Analysis Progress for d_2^n

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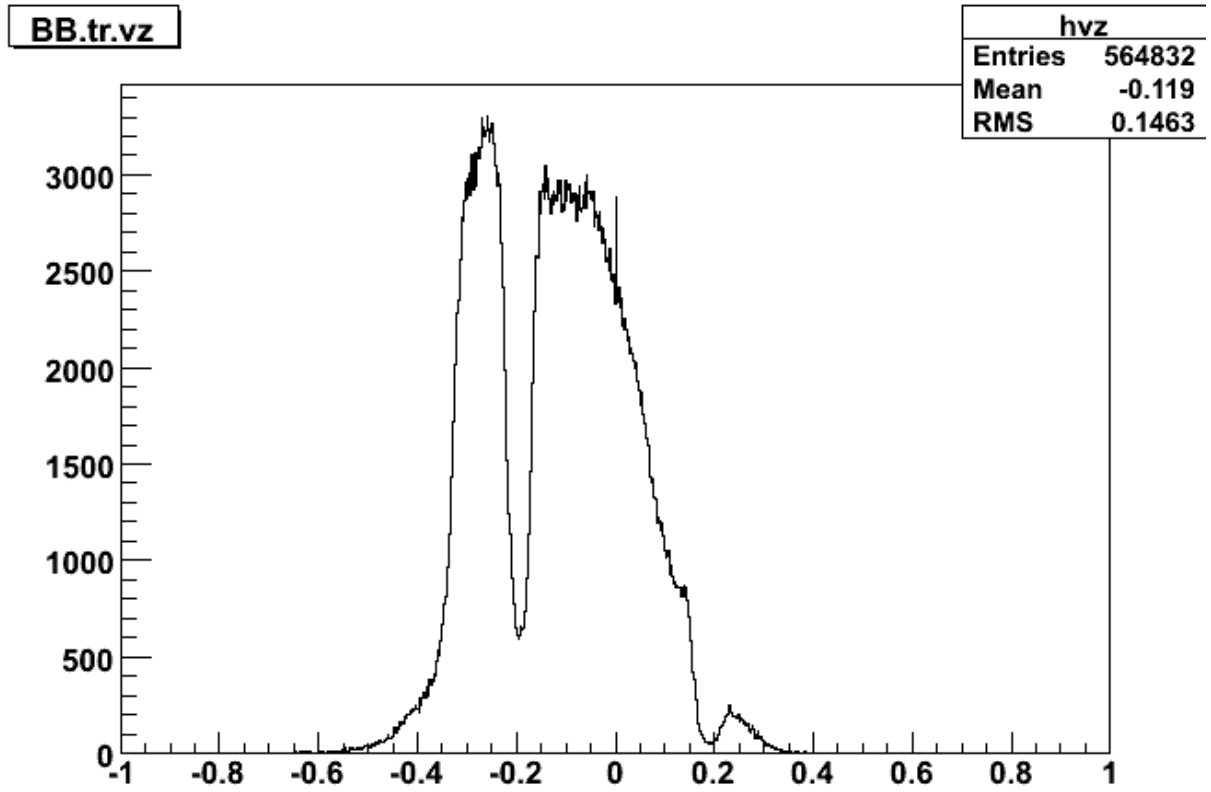
In this issue:

- Cuts on vertex position
- Energy loss

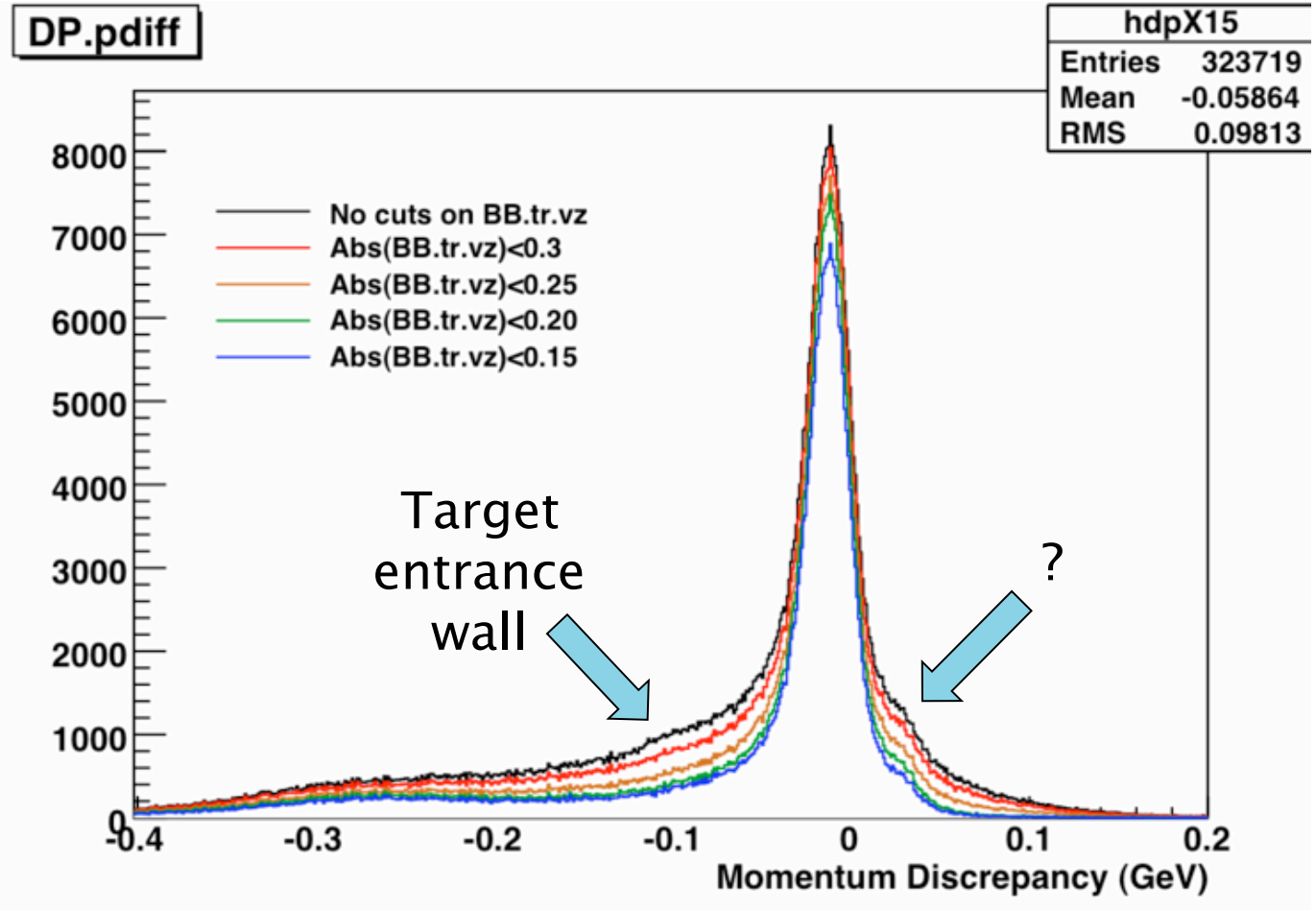
Cuts on Vertex Position (1)

- Last week, we discussed whether structures in the shape of dp/p were due to scattering in target glass
- The vertex *z* position (BB.tr.vz) can answer this question
- I looked at a ^{2}H target elastic run (1258)

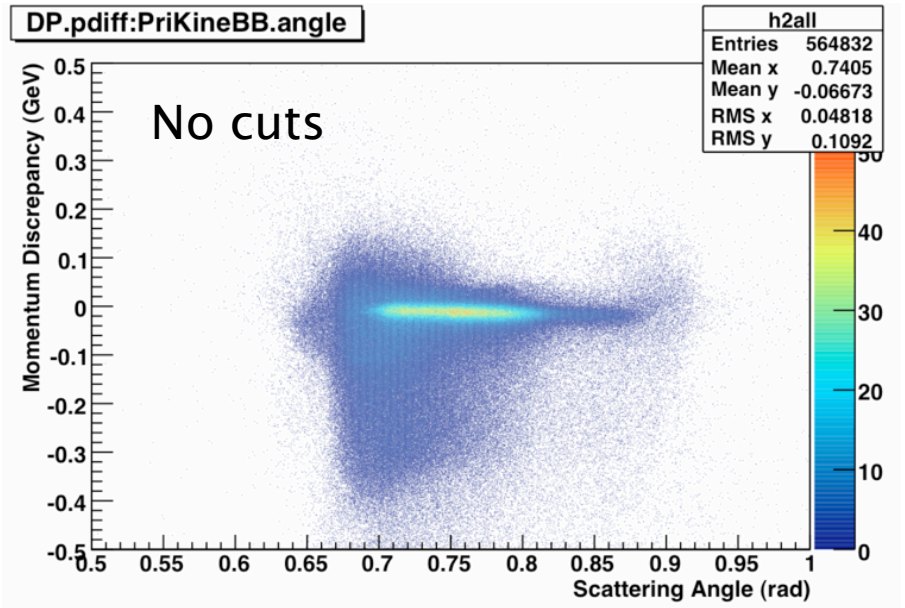


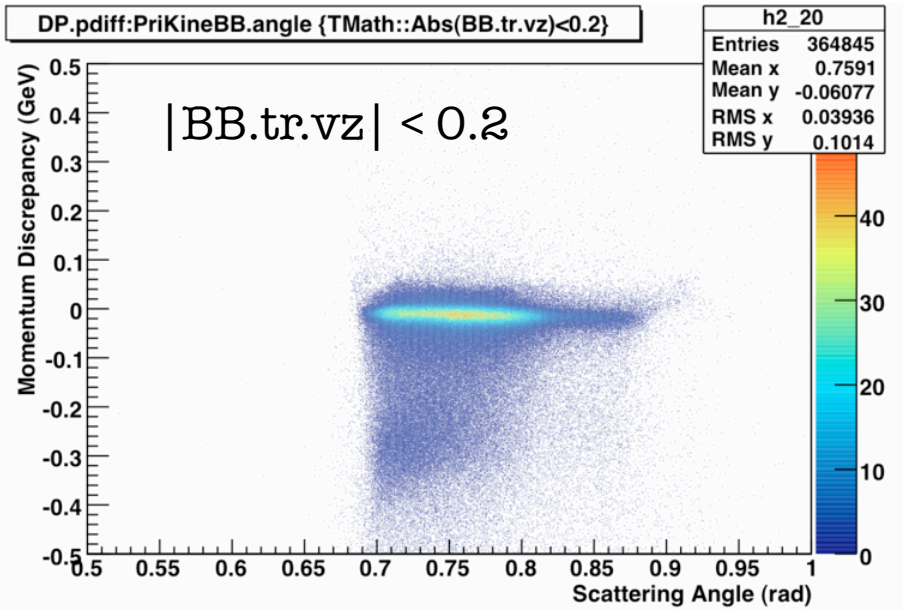
Cuts on Vertex Position (2)

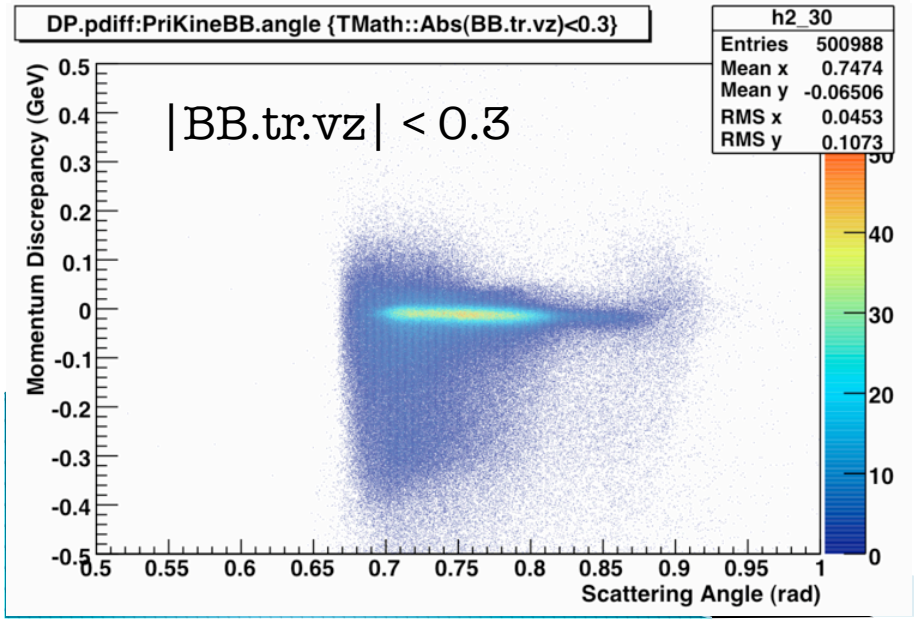
- Cuts on BB.tr.vz remove one shoulder from pdiff = dp = $p_{tr} - p_{elastic}$, but not the other

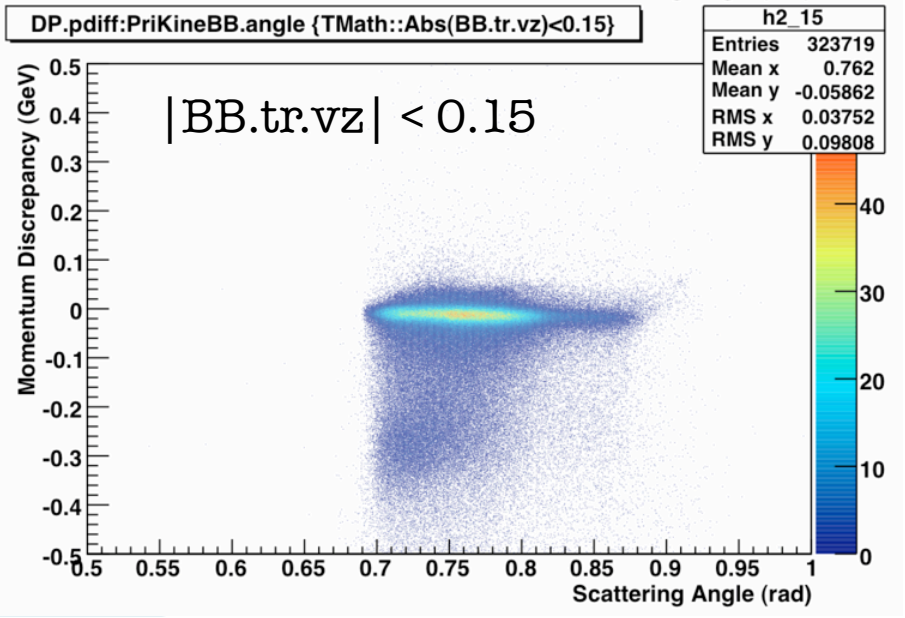


Cuts on Vertex Position (3)







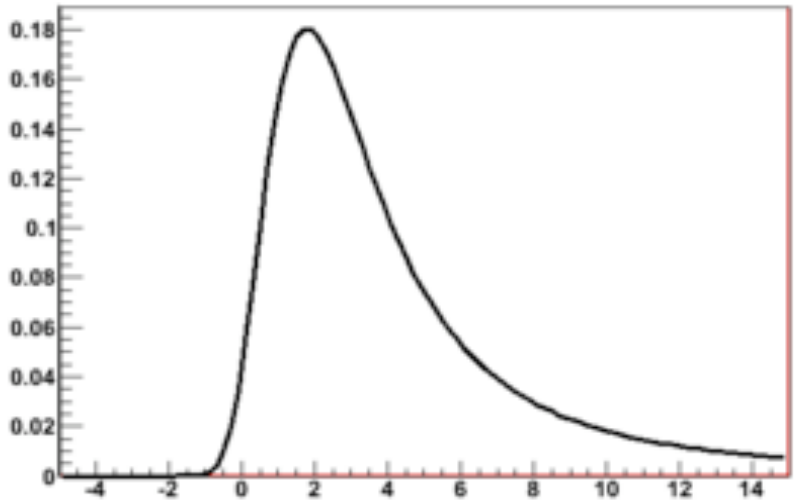


Energy Loss: Landau Curve

- Energy loss is usually modeled as a Landau distribution

$$\left\langle E_{final} \right\rangle = E_0 e^{-L/X_0}$$

- However, the most likely energy loss $<E_{final}>-E_0$ is less than the mean energy loss
- The final energy loss value must account for this distinction



sample Landau curve from Wikipedia

Incoming Energy Loss (1)

- We can divide energy loss into two regimes:
  - Before scattering (electrons incoming to target)
  - After scattering (electrons outgoing from target)
- From Chiranjib's dissertation, materials in the path of the incoming electron are:

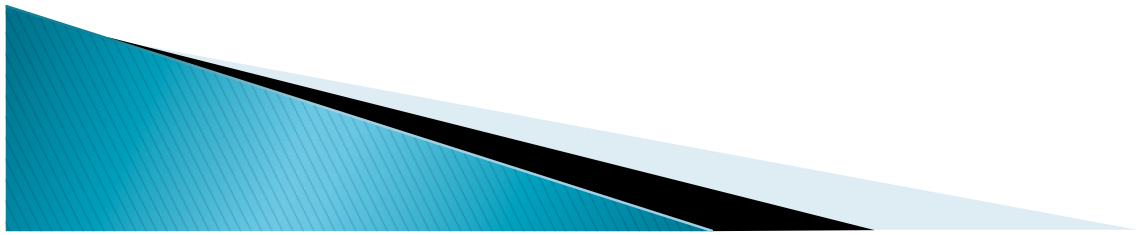
Material	X_0 (cm)	ρ (cm)	Thickness (cm)	Thickness (X_0)
Be (beam pipe window)	35.28	1.848	0.0254	0.000719
^{4}He (in target enclosure)	528107.5	0.00166	22.86	0.0000433
Glass (target cell window)	7.038	2.76	0.01	0.00142
^{3}He (half of target cell)	43423	0.00125	19.9	0.000456

Incoming Energy Loss (2)

- To handle energy loss on incoming particles, Transversity used a special class THaBeamElossE06010
- From replay_prod4.C:

```
THaBeamElossE06010 *beam_eloss = new THaBeamElossE06010
    ("b_eloss","beam energy loss module for E06010","rb");
gHaPhysics->Add(beam_eloss);
```

- We don't have this class in our build (although we do have a THaBeamEloss)
- Discrepancies in our handling of energy loss could affect our observed momentum shift



Outgoing Energy Loss (1)

- For glass and ^{3}He traversed by outgoing particles, the number of radiation lengths traveled depends on the scattering angle

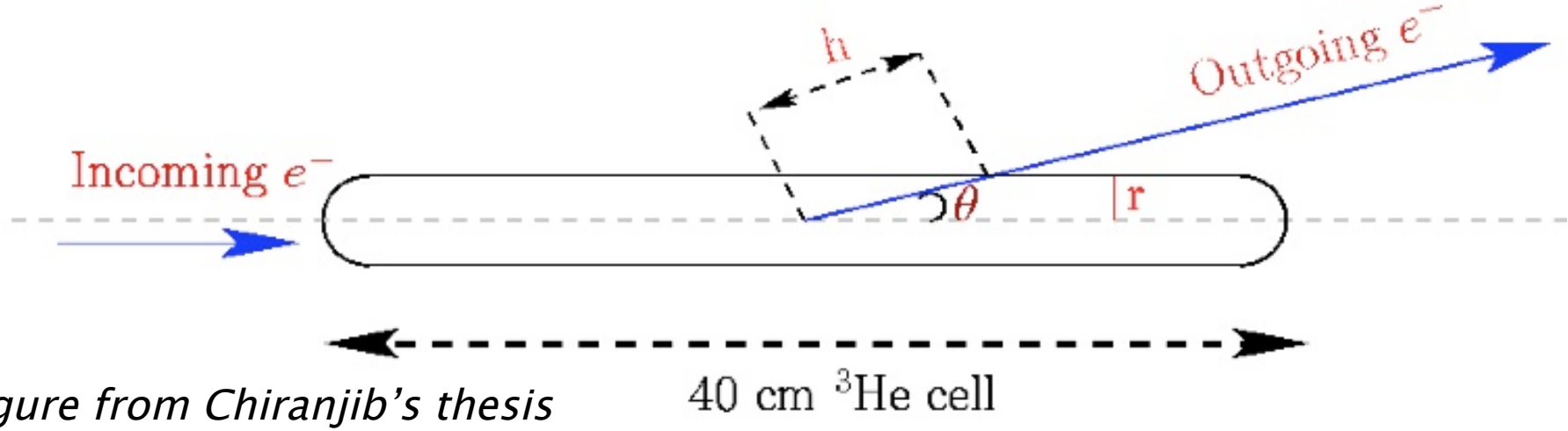


figure from Chiranjib's thesis

$$h = \frac{r}{\sin\theta}$$

Outgoing Energy Loss (2): LHRS

- For the LHRS, the scattering angle is fairly well-defined as $\theta \sim 45^\circ$

Material	X_0 (cm)	ρ (cm)	Thickness (cm)	Thickness (X_0)
^{3}He (in cell)	43423	0.00125	1.3435	0.0000309
Glass (cell wall)	7.038	2.76	0.1556	0.0221034
^{4}He (in target enclosure)	528107.5	0.00166	79.05	0.0001496
G10 epoxy (yellow cover)			0.0254	
Air	30423	0.00121	51.23	0.0016839
Kapton (LHRS entry window)	28.6	1.42	0.0254	0.0008881

Outgoing Energy Loss (3): BigBite

- The optics package works backwards from the detected momentum to the electron momentum immediately post-scattering
- This must be done on a track-by-track basis due to dependence on
  - Scattering angle
  - Path length
  - Vertex location (not supported in optics package)
- Materials information is hard-coded into compiled `THaBeamElossE06010` class

What's Next?

- Optics
  - I've made a lot of progress understanding the BigBite optics algorithm
    - I'll have a report ready by next time
  - I am close to getting the coordinate transformation worked out (for calculation of scattering angle)
- Energy loss
  - Possible discrepancy in E_{loss} for incoming particles
- Elastics
  - Further work on cuts, understanding p_{diff} structure
- Compton