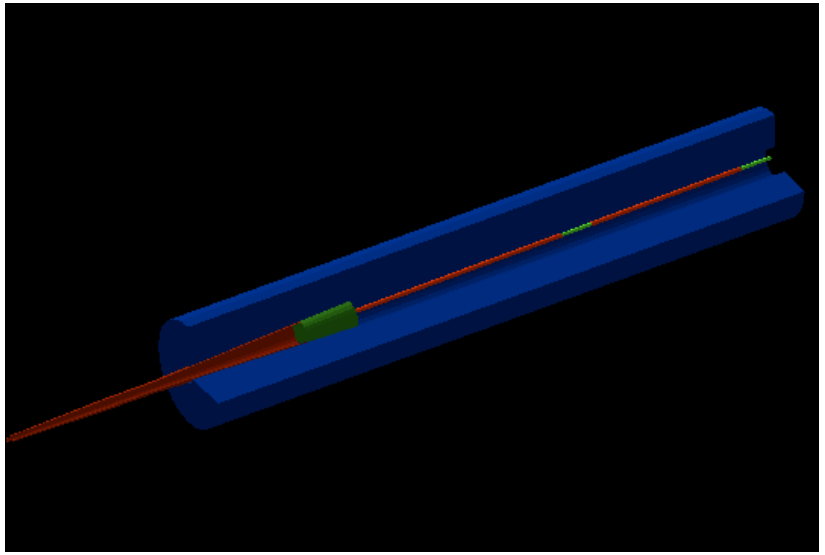
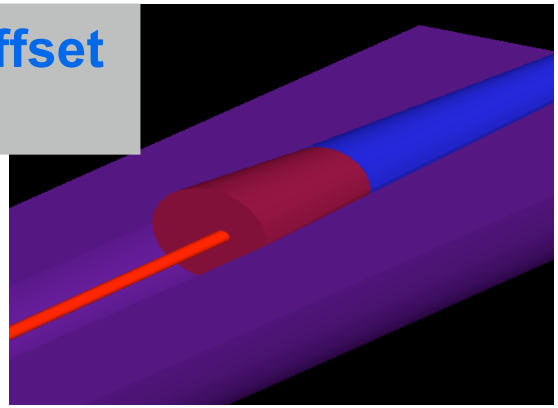
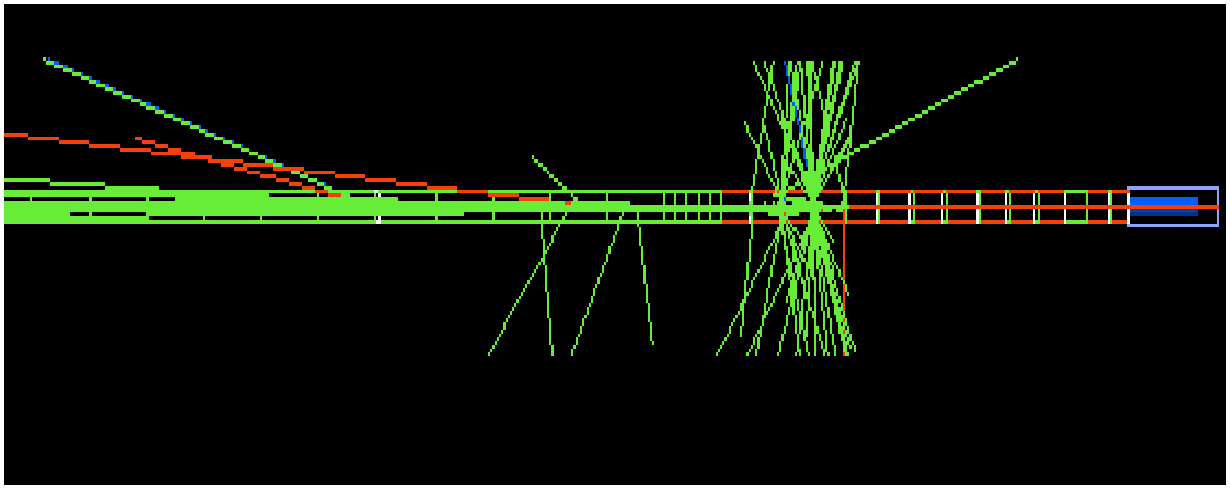
Background from beam losses along the 20mrad ILC extraction line



1TeV high luminosity parameters 80nm vertical offset in the case of “SiD” concept detector





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Resume

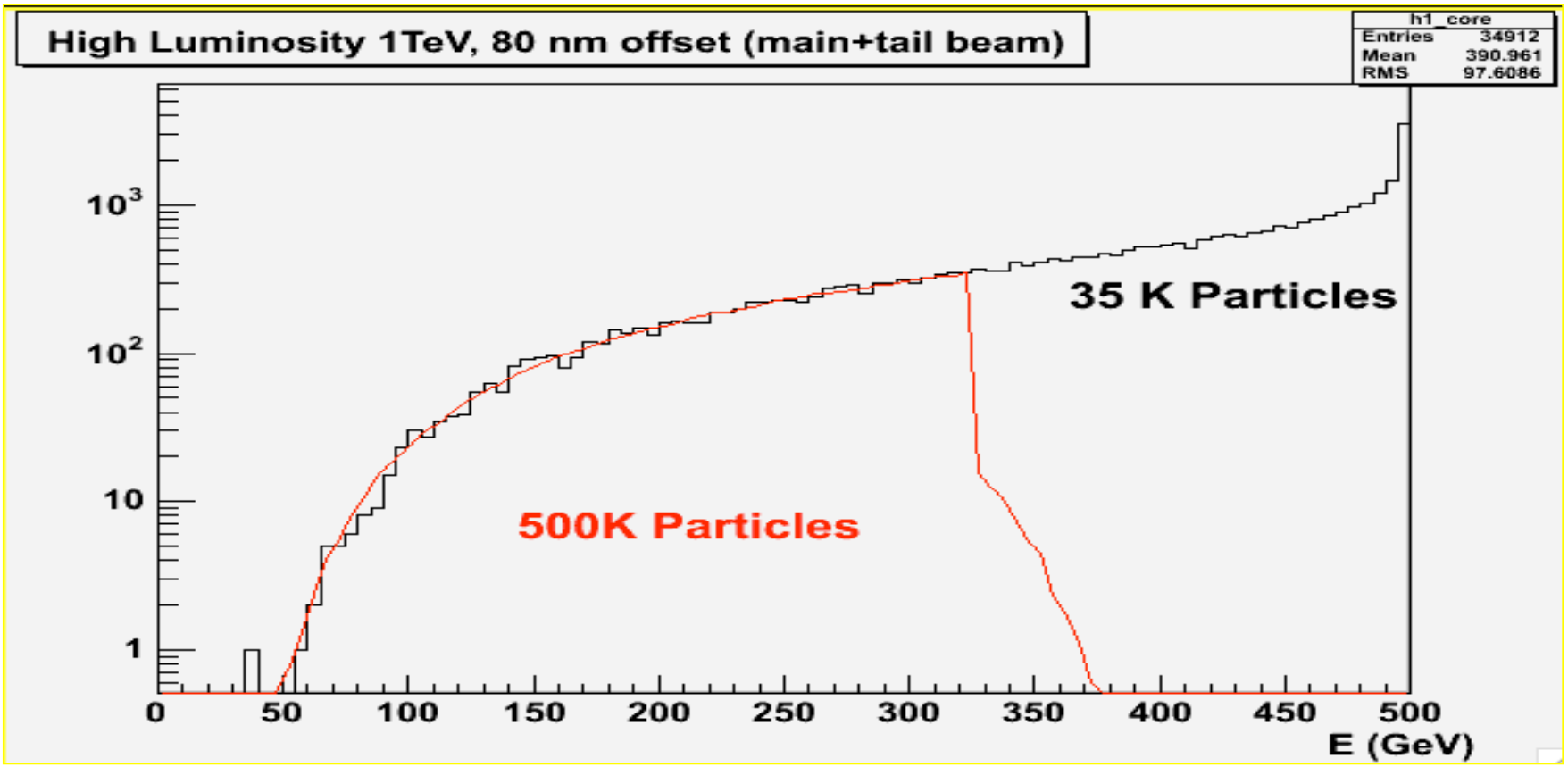
- Introduction
- The disrupted beam and power losses along the 20 mrad extraction line
- “SID” with the 20 mrad in BDSIM
- Backscattered photons
- Backscattered electrons
- Conclusion

Introduction

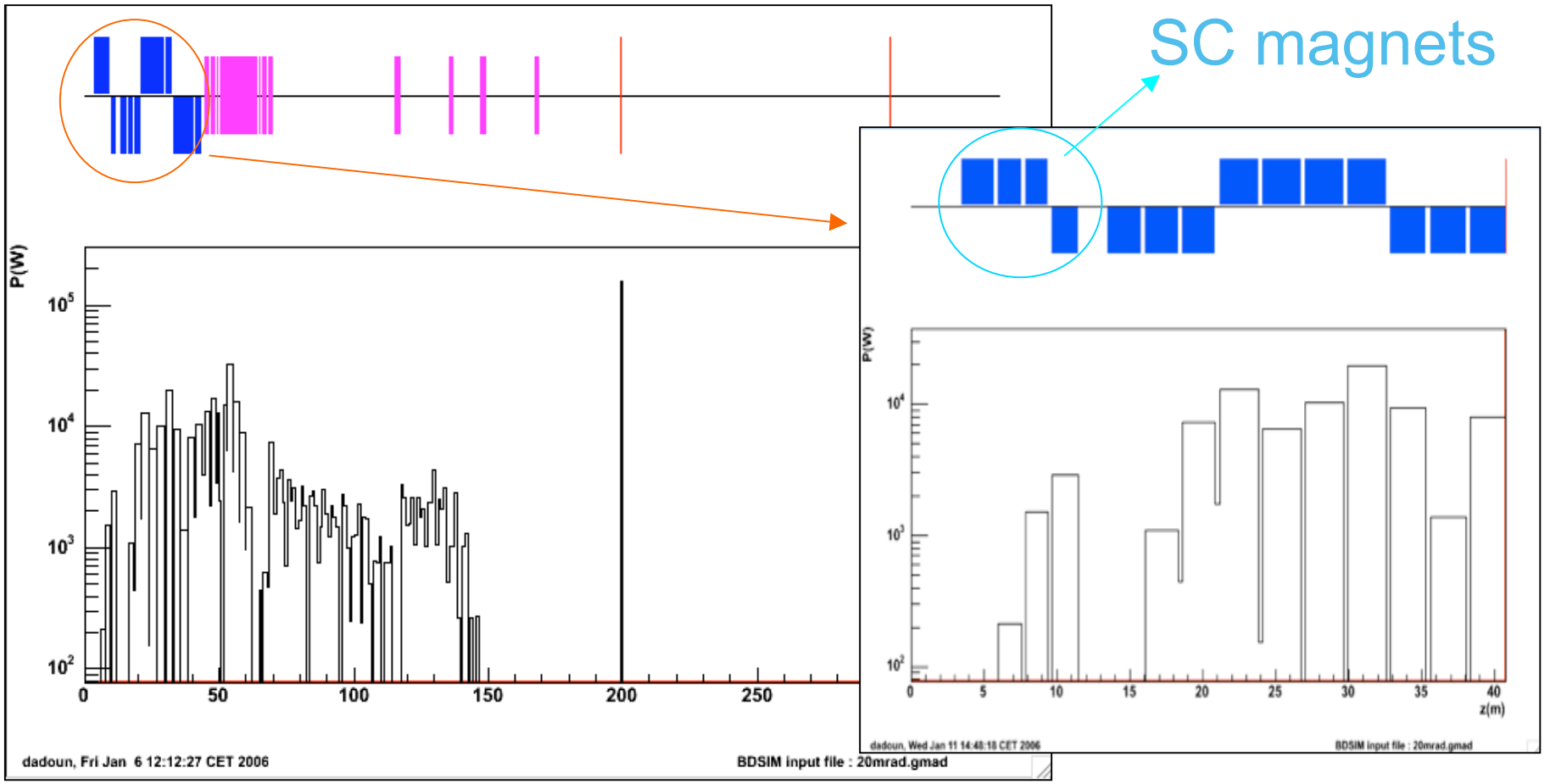
- Depend on the beam parameters set, the post collision beam could be very degraded (beamstralung photon)
- Need to extract those beams and transport them with the minimal losses to the dump
  - **In any case we will have some losses**
    - damage on beam magnet and specially the SC magnets
    - background generation
- One of our goals:
  - **Evaluate the backscattered particles into the detector region using BDSIM toolkit (Geant4 based)**
    - nb: 4detectors concept X 3(4) extractions line

Disrupted beam

- To maximize the power losses and the secondaries I used the High luminosity beam parameters @ 1TeV machine with dy=80 nm beam offset (worst case not really realistic)
- 15 MW post collision beam to extract (~kW/m in the SC magnets !!!)



Power losses

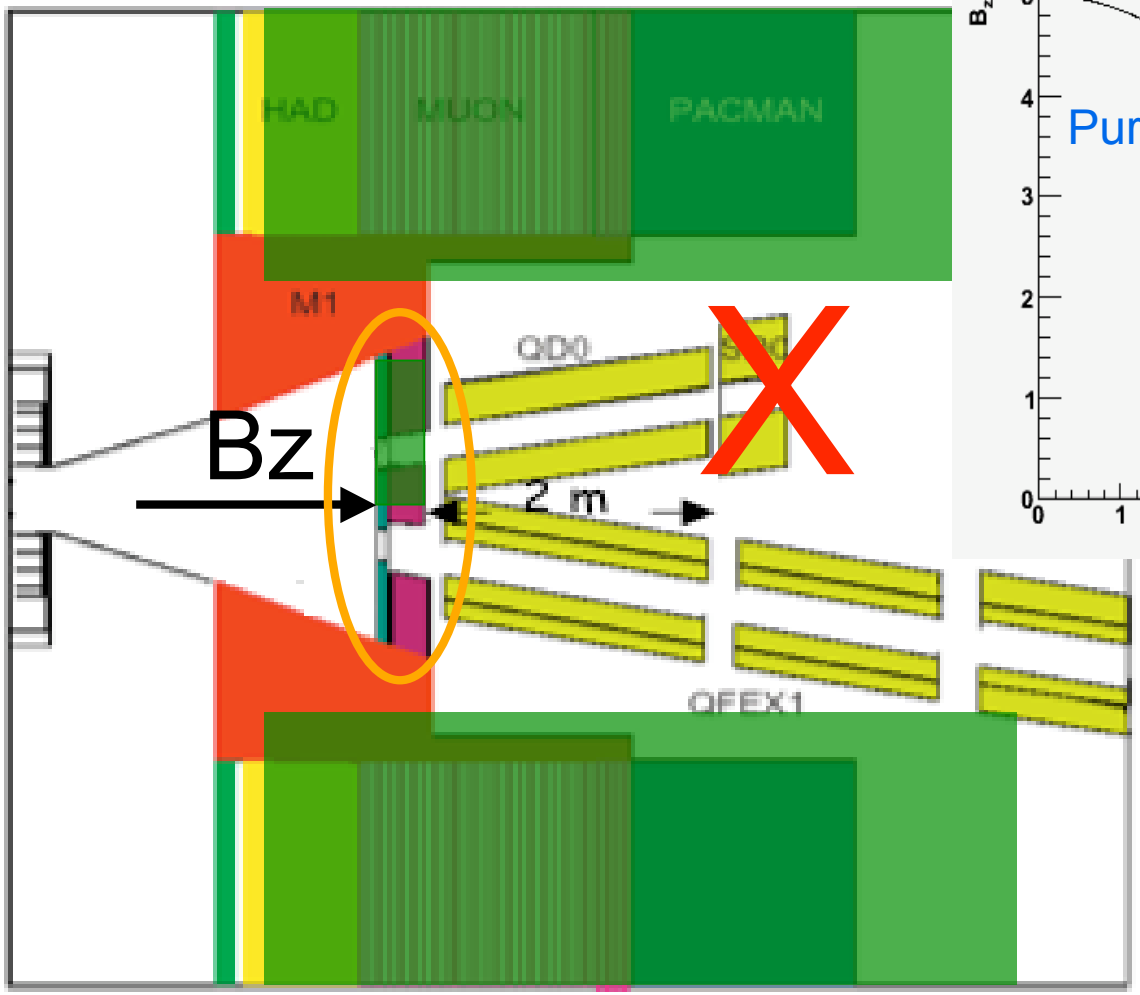


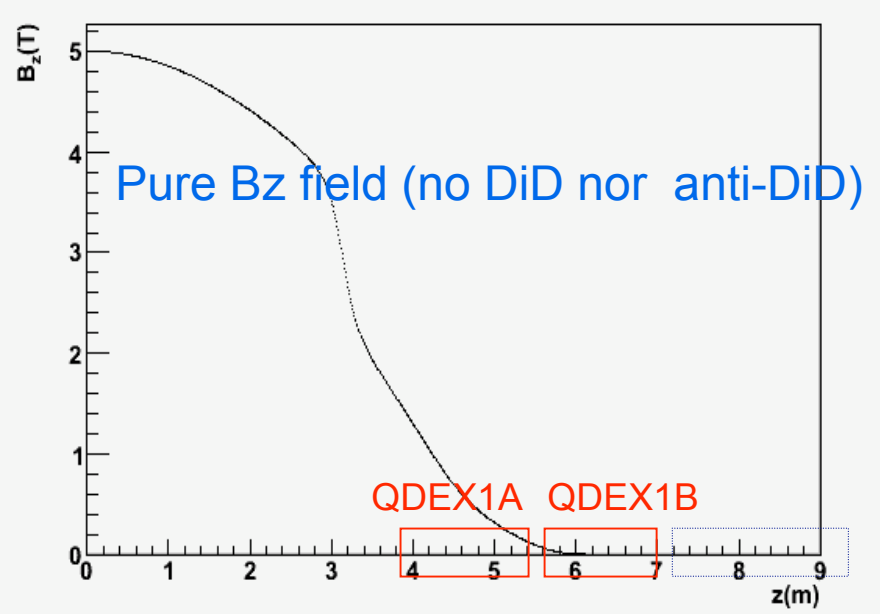
Comment:

Paper on an Abacus power in the case of the 2, 14 and 20 mrad extraction line, using different beam parameters set

(GuineaPig files with huge static available soon on ilc SE :))

“SID” detector concept

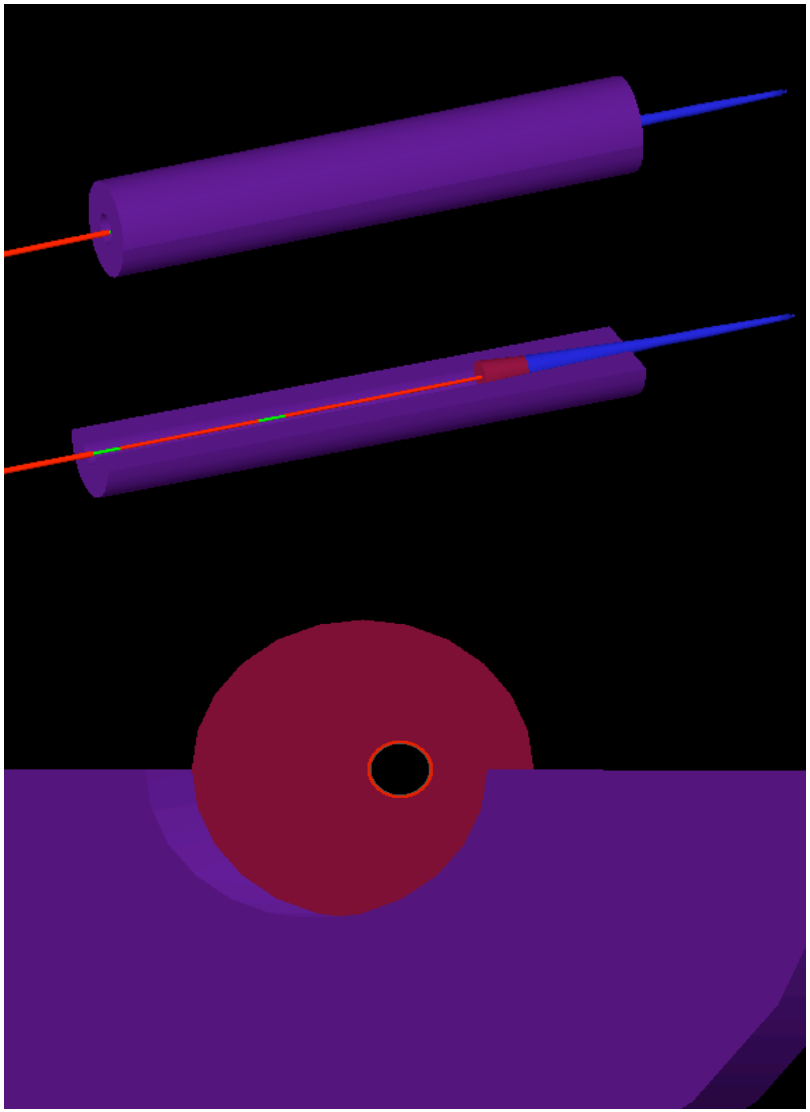


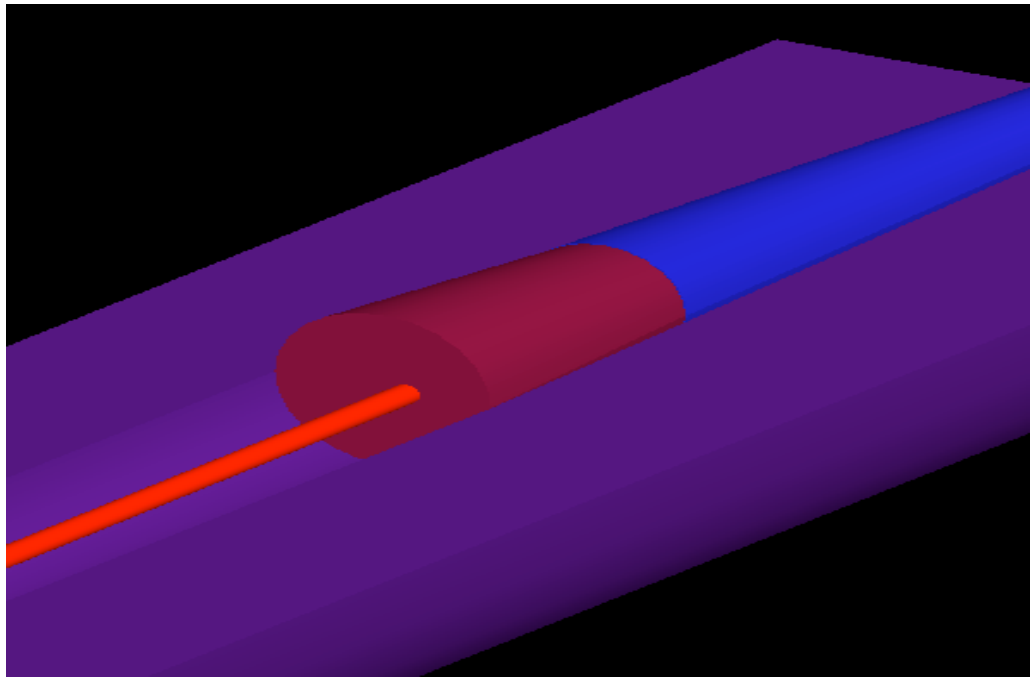


- Mask @ z=3m
  50cm of Tungsten (only the exit hole)
- Only the extraction line simulated (50m out of 300m)

“SiD” in BDSIM simulation

(Mokka description)





This is a very simplify SiD detector description with pure Bz field

Need to simulate in BDSIM the real detector description

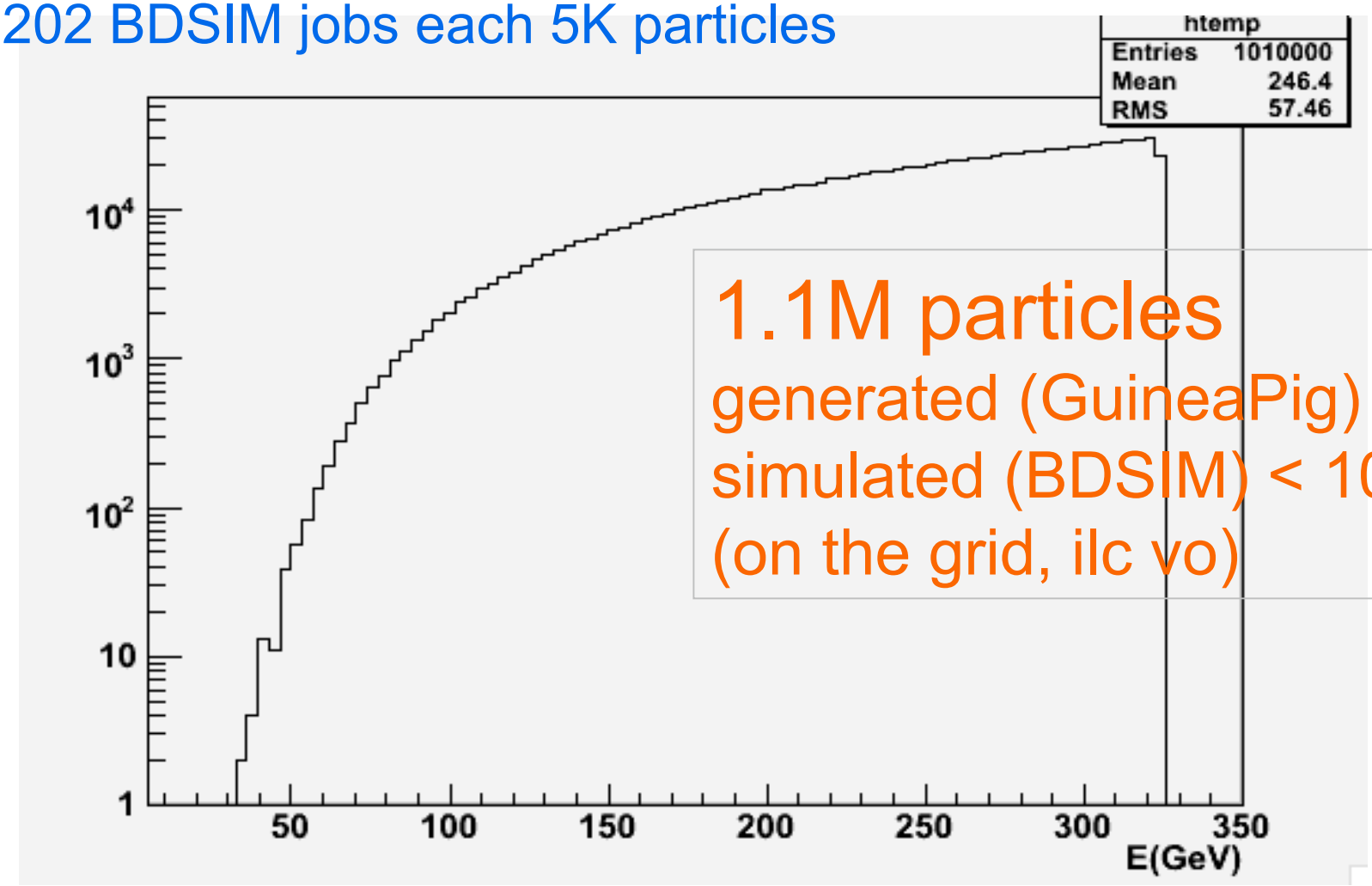
BDSIM Geant4 flags

- beampipeRadius = 10 * cm,
- beampipeThickness = 0.1 * cm,
- tunnelRadius= 2.0 * m,
- physicsList="em_standard”
  - **Ionization**
  - **Bremsstrahlung**
  - **Multiple scattering**
- thresholdCutCharged = 10 * KeV,
- thresholdCutPhotons = 10 * KeV;

Hadronic process not take into account

Disrupted beam

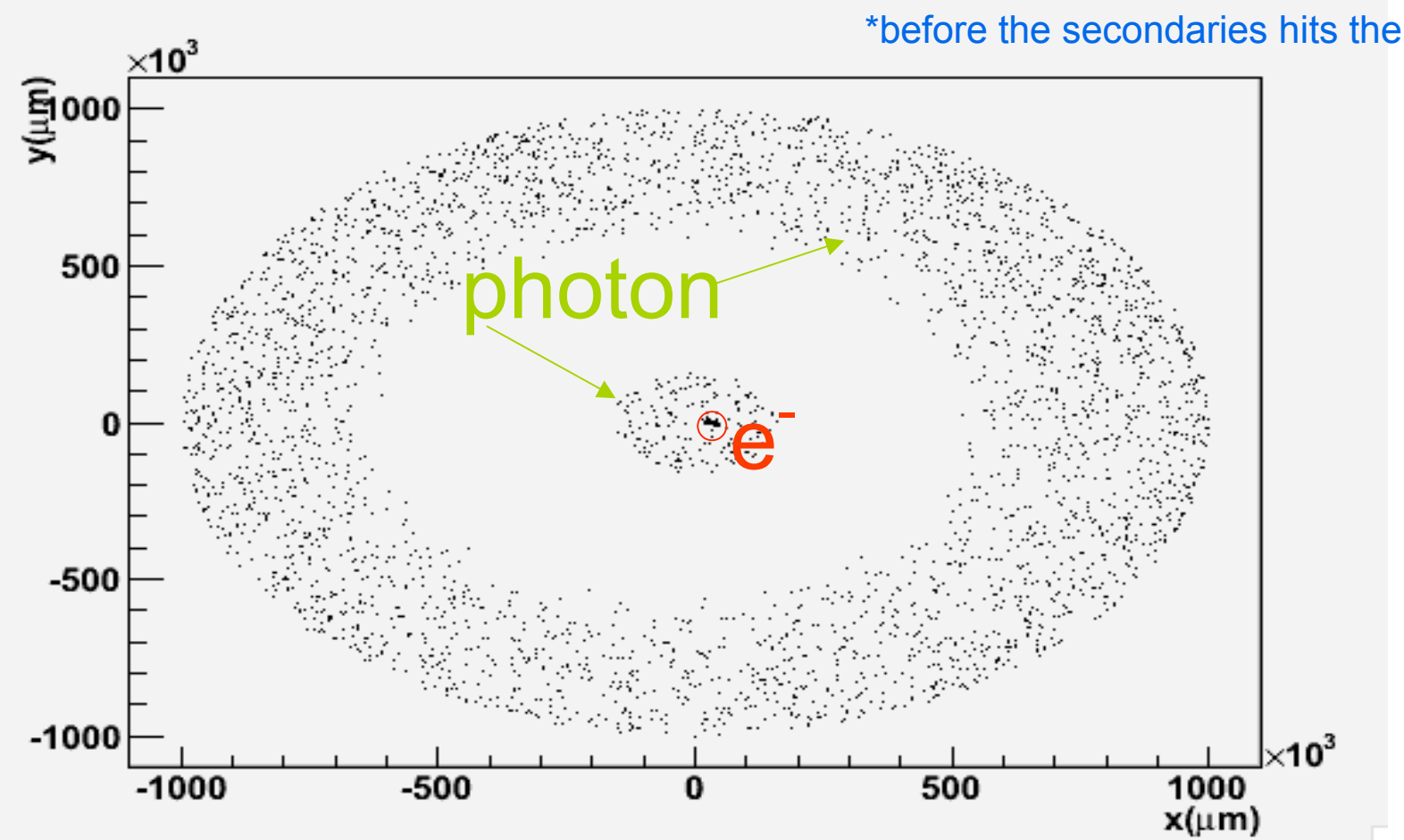
- ~100 GuineaPig jobs (50K particles, ~ 25% below 325 GeV)
- 202 BDSIM jobs each 5K particles



1.1M particles
generated (GuineaPig) &
simulated (BDSIM) < 10h
(on the grid, ilc vo)

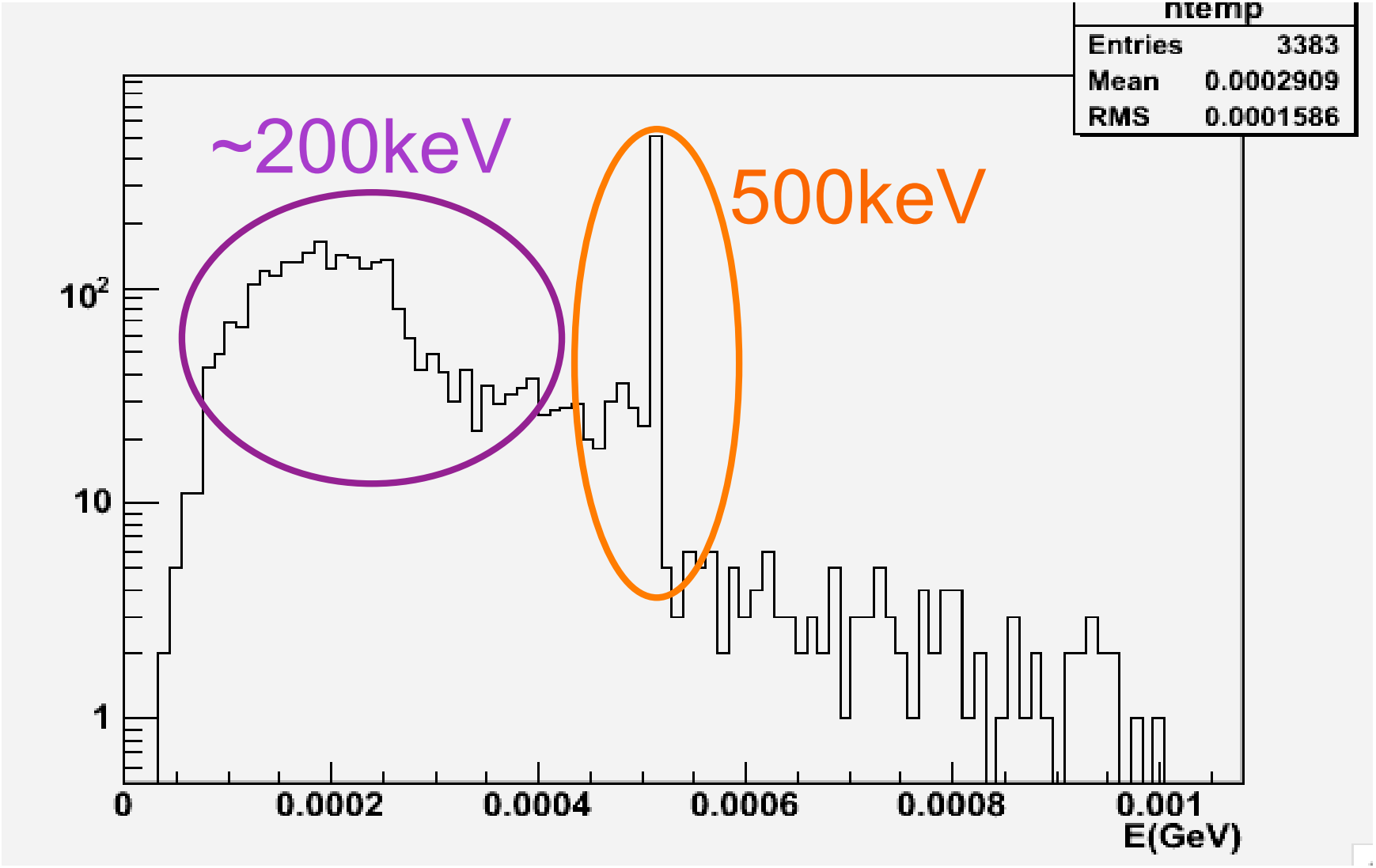
Backscattered particles @ 3.5m before* the mask

*before the secondaries hits the mask

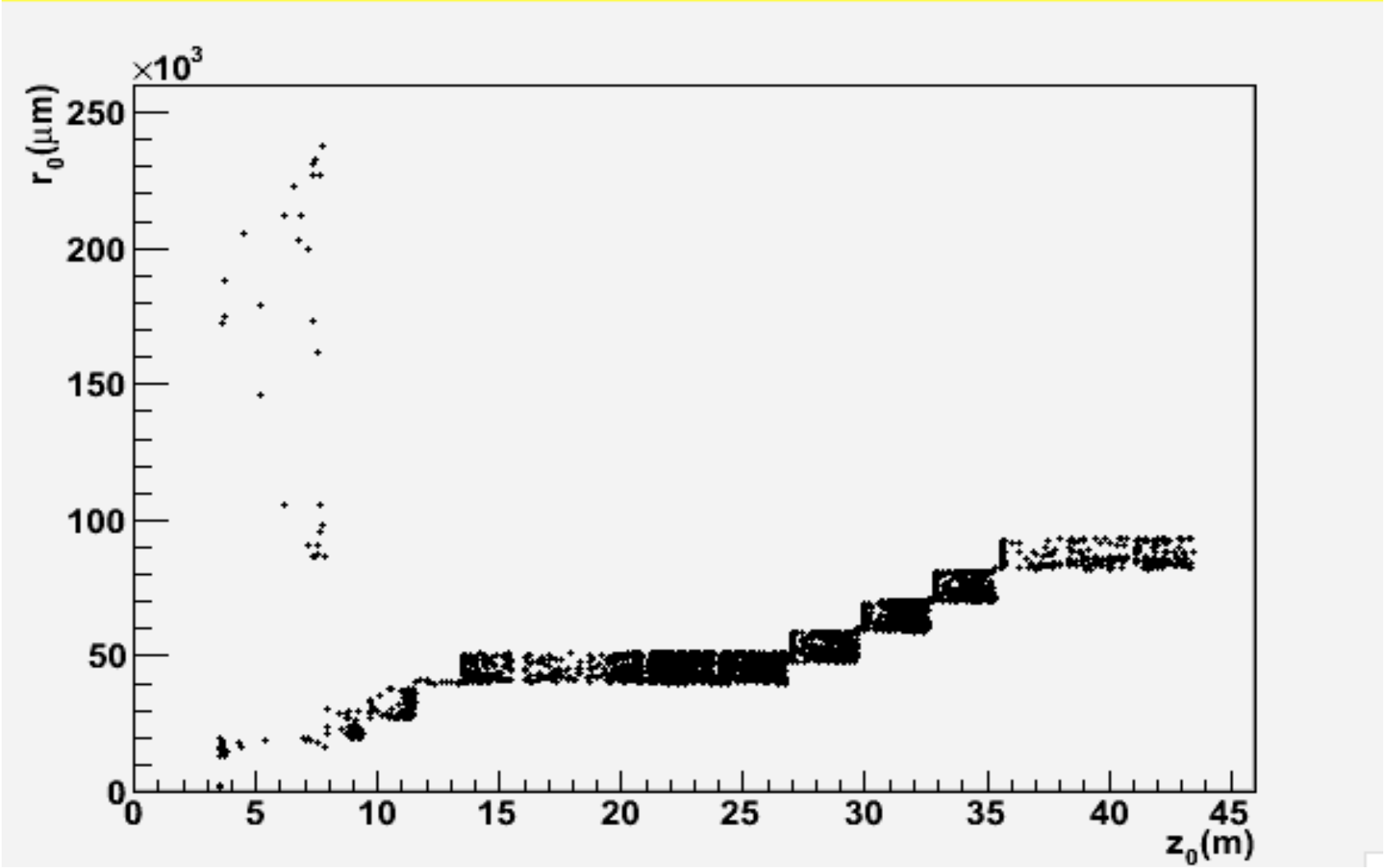


- 5030 backscattered particles:
  - **3501 photons, 1520 e^- & 9 e^+**

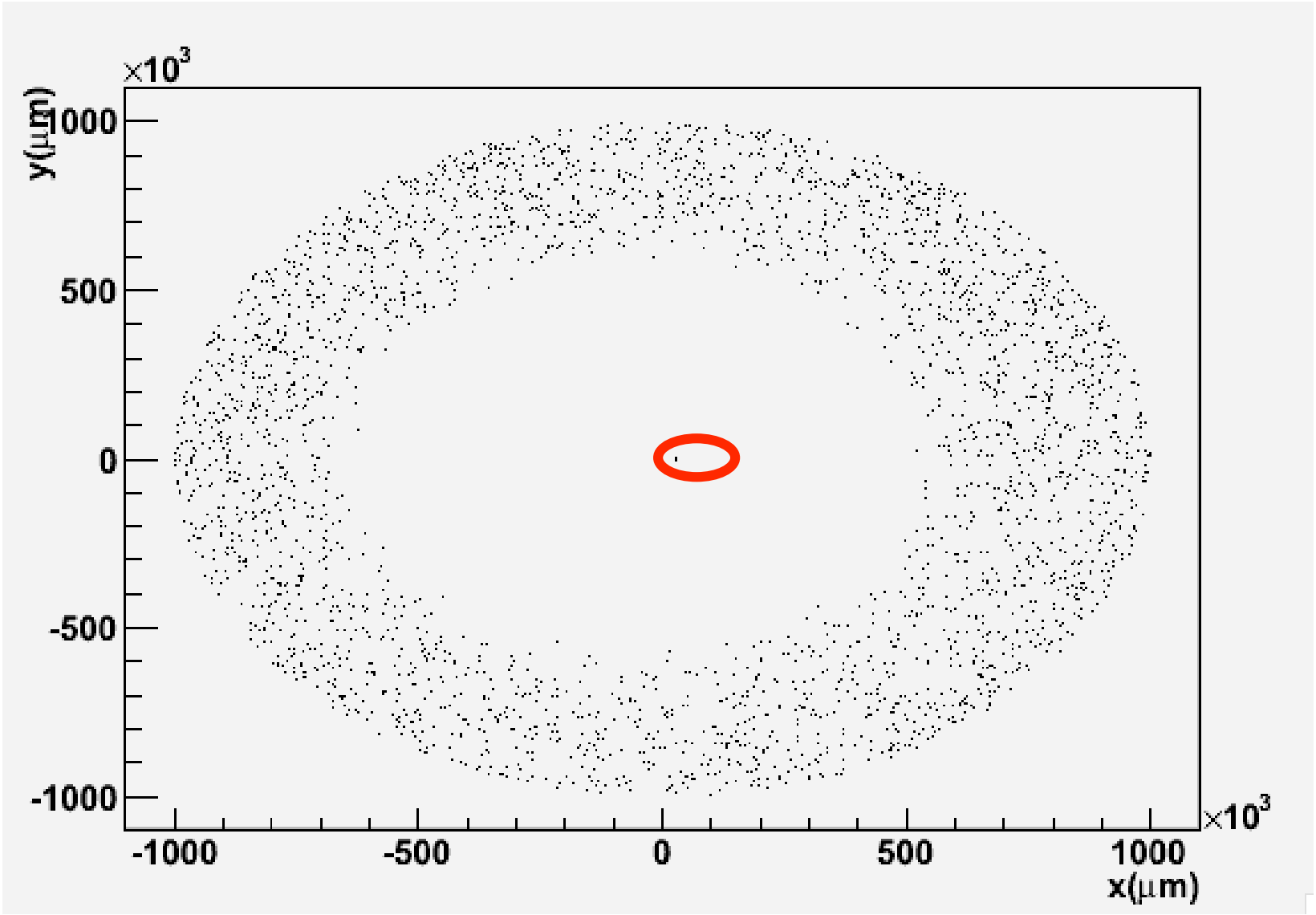
Photons energy spectrum



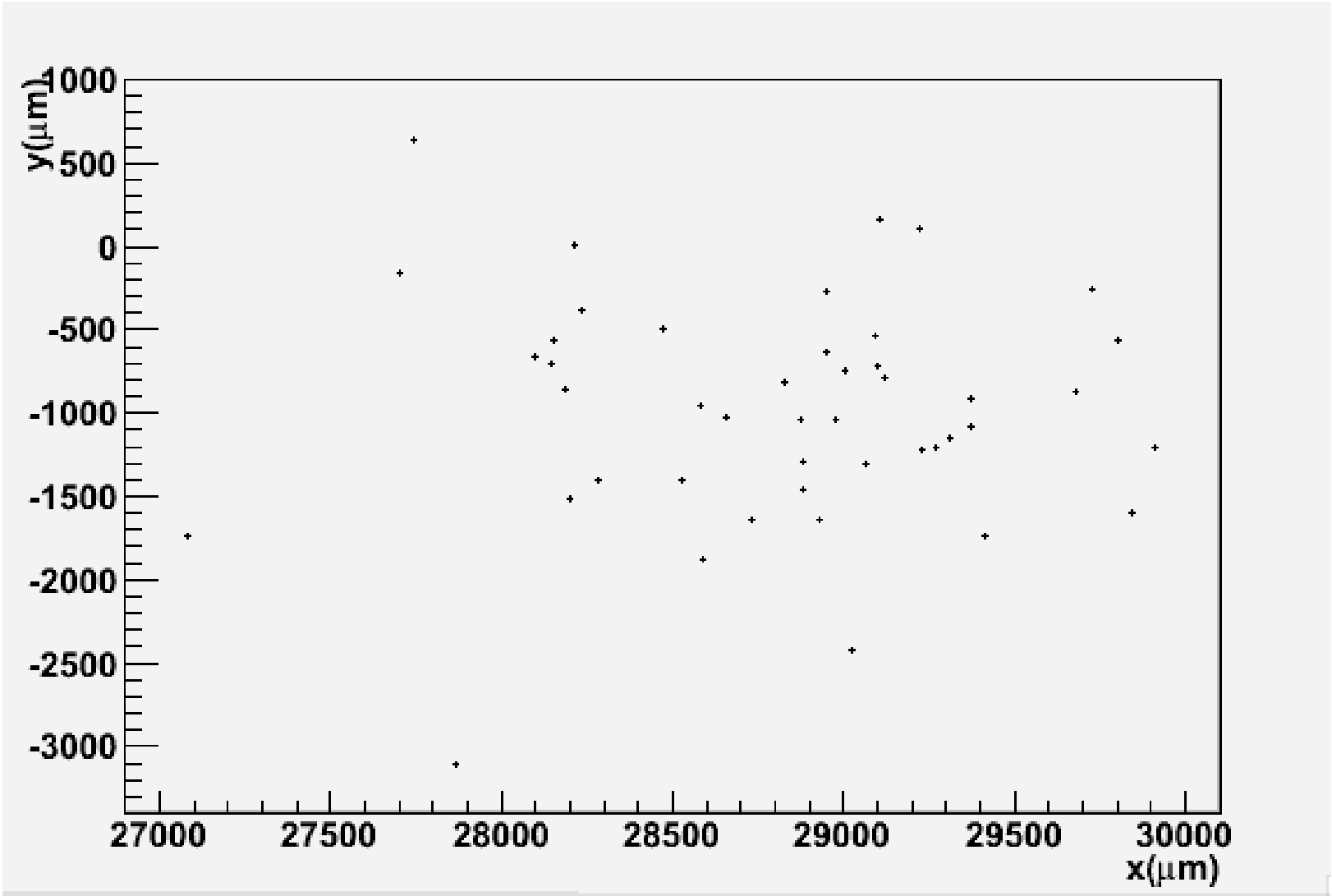
Where those photons were created ?



The tungsten mask stop most of the backscattered photons in center region…

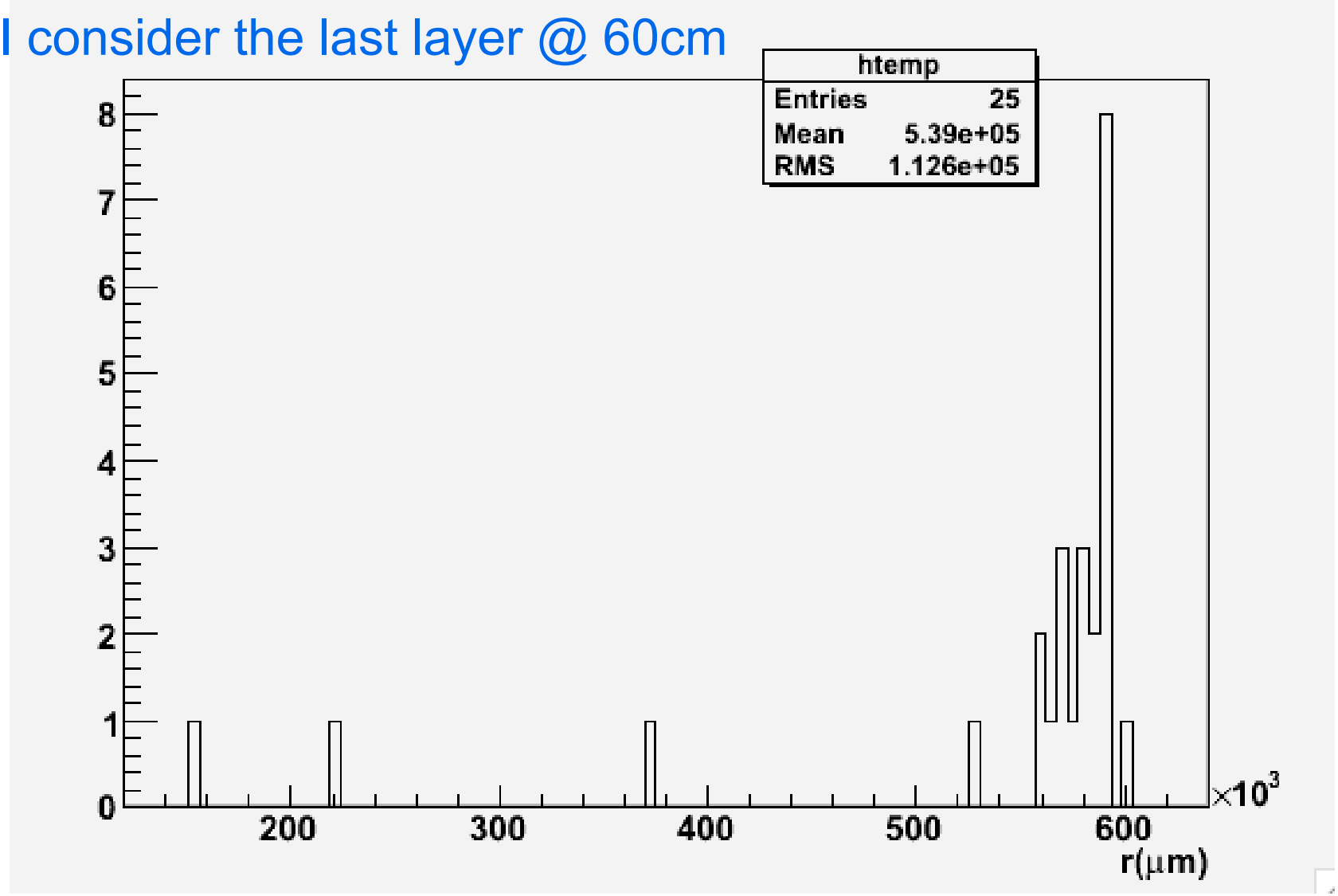


… but some of them passed through the hole of the mask …

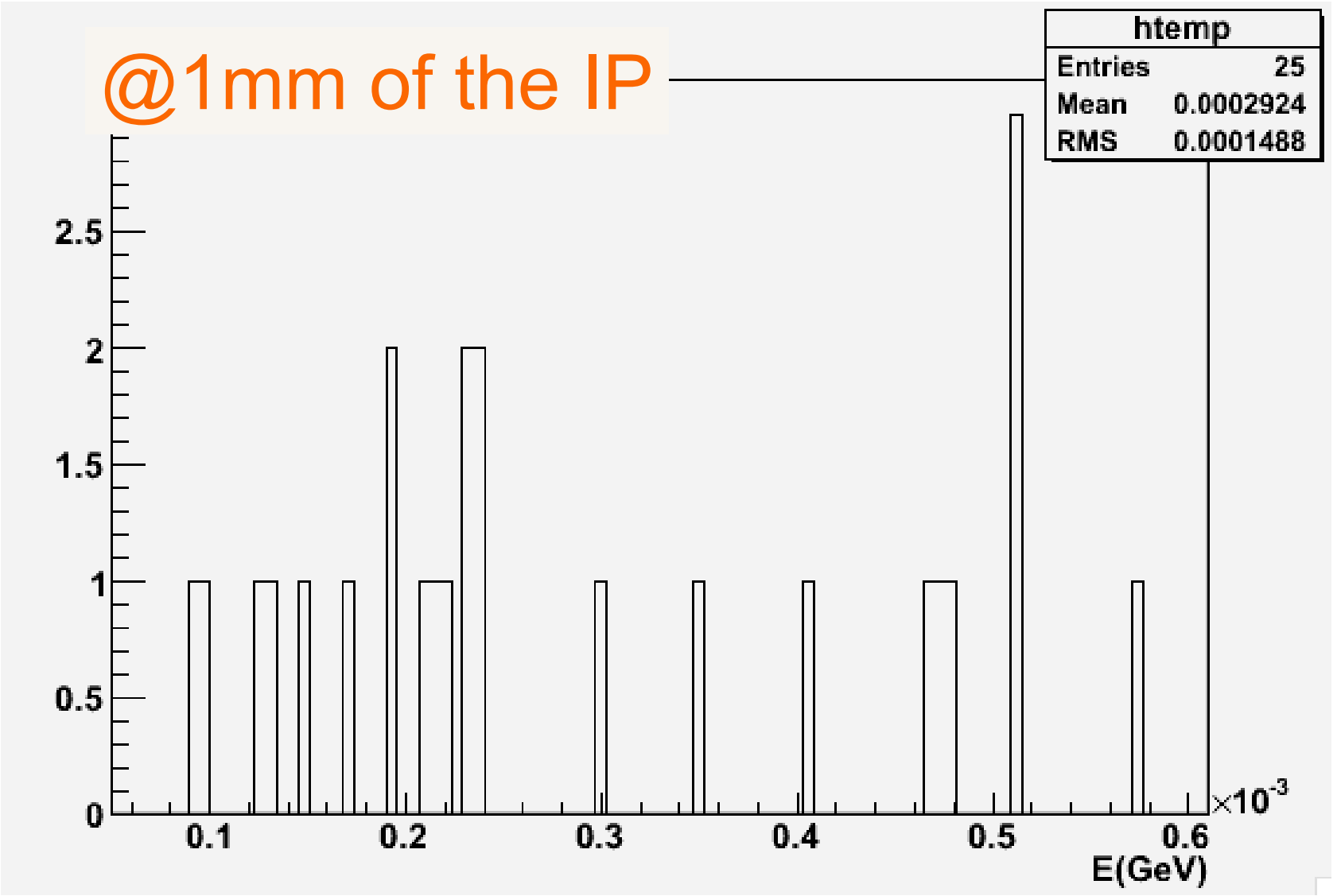


… and can reach the VXD …

I consider the last layer @ 60cm



… with this energy spectrum …



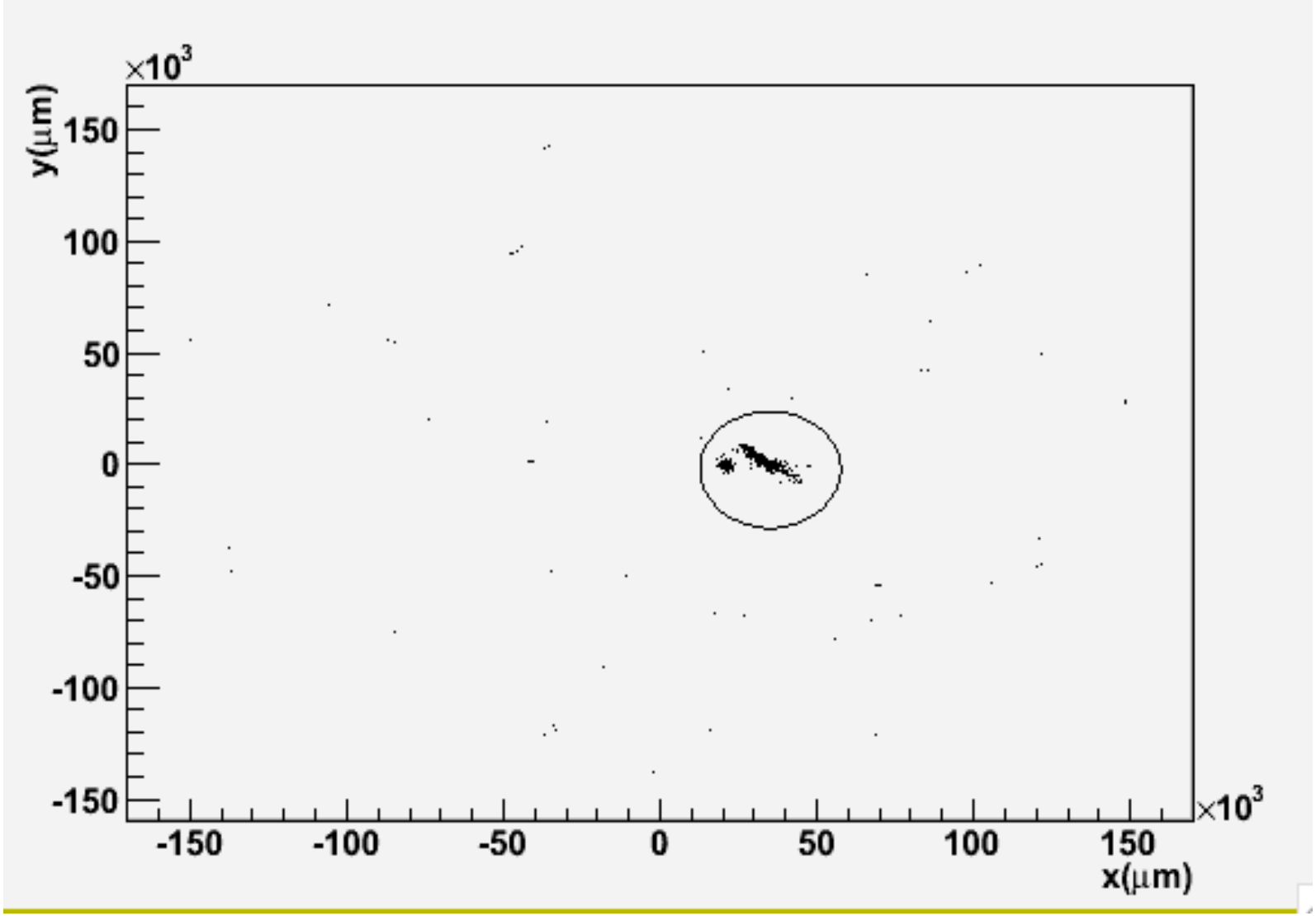
… and make a hit …

- 25 photons from 1.1M tail macro-particles
- 113K for the full $2*10^{10}$ particles beam
- For Si (Z=14, ρ=2.33g/cm^3)
  @ ~300keV gamma energy

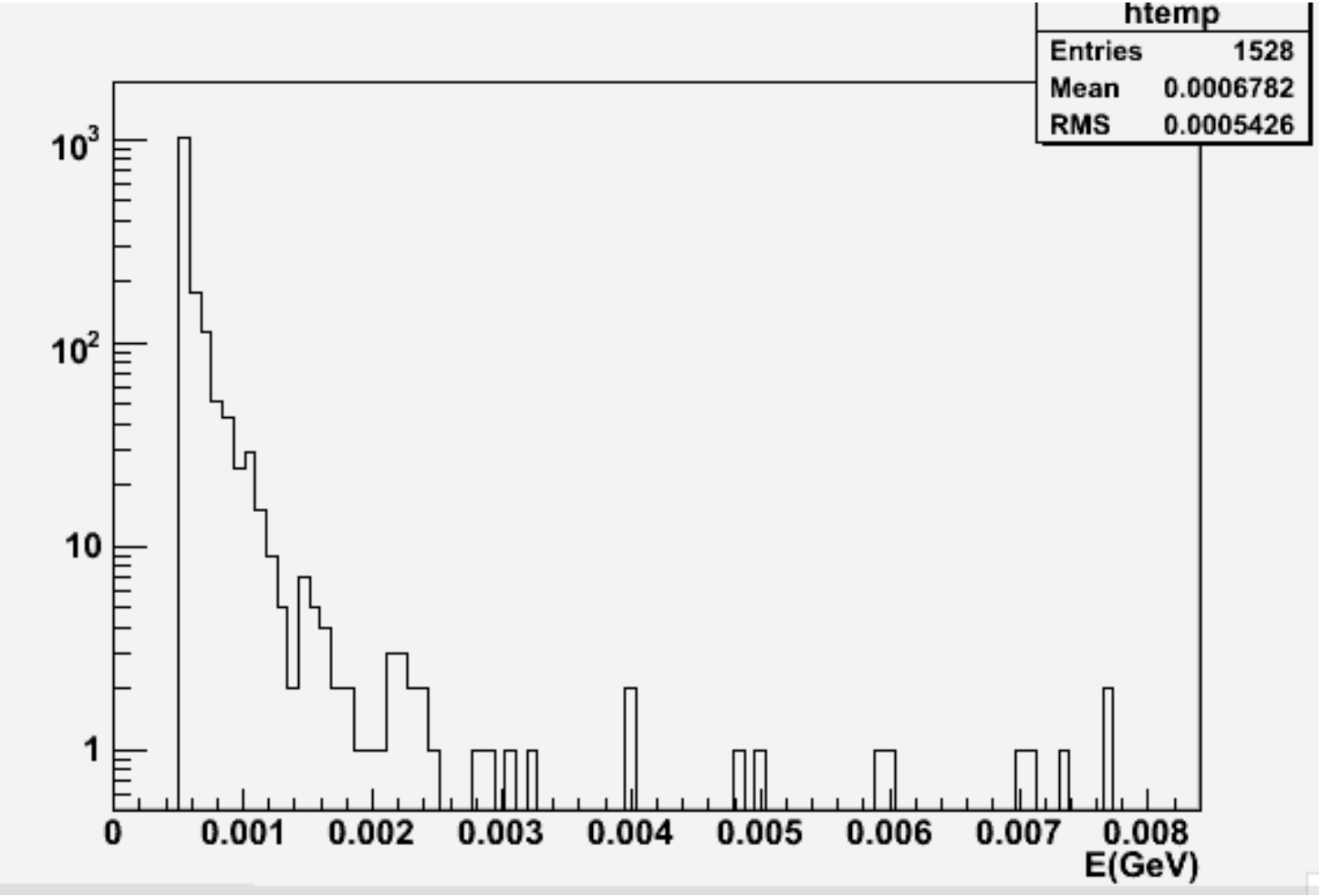
  - **absorbtion lenght λ~7 g/cm^2**
  - **300μm thickness**
  - **1% probability to be absorbed**

  113K * 1%= 1130 hits in the VXD
- To be compared with 300 direct incoherent pairs hits …

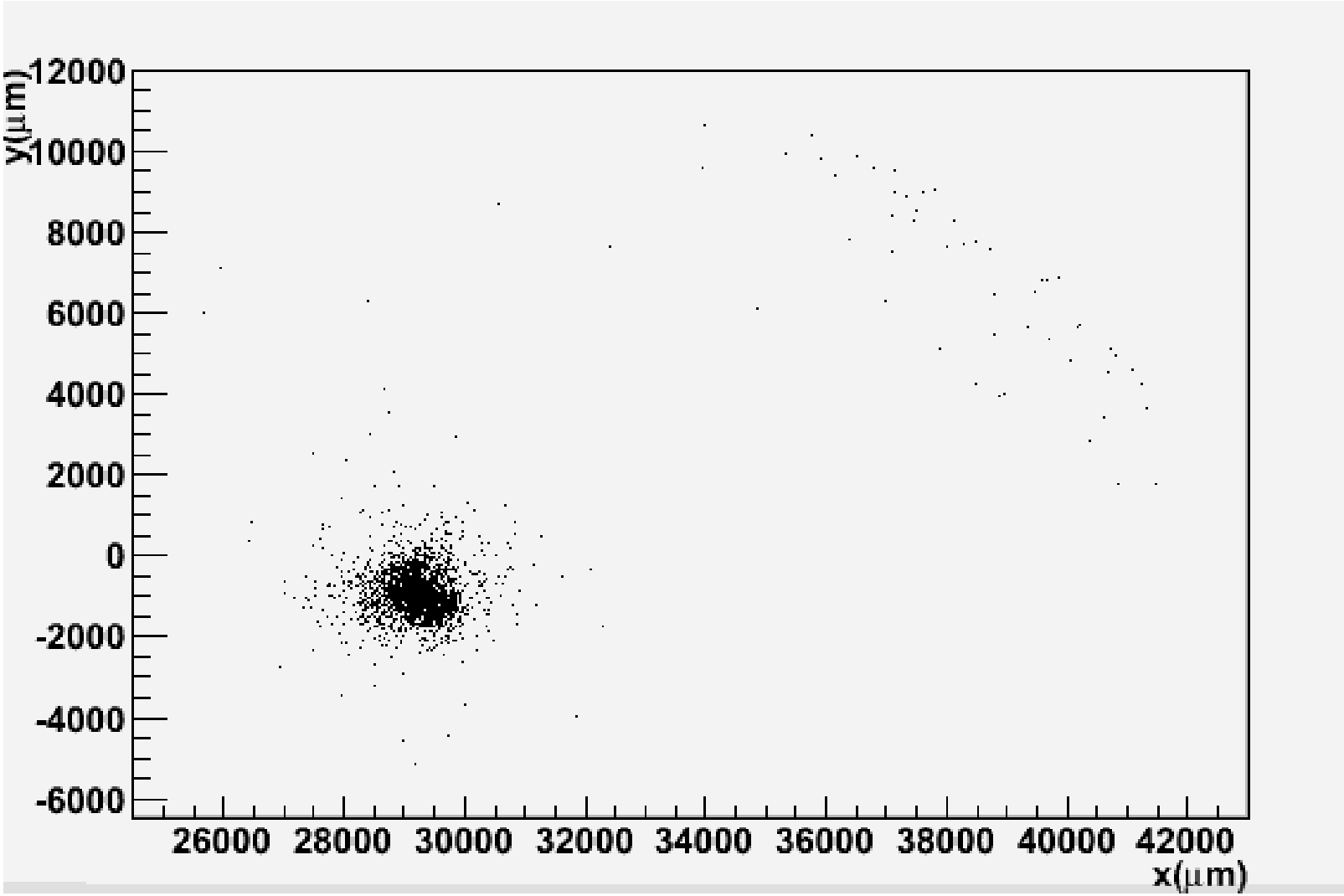
Backscattered e^- @ 3.5m (y vs x)



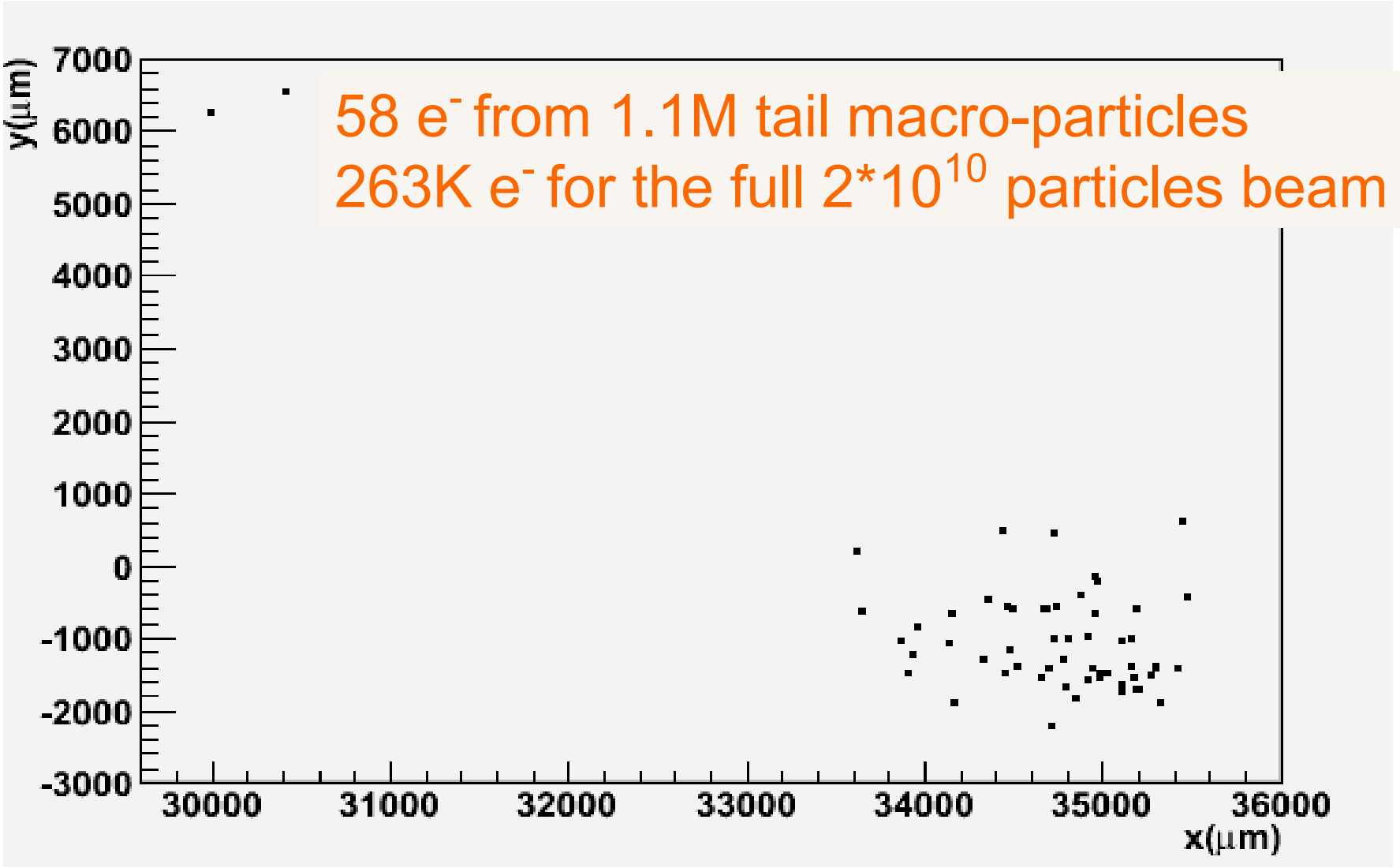
Backscattered e^- @ 3.5m energy spectrum



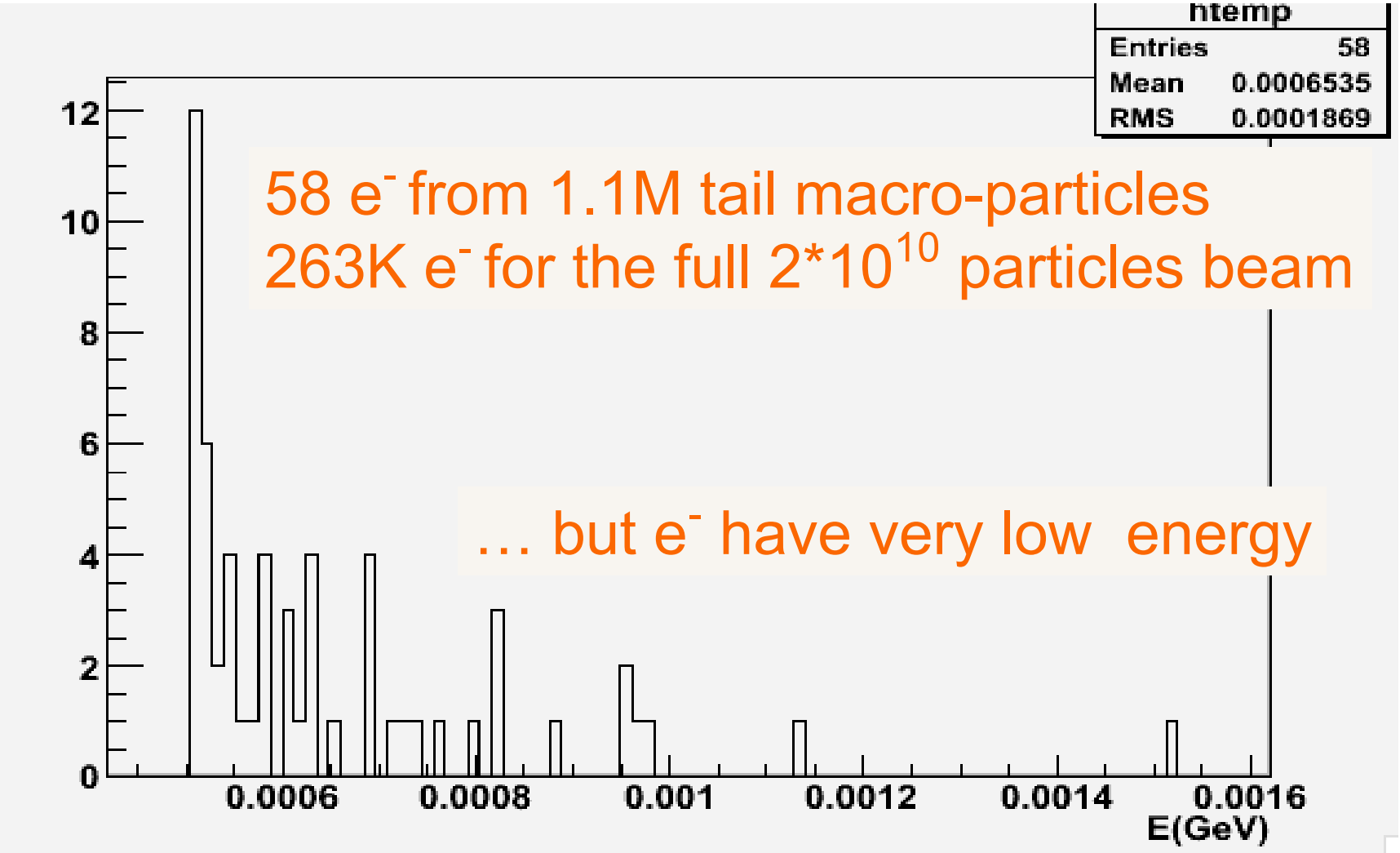
Backscattered e^- @ 3m



Backscattered e^- @ 10cm



Backscattered e^- @ 10cm



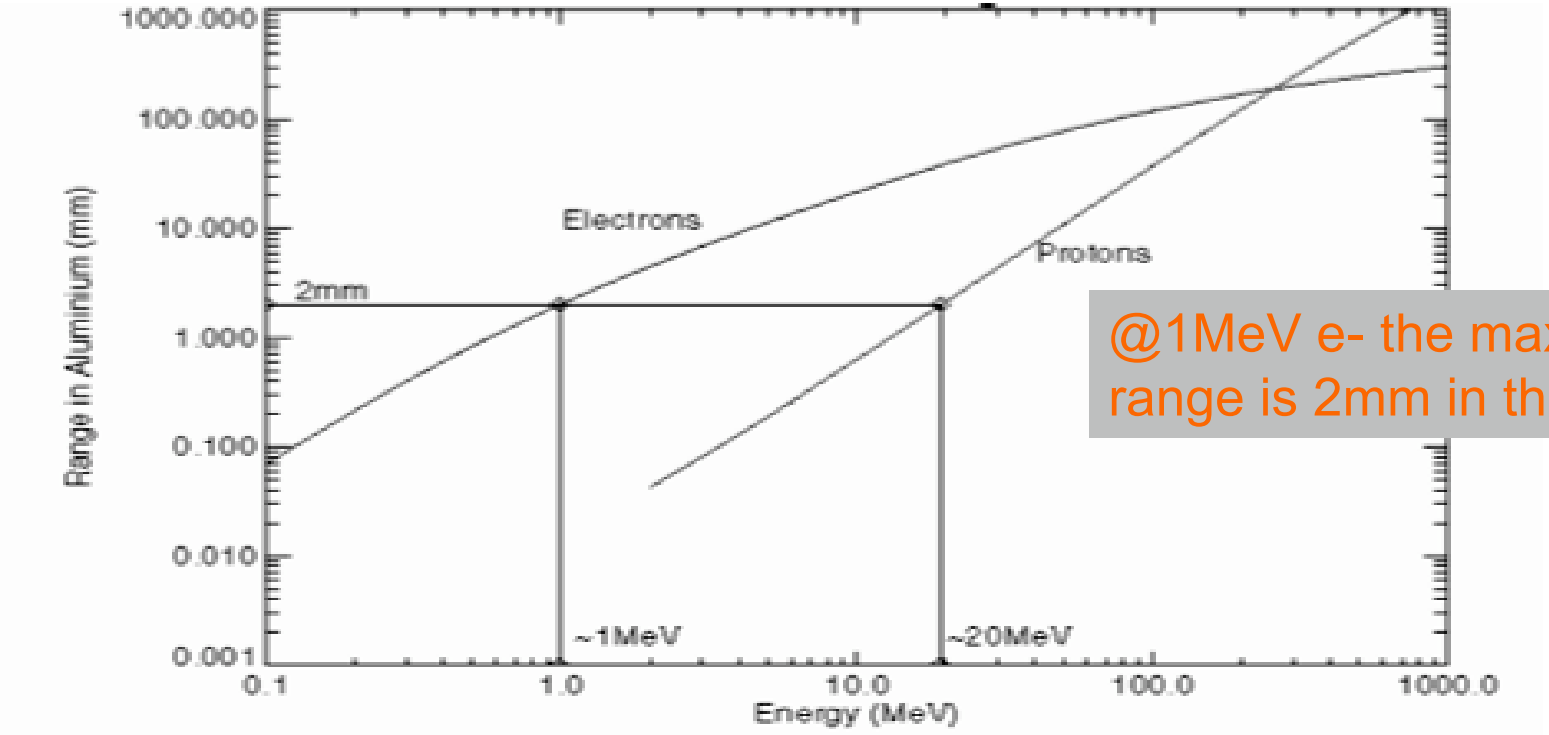
Beta particle Range

- Maximum range (material independent)

  $R_{max}[g/cm^2]=0.412E^{1.265-0.0954\ln E}$, 10 keV ≤ E ≤ 2.5 MeV

- The maximun length depend on the number of e^- in the material

  d=R/r with r(Al)=2.7 g/cm3



@1MeV e- the maximal range is 2mm in the Al

L.Katz & A.S Penfold, Rev. Mod. Phys, 24 (1952)

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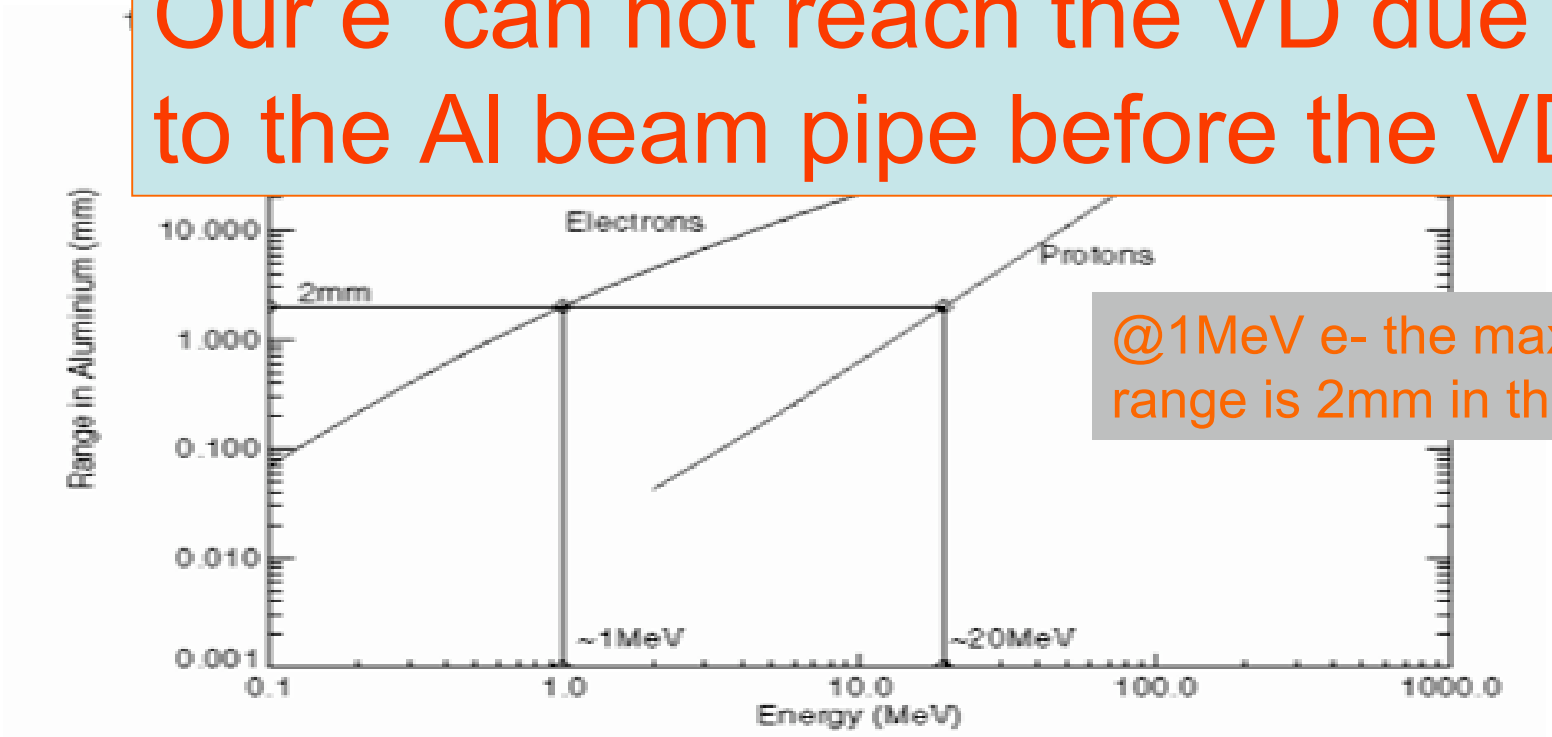
Our e^- can not reach the VD due to the Al beam pipe before the VD



@1MeV e- the maximal range is 2mm in the Al

L.Katz & A.S Penfold, Rev. Mod. Phys, 24 (1952)

Conclusion

- Backscattered electrons not a problem
- Background are from the photons generated along the extraction line

Future

- Take the full Mokka detector description (DESY group)
- Take into account the losses from radiative Bhabhas
- Put the hadronic flag on …

Question

- How long the extraction line must be simulated ?
- Studies: 3(4) detectors concept X 3(4) extractions line