Pair Spectrometer Tracker Hit Densities

- To help decide which silicon sensor technology to use, we need to know how many electrons / pixel / sec are expected at the tracking planes.
- In particular, the sensor signal integration time is important to consider. Bunch crossings occur every 10 nsec at peak luminosities.

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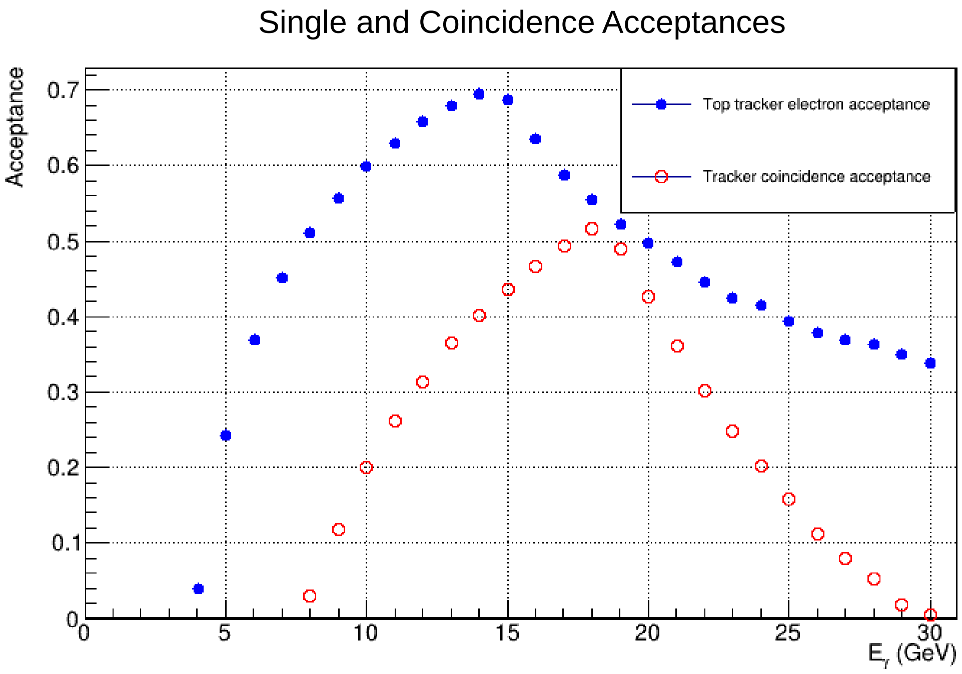
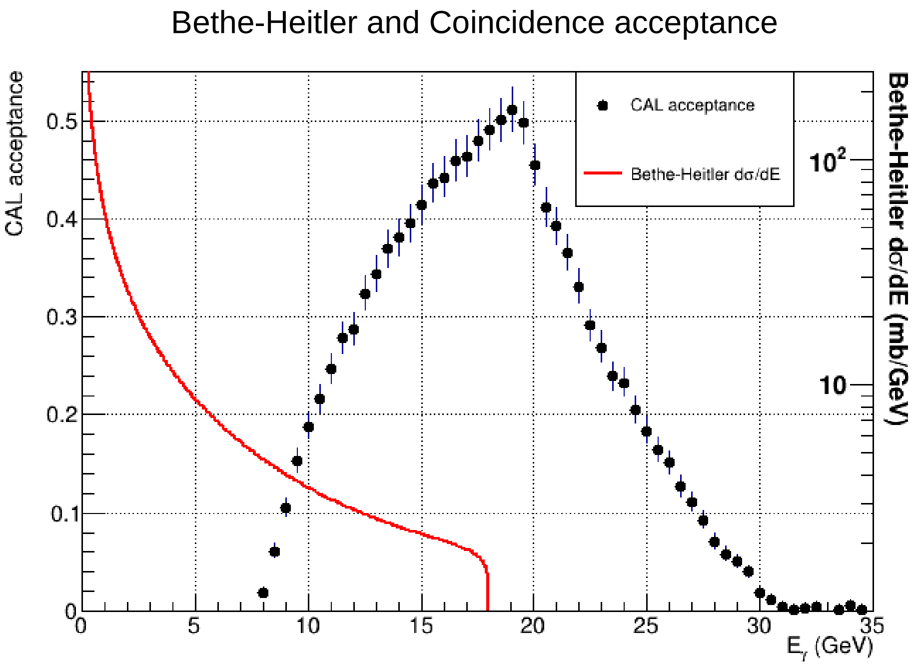
Tracker Acceptances





Math to calculate hit densities from the simulation

$$\sigma_{eff} = \int BH(E) \times A(E)dE$$

ep 275 GeV x 18 GeV

= 25.5 mb (singles in top tracker)

= 7.6 mb (coincidence)

Use "singles" to assess sensor occupancy.
I generate 10,000 events with 1 photon each. 5,212 detected singles ($N_{singles}$)
The photon energy is sampled according to the Bethe-Heitler spectrum.
For convenience, Emin = 5 GeV.
The number of observed electrons in the top tracker is used to find the effective "time window" of the simulation, T_{eff}.

Conversion probability = 0.01

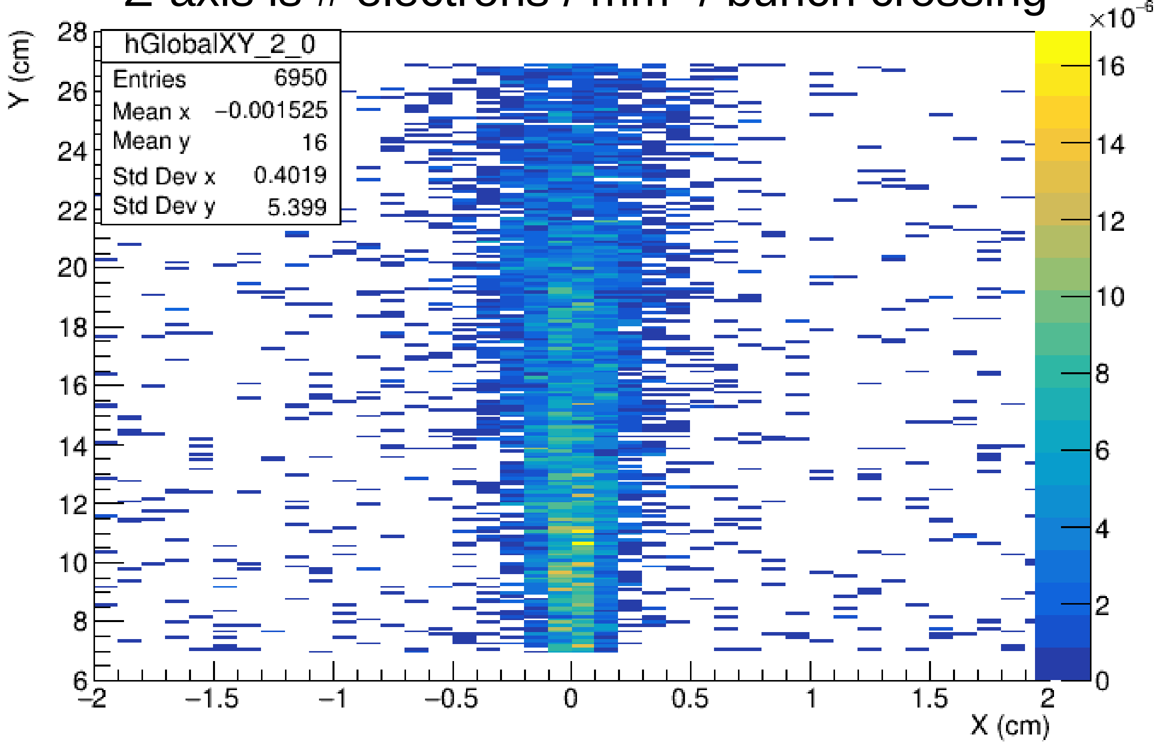
$$N_{singles} = f \times \mathcal{L} \times \sigma_{eff} \times T_{eff}$$

$$T_{eff} = 13 \times 10^{-3} sec$$

This is to be used to normalize the spatial hit density in my particular simulation.

Electron hit density in top tracking planes

Z-axis is # electrons / mm^2 / bunch crossing



- For ep 275x18, we have at most ~16e-6 electrons / mm^2 / bunch Xing

- Highest rate is for eA 110x10, which is ~x20 higher = 3e-4 electrons / mm^2 / bunch Xing

- Pixels sizes are generally smaller than 1mm^2
- Beam effects will further dilute the hit density

Critical time = 1 / Z-axis, is the integration time that gives 1 electron per pixel (pileup begins).

	ACLGAD pixel size: 500 µm	Tower Jazz HV-MAPS: pixel size: 36 µm
Critical time	1.3e4 bunch Xings = 133 µsec	2.6e6 bunch Xings = 26 millisec

Extremely low occupancy.

Would MAPS sensors be sufficient?
Pros: very low material budget.