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LINEAR COLLIDER WORKSHOP
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Worldwide Study of the Physics and Detectors for Future Linear e+e- Colliders

Background in LDC Detector from backscattered photons induced by beam losses in the extraction line

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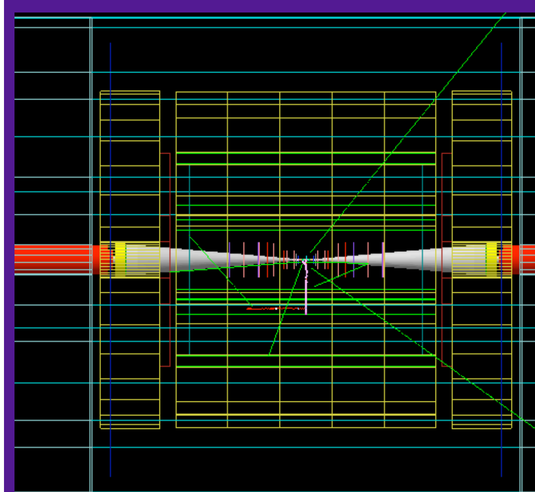
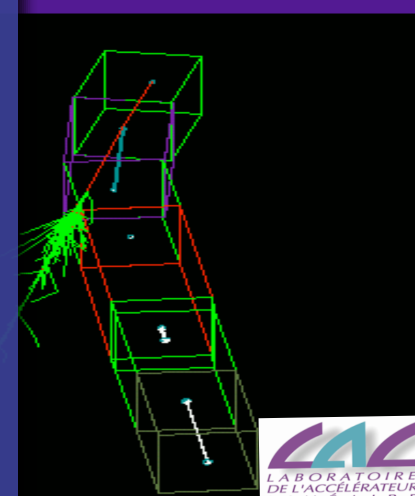


Contents

- Introduction
- Backscattered photons from disrupted beam losses
- Mokka simulation
- Conclusion



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)

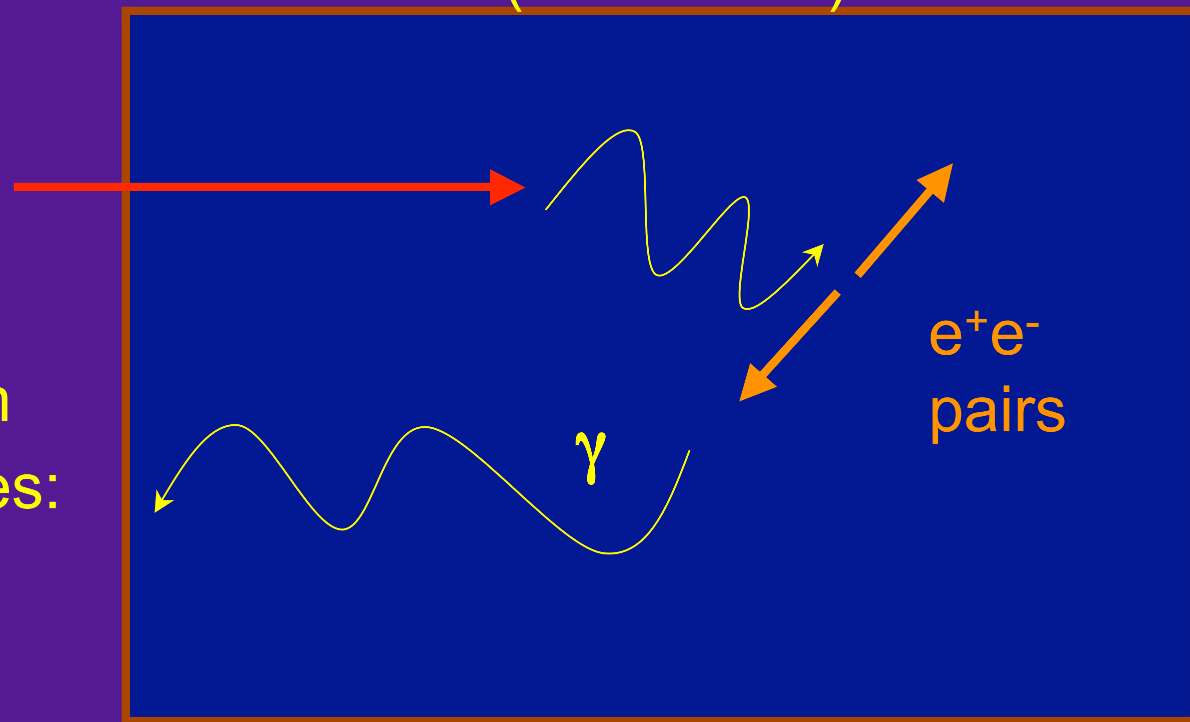
Aims

- 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

Main processes for backscattered photons

Bremsstrahlung photons
(E >> MeV)

e^- (several GeV)

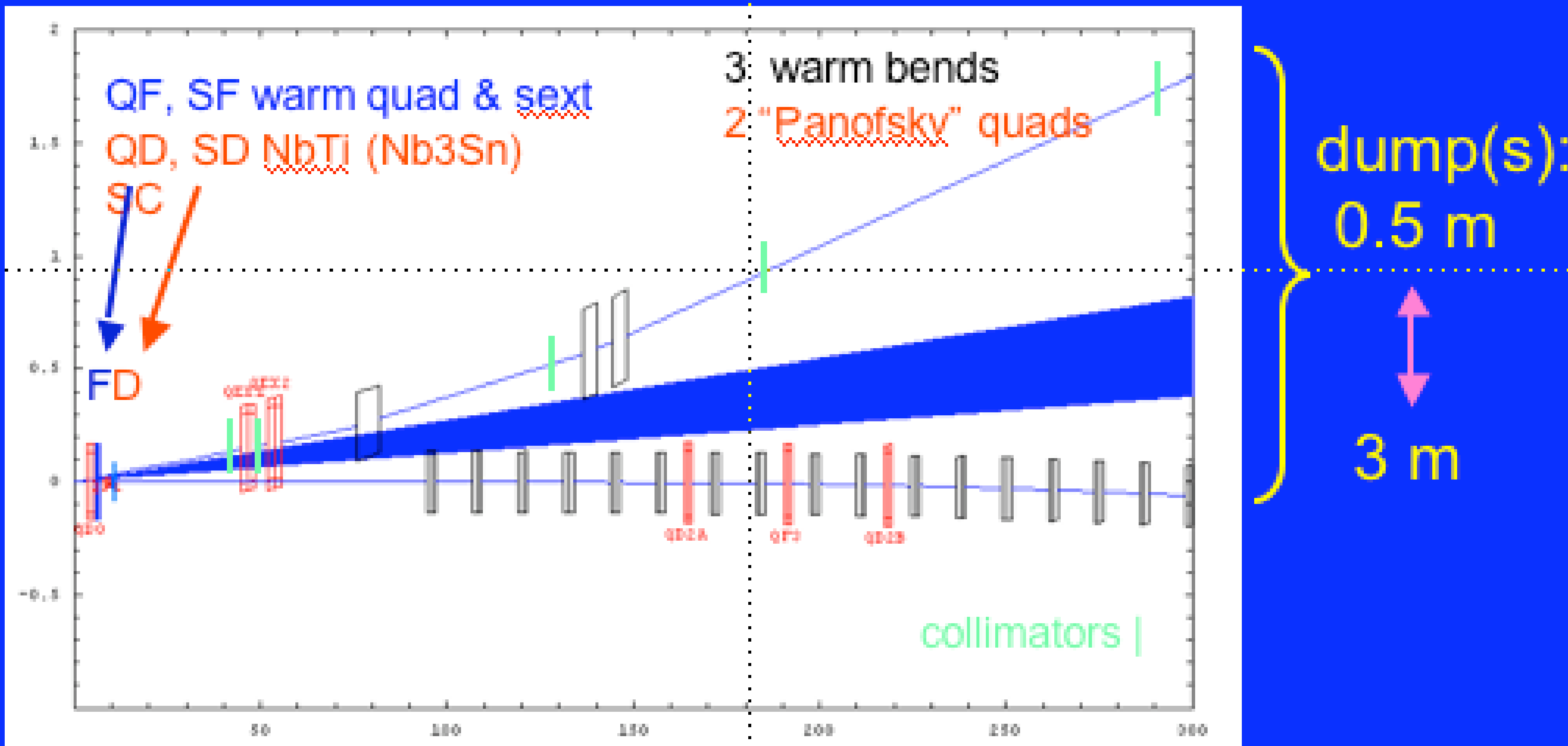


Backscattered γ from cascades of processes:
- Bremsstrahlung
- Compton
- if e^+, annihilation

Material (collimator, beam pipe …)

New “minimal” extraction line concept

➔ Explicit goals : short & economical, as few and feasible magnets as possible, more tolerant and flexible

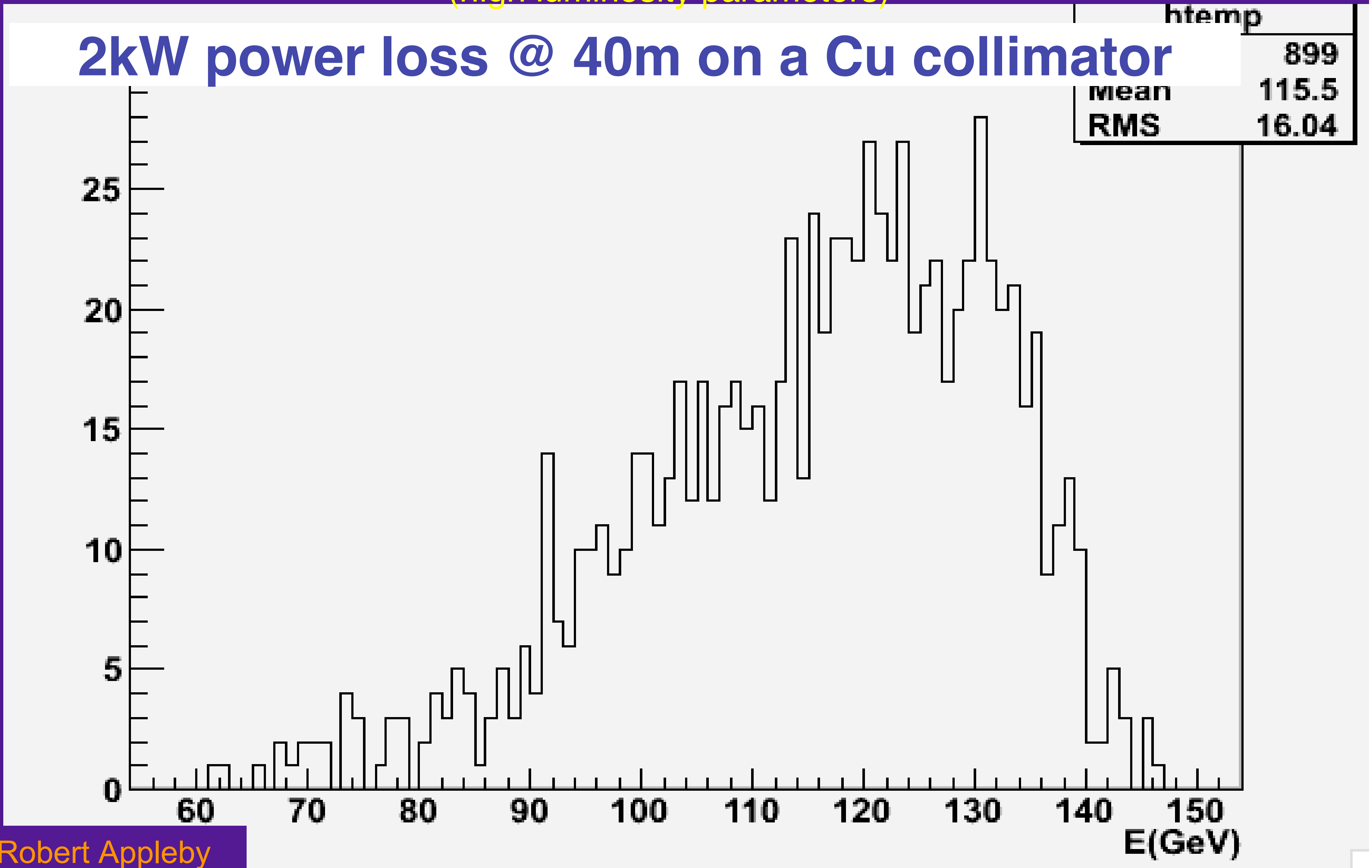


Length ~ 300 m

Philip Bambade

2mrad disrupted beam losses

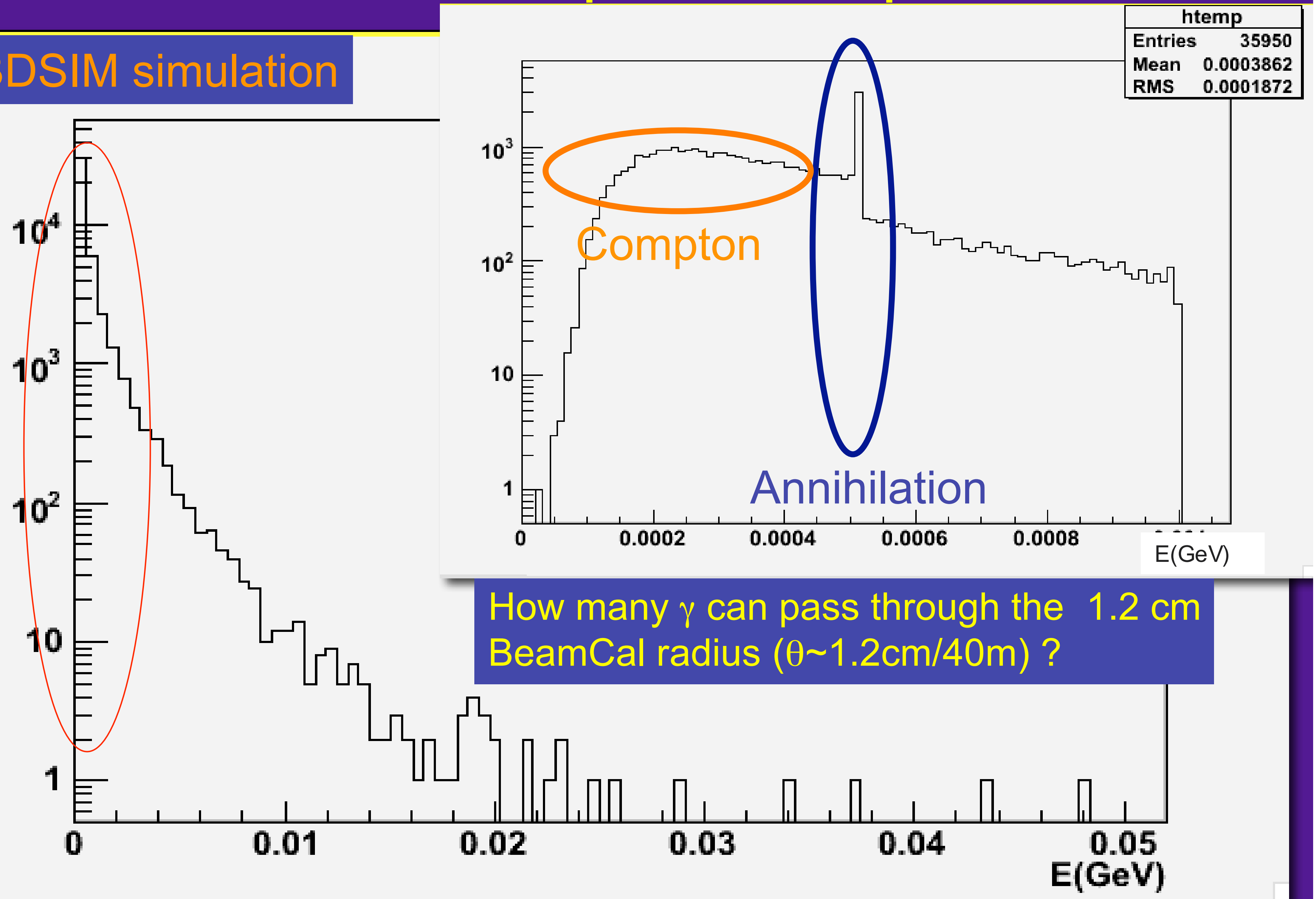
(high luminosity parameters)



Robert Appleby

Backscattered photons spectrum

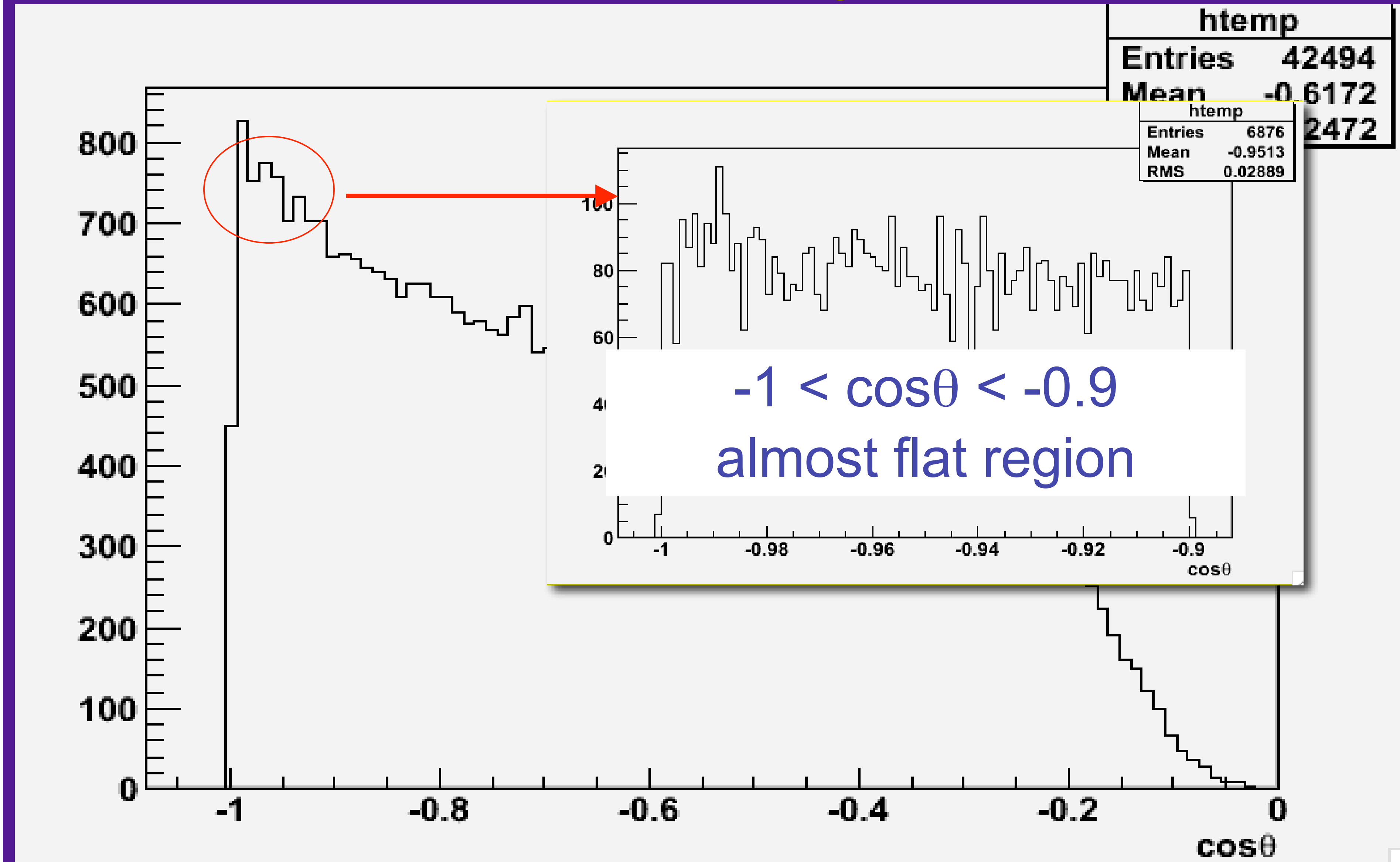
BDSIM simulation



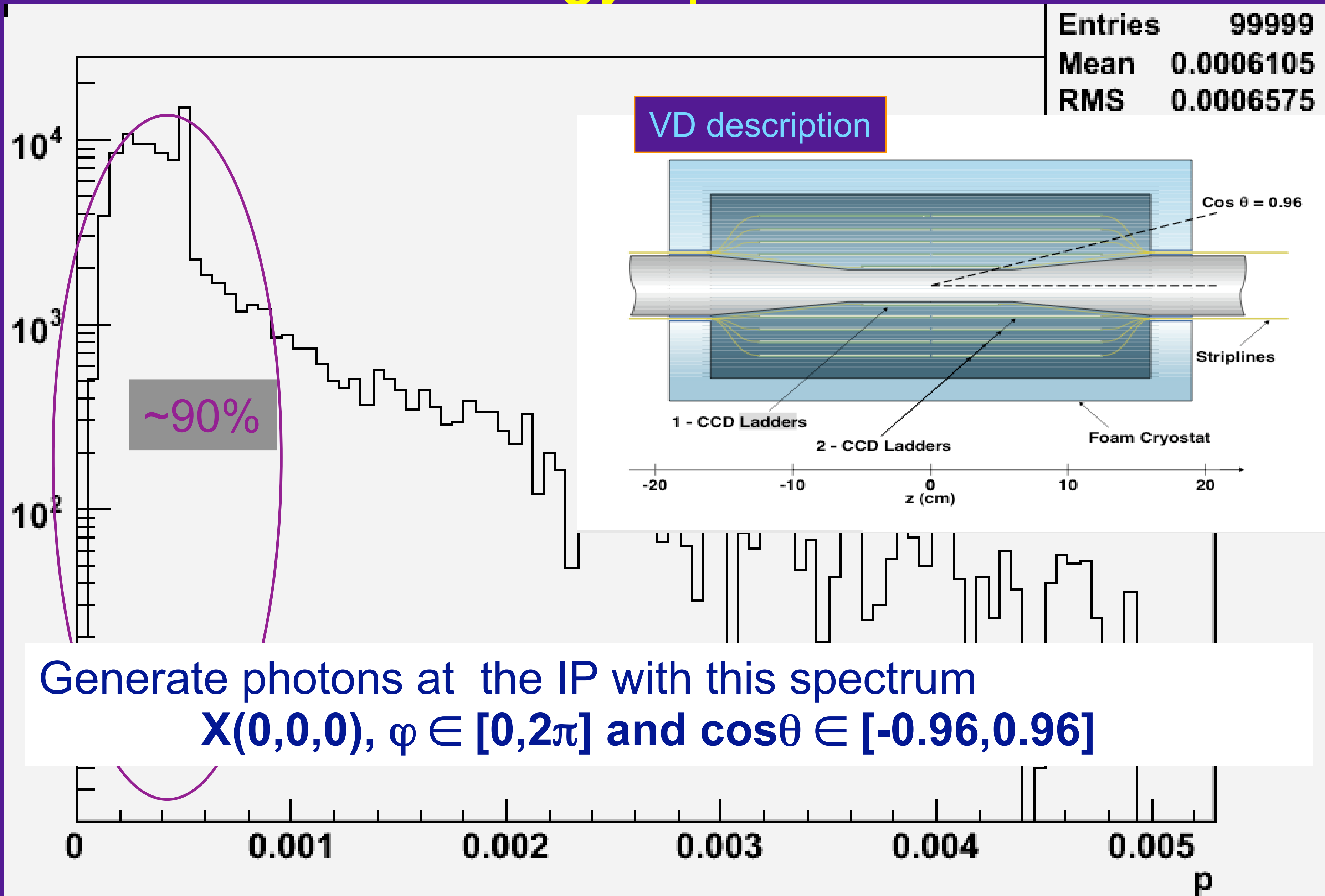
How many γ can pass through the 1.2 cm BeamCal radius (θ~1.2cm/40m) ?

Extrapolation using flatness of cosθ distribution

→ 100 photons pass through BeamCal



Energy spectrum

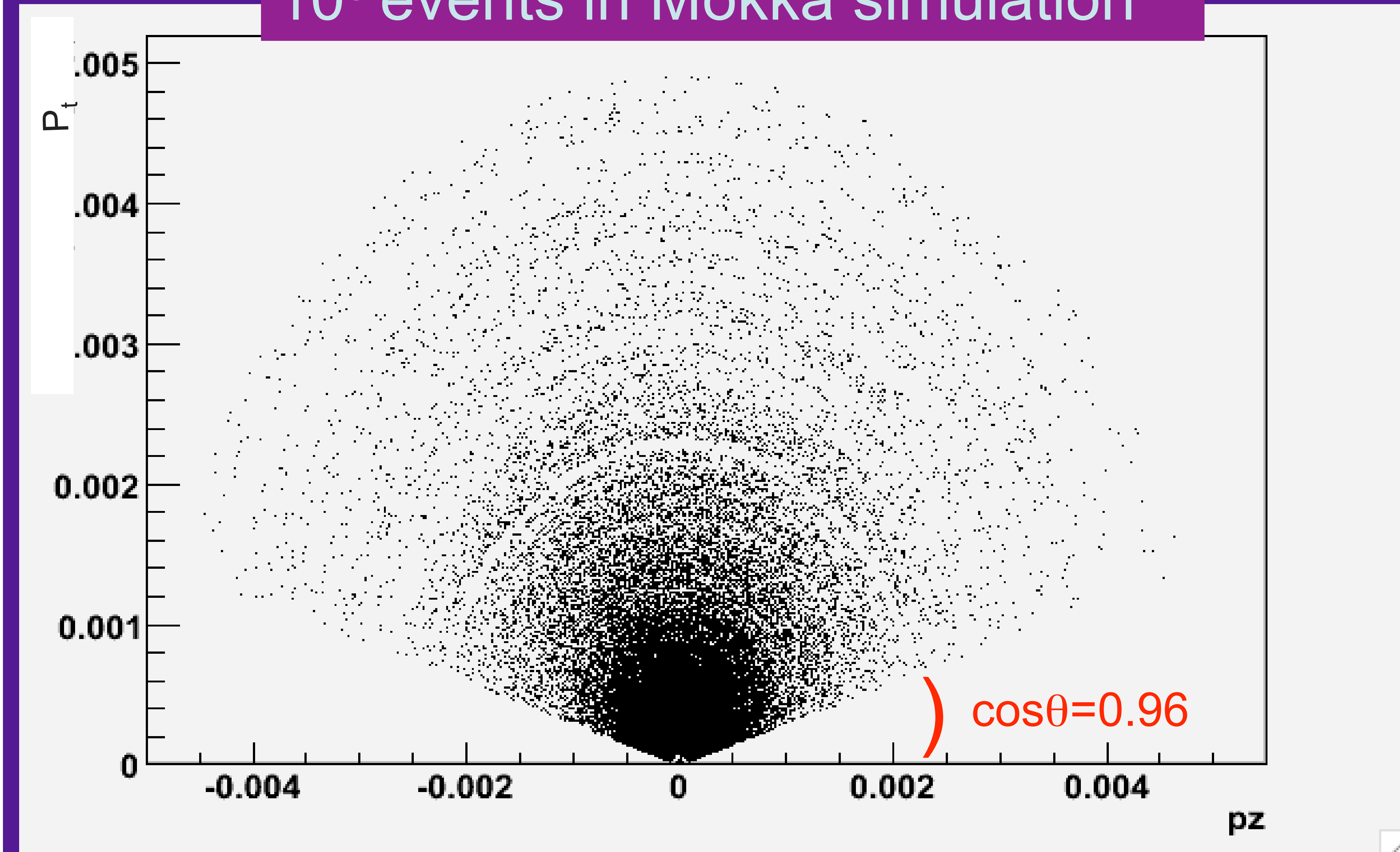


Generate photons at the IP with this spectrum

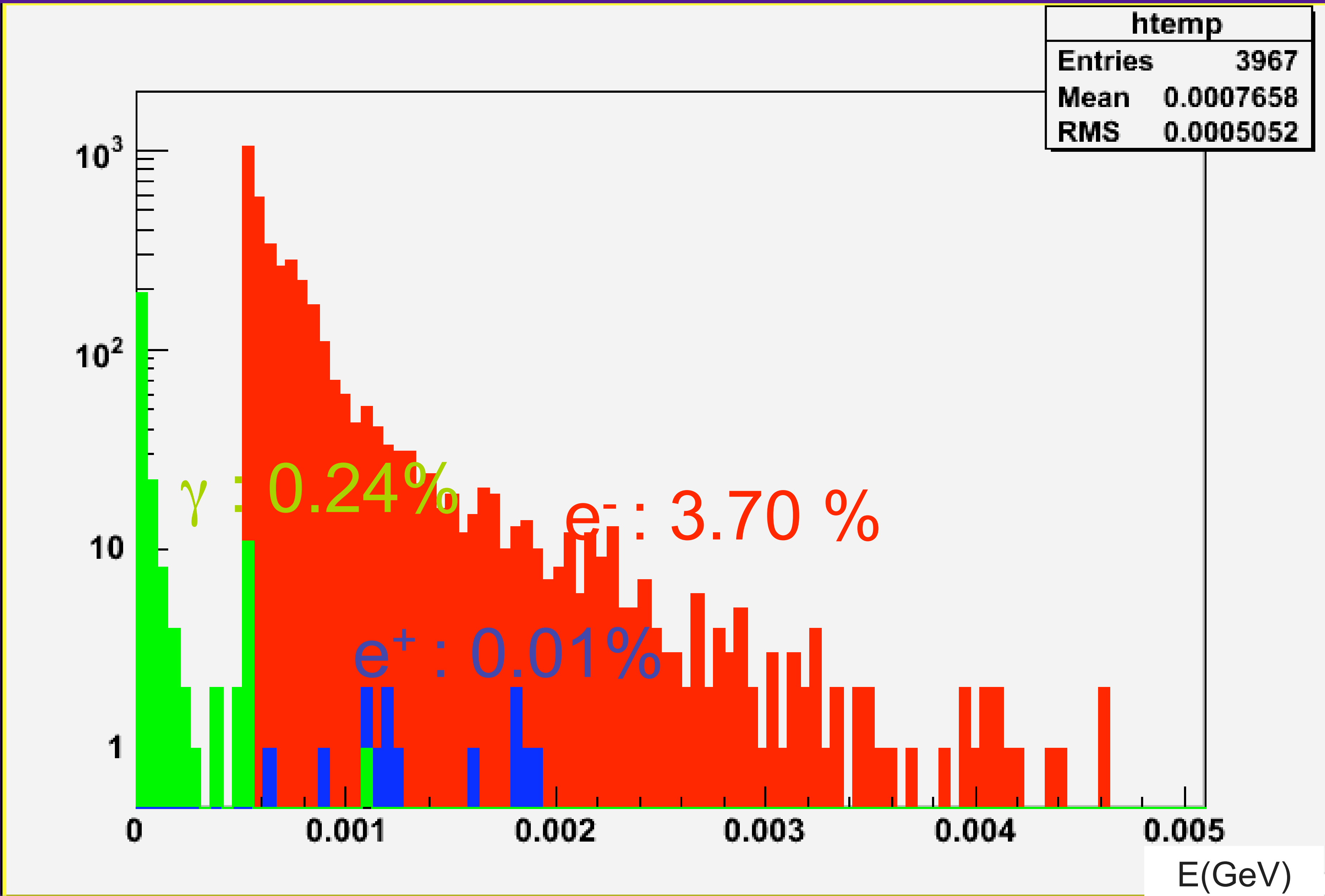
X(0,0,0), $\varphi \in [0,2\pi]$ and $\cos\theta \in [-0.96,0.96]$

P_t vs P_z

10^5 events in Mokka simulation



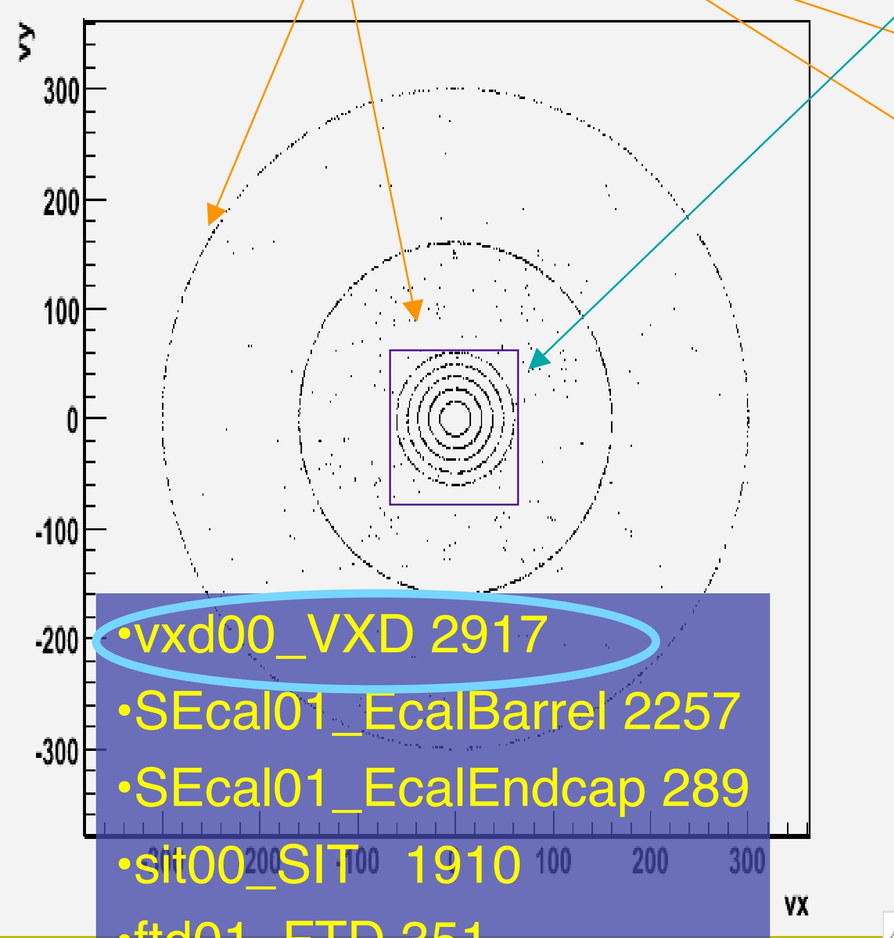
Energy spectra of secondary particles



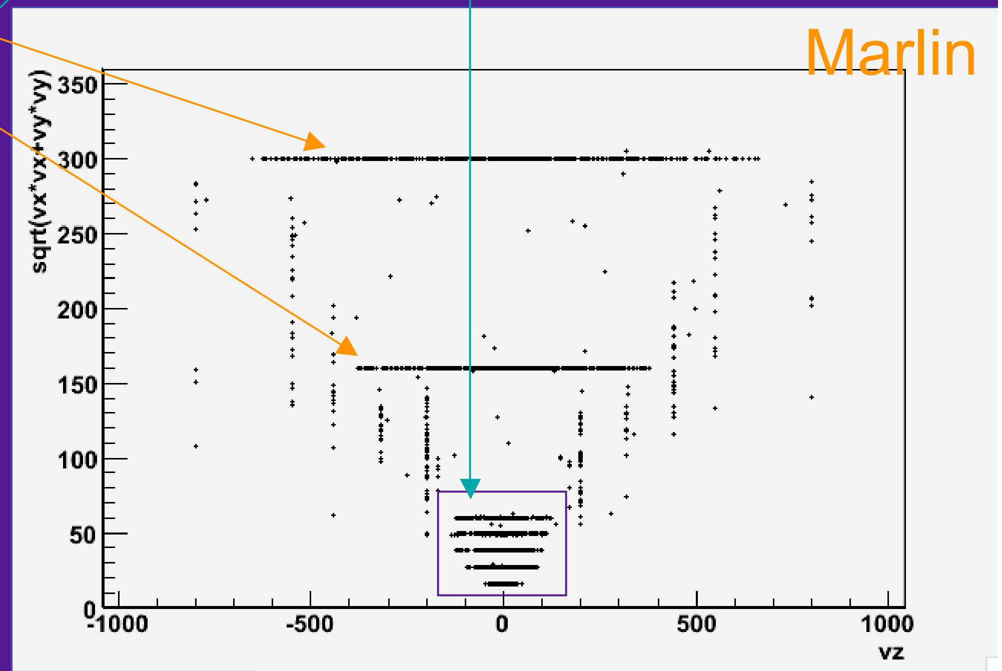
Creation location, sub detectors hits

SIT 2 layers

VXD 5 layers (16 up to 60 mm)



- vxd00_VXD 2917
- SEcal01_EcalBarrel 2257
- SEcal01_EcalEndcap 289
- sit00_SIT 1910
- ftd01_FTD 351
- STpc01_FC 71



~ 3% generate a “hit” in the VD

Conclusion & prospect

- 2.5 kW disrupted beam losses @ 40m in the redesigned "minimal" 2mrad extraction line

→ 3 hits in the VD

Need to check when generating the photons at the entrance of the detector (should be less from the geometry)

- Takashi Maruyama predicted 2200 photons from the SR lost on the septum @ 90 m in the old Snowmass 2mrad design for a 2cm BeamCal radius. We have cross-checked this result and found a similar number.

  This corresponds to 800 photons for the 1.2 cm radius in the new design:

→ 24 hits in the VD

This is 10% of the ~ 250 hits from incoherent pairs which hit the VD directly

- Reconstruction criteria for photons and charged particles as a function of their energy
- Multiple photon reflexions in the beam pipe using event biasing techniques

Thanks to Adrian Vogel for useful discussion