

Graph Construction Optimizing Cuts

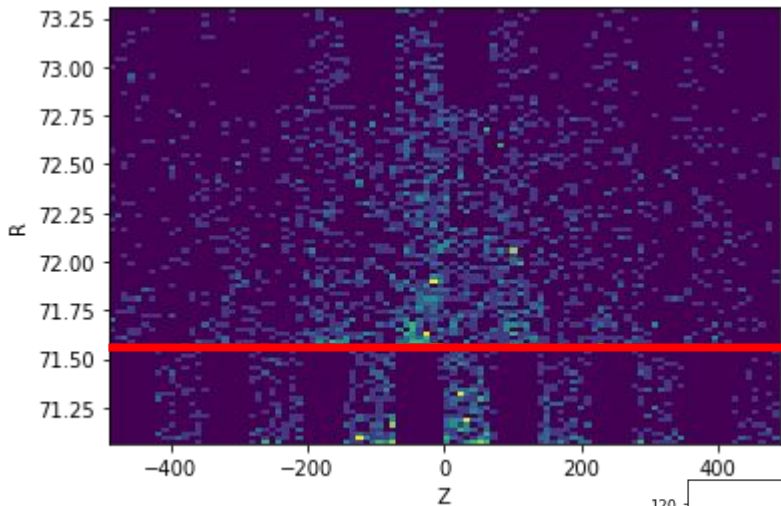
Markus Atkinson

4 cuts are currently used

- Cut used for selecting Nodes
 - Truth level pT cut, used to scale graph node complexity
 - Not much to optimize here, goal is to remove it
- Cuts used for selecting Edges
 - All cuts are geometric
 - deltaR cut
 - Phi_slope cut
 - z0 cut
 - These can all be optimized

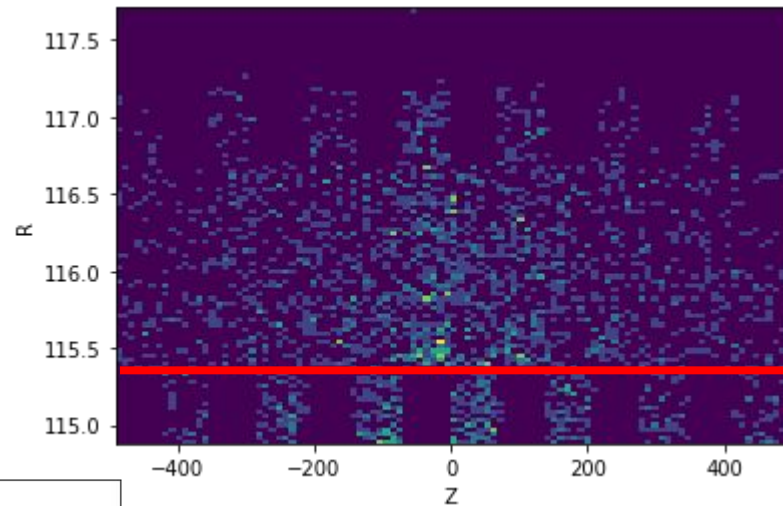
Replace dR cut with Line Segment Intersection cut

Second Barrel Layer

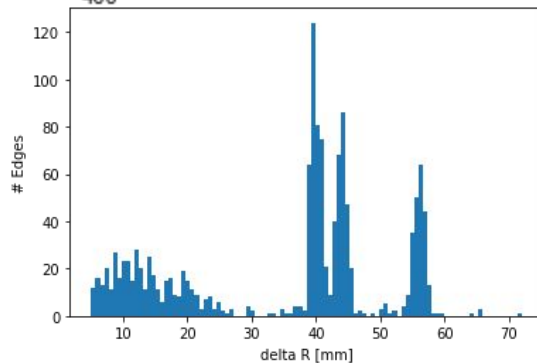


- $R = 71.56298065185547$
 - $Z [-490.975, 490.975]$

Third Barrel Layer

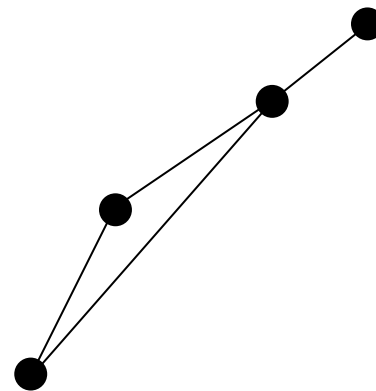


- $R = 115.37811279296875$
 - $Z [-490.975, 490.975]$

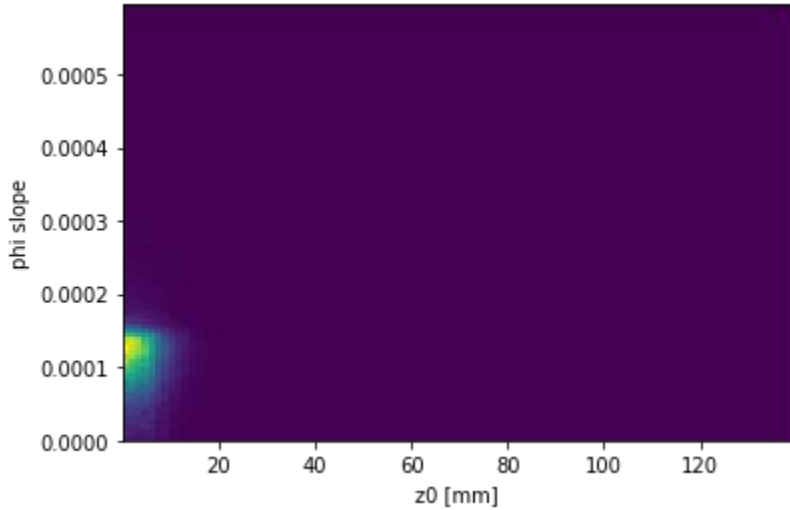


Updated Tracking Efficiency

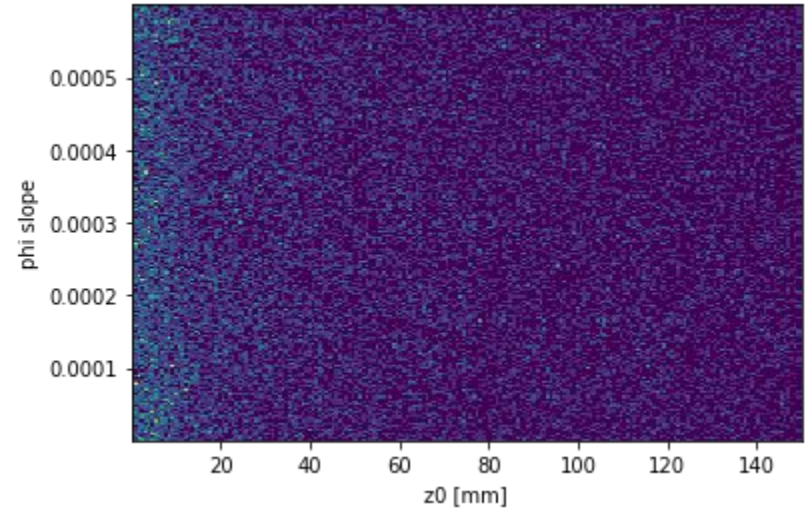
High p_T 2.0 GeV	Previous Best dR < 65 mm Phi_slope < .0006 z0 < 150 mm	Intersecting Line Cut
Track Efficiency	.6651	.9696
Fake Fraction	.2350	.0188



Plots of phi_slope and z0 distributions



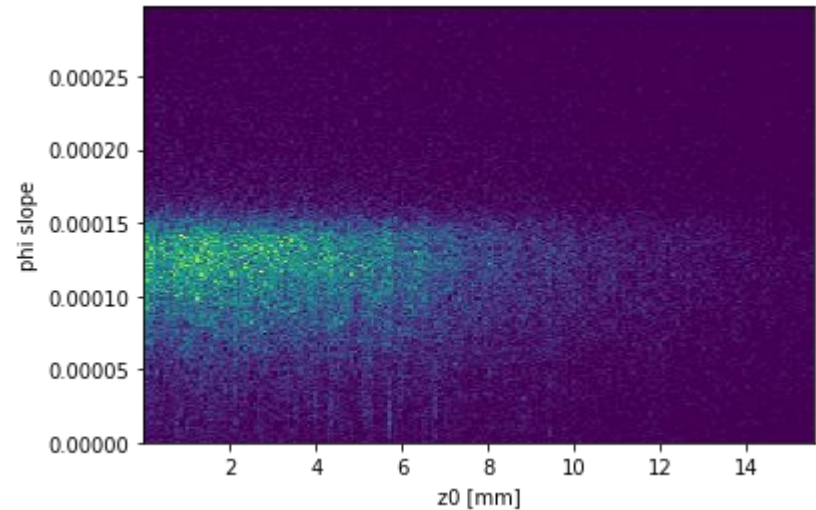
True Edges



False Edges

Extract cut values

- Wrote some code that would extract cut values, with desired truth efficiency
 - 99% efficient values
 - Phi slope = .000262
 - $z_0 = 15.693$
 - 98% efficient values
 - Phi slope = .000212
 - $z_0 = 13.696$
 - 97% efficient values
 - Phi slope = .000189
 - $z_0 = 12.652$



Updated Tracking Efficiency

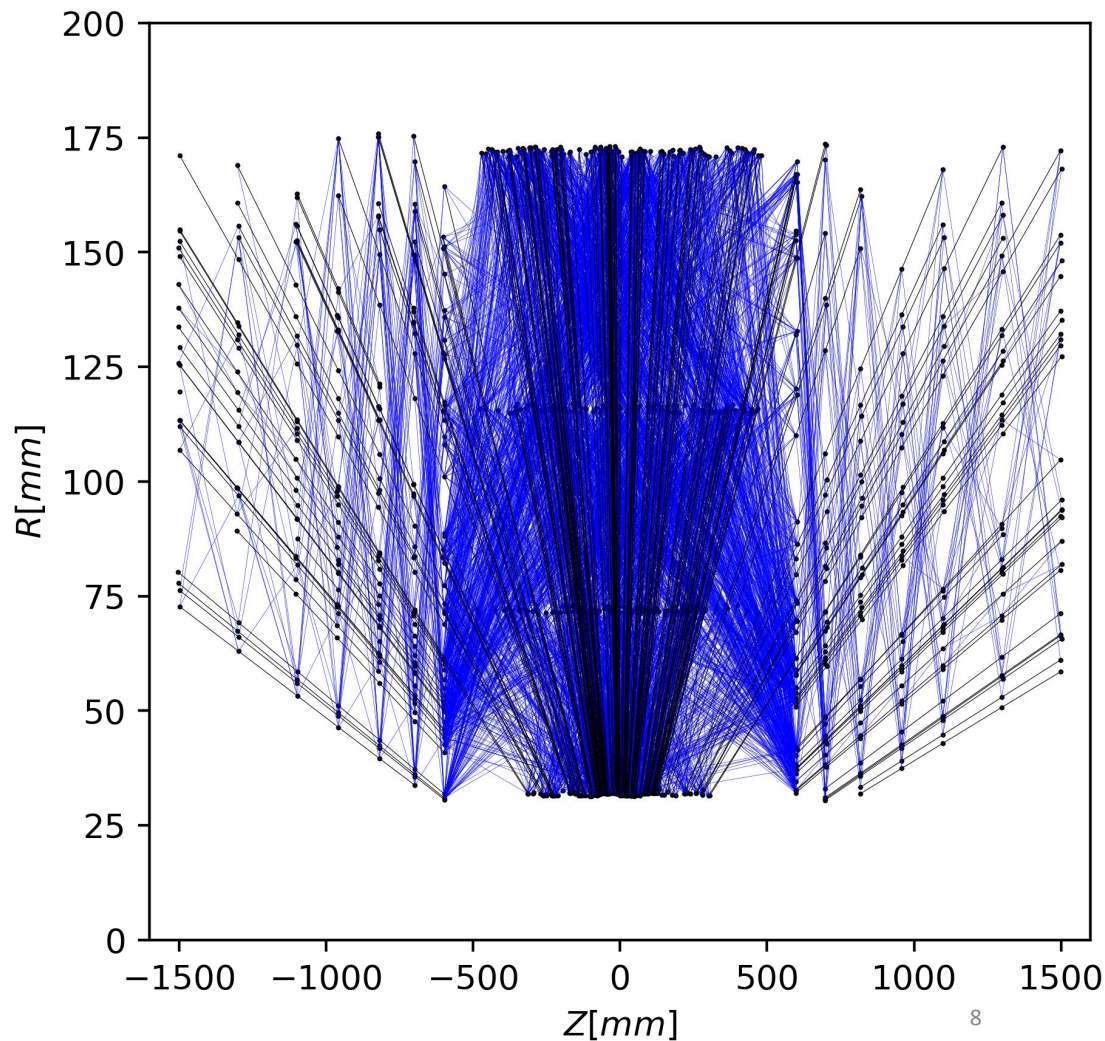
High p_T 2.0 GeV	Previous Best dR < 65 mm Phi_slope < .0006 z0 < 150 mm	Intersecting Line Cut	Including Phi_slope < .000262	Including Phi_slope < .000262 z0 < 15.693 mm
Track Efficiency	.6651	.9696	.9848	.9527
Fake Fraction	.2350	.0188	.0098	.0331

Attempting to lower the z0 cut
made the results worse



Removing z0 cut

- Noticed that lower z0 cut was, worse the results were
- So I followed this trend and increased z0 cut and things improved
- So I took it to the extreme and dropped the cut entirely



Updated Tracking Efficiency

High p_T 2.0 GeV	Previous Best dR < 65 mm Phi_slope < .0006 z0 < 150 mm	Intersecting Line Cut	Including Phi_slope < .000262	Removing z0 cut	Adding Phi-Reflections
Track Efficiency	.6651	.9696	.9848	.9867	.9959
Fake Fraction	.2350	.0188	.0098	.0087	.0027



New Best

Intersecting Line Cut
Phi_slope < .000262
No cut on z0 (z0 < 15000 mm)
Phi-Reflected graphs

Conclusion

- The Intersecting line cut is an absolute monster
 - 30% improvement all by itself, wow
- Tightening up the ϕ _slope helps
 - leads to small drop in true edge efficiency (value chosen is 99% efficient)
- Removing z_0 cut floods the graph with tons of non physical edges
 - These bad edges seem to help the network learn more about what makes an edge bad
 - Goal is to keep a balance between good and bad edges in the graph
- Phi-Reflections added last cause it doubles training time and already known to be magical (previous talk)

- How does this transfer to other p_T cuts? (next week)