SuperBELLE IR Background Study

Synchrotron Backscattering Modelling

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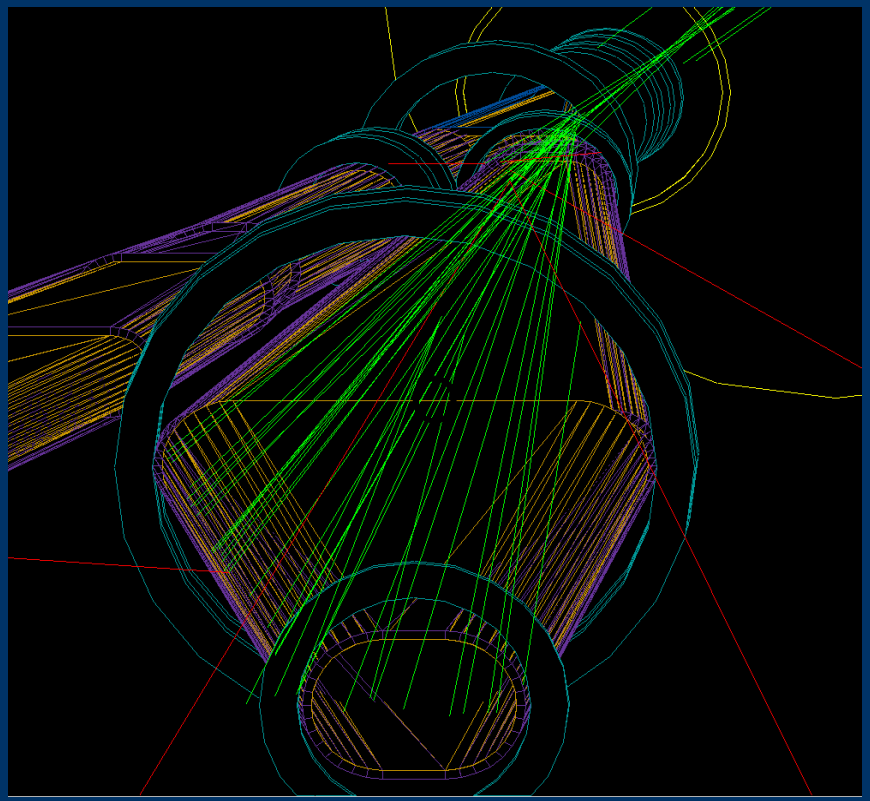
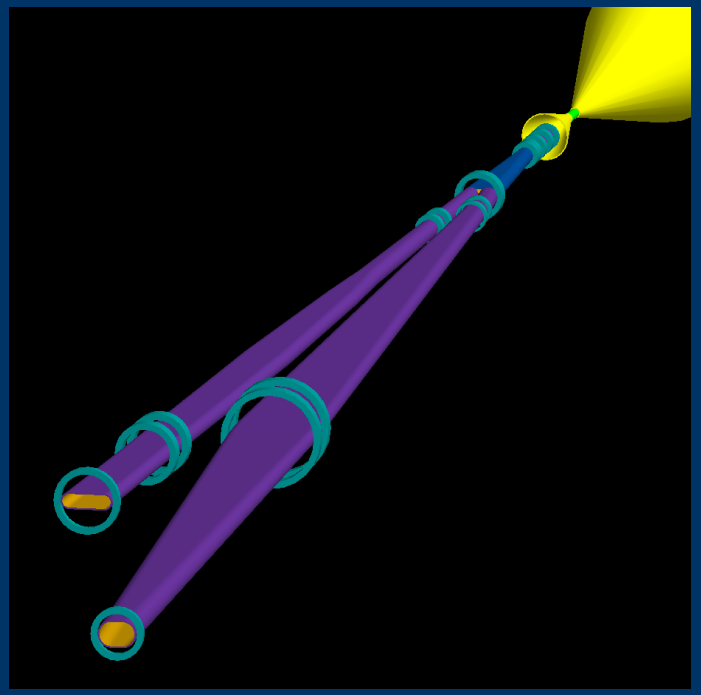
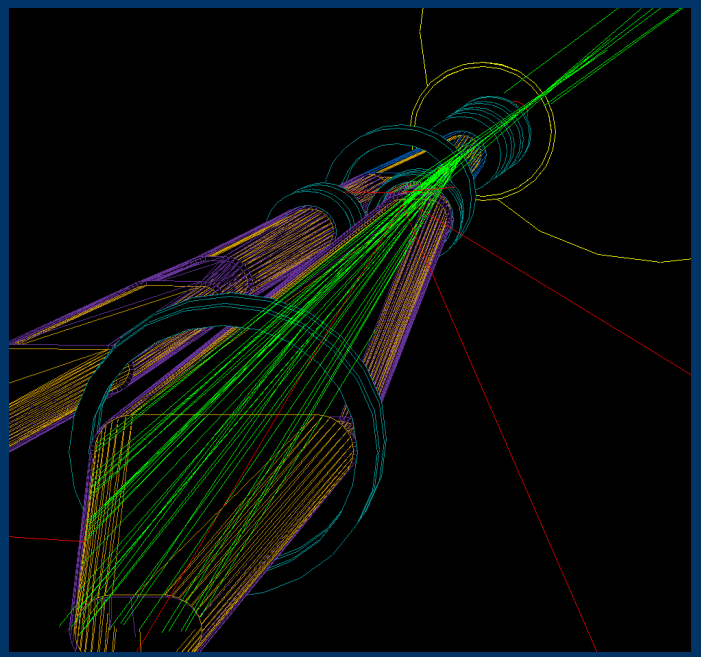


Outline of the study

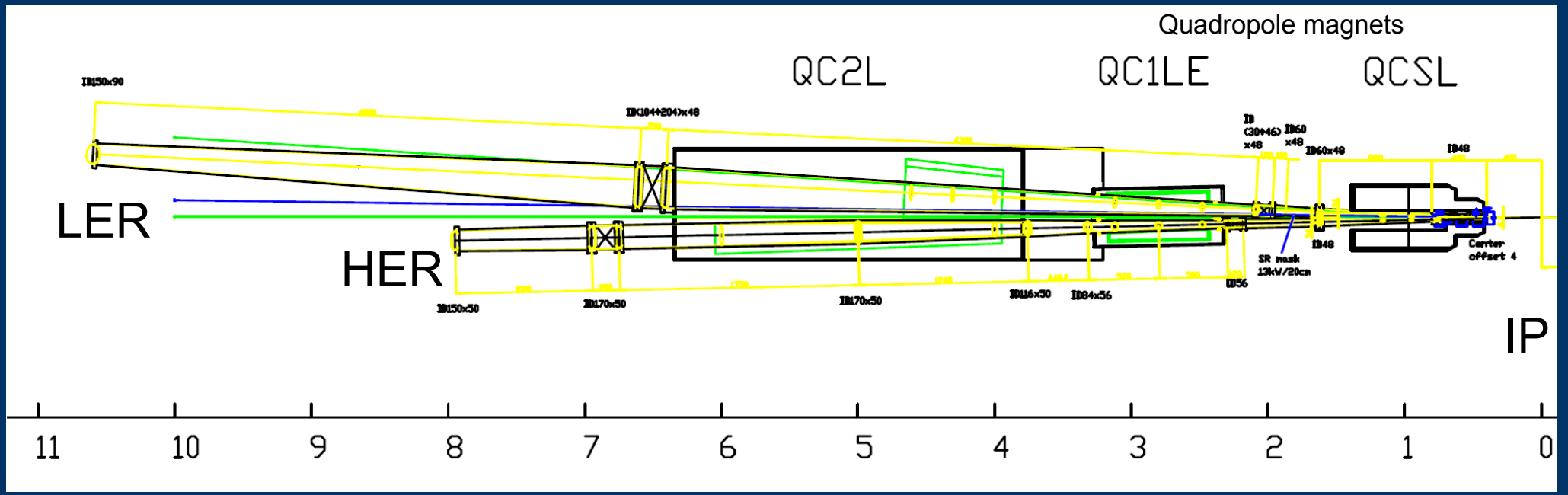
- Simulated with Geant4 4.9.1(earlier versions have geometry bugs) and LCBDS beam simulation framework
- LER and HER Downstream Geometry:
- Converted 2D AutoCAD plan by Kanazawa-san to 3D Geant4 geometry
- Insert SR events simulated in Geant4 by Iwasaki-san - ~1B photons, or ~1/300 of a bunch
- Energy deposit calculations for IP pipe and different materials



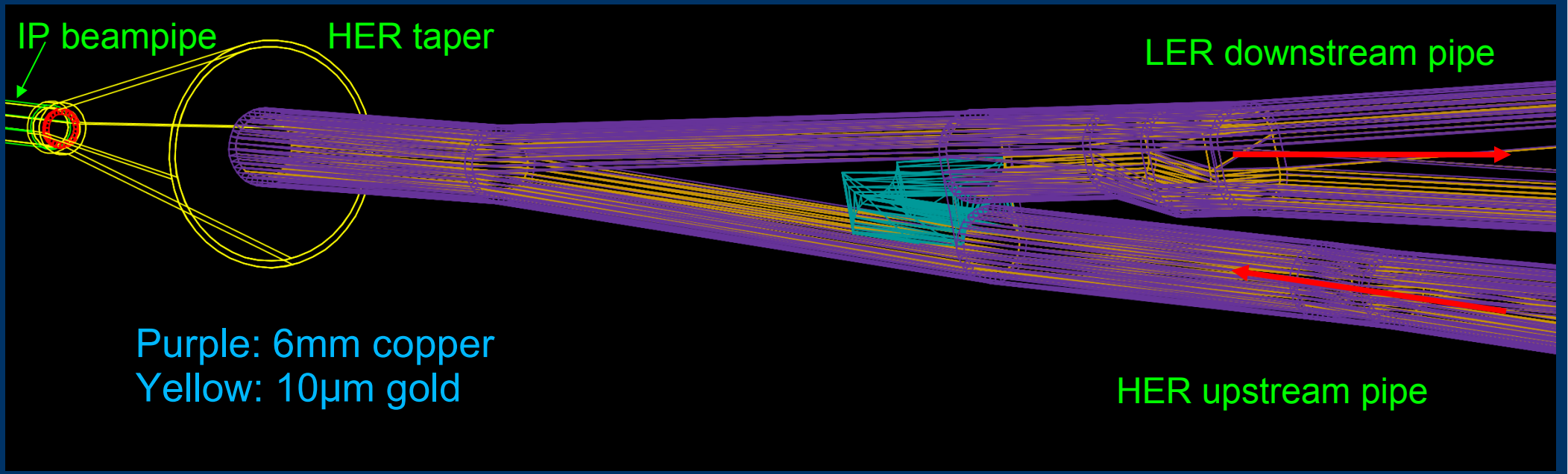


SuperKEKB LER Downstream IR Beampipe

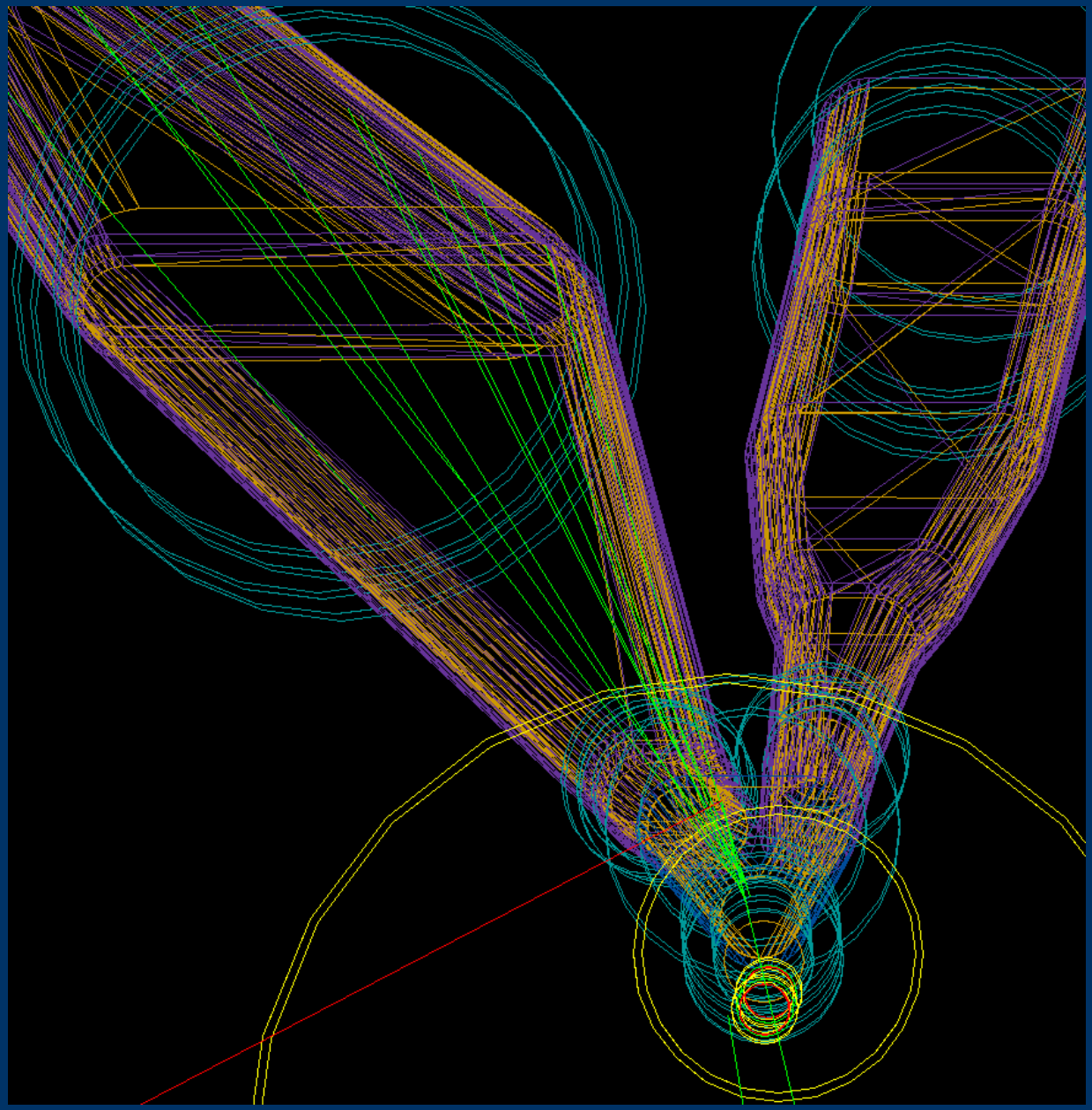
- AutoCAD plan



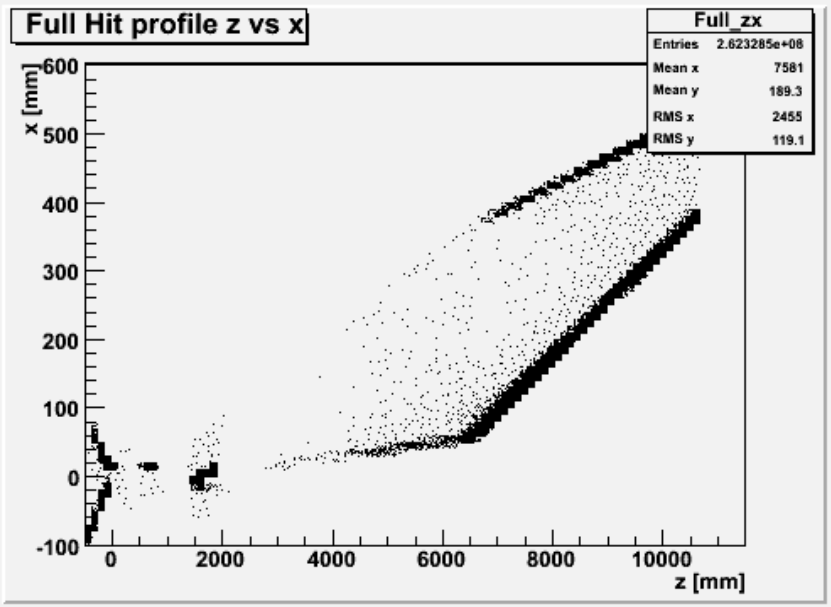
SuperKEKB LER Downstream side Beampipe

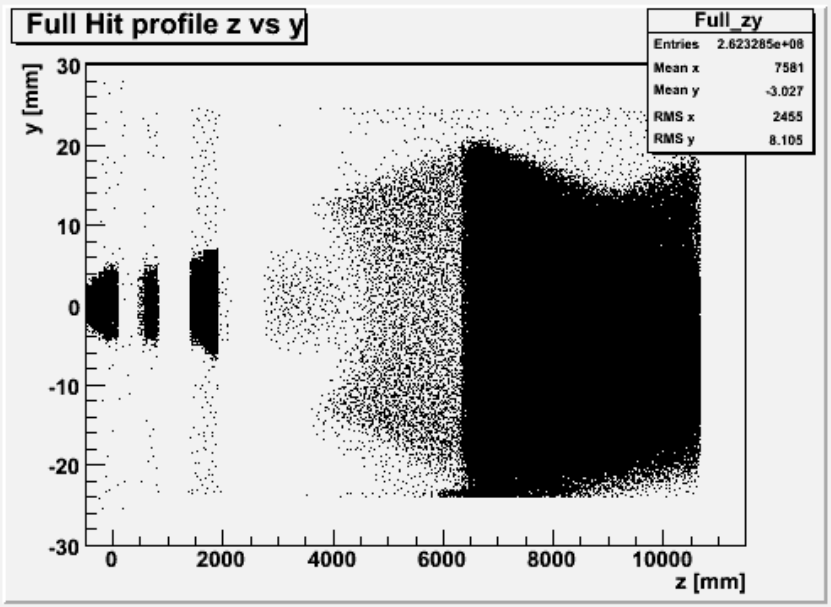


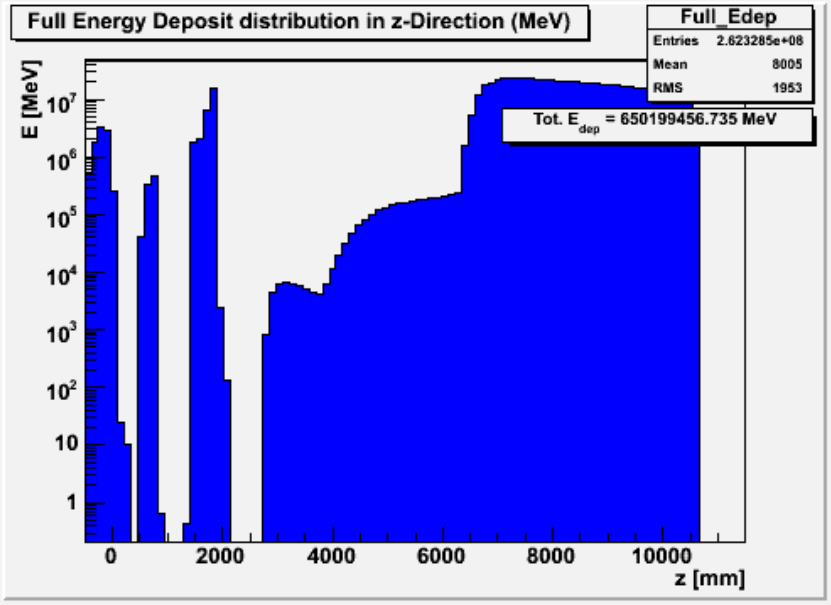
Synchrotron Backscattering

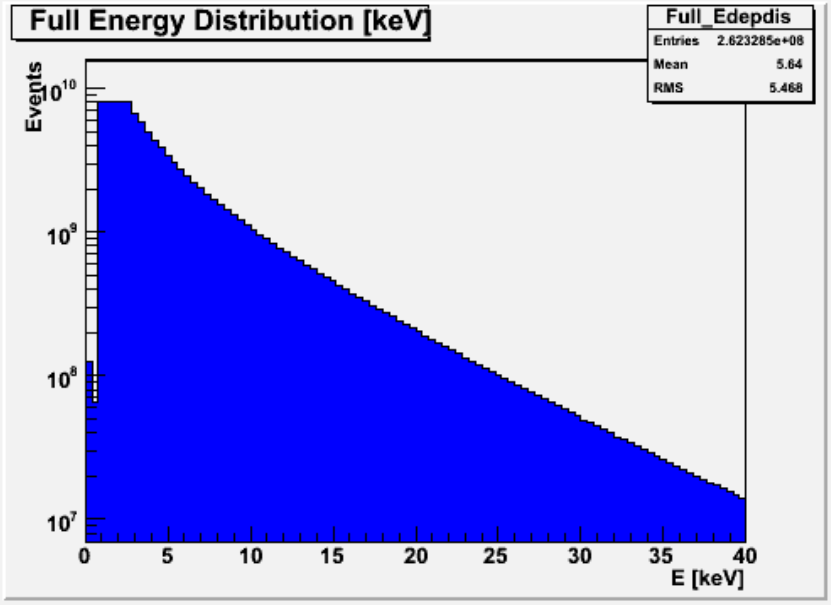


LER Full (input cut: E > 1keV)

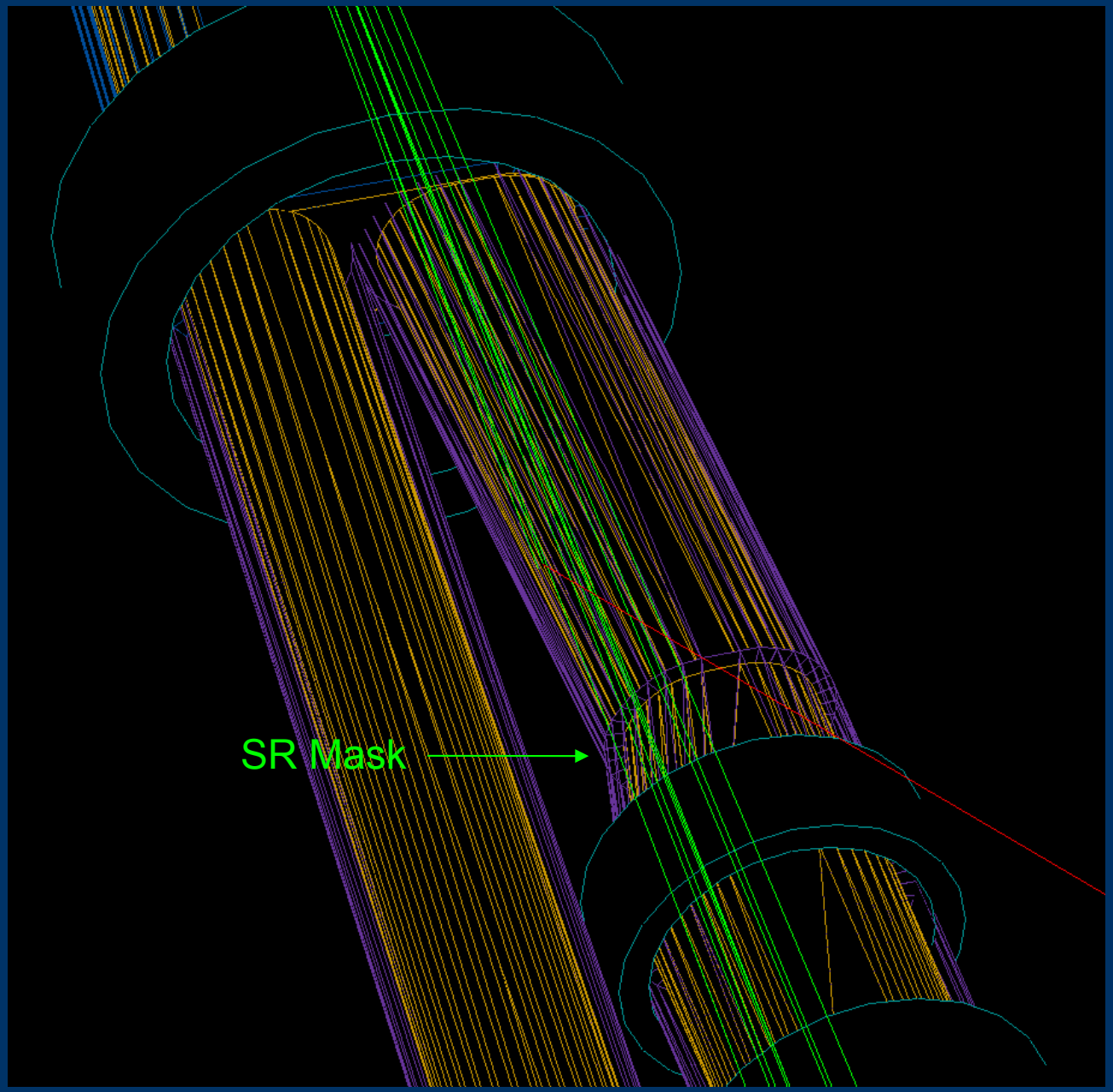








SR Mask



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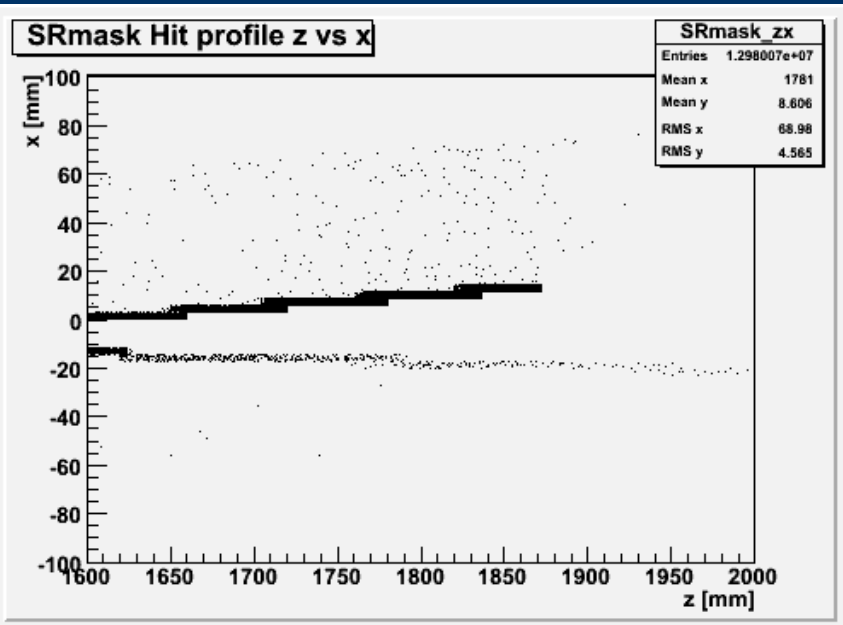
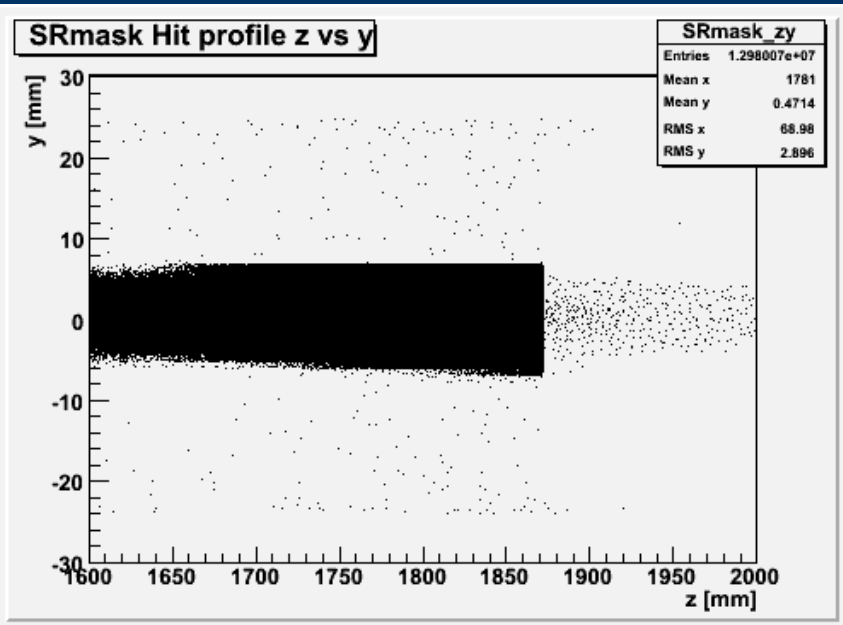

SRmask Hit profile z vs x
SRmask_zx
Entries 1.298007e+07
Mean x 1781
Mean y 8.606
RMS x 68.98
RMS y 4.565
x [mm]
z [mm]


SRmask Hit profile z vs y
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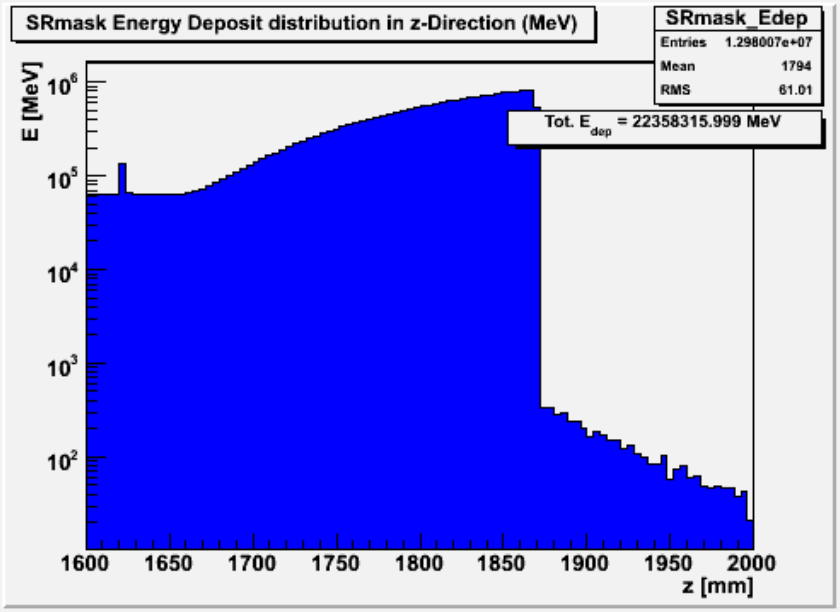
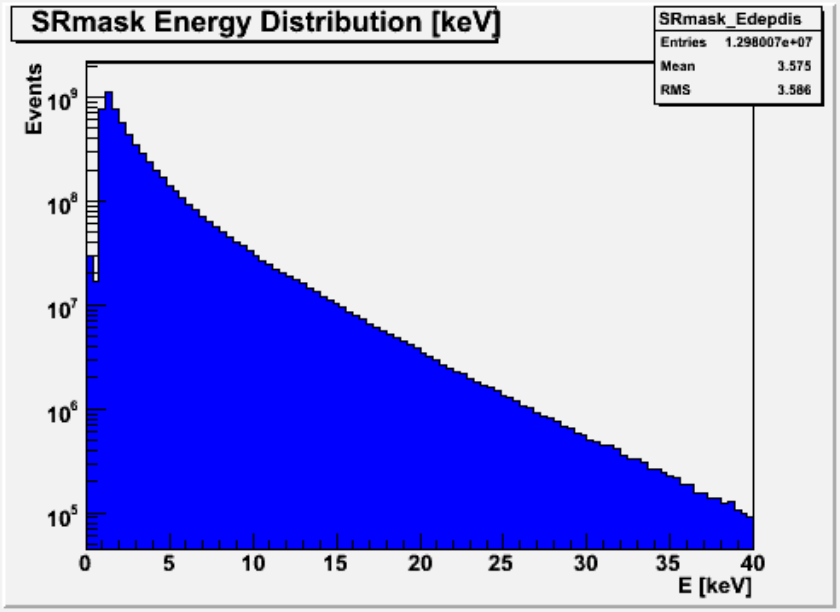
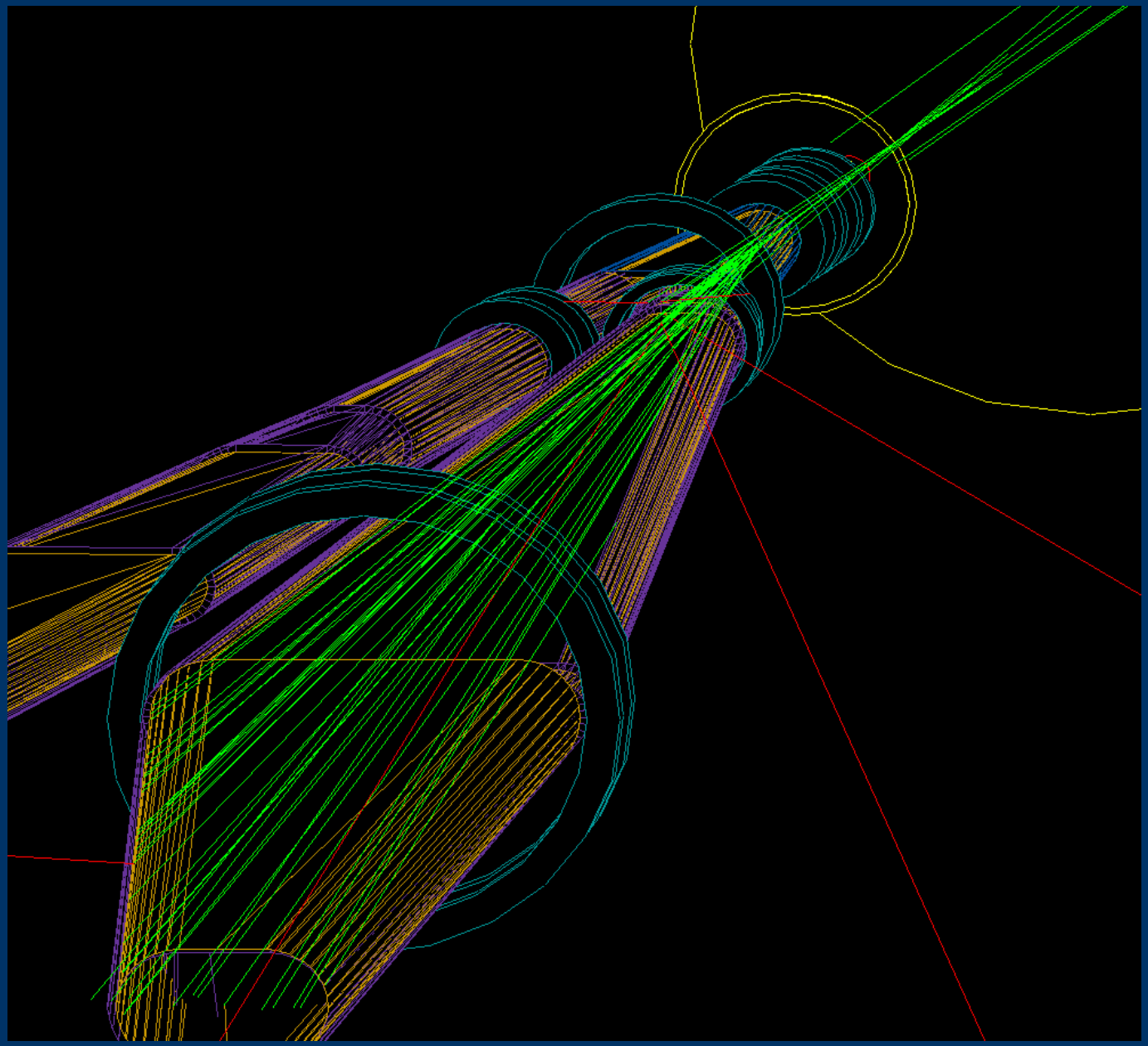
Mean x 1781
Mean y 0.4714
RMS x 68.98
RMS y 2.896
y [mm]
z [mm]

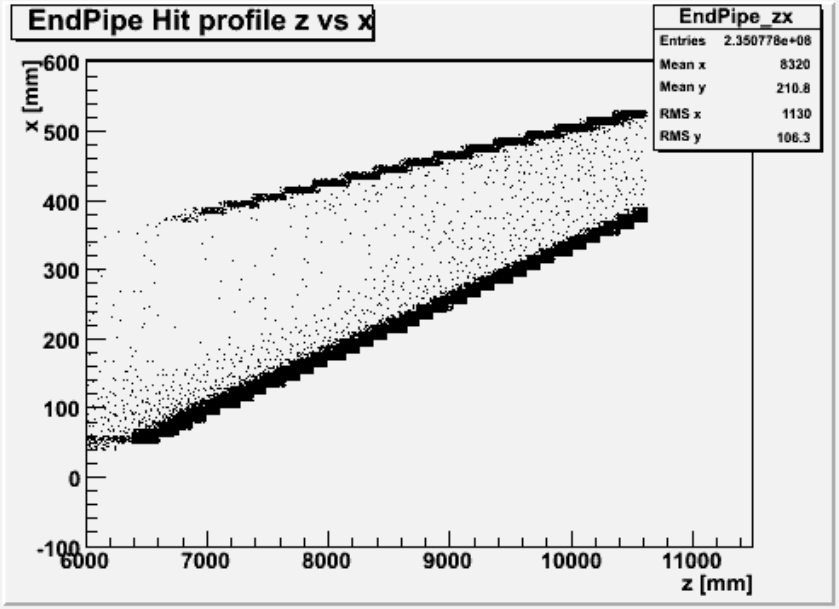

SRmask Energy Deposit distribution in z-Direction (MeV)
SRmask_Edep
Entries 1.298007e+07
Mean 1794
RMS 61.01
Tot. E_dep = 22358315.999 MeV
E [MeV]
z [mm]

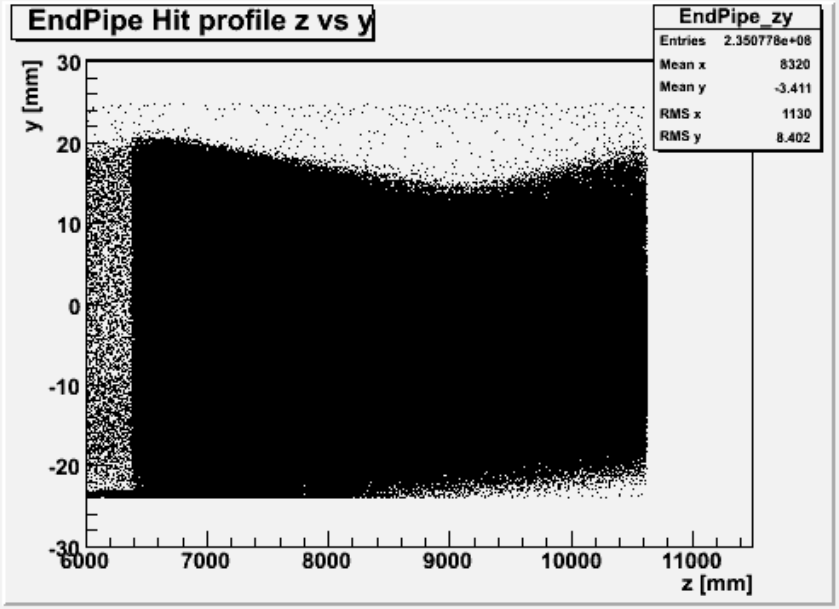

SRmask Energy Distribution [keV]
SRmask_Edepdis
Entries 1.298007e+07
Mean 3.575
RMS 3.586
Events
E [keV]

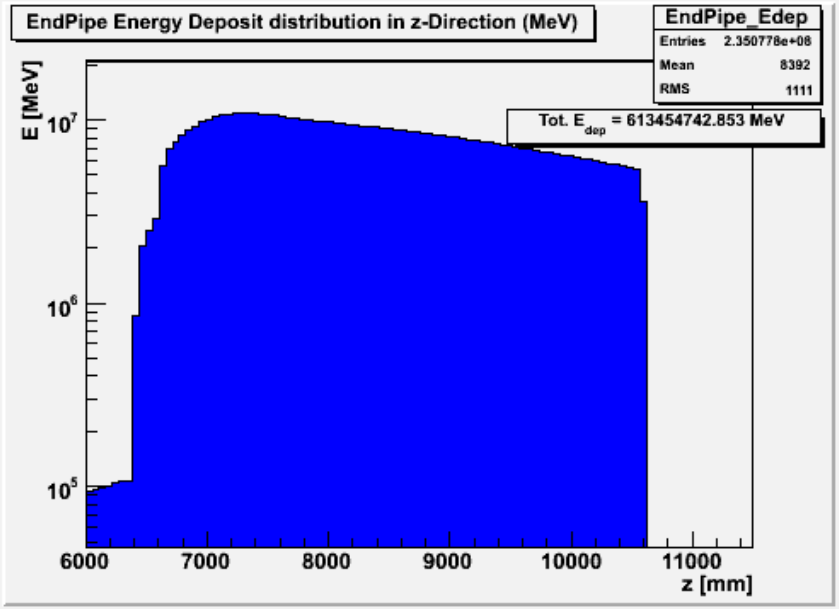
End Pipe

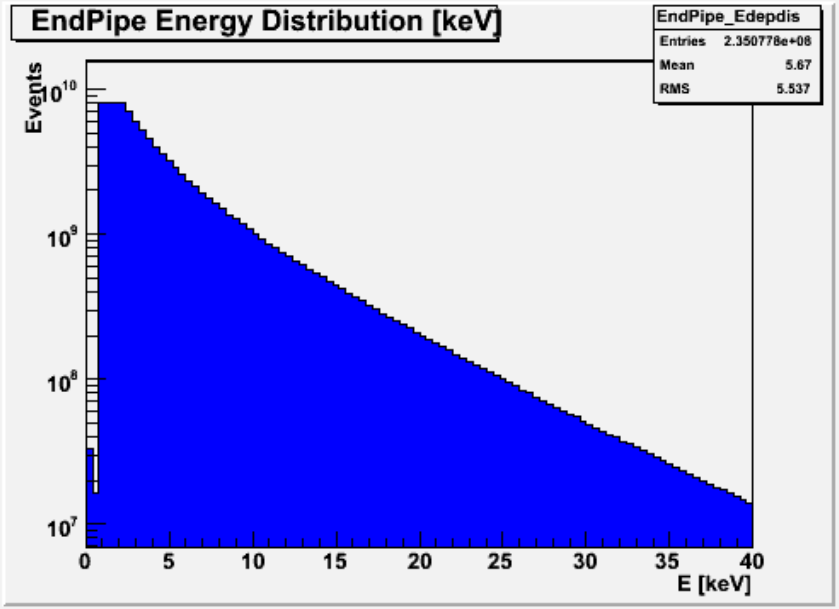


End Pipe

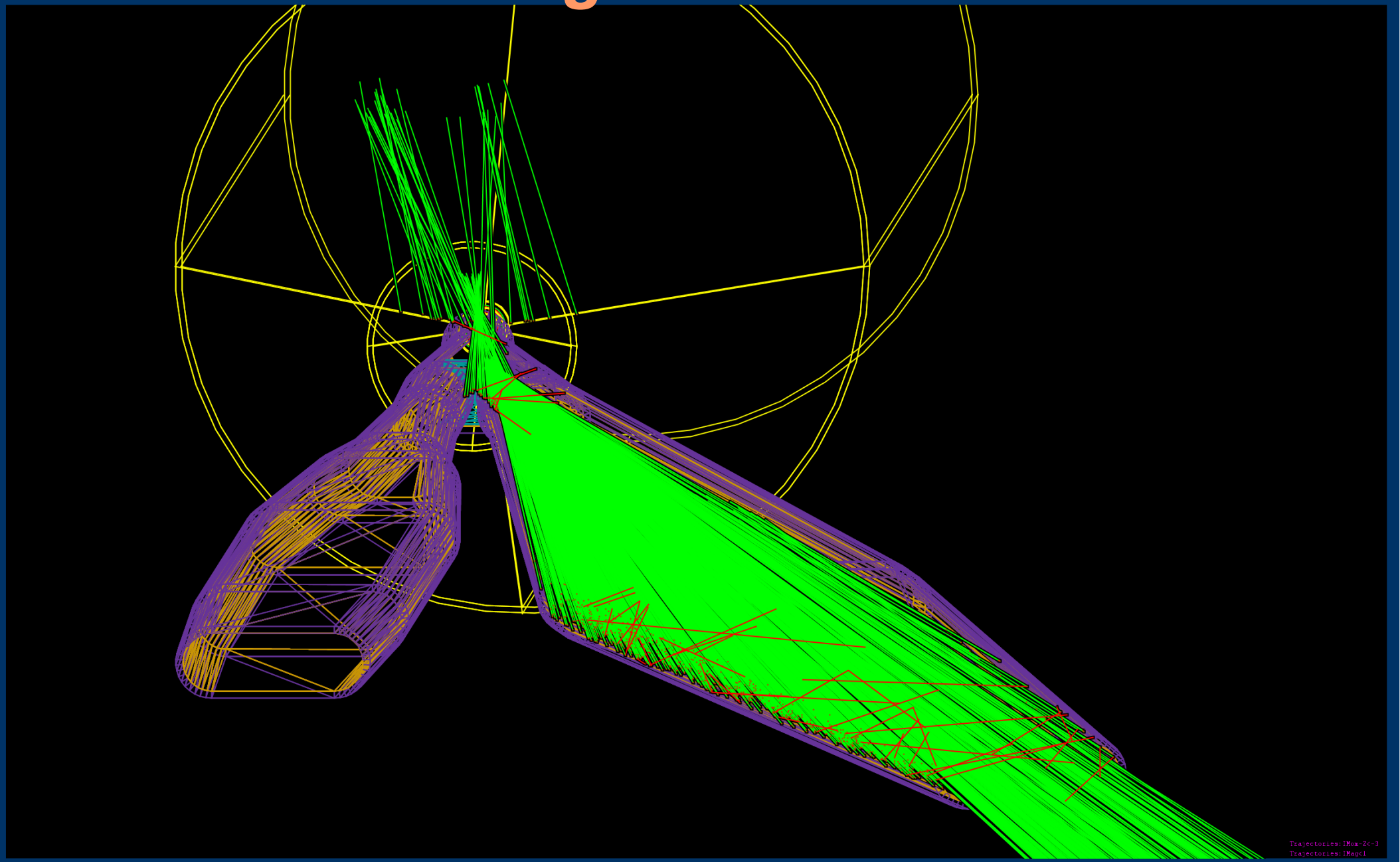

EndPipe Hit profile z vs x
EndPipe_zx
Entries 2.350778e+08
Mean x 8320
Mean y 210.8
RMS x 1130
RMS y 106.3
x [mm]
z [mm]


EndPipe Hit profile z vs y
EndPipe_zy
Entries 2.350778e+08
Mean x 8320
Mean y -3.411
RMS x 1130
RMS y 8.402
y [mm]
z [mm]

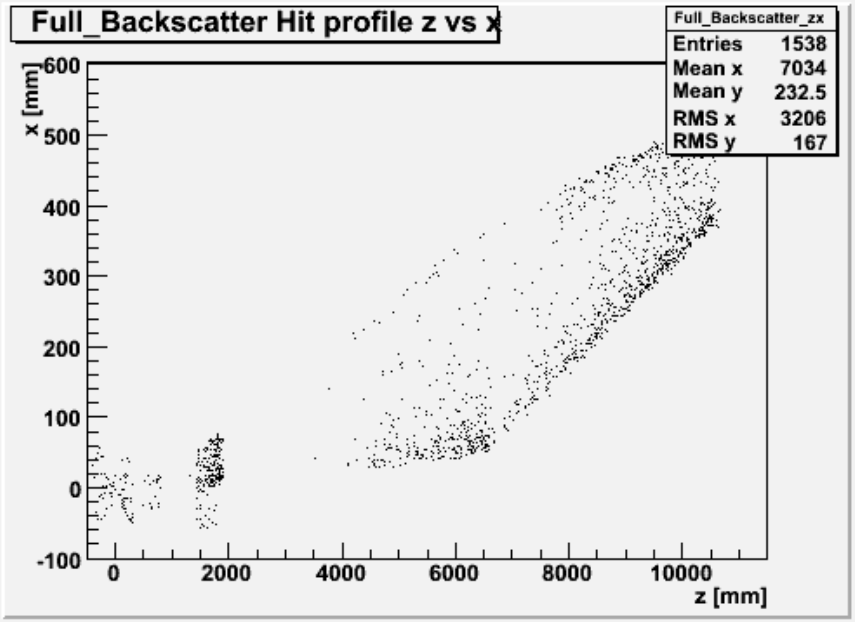

EndPipe Energy Deposit distribution in z-Direction (MeV)
EndPipe_Edep
Entries 2.350778e+08
Mean 8392
RMS 1111
Tot. E_dep = 613454742.853 MeV
E [MeV]
z [mm]

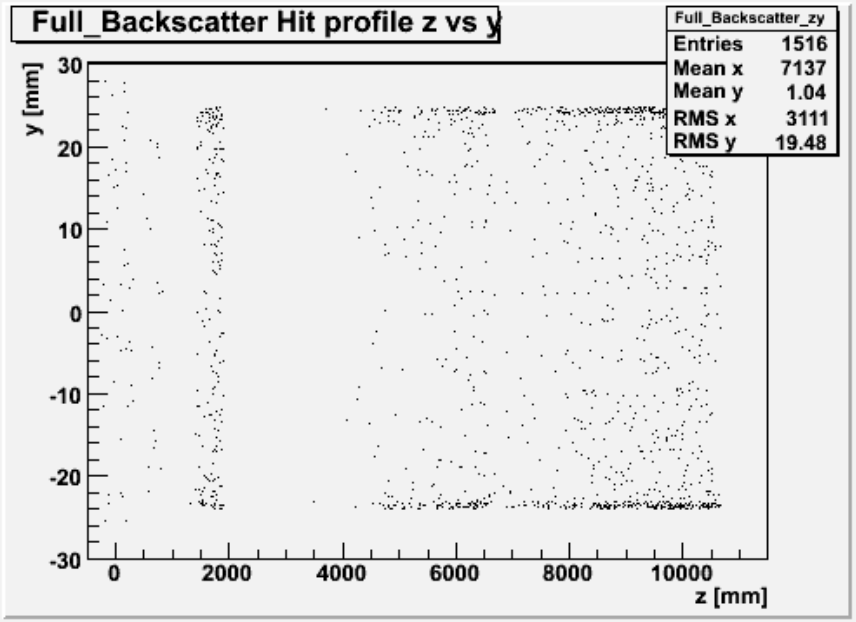

EndPipe Energy Distribution [keV]
EndPipe_Edepdis
Entries 2.350778e+08
Mean 5.67
RMS 5.537
Events
E [keV]

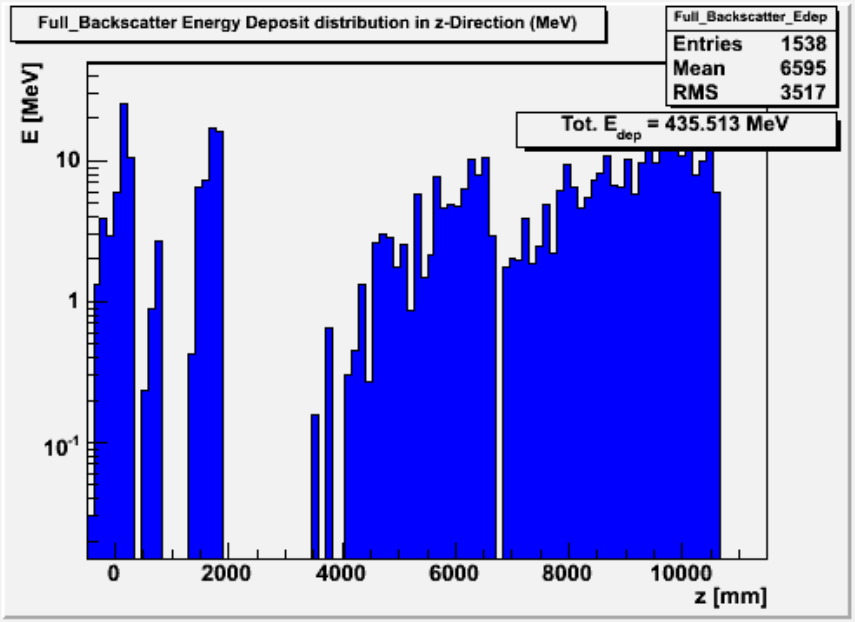
Backscattering

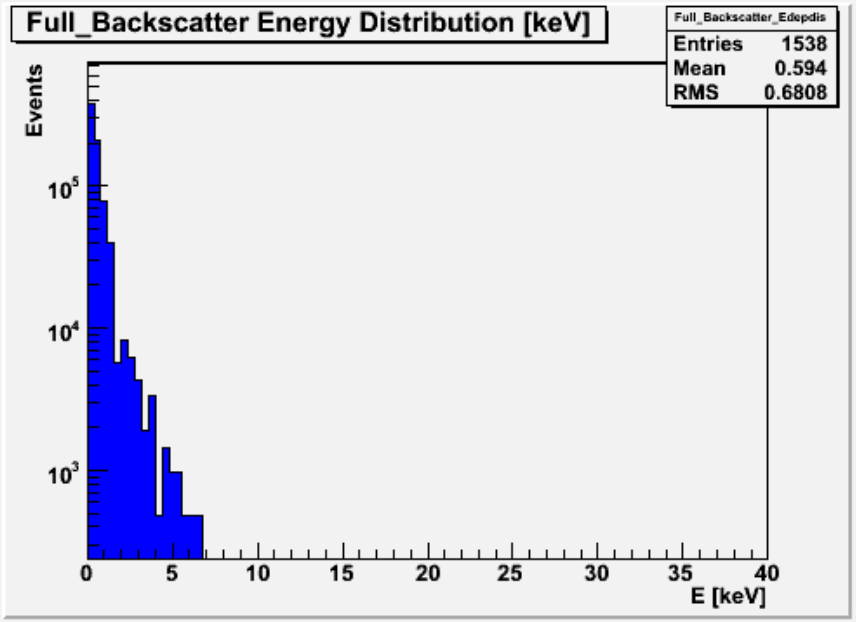


LER Backscattering - Full

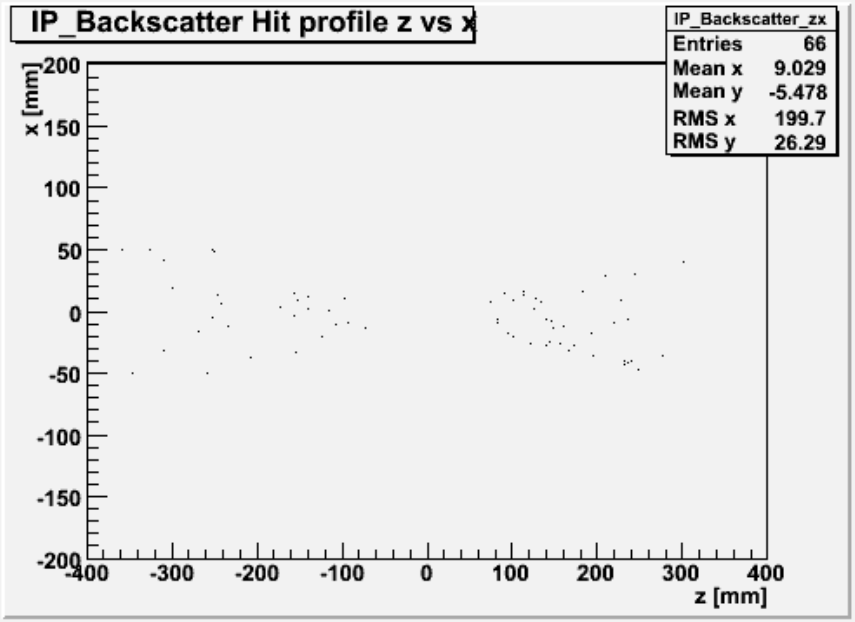


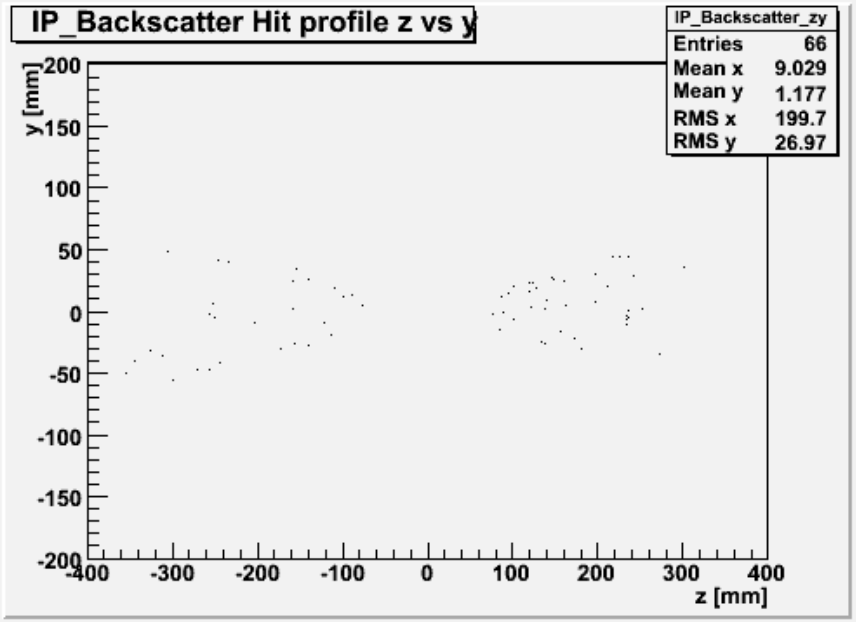


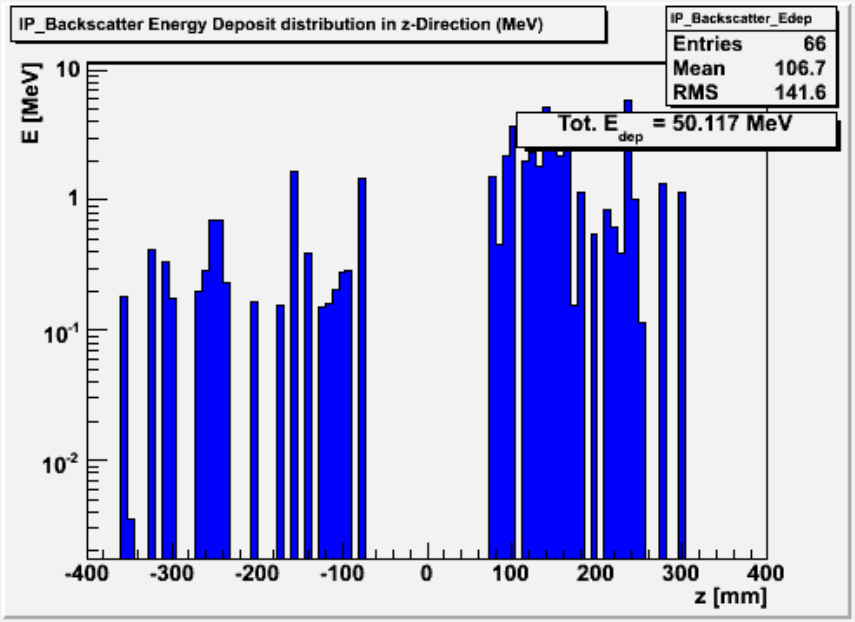


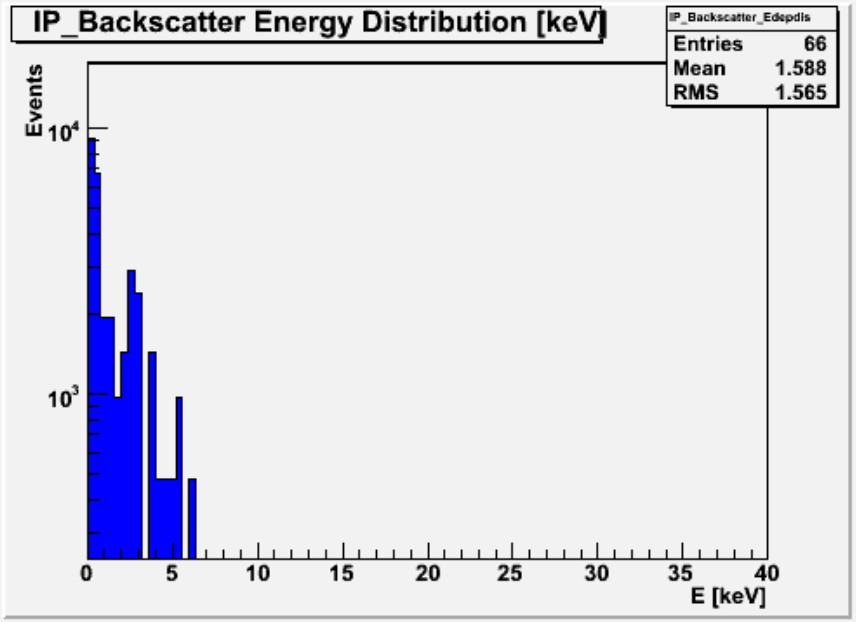


LER Backscattering - IP



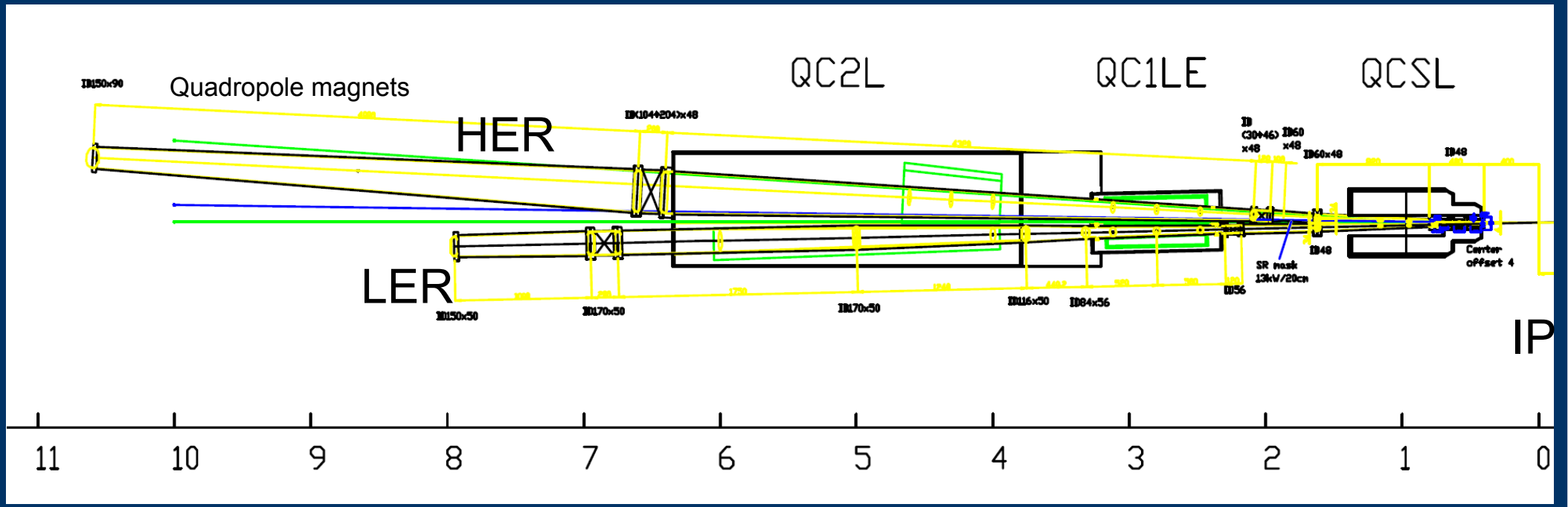




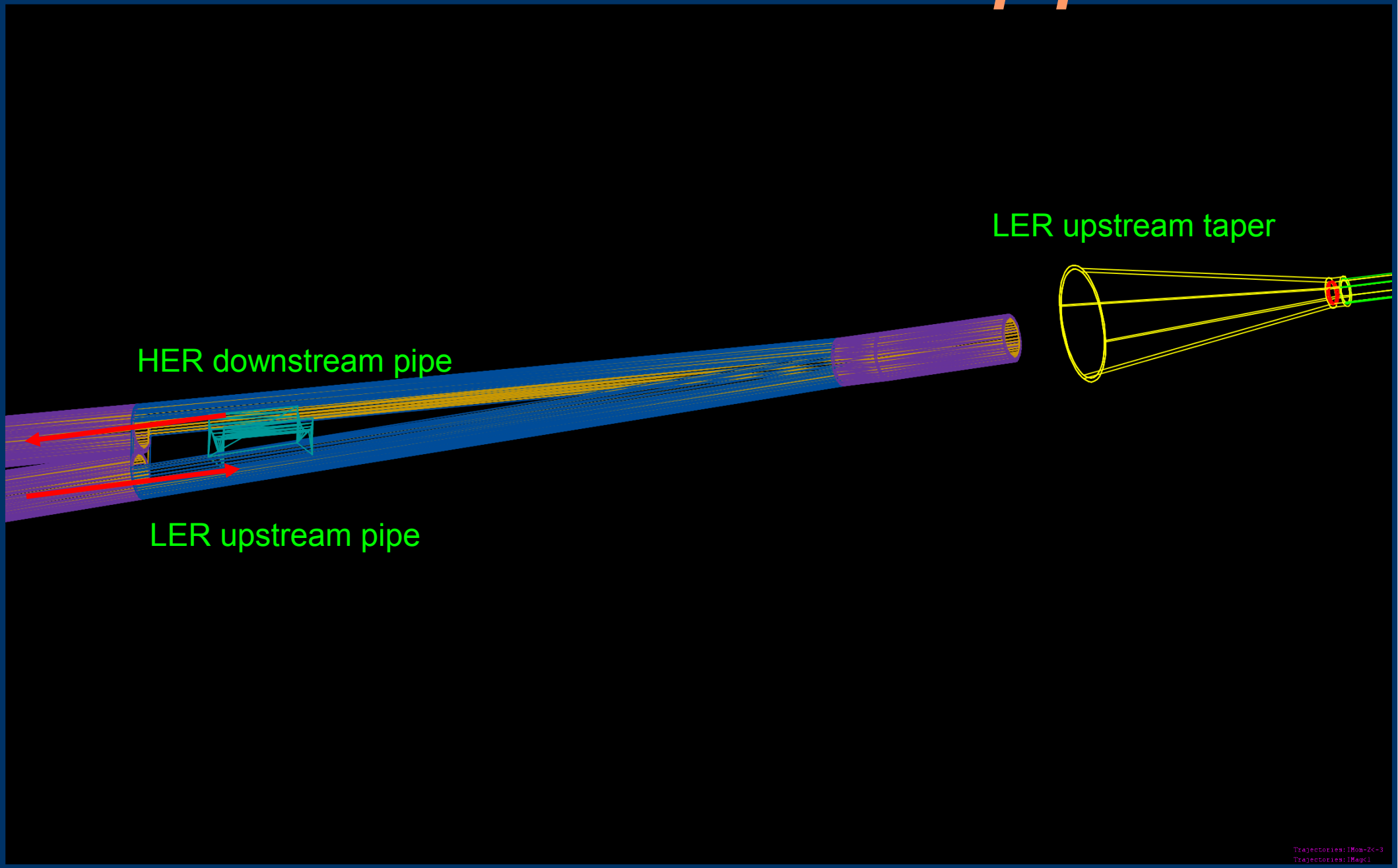


HER Synchrotron Backscattering

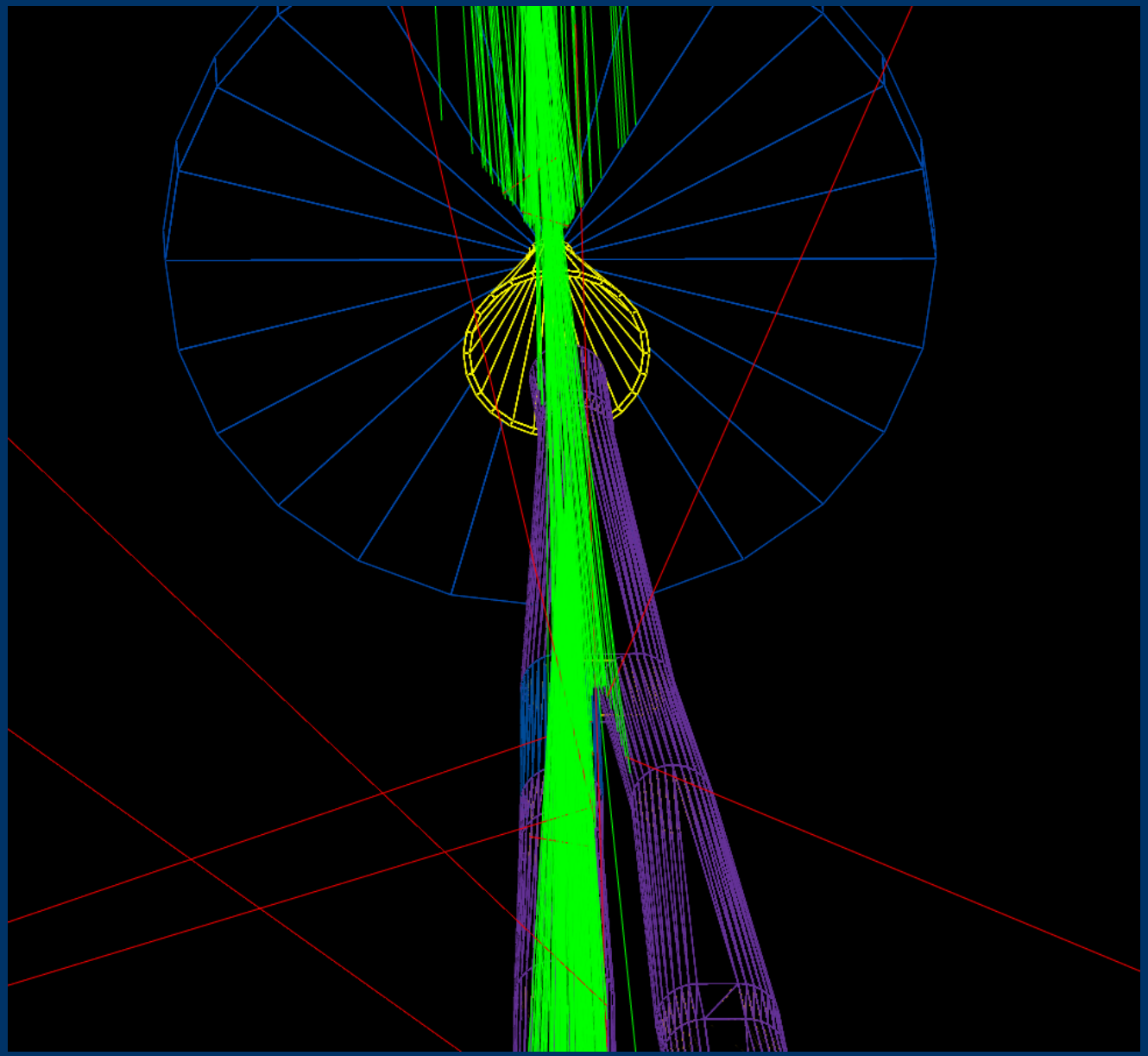
- AutoCAD plan



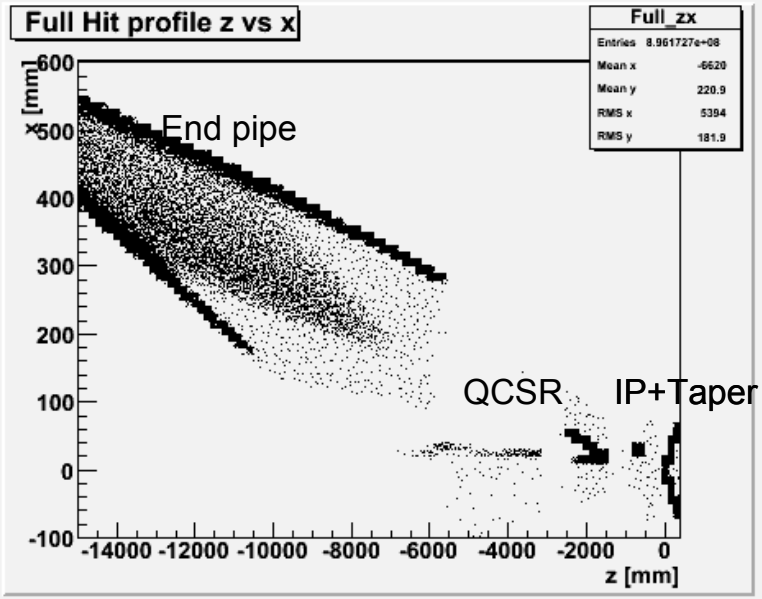
HER Downstream IR Beampipe

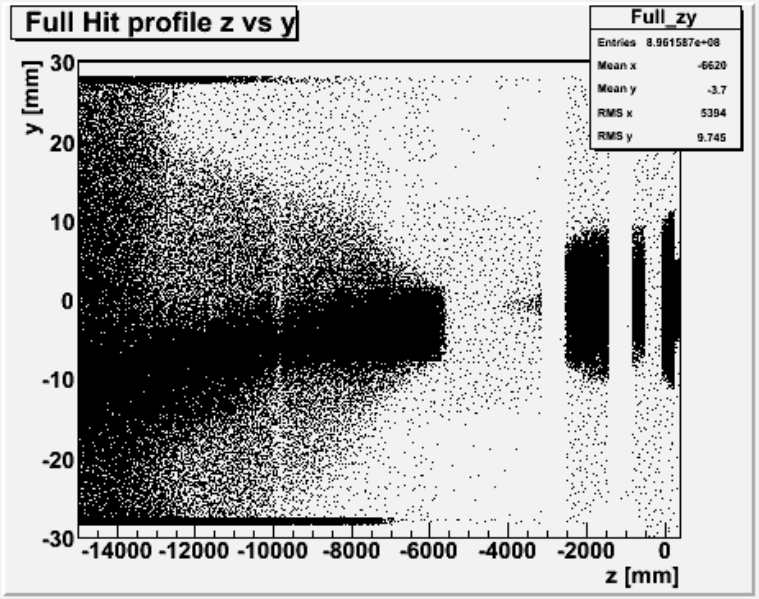


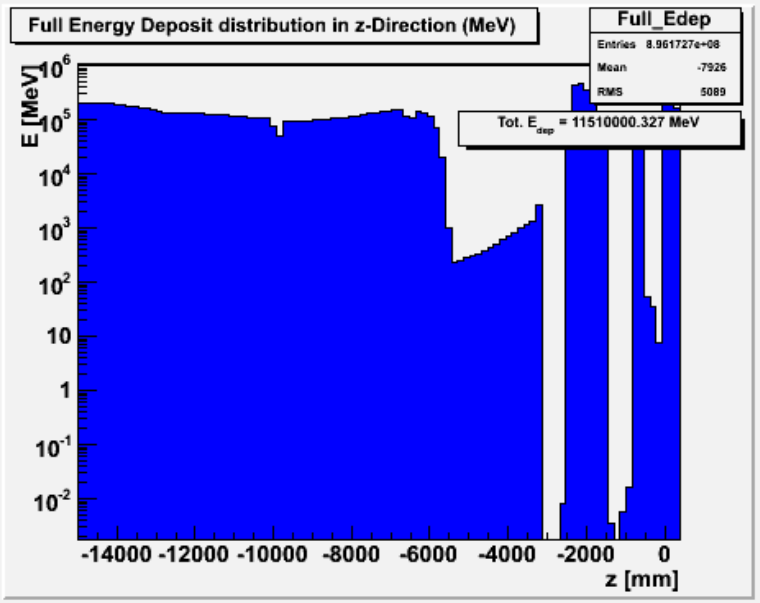
HER Downstream IR Beampipe

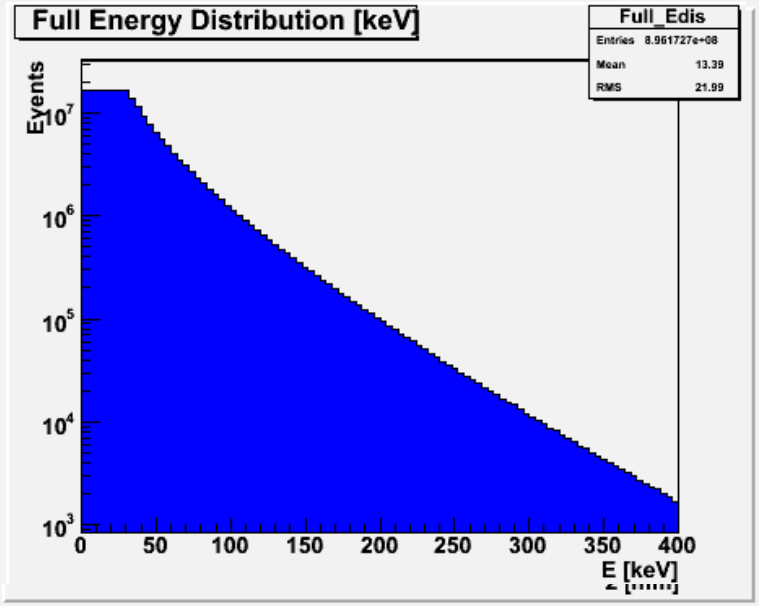


HER Full (Input filter: E > 1keV)

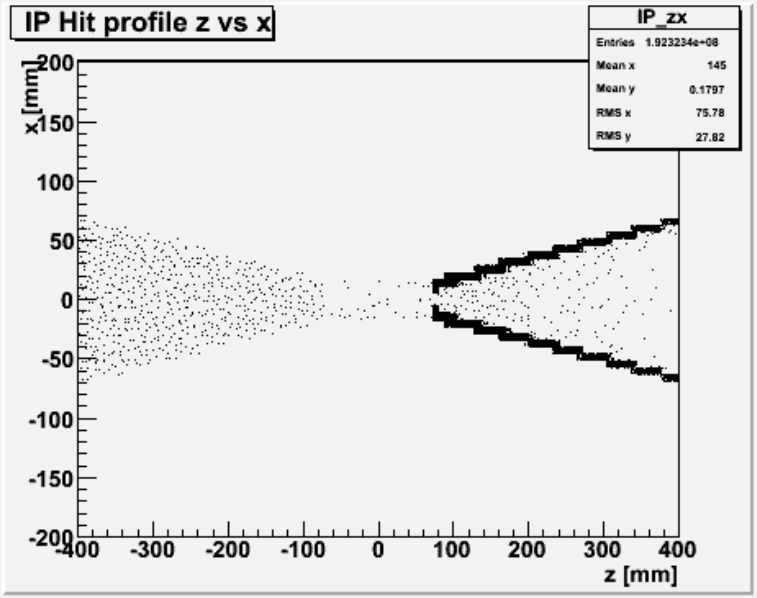


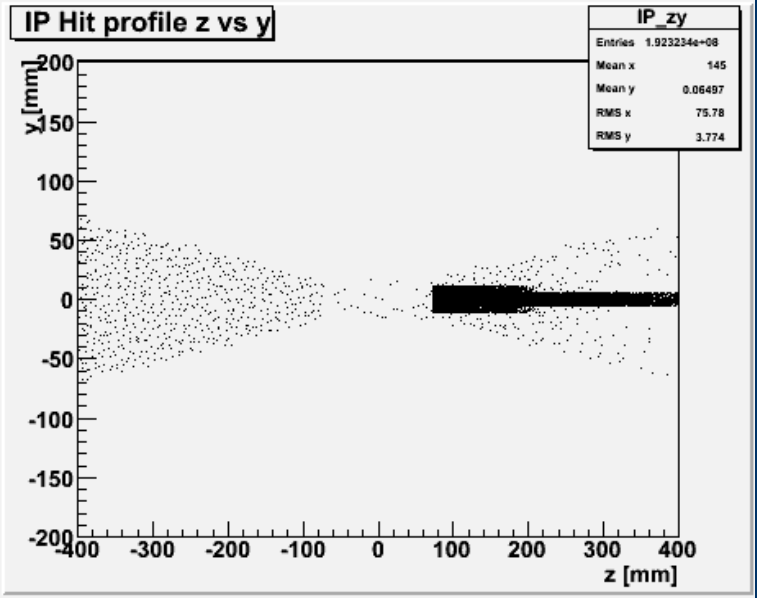


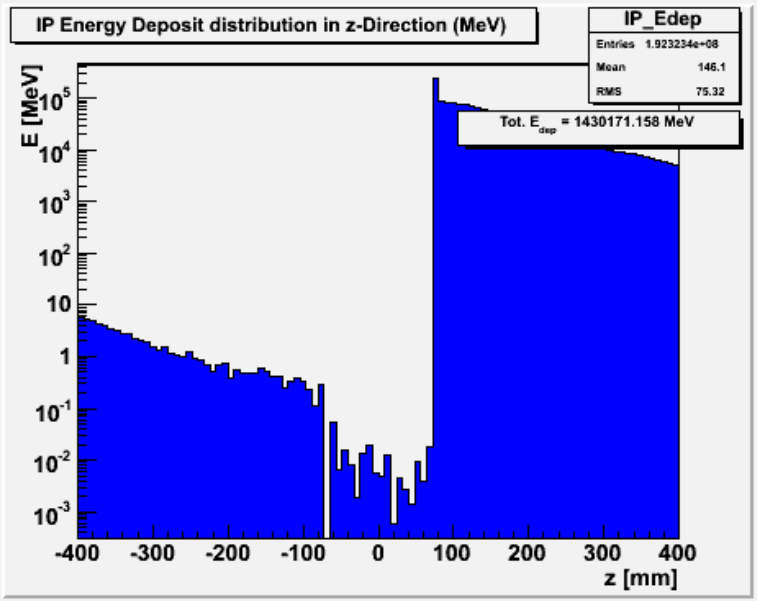


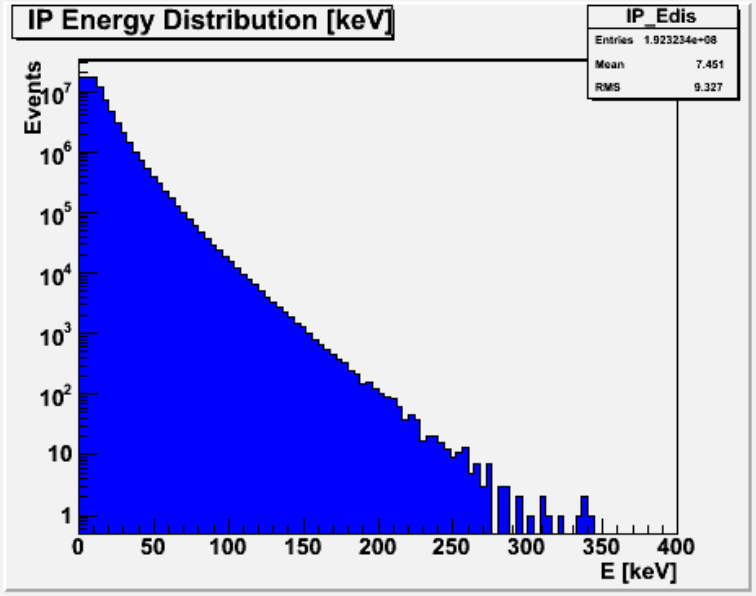


IP beampipe + Taper

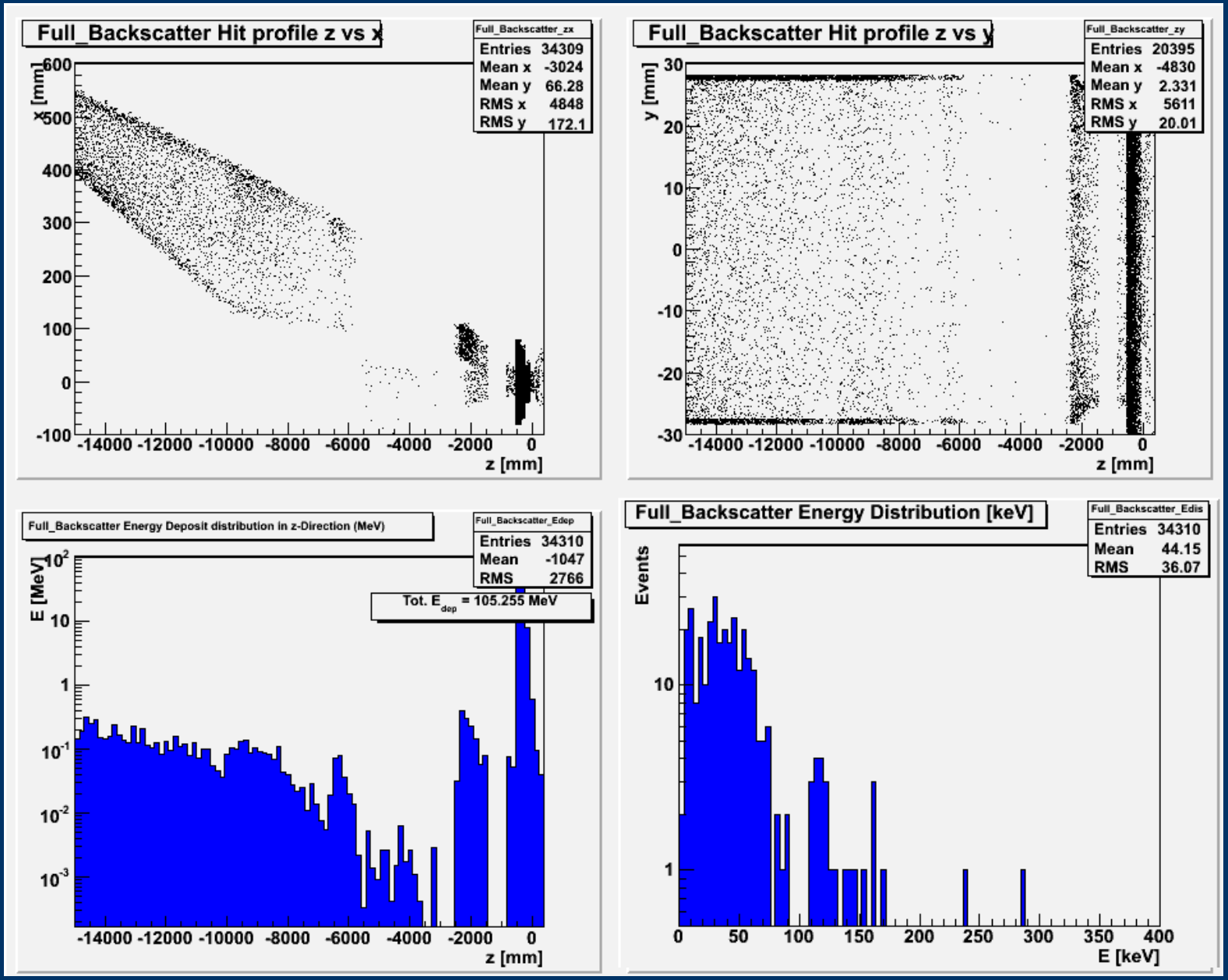




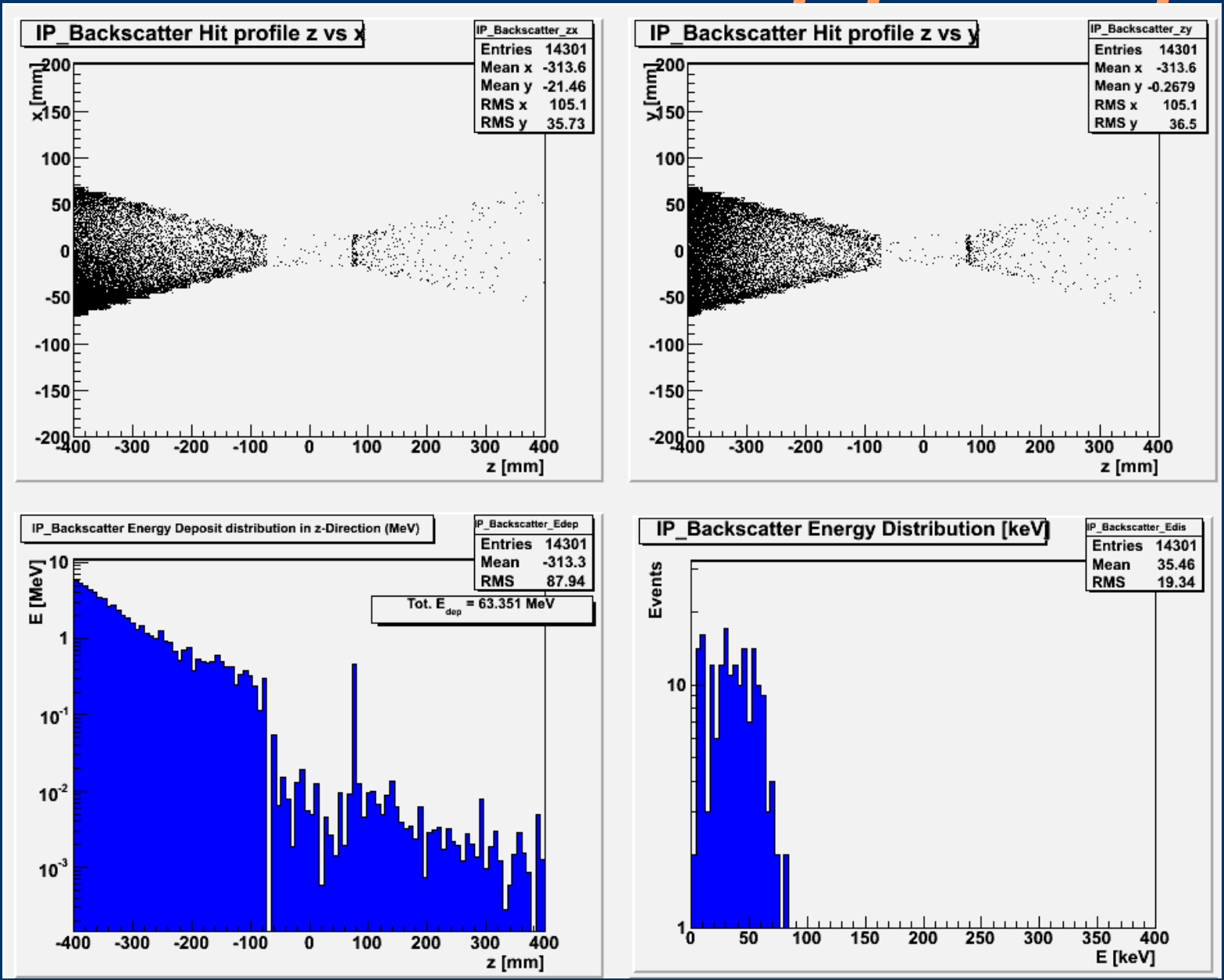




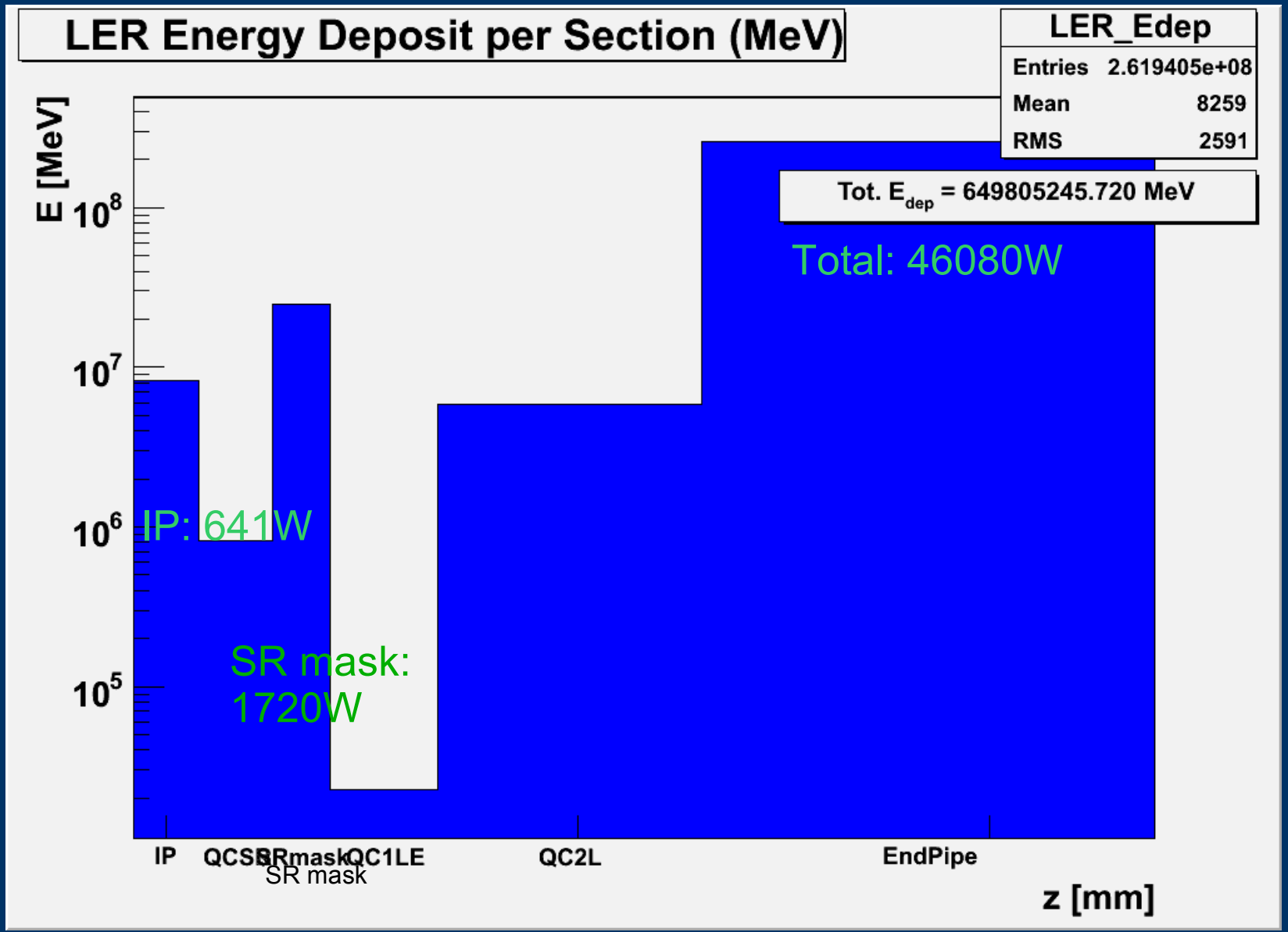
Backscatter – Full beampipe



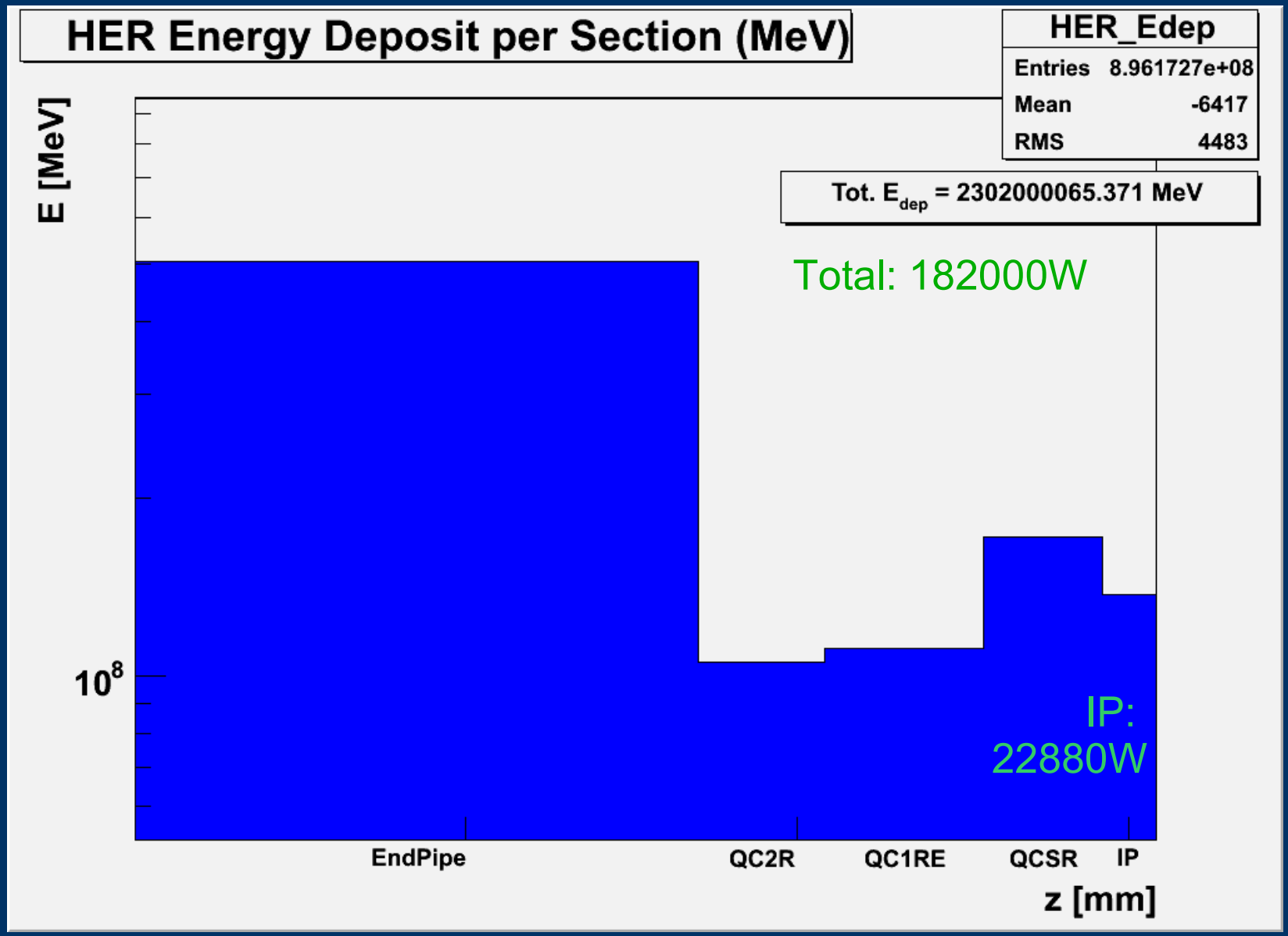
Backscatter – IP beampipe + Taper



Energy Deposit per Region - LER

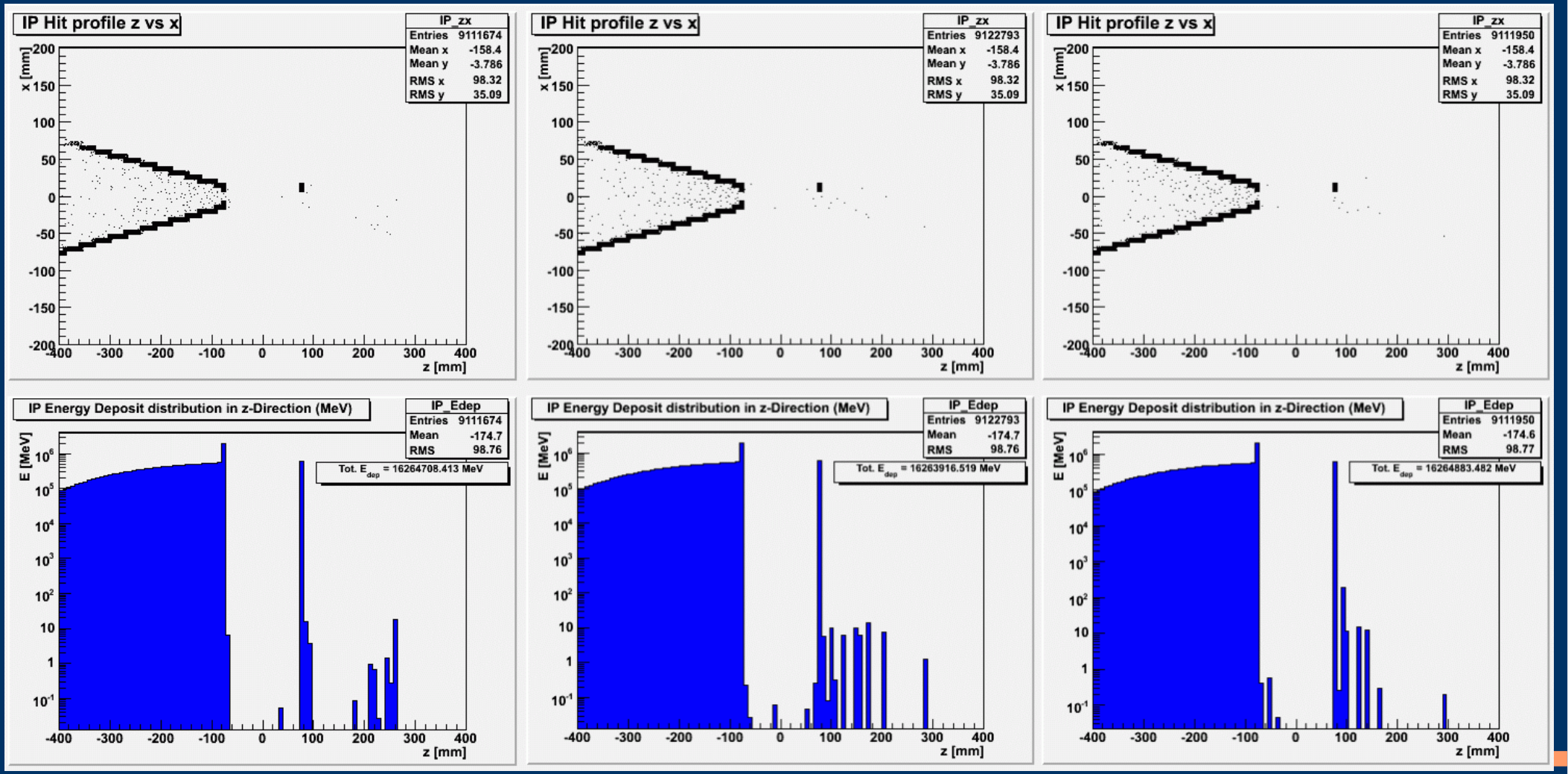


Energy Deposit per Region - HER



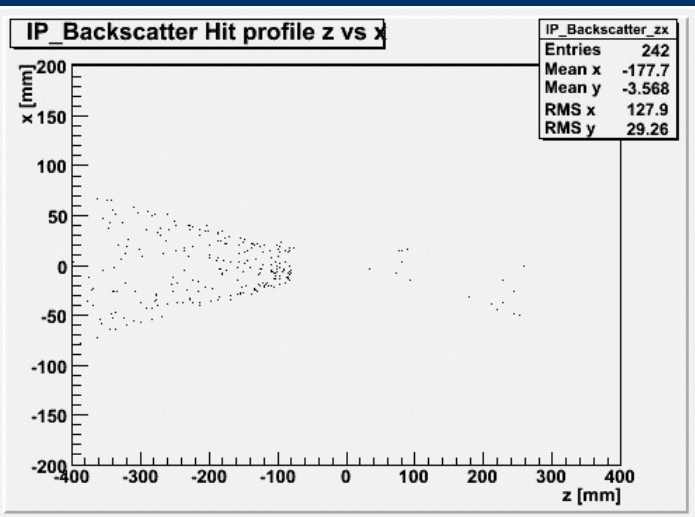
Material study - LER

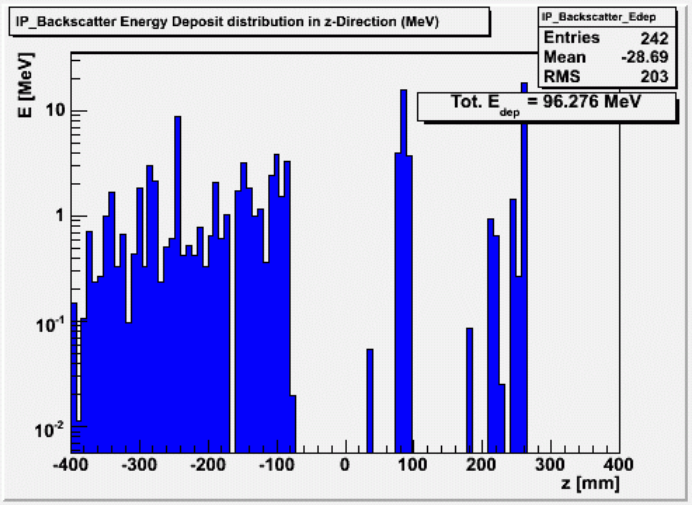
- Study effects on the IP region for different materials – Au + Cu, Cu only and Al



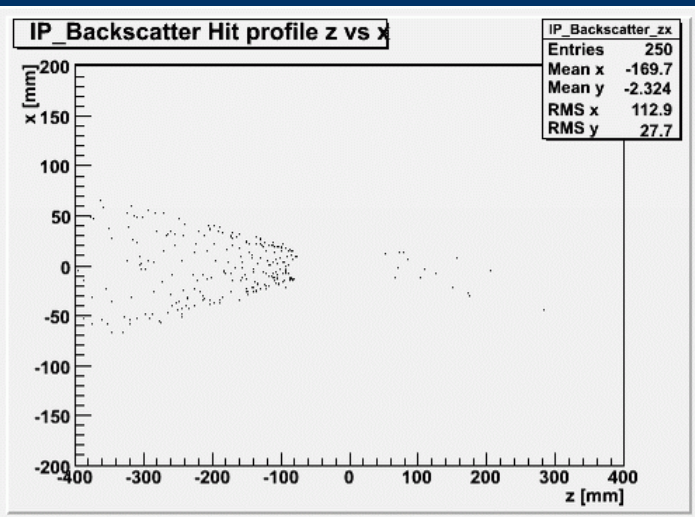
LER - Backscatter

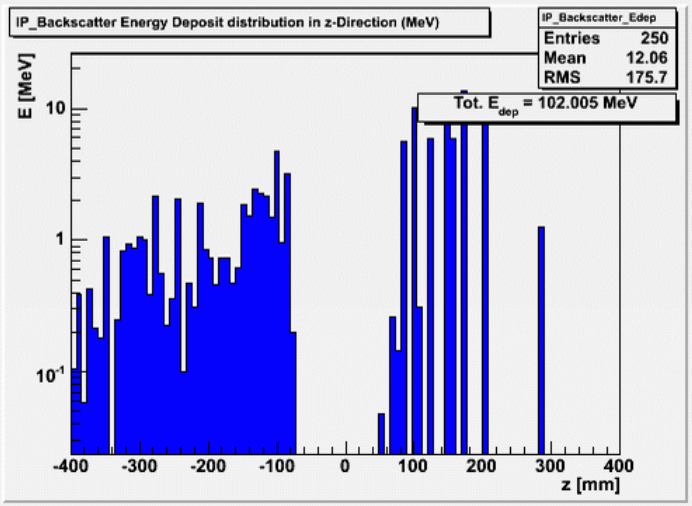
Au + Cu



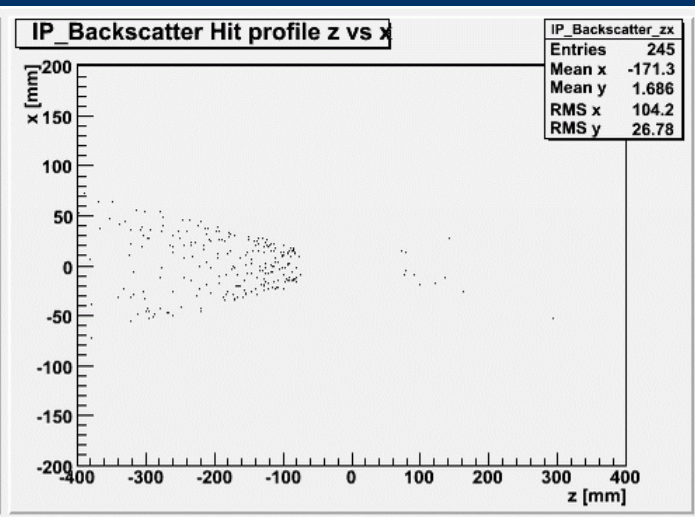


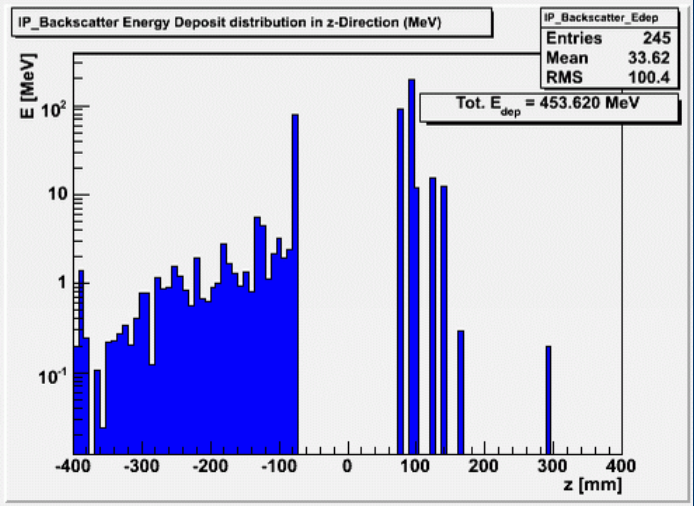
Cu





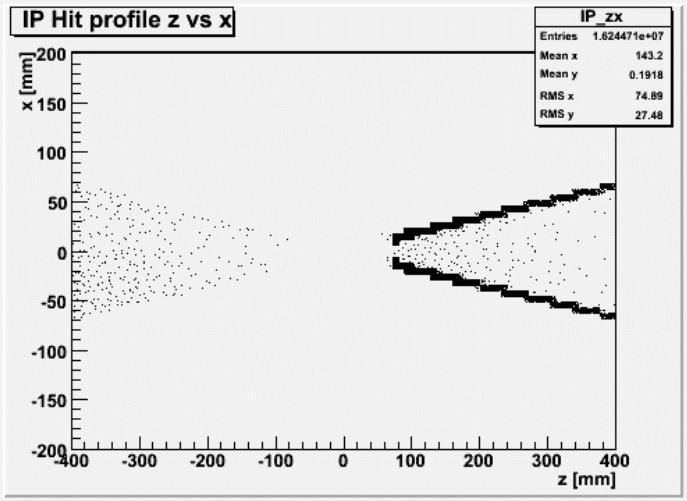
Al

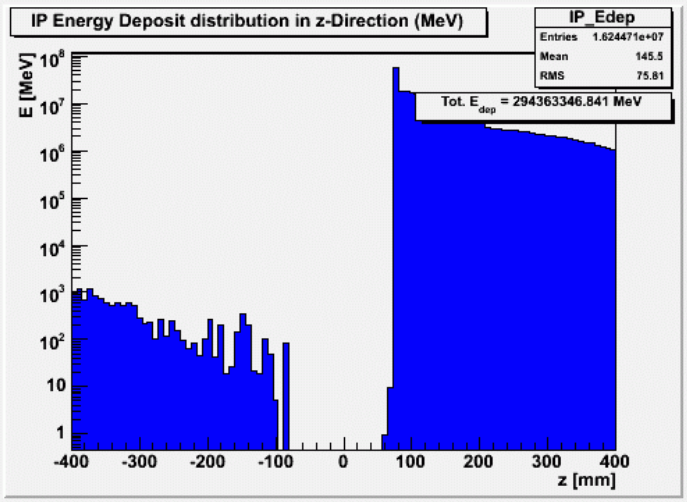




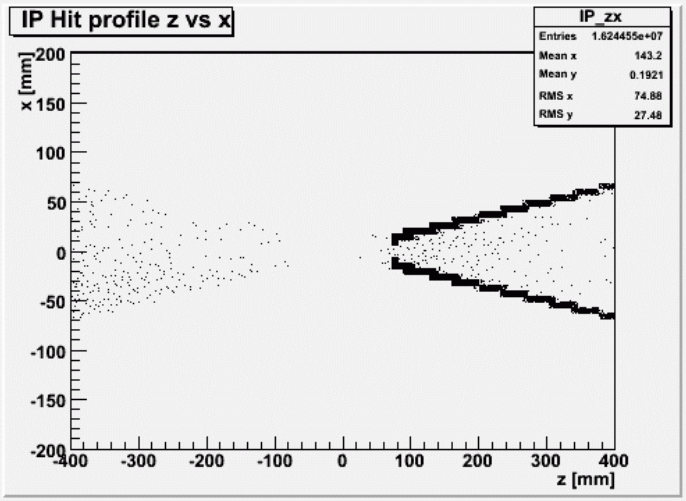
HER - IP

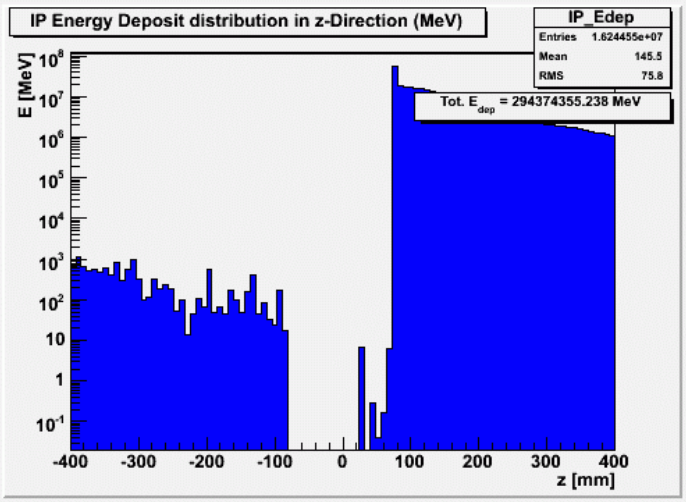
Au + Cu



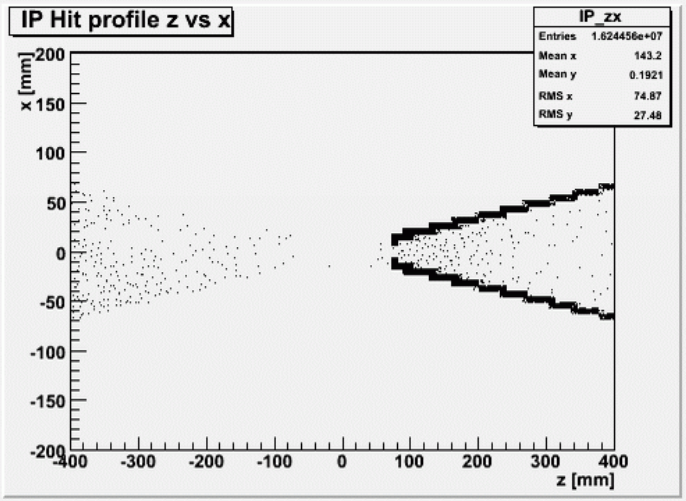


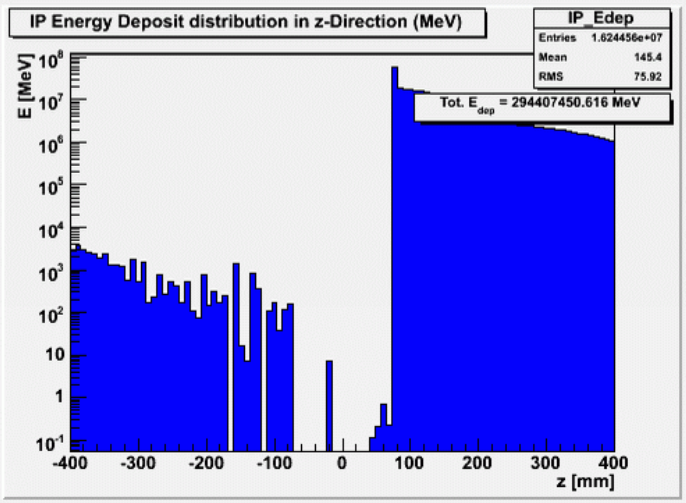
Cu





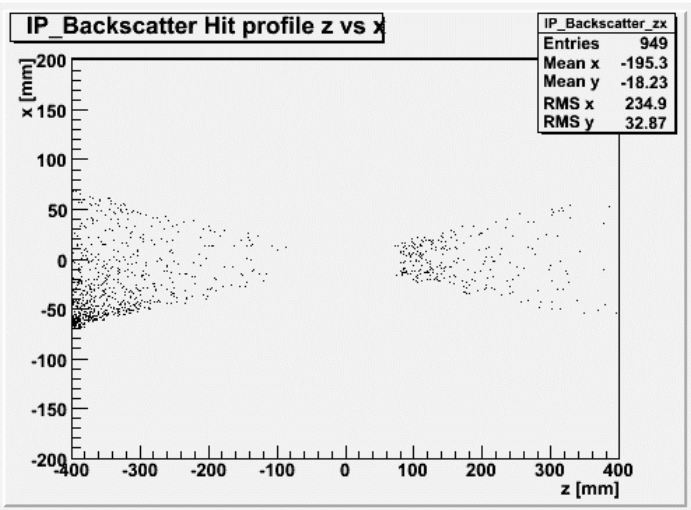
Al

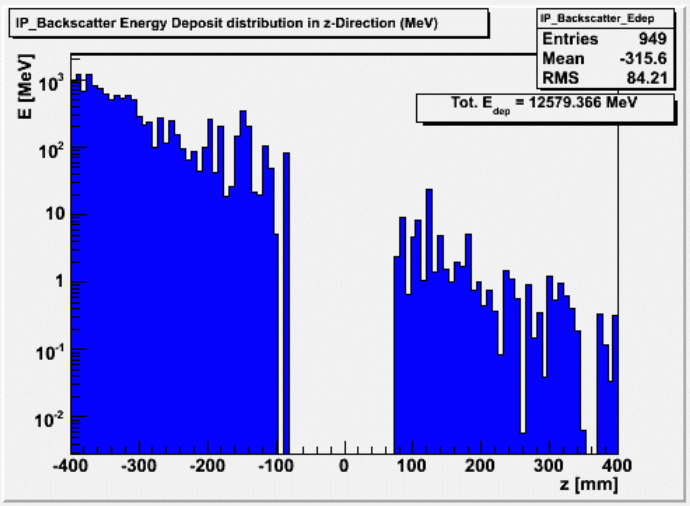




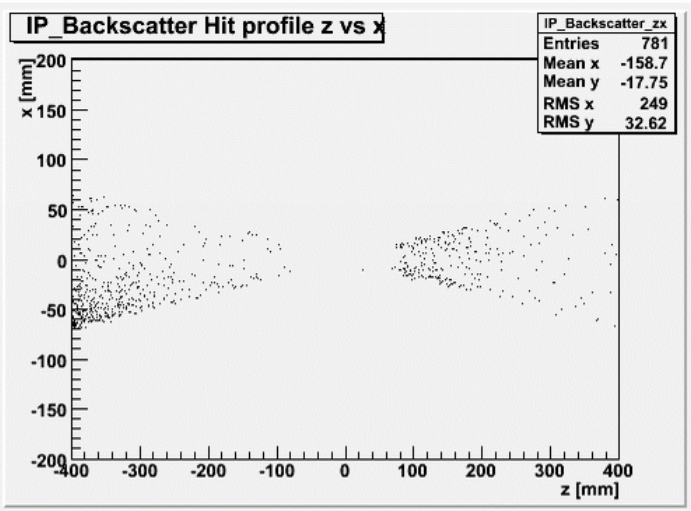
HER - Backscatter

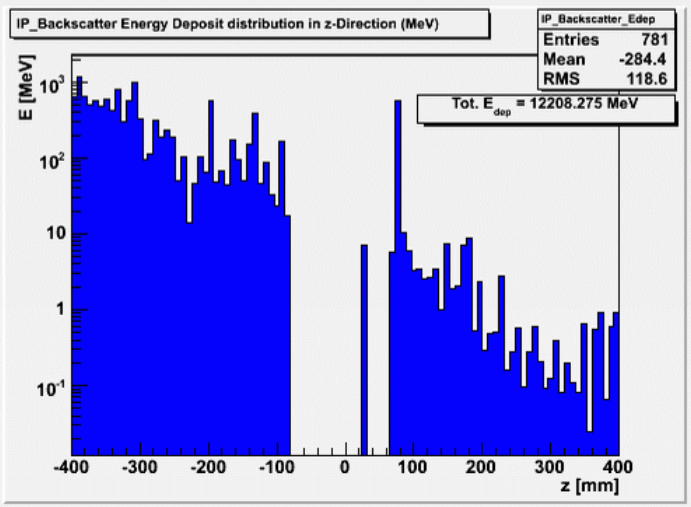
Au + Cu



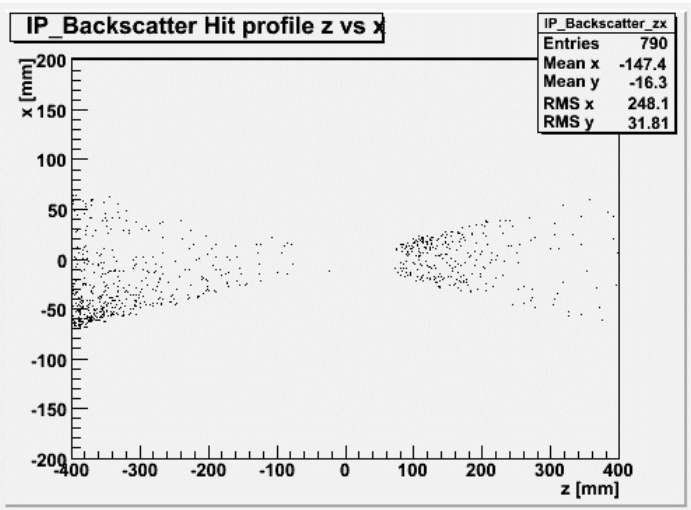


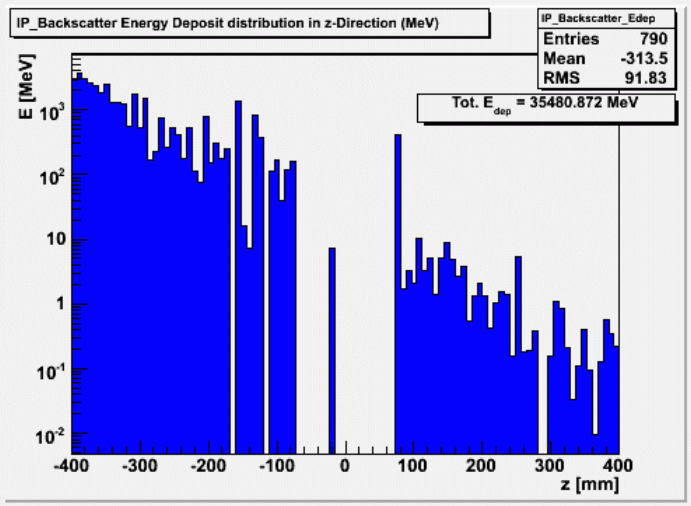
Cu



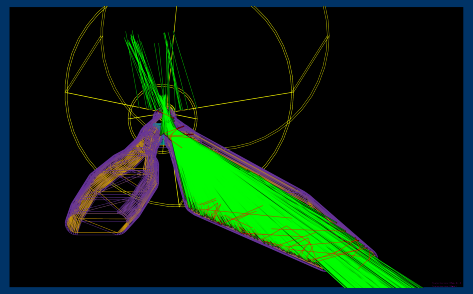


Al





Summary



An accurate Geant4 geometry study of the SuperBELLE IR beampipe SR backscattering has been performed (statistics of ~1.4 billion (>1keV) photons, 1/400 of a bunch for LER, 1/200 HER)

- 1 out of 600 million LER downstream photons may hit the IP beryllium pipe from each side – low energy deposit
- ~100 out of 800 million HER photons may hit IP pipe – low energy deposit, but occupancy problems?
- ~640W (?) deposit to LER IP + taper, ~22880W to HER
- The Au + Cu set up performs similarly to just Cu alone – the Au is more effective at absorbing high energy photons. For HER side Au might be better. Al is too reflective for use on either side