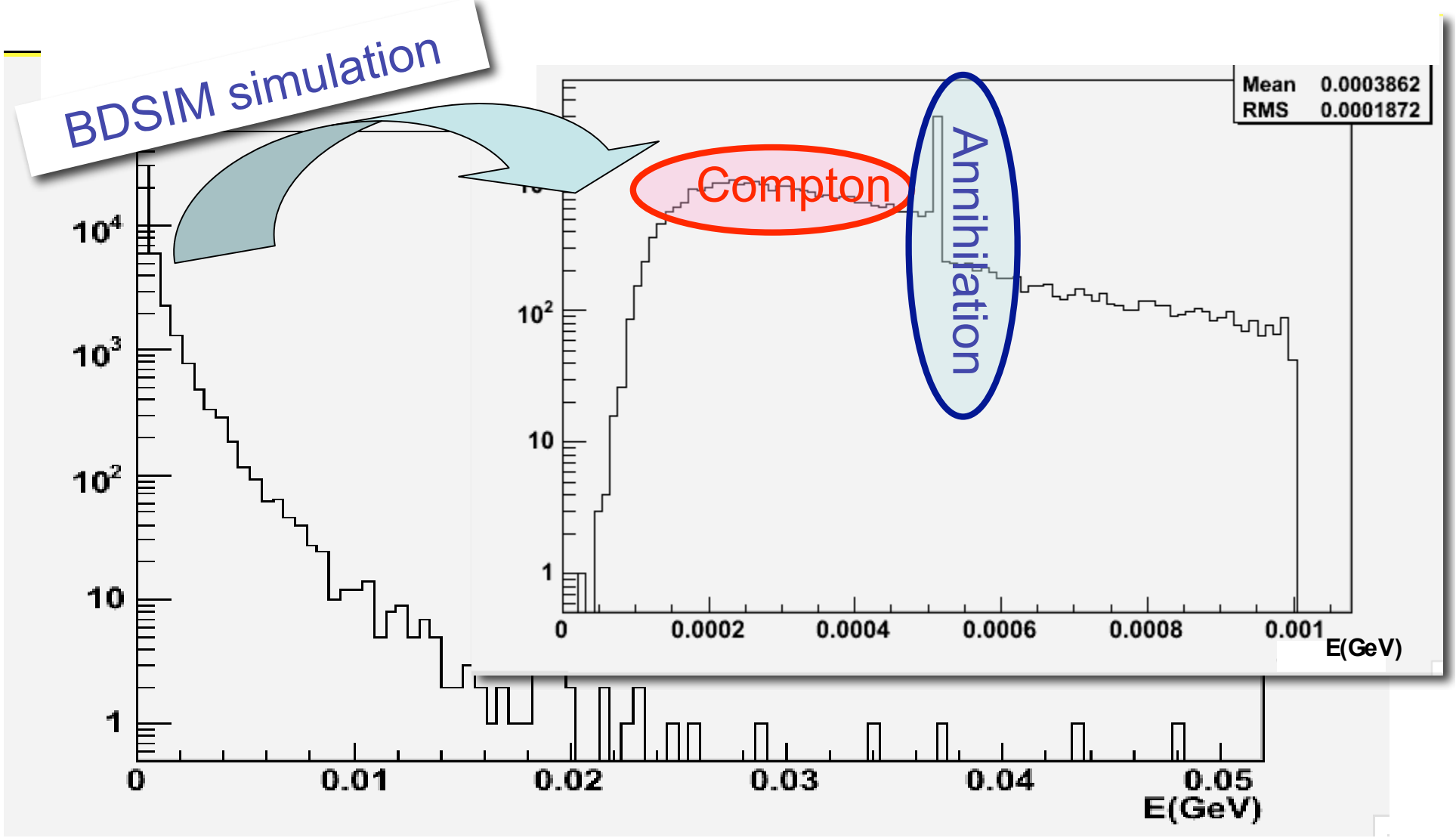
Main processes for backscattered γ



Backscattered γ from cascades of processes:

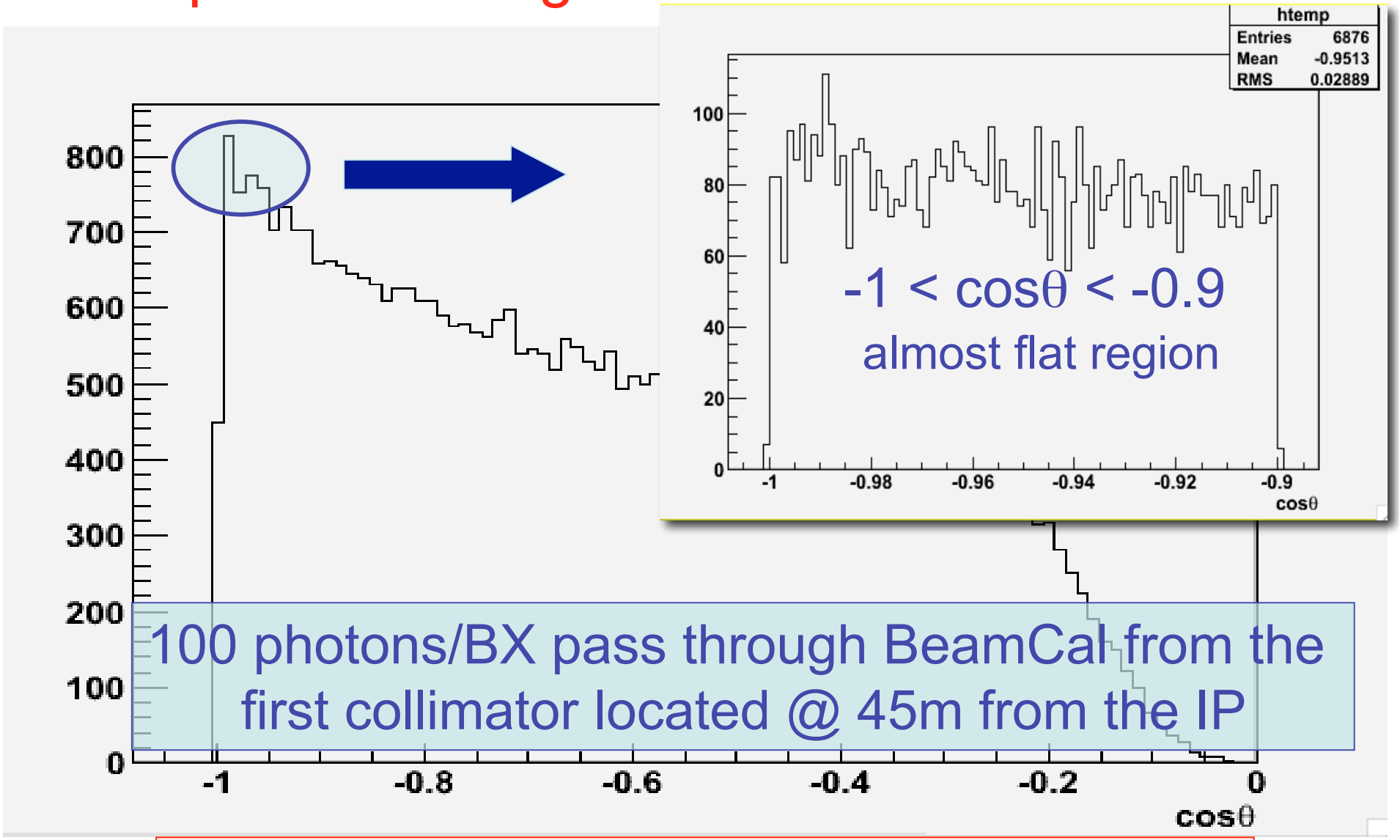
- Bremsstrahlung
- Compton
- if e+, annihilation
- Xray emission (can not be seen here due to our energy threshold)

Backscattered γ spectrum



How many γ can pass through the BeamCal r=12 mm with θ~12mm/45m ?

Extrapolation using flatness of cosθ distribution



How many hits they will produce in the VD ?

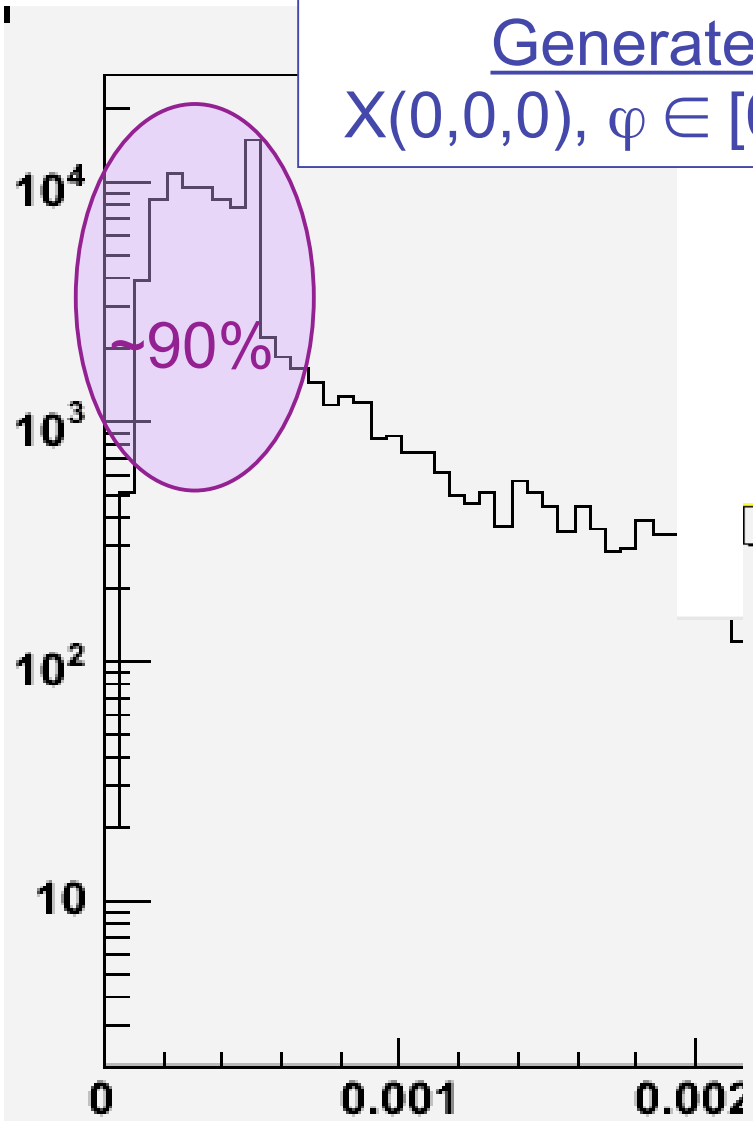
Mokka Simulation & Marlin reco.(1)

γ generated at the IP

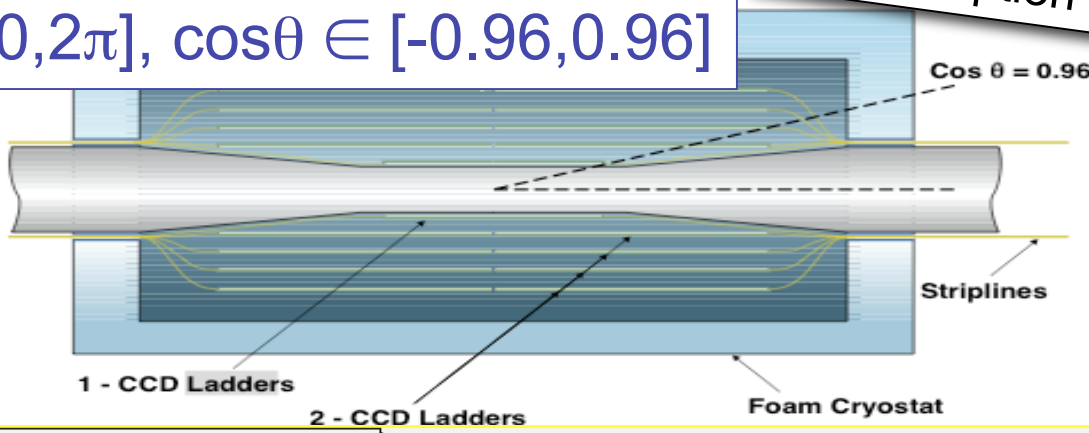
To see the detector response with those low energy γ need to study a simple case

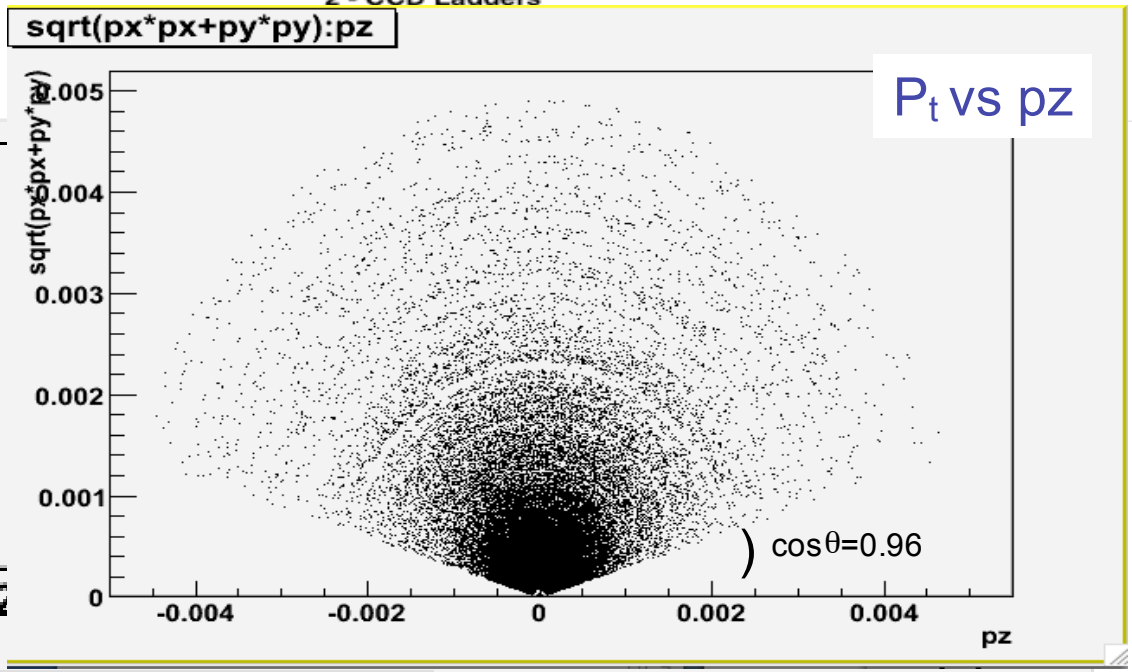
Generate photons at the IP:

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



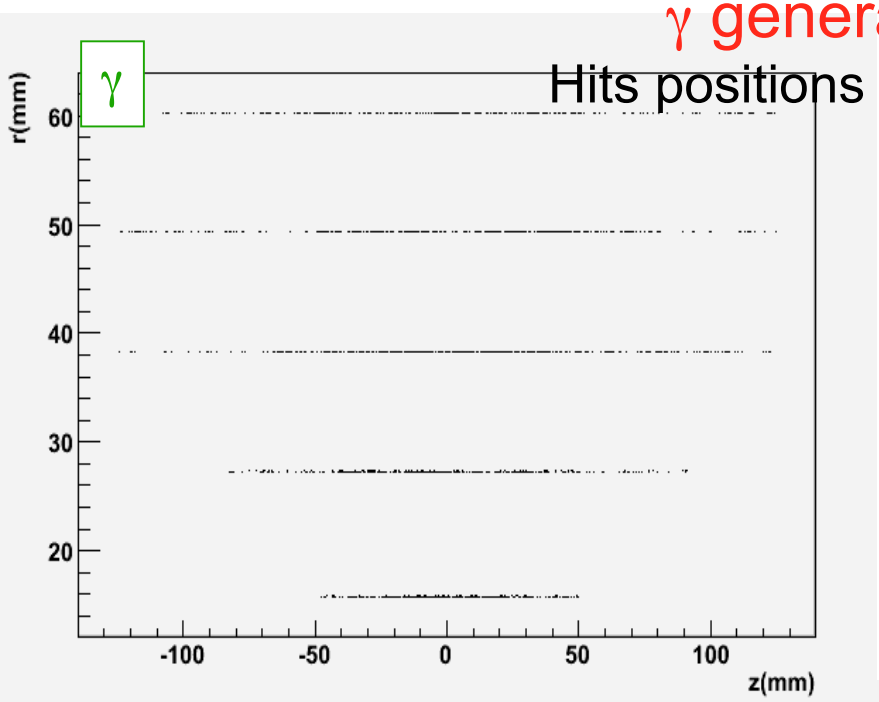
VD description

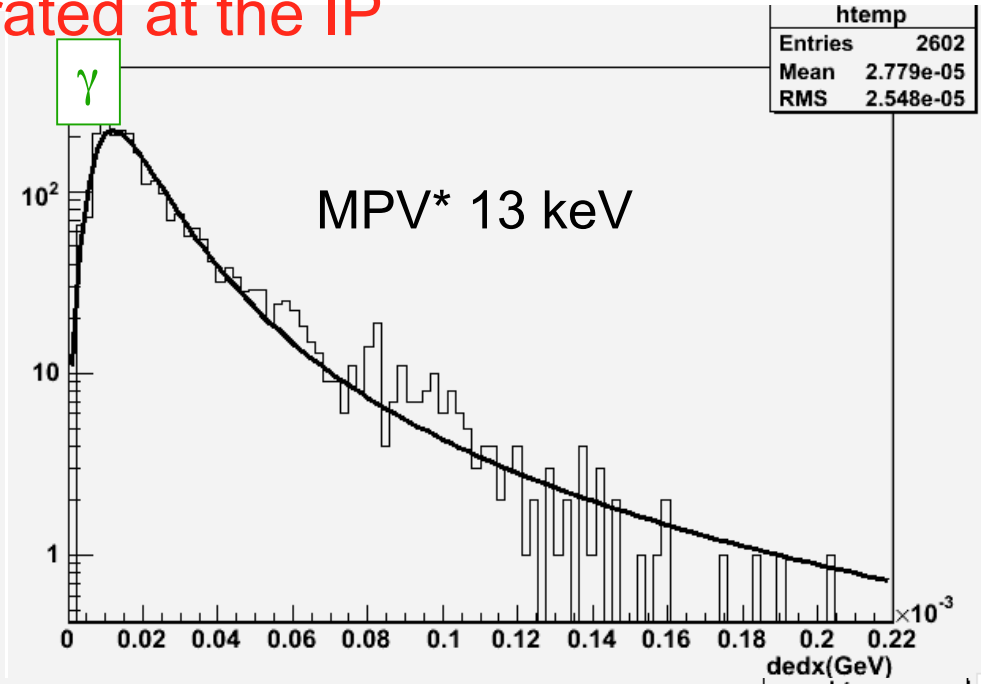




Mokka Simulation & Marlin reco.(1)

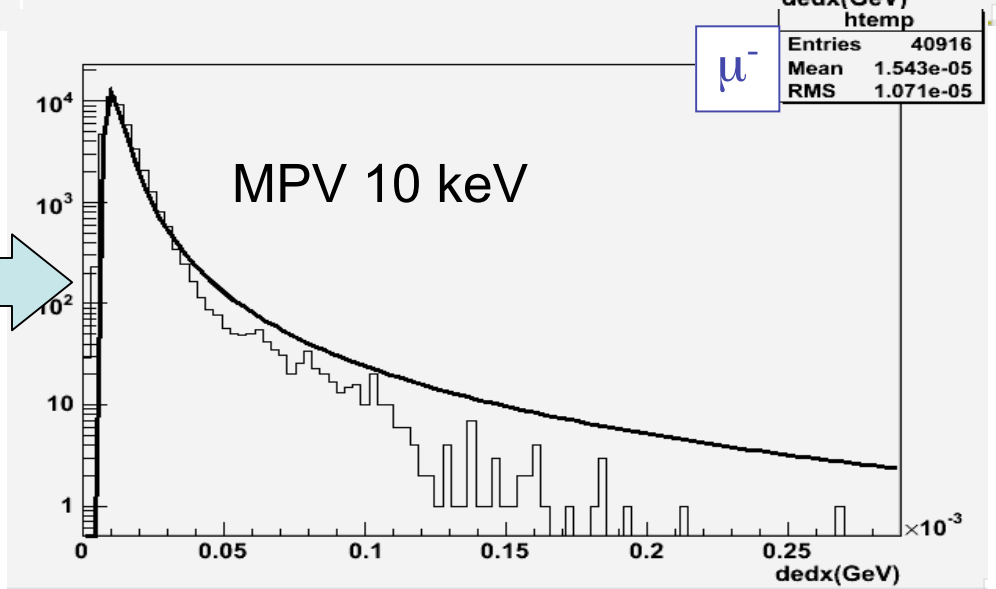
γ generated at the IP





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})

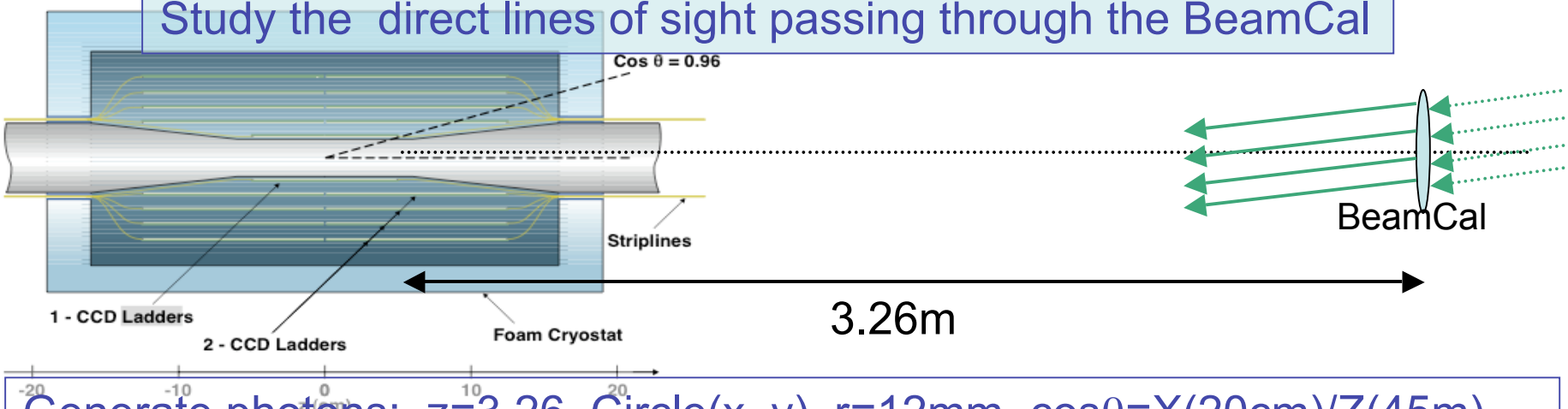


*Most probable Value

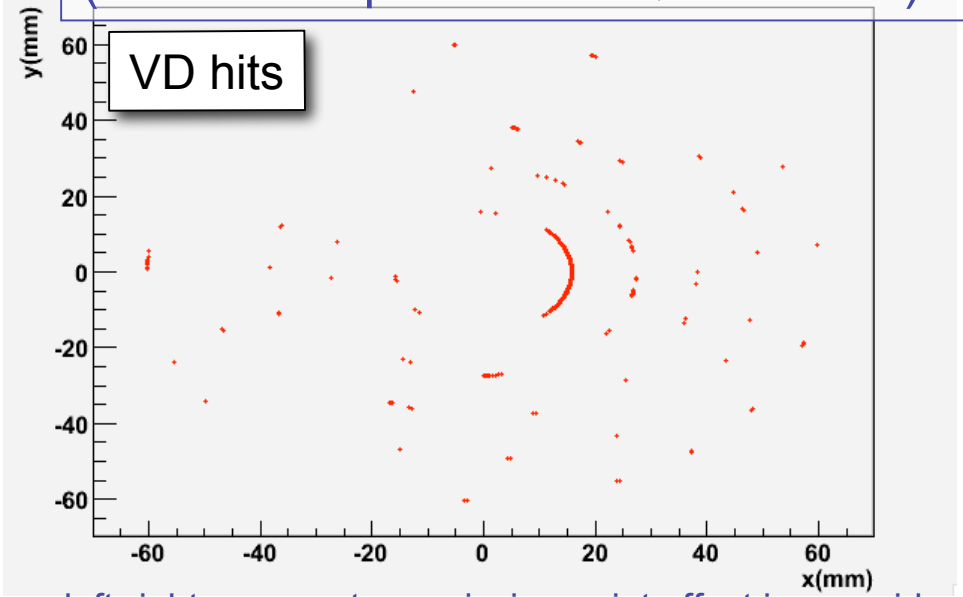
Mokka Simulation & Marlin reco.(2)

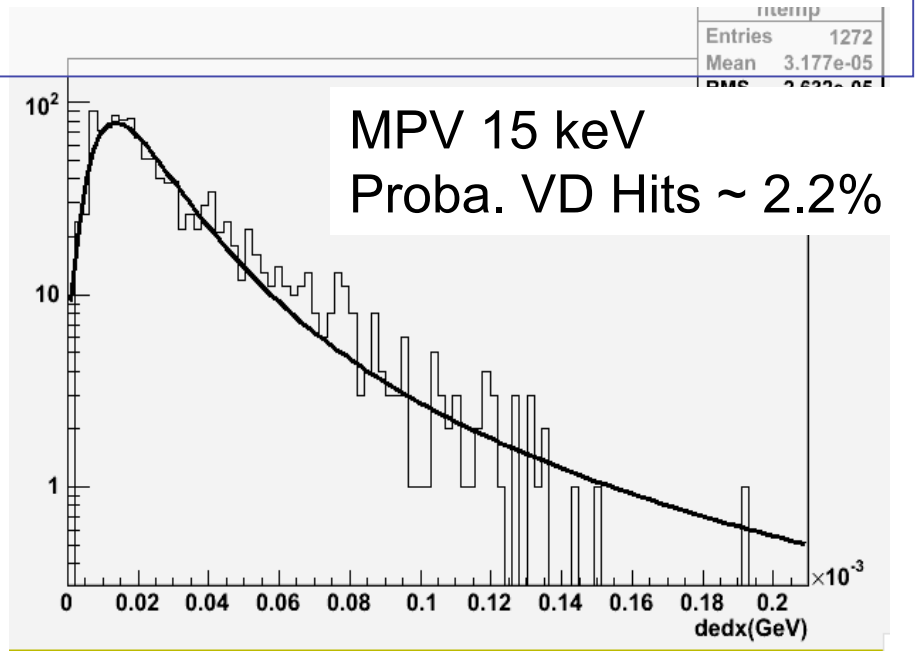
γ generated with very small angle

Study the direct lines of sight passing through the BeamCal



Generate photons: z=3.26, Circle(x, y), r=12mm ,cosθ=X(20cm)/Z(45m)
(Beam loss position at QEX1COLL)





left-right asymmetry, emission point offset in one side

VD Hits in the minimal 2mrad (nominal)

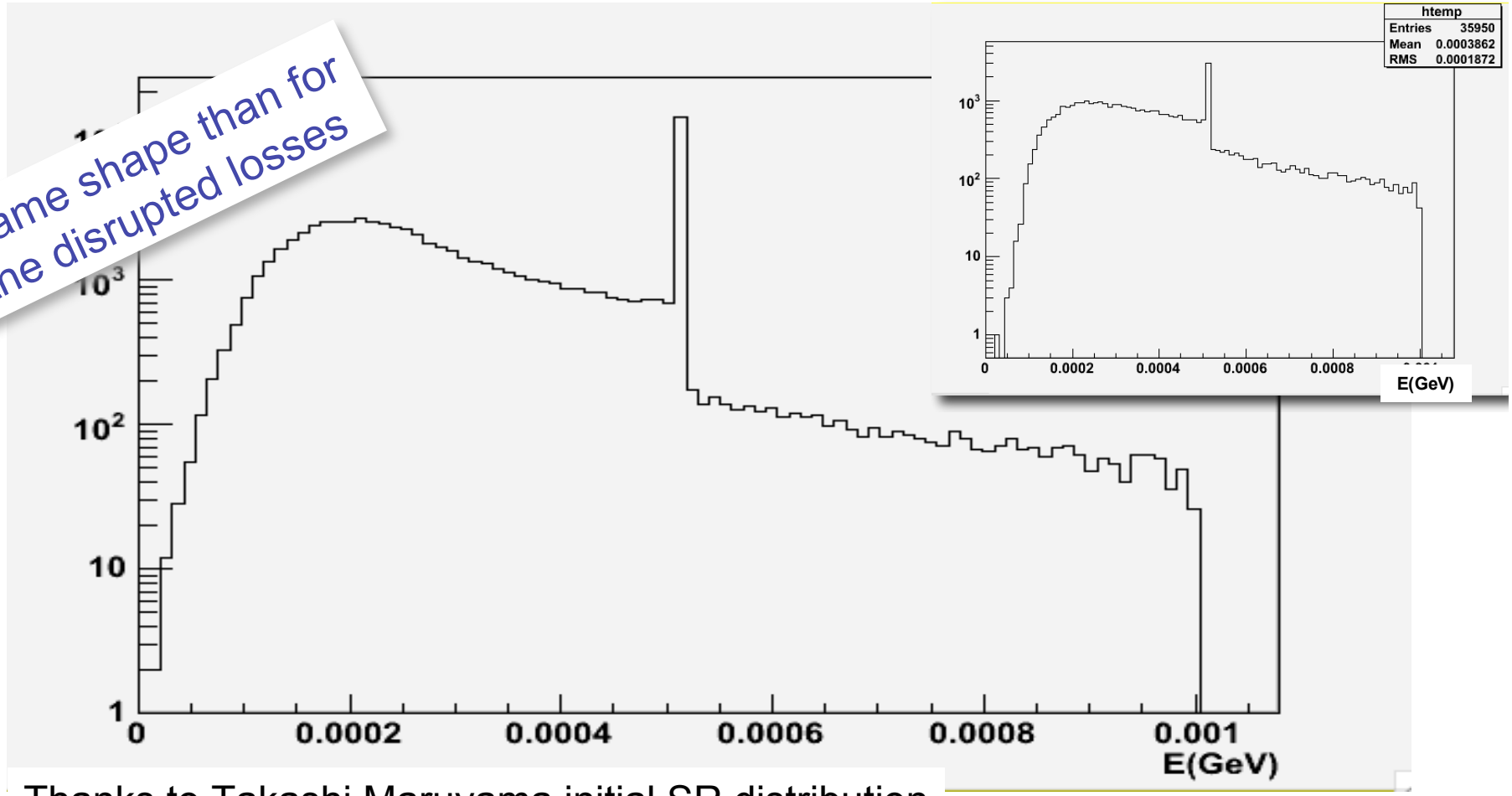
Assuming the same energy spectrum for the beam particles lost on collimators, the fraction of VD hits from other backscattered γ emission sources will be the same: ~ 2.2%

	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

Even for high luminosity parameters hits are negligible

Backscattered γ energy from QD0 SR

(Cu for the septum material @ 90 m)



Thanks to Takashi Maruyama initial SR distribution

2200 γ/BX at the IP * 2.2% ~ 50 VD hits/BX < 300 direct hits from incoherent pairs (Cecile Rimbault's et al. paper)

Conclusion

- Back-scattered photons due to disrupted beam losses & SR (from QD0) in the 2mrad produce negligible effects in the VD

- 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
  -event biasing method (Marc's talk)-

- 14mrad background studies with LDC/GLD detector