

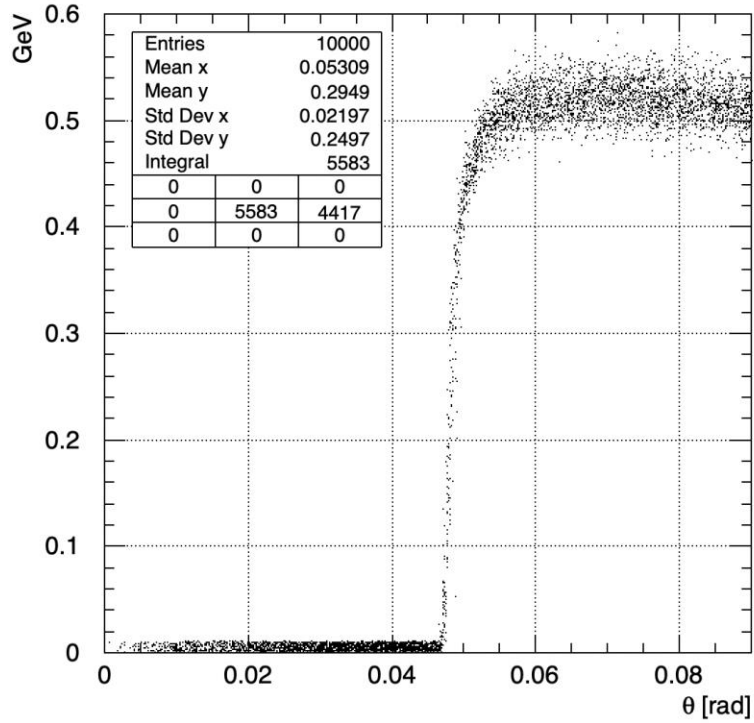
Signals from Incoherent Pairs in LumiCal

FCC MDI Meeting #62
Dec 16, 2024

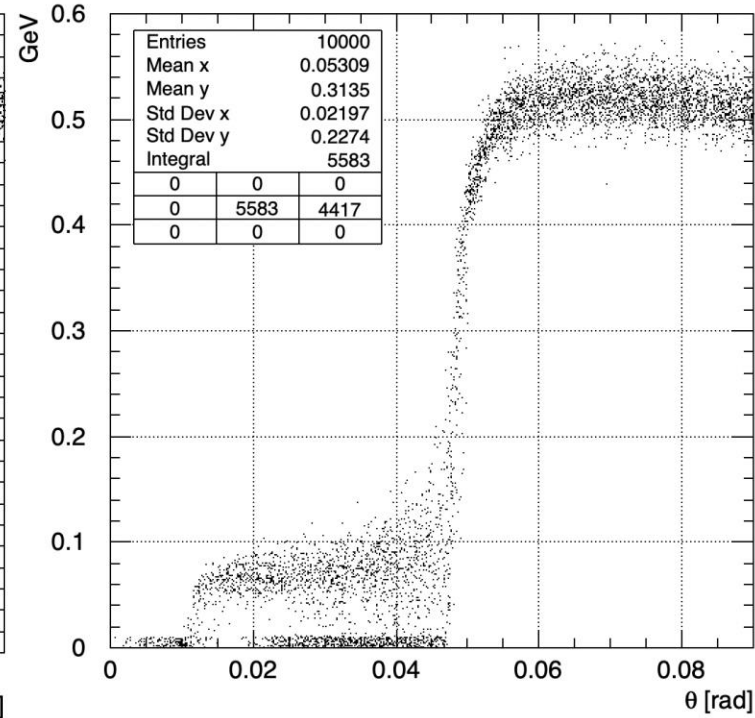
Mogens Dam
Niels Bohr Institute

Beam pipe

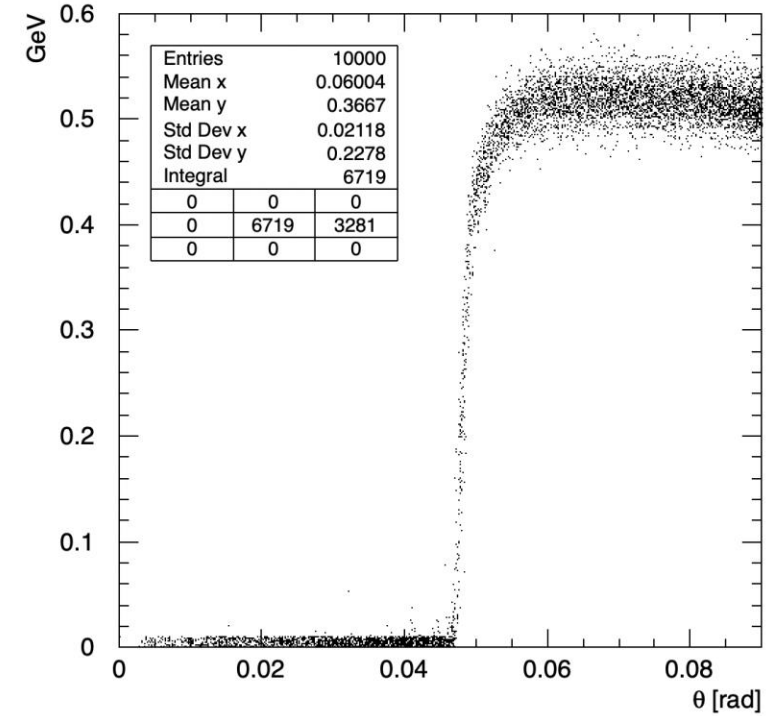
No beam pipe



Annecy CAD beam pipe

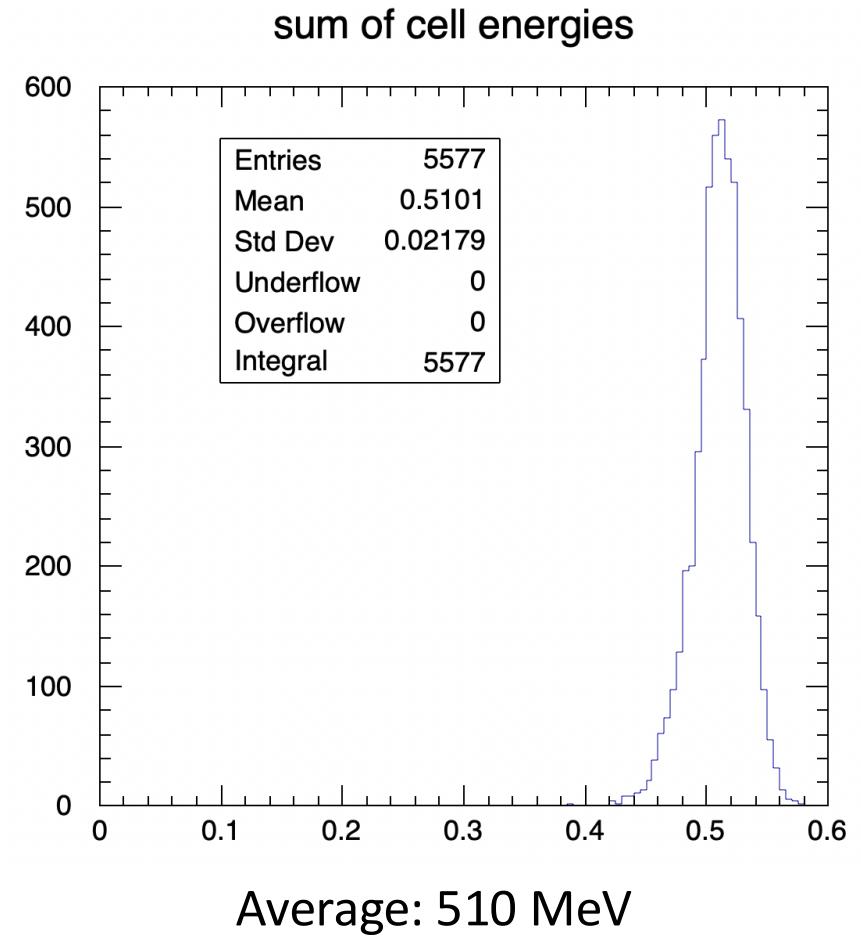
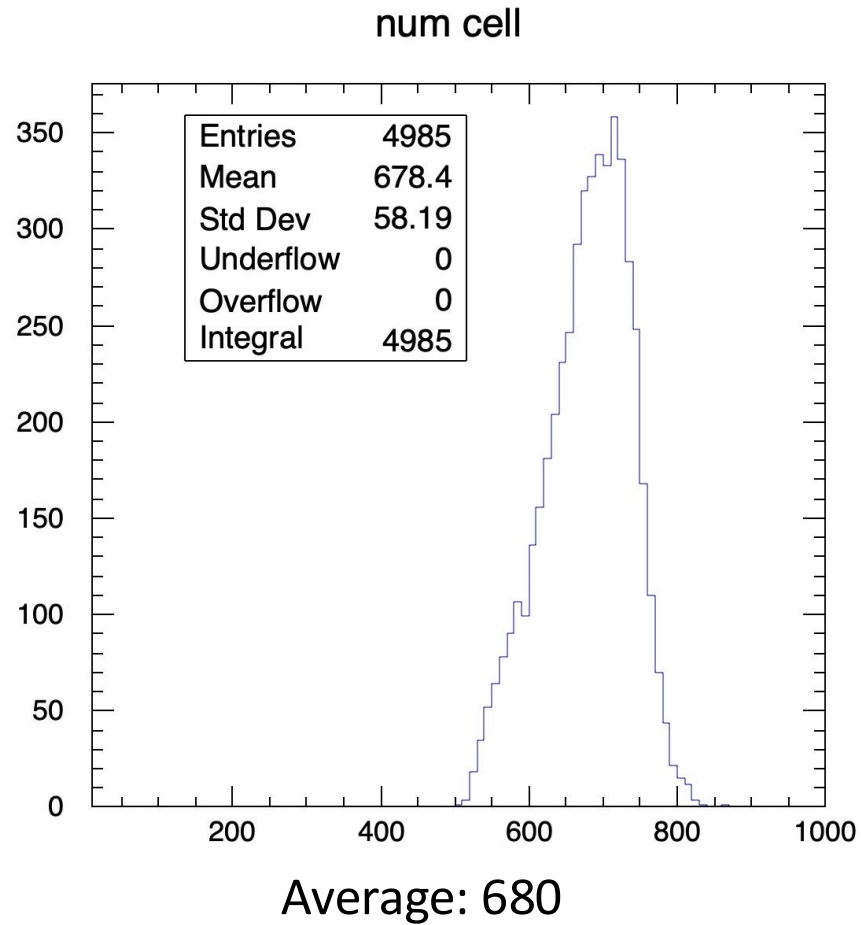


New CAD beam pipe



New beam pipe is major improvement compared to Cu manifold

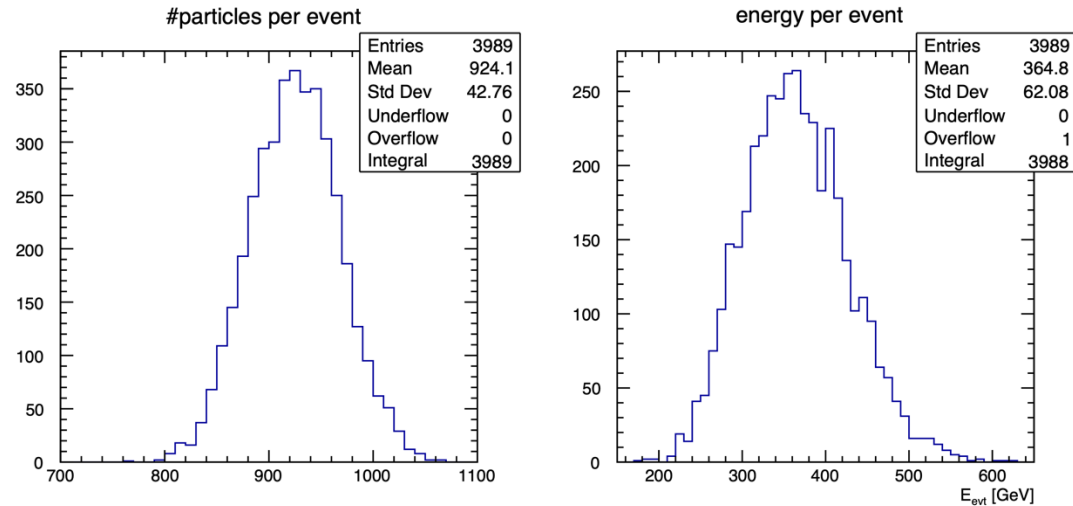
LumiCal response to 45.6 GeV electrons



Sampling fraction: $0.510/45.6 = 1.1\%$

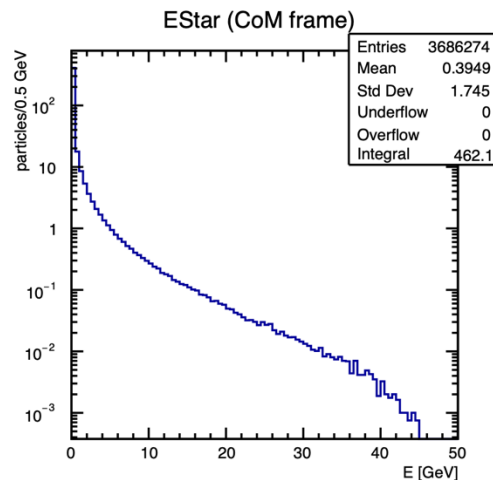
IPC particles at 45.6 GeV

3989 events GP generated by Andrea Ciarma
No minimum momentum cut-off on electrons



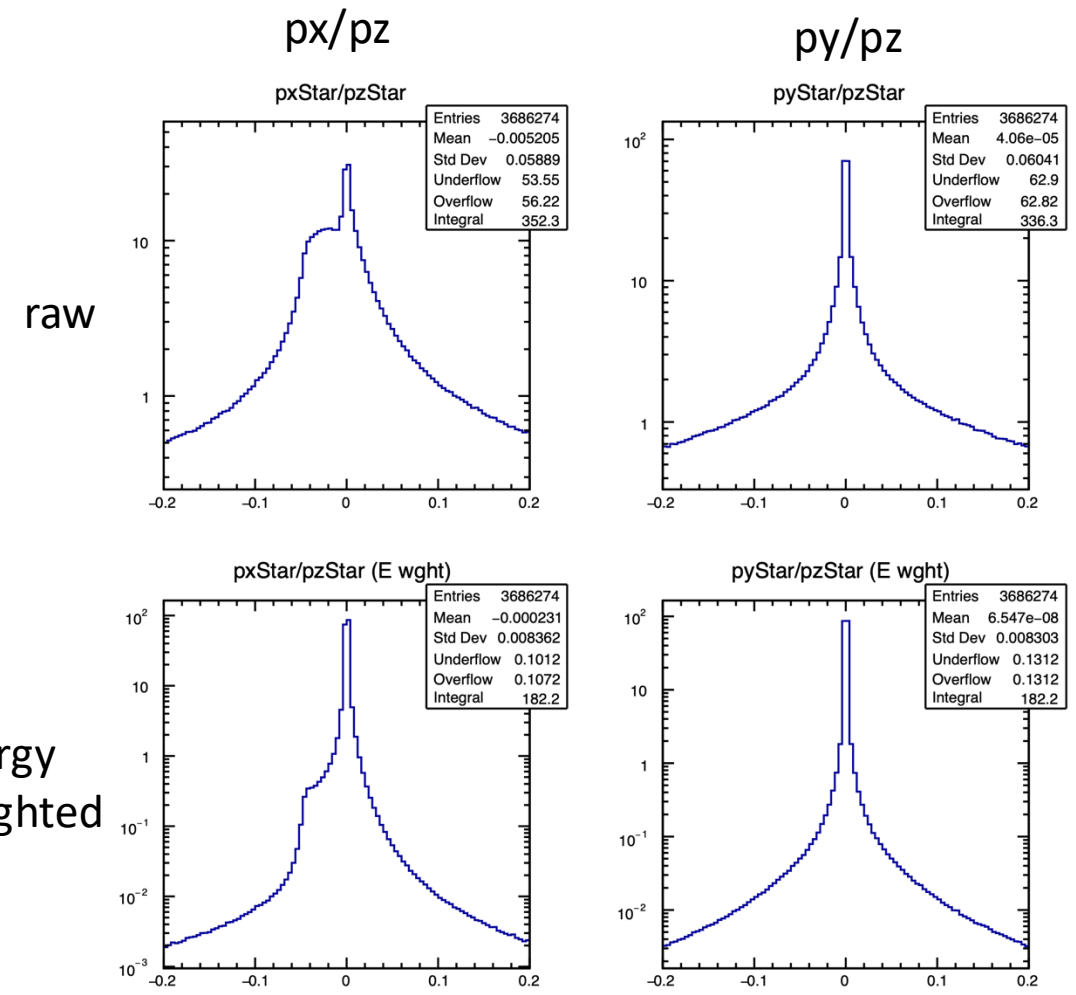
924 particles per event

365 GeV per event



Average particle energy: 395 MeV

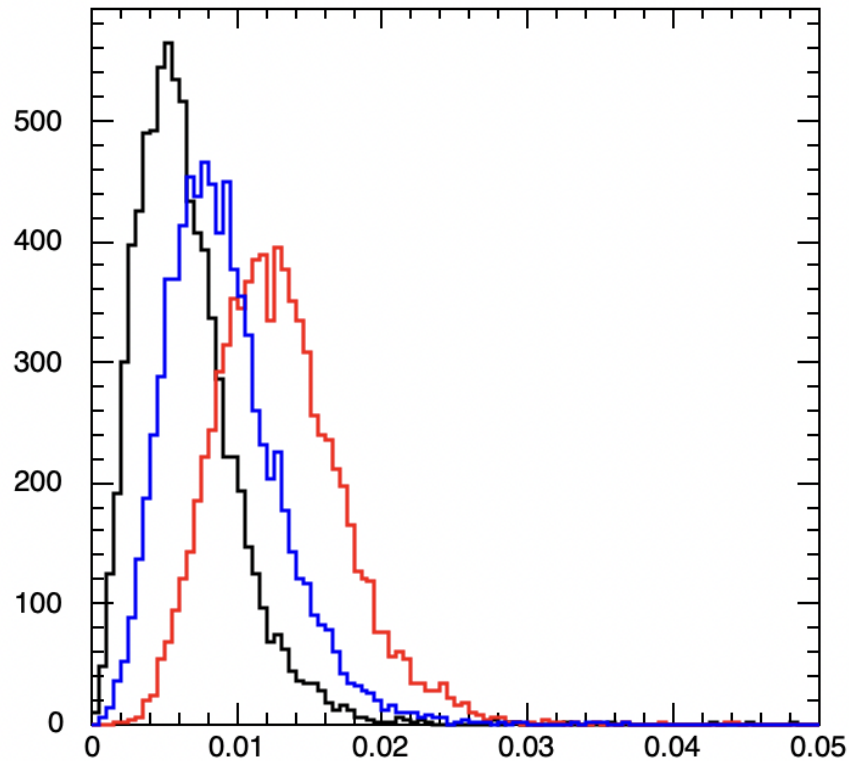
CMS Frame = LumiCal System



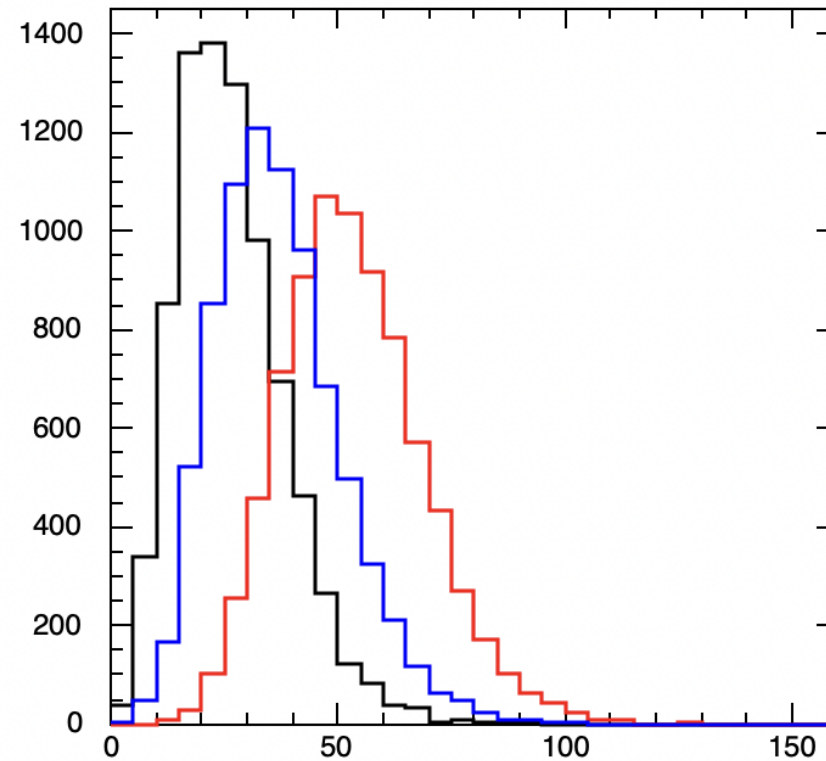
Very strongly forward peaked (along outgoing beam)
• In particular, energy

Response to ICP (45.6 GeV)

sum of cell energies (above mip cut)



no. cells (above mip cut)



- Red: No mag field
- Black: 2T field
- Blue: 2T + anti field

For full field (blue):

Avg. = 9.0 MeV

1.7% of 510 MeV (45.6 GeV electrons)

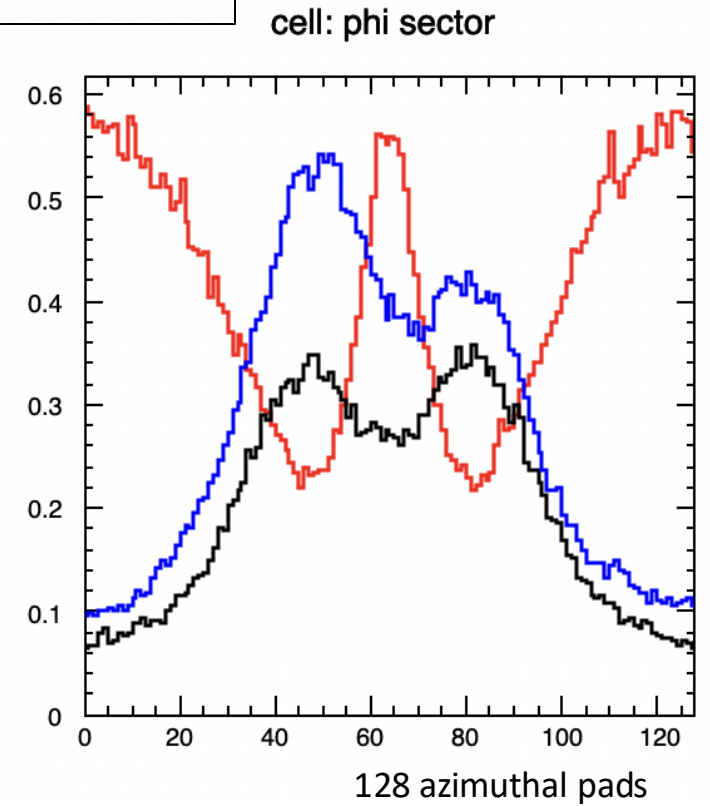
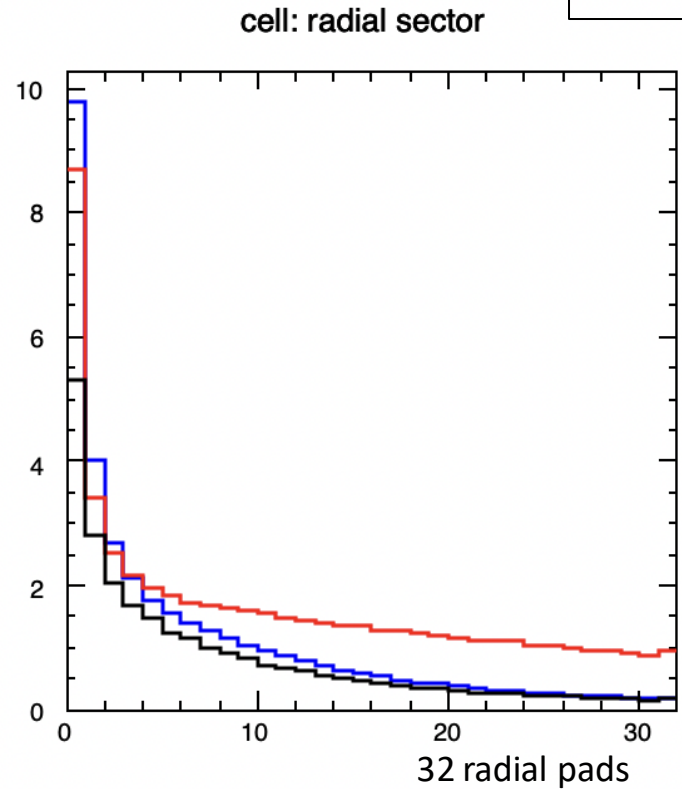
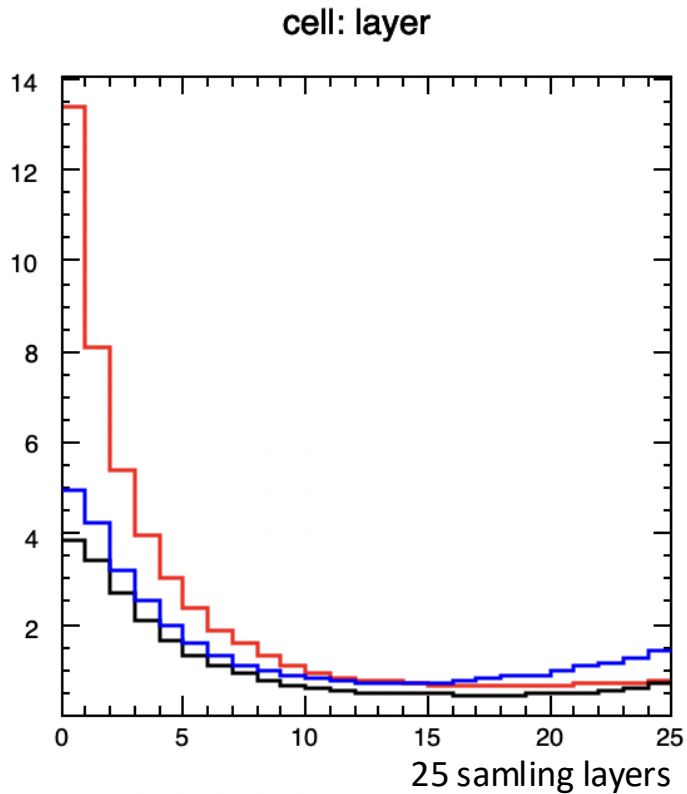
Avg. = 36 cells

5.3% of 680 (45.6 GeV electrons)

ICP - Distribution of hit cells (45.6 GeV)

y-axes: cells hit per event per LumiCal

- Red: No mag field
- Black: 2T field
- Blue: 2T + anti field



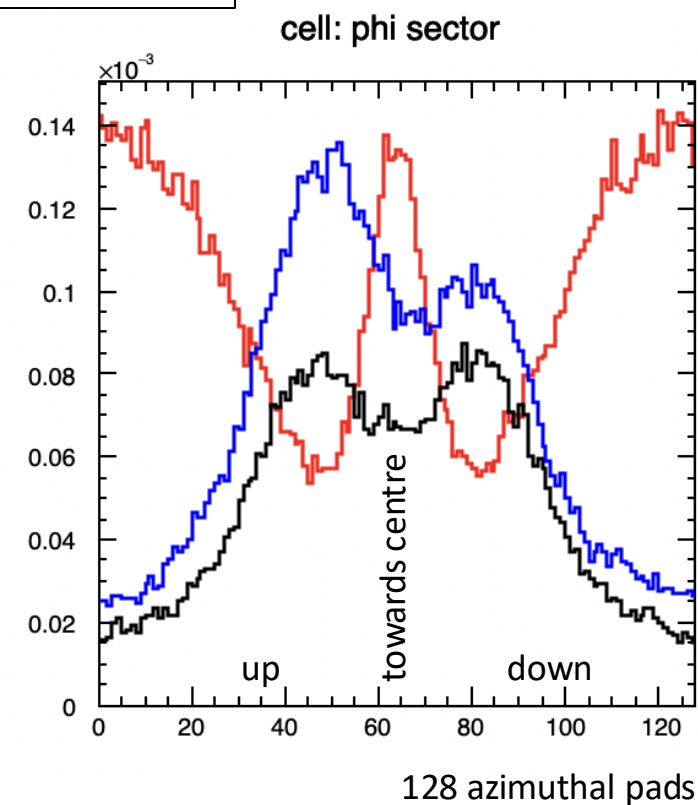
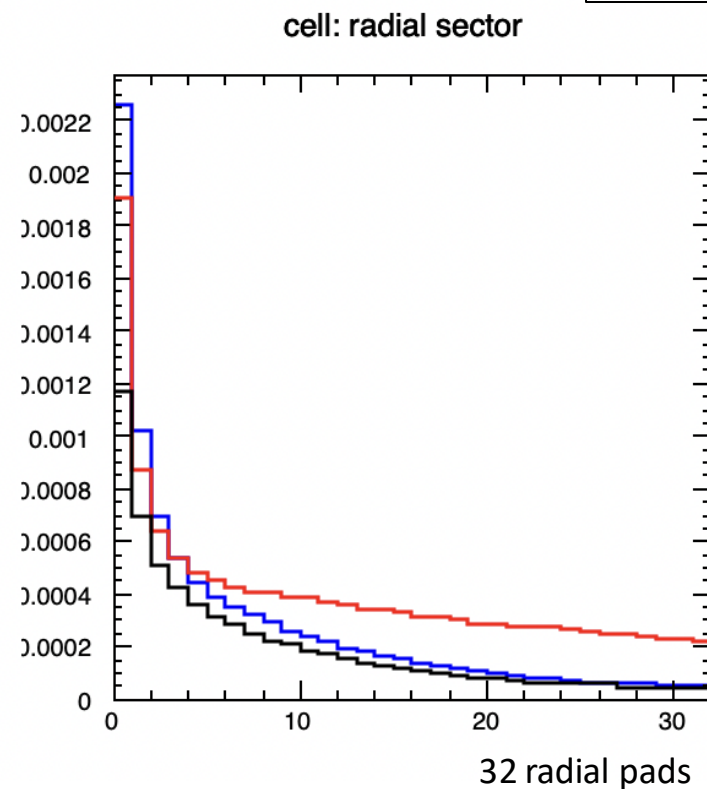
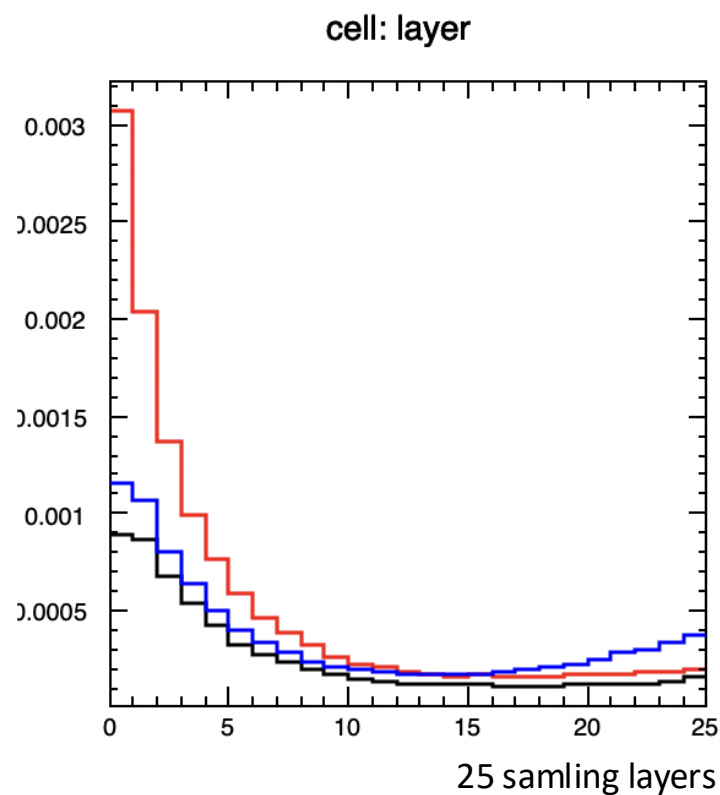
- Many particles hitting front face – also for larger radii
- Suppression in particular of particles hitting face
- Higher overall, but in particular at rear of LumiCal
-> Divergence in radial coordinate of field

Complicated ...

ICP - Distribution of deposited energy (45.6 GeV)

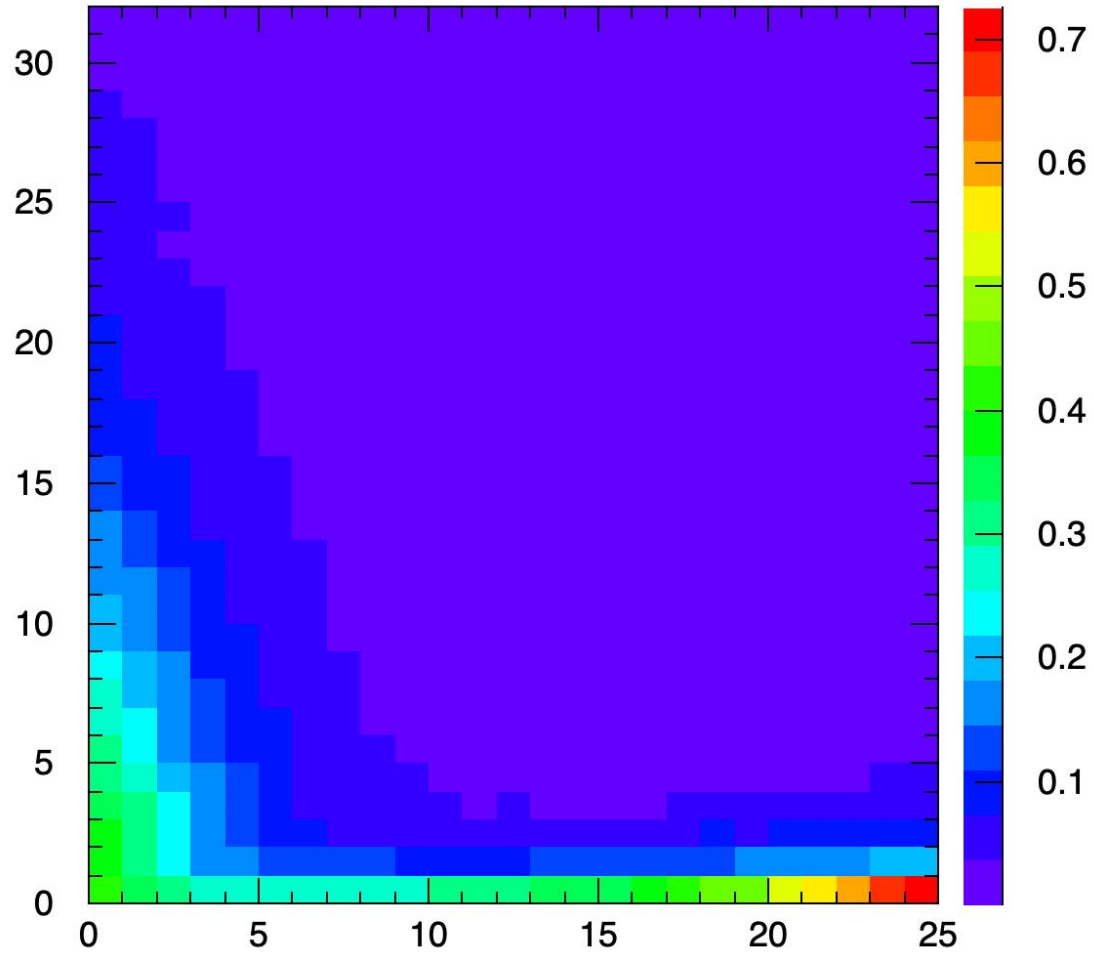
y-axes: deposited energy [GeV] per event per LumiCal

- Red: No mag field
- Black: 2T field
- Blue: 2T + anti field

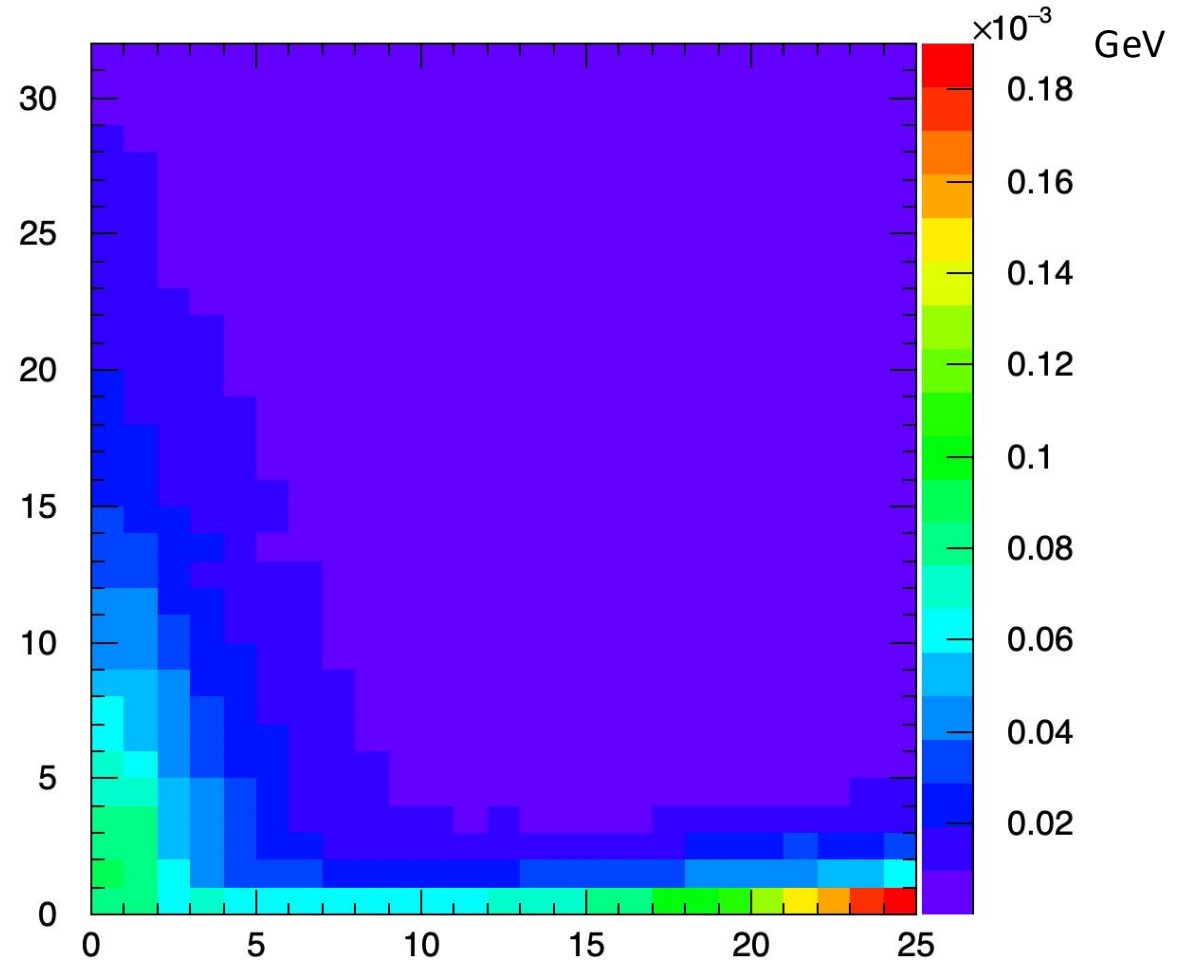


ICP - Distribution of hit cells and energy (45.6 GeV)

cell: radial sector VS layer



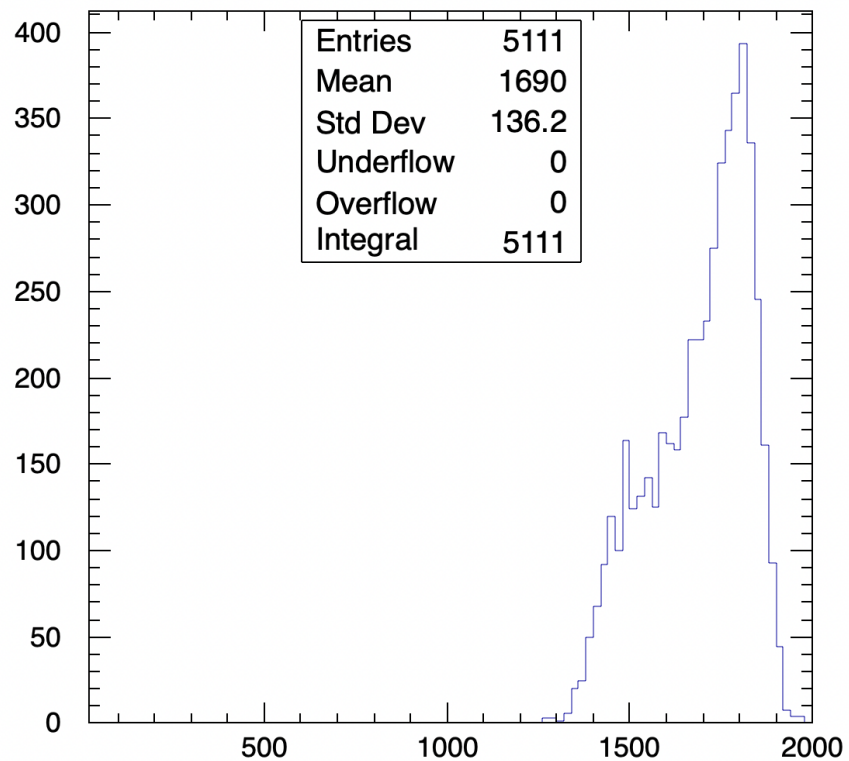
Energy : radial sector VS layer



Full B field: 2T + anti solenoid

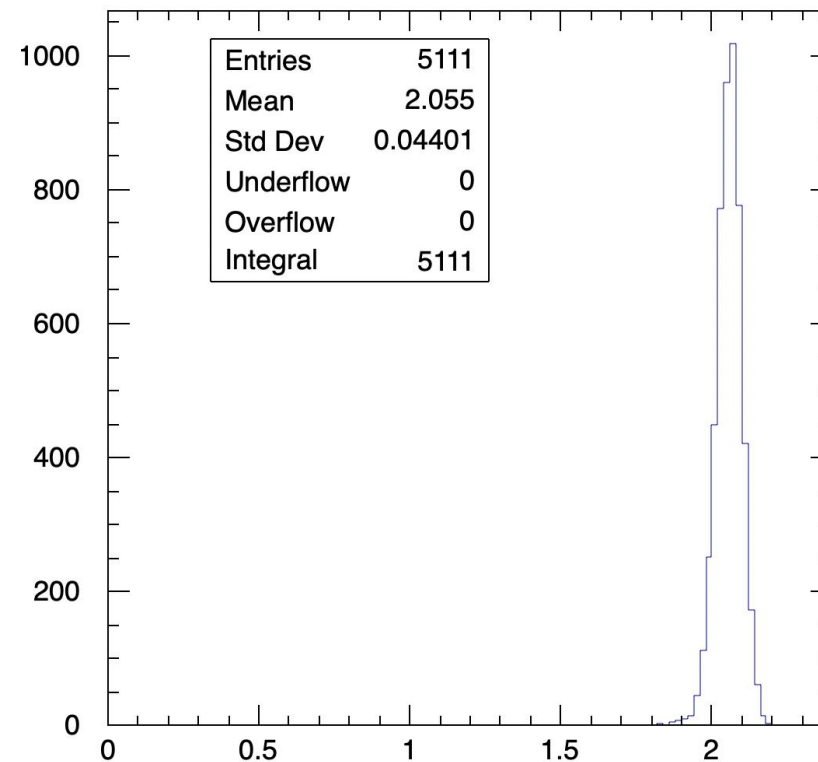
LumiCal response to 182.5 GeV electrons

num cell



Avg.: 1690 cells

sum of cell energies

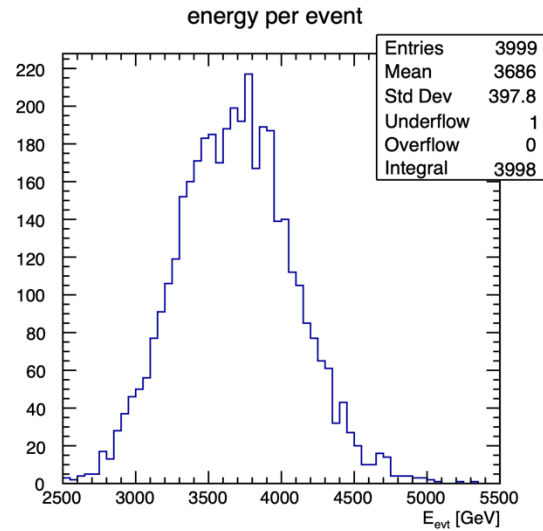
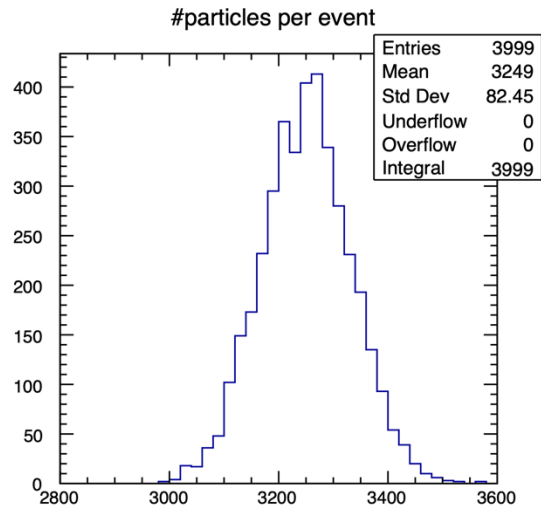


Avg.: 2.06 GeV

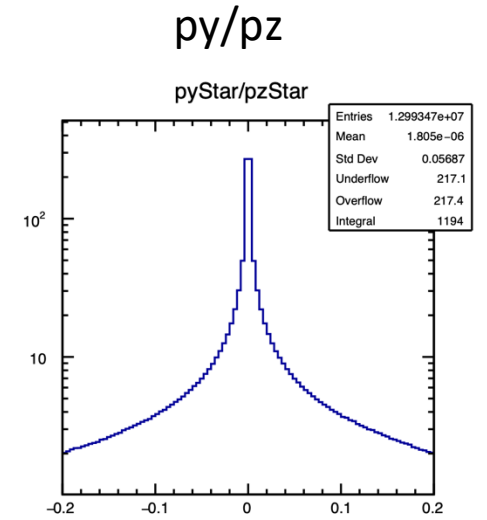
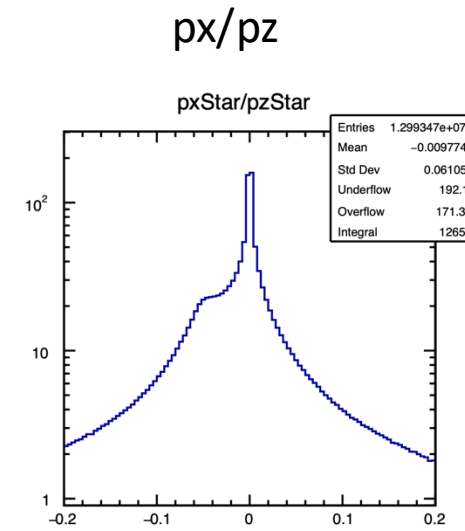
Expect: $182.5/45.6 * 0.51 \text{ GeV} = 2.04 \text{ GeV}$

IPC particles at 182.5 GeV

CMS Frame = LumiCal System

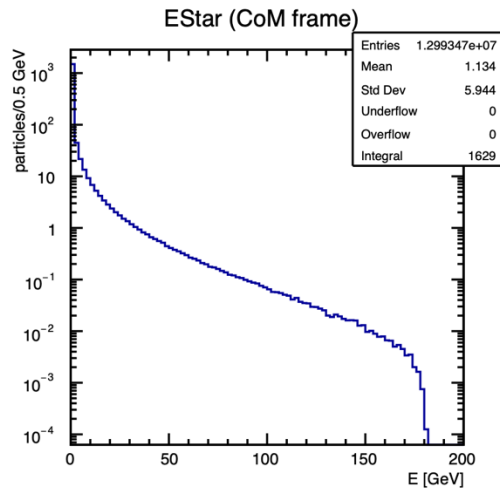


raw



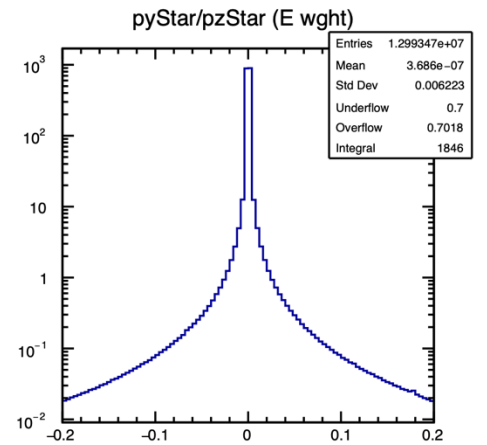
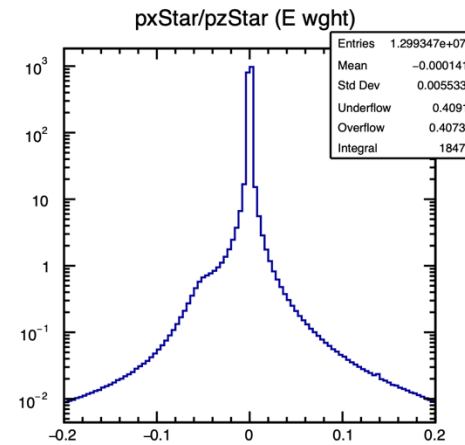
3250 particles per event

3.6 TeV per event



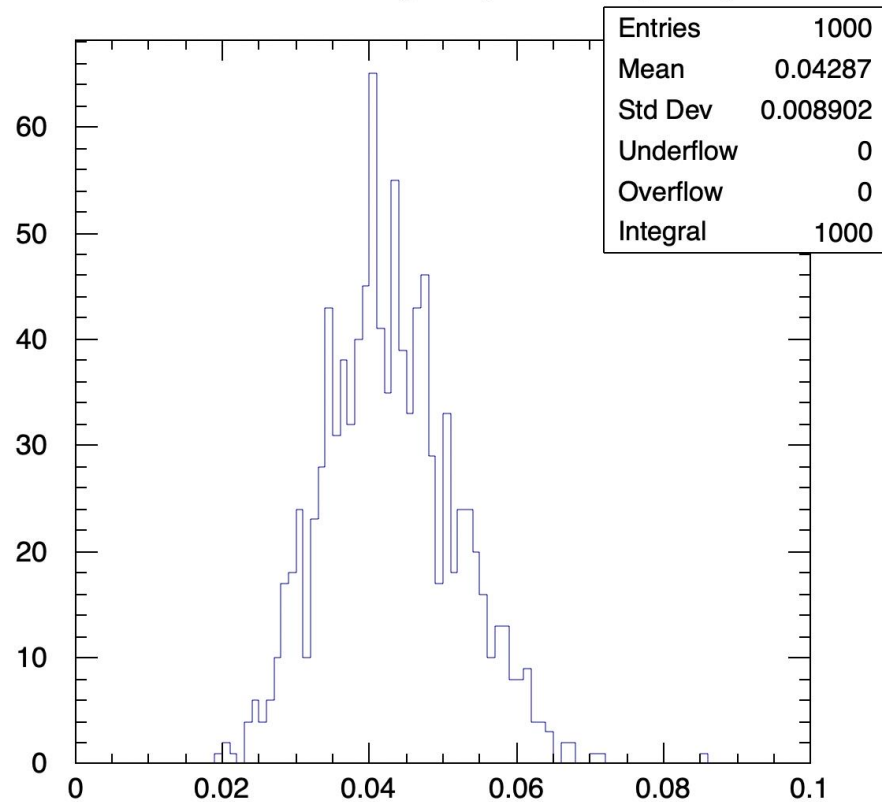
Average particle energy: 1.1 GeV

Energy weighted



Response to ICP (182.5 GeV)

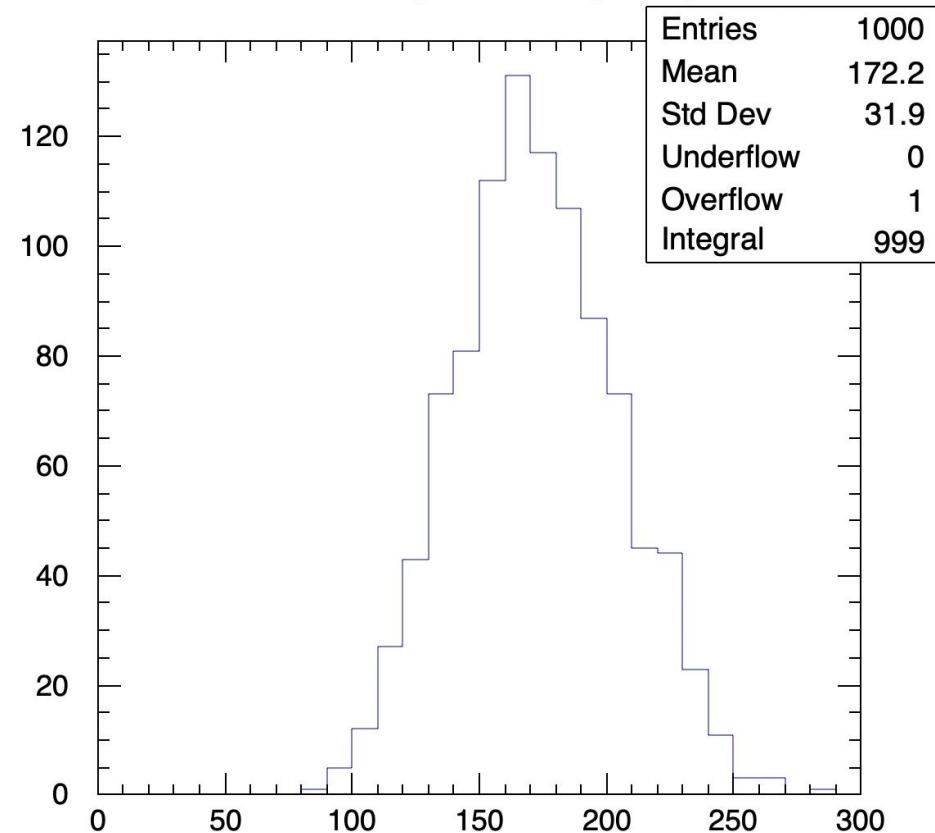
sum of cell energies (above mip cut)



Avg. = 43 MeV

2.1% of 2.06 GeV (182.5 GeV electrons)

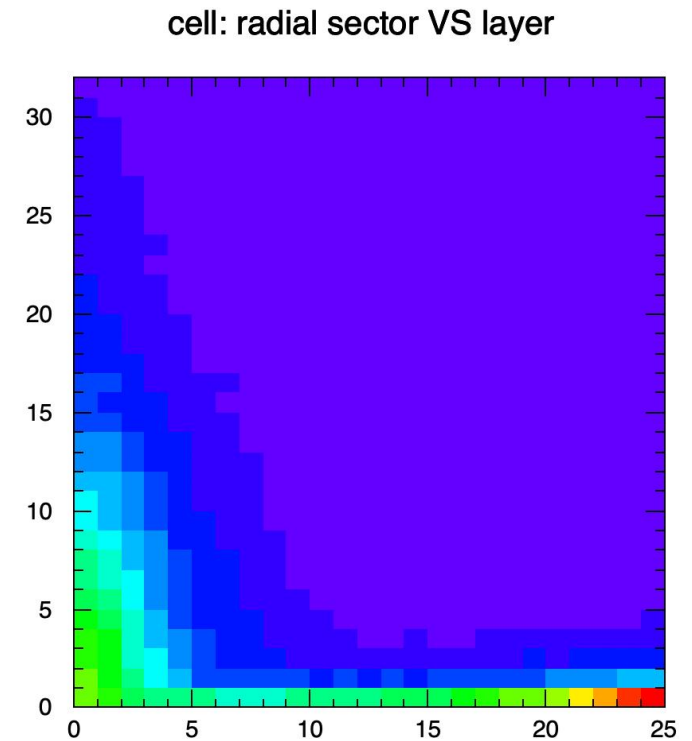
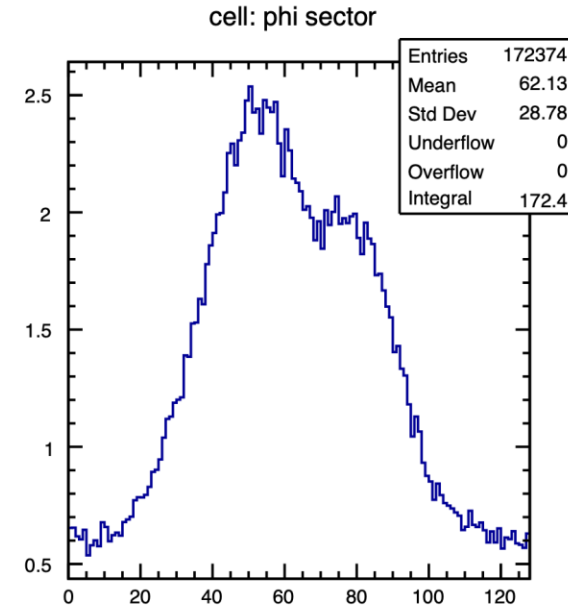
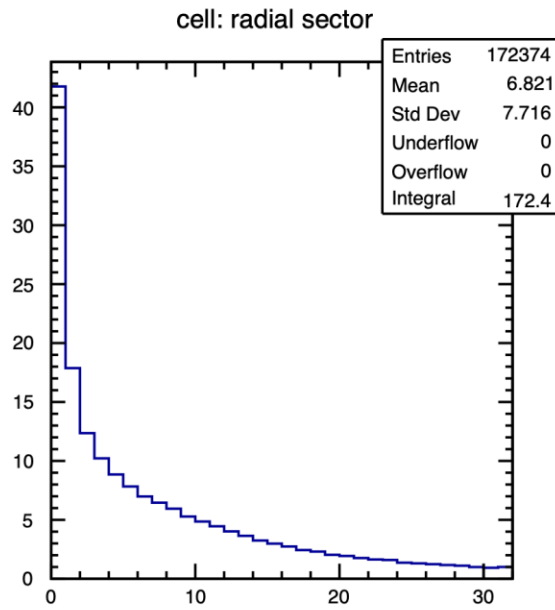
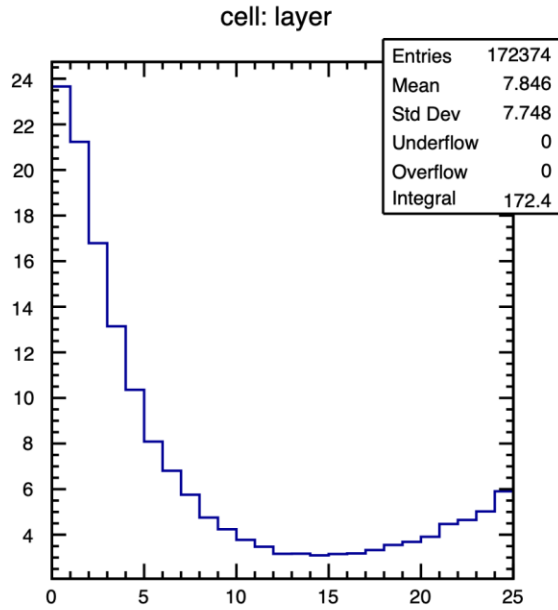
no. cells (above mip cut)



Avg. = 172 cells

10.2% of 1690 (182.5 GeV electrons)

ICP - Distribution of deposited energy (182.5 GeV)



Summary & Conclusions

- ◆ Observe non-negligible energy deposits from beamstrahlung in LumiCals
 - Few %-level relativ to Bhabha electrons
 - Mainly concentrated at face and inner radius
- ◆ Have to decide whether this is a problem
 - Radiation hardness of sensors
 - For precision luminosity measurement
 - ...