Properties of DØ Run II Cone Algorithm

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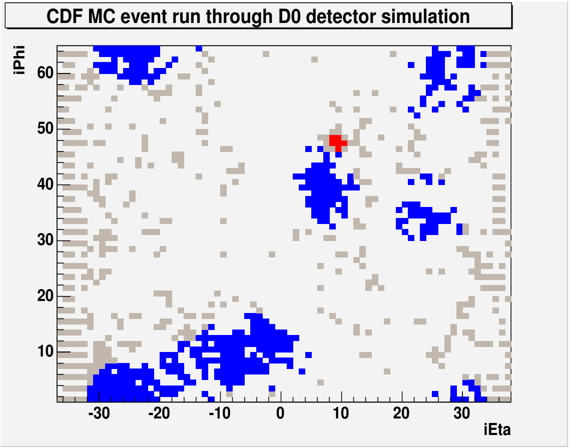
Motivation

- To address CDF observation of unclustered E_T



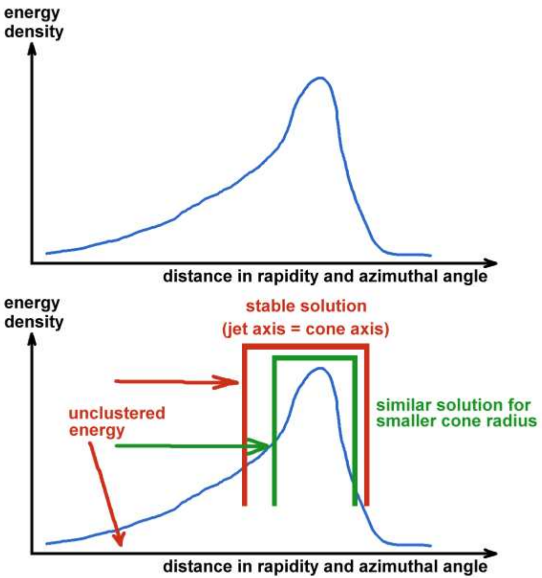
- RunII cone $R = 0.7$
- **Jet** towers
- **Unclustered** towers $pT < 2GeV$
- **Unclustered** towers $pT > 2GeV$

We see it too!

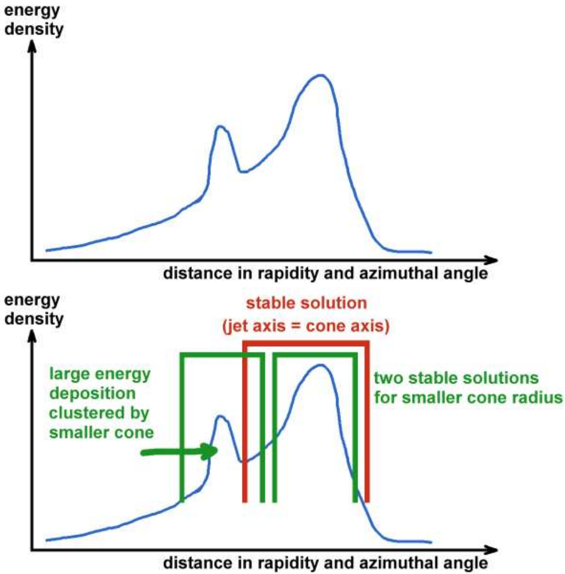
Brief DØ Cone Algorithm Description

- Follows RunII Jet Physics Workshop HEP-EX/0005012
- Iterative procedure to find proto-jets
- Midpoints added between each pair of proto-jets
- Overlap treatment
- Cone radius 0.7 for QCD jet analyses, 0.5 for top, Higgs and others
- Minimal jet pT: 6 GeV (DØ public results have 8 GeV)
- Overlap fraction $f = 0.5$

How the algorithms works 1



Both algorithms find the same solution



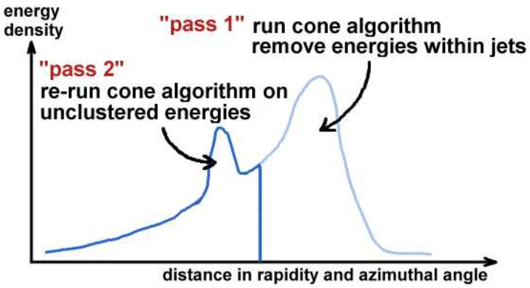
Larger cone does not find a second jet

DØ quantitative analysis on MC

- introduce 'Second Pass Jets'
  - use the same jet algorithm, but
  - the same algorithm runs only on the remaining unclustered towers after the first run of the algorithm
- study their characteristics as a
  - function of distance to the closest first pass (aka normal) jet
  - function of their pT ratio to the closest first pass jet
  - function of cone radius
  - function of rapidity
- study done on DØ MC

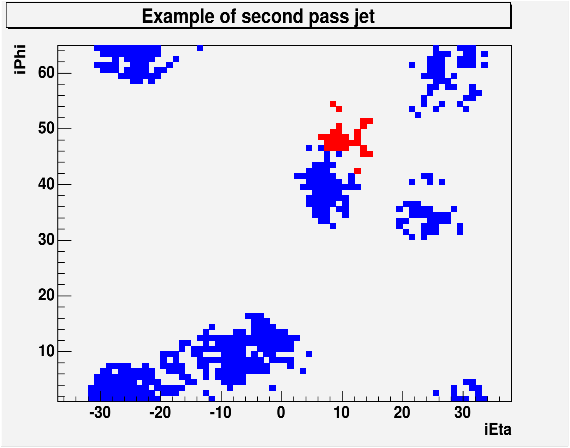
'Second Pass' Jets comments:

- Where are they defined



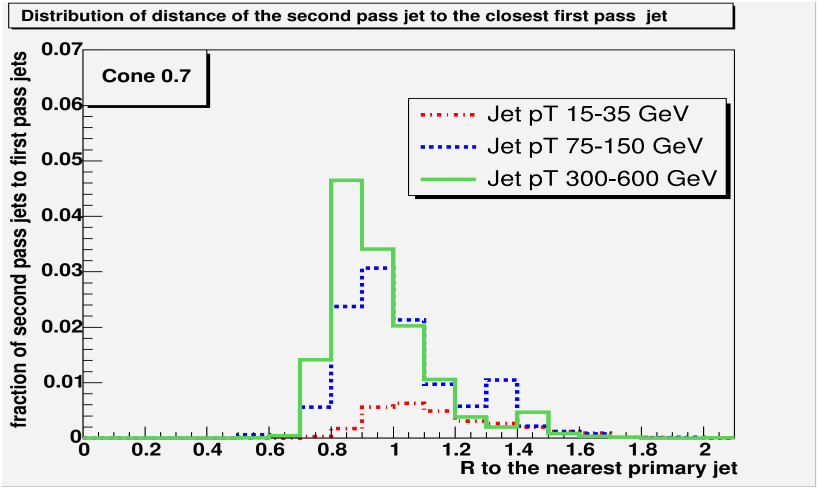
$\Longrightarrow$ they are not completely perfect jets . . .

'Second Pass' Jets



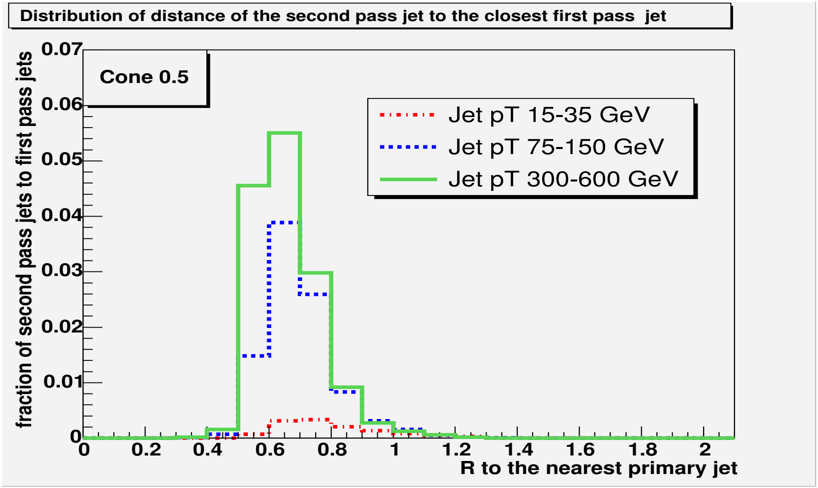
The unclustered energy made a second pass jet!

Distance between Second Pass and First Pass Jets



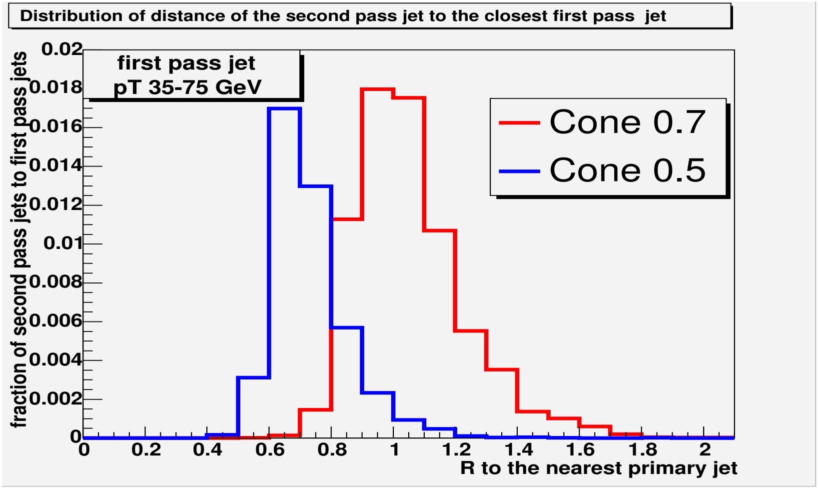
High pT jets are more likely to have a second pass jet nearby (low pT cut for second pass jets: $pT > 6\text{GeV}$)

Distance between Second Pass and First Pass Jets



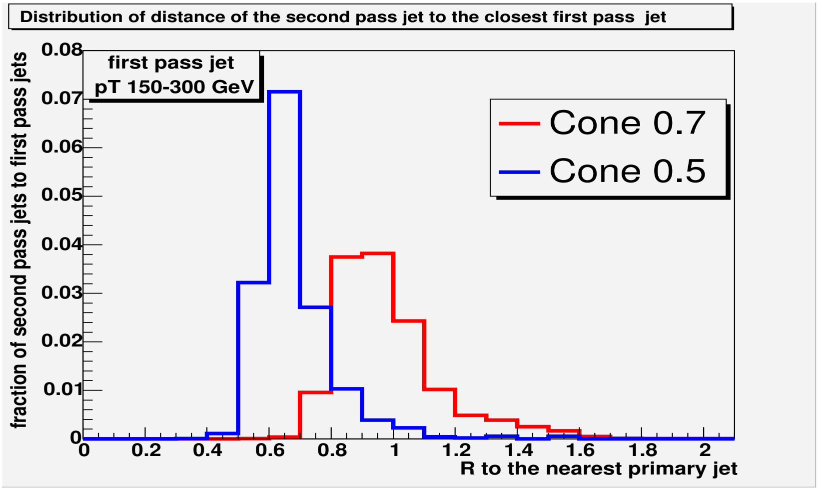
Similar observation is found for cone 0.5,
but peak is shifted because of cone radius

As a function of cone radius . . .



Total fraction of second pass jets (= integrated over R) is higher for $R = 0.7$ Cones at lower pT. And the distributions are different.

As a function of cone radius (cont'd)



At higher pT the total fractions are practically equal, but the distributions are different.

Brief summary

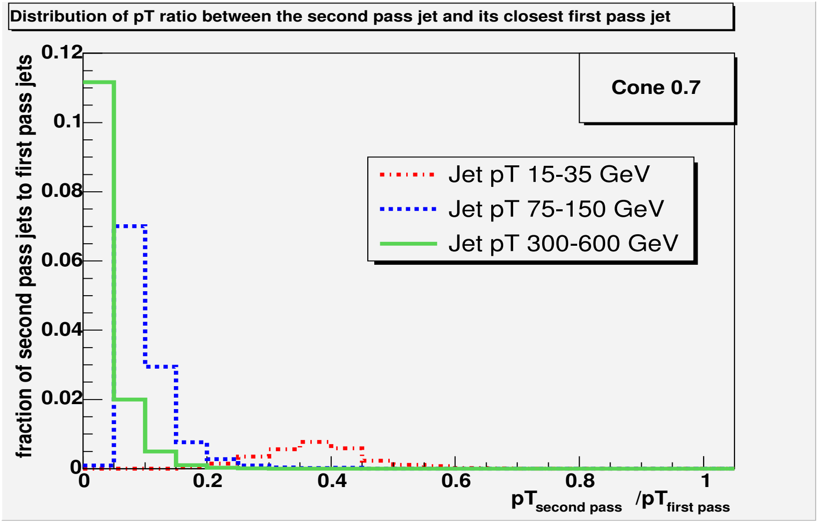
Done:

- Second Pass Jets were observed
- their distance from first pass jets was investigated

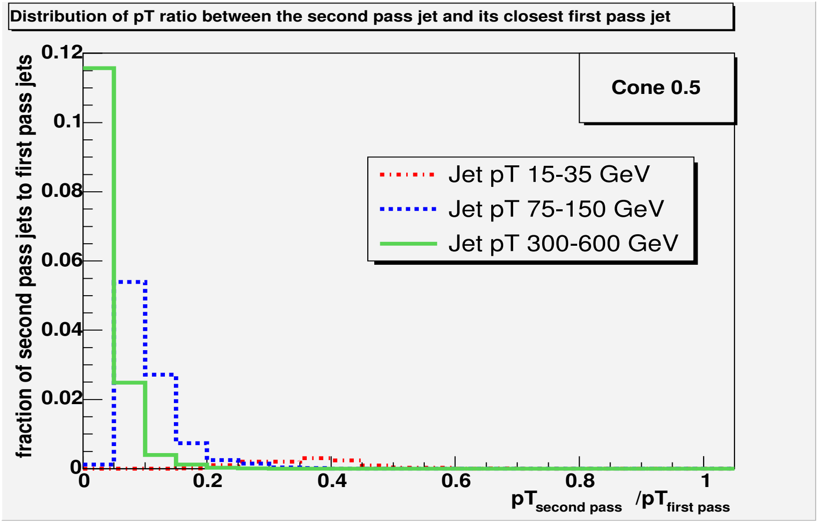
Next: How does it influence are physics meassurements?

- Study the fraction of pT carried by Second Pass Jets
  - Distribution of $pT_{2^{nd}\text{Pass}}/pT_{1^{st}\text{Pass}}$
  - Distribution of $R_{2^{nd}\text{Pass}-1^{st}\text{Pass}}$ in different $pT_{2^{nd}\text{Pass}}/pT_{1^{st}\text{Pass}}$ bins
- Look at the pT spectra of these jets

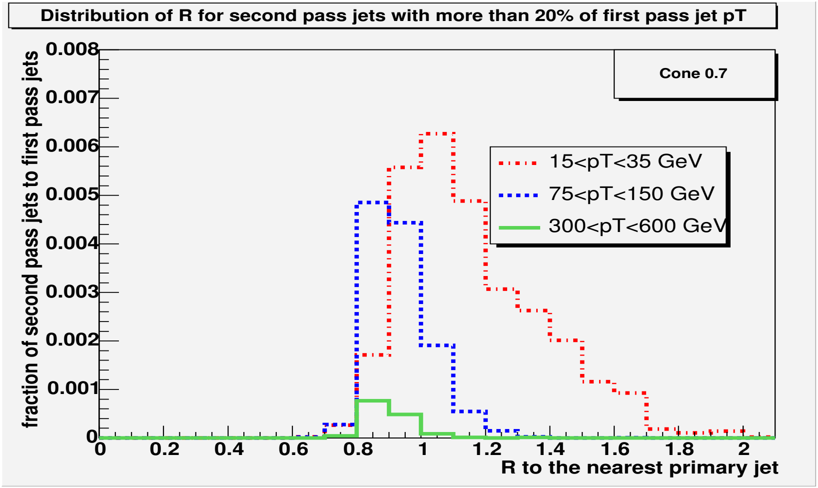
$pT_{\text{2ndPass}}/pT_{\text{1stPass}}$ ratio distribution



$pT_{\text{2nd Pass}}/pT_{\text{1st Pass}}$ ratio distribution



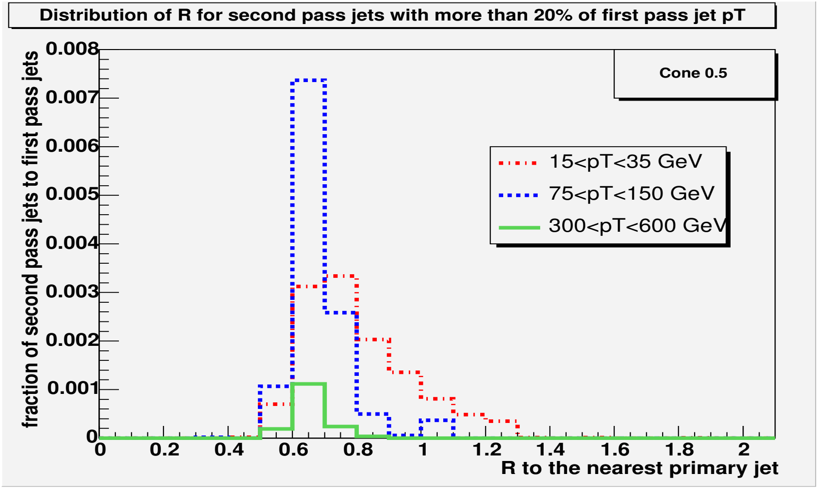
Second Pass Jets carrying more than 20% of First Pass Jet pT



At low pT, the fraction is a few %

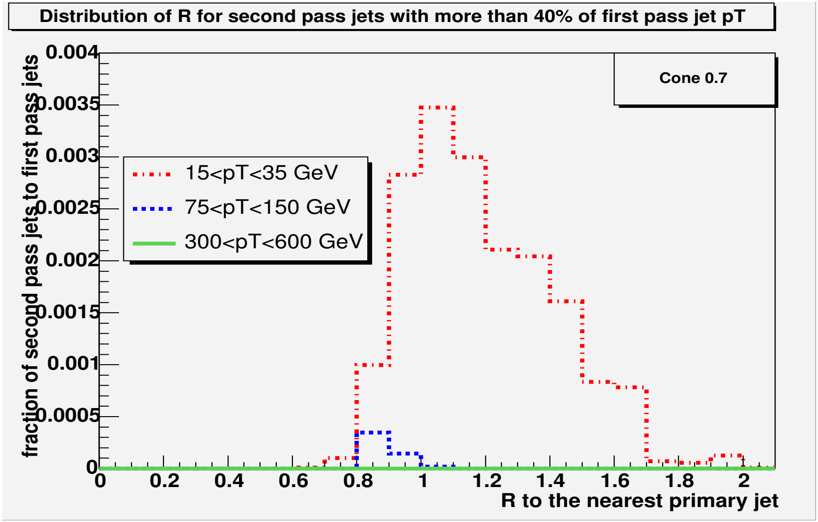
At $pT = 75 - 150$GeV, the fraction is $\sim 1.5\%$

Second Pass Jets carrying more than 20% of First Pass Jet pT



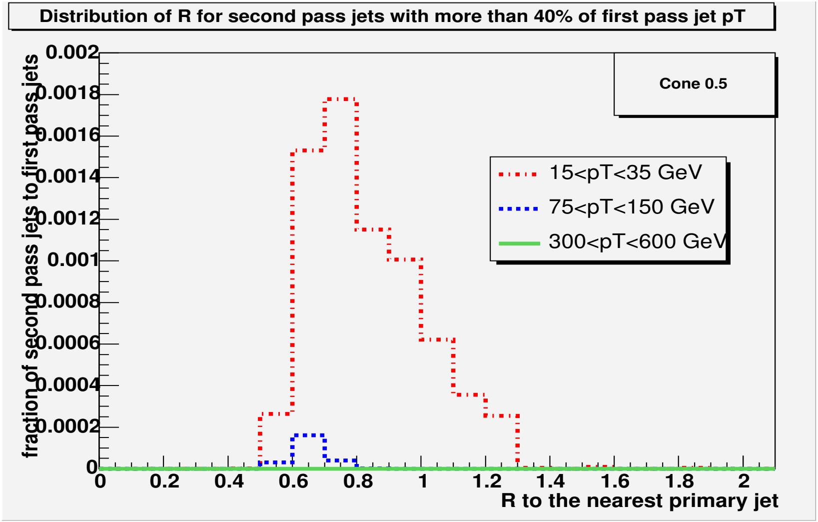
At $pT = 300 - 600\text{GeV}$, the fraction is $< 0.2\%$

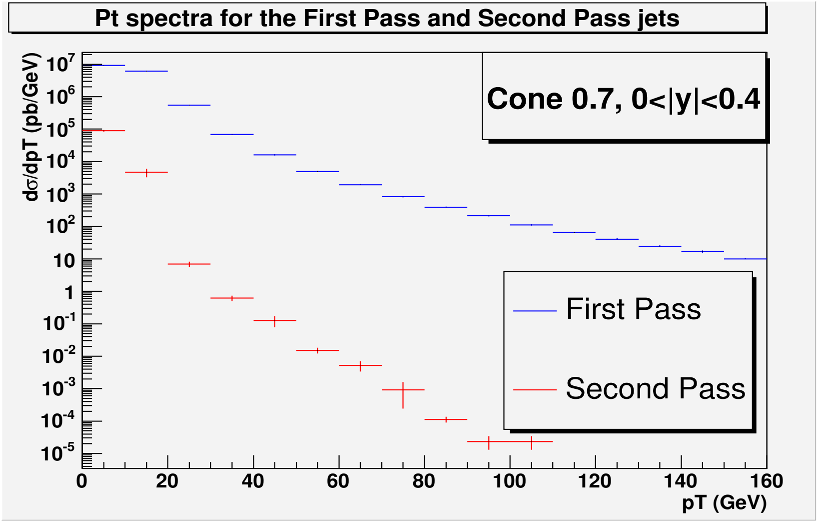
Second Pass Jets carrying more than 40% of First Pass Jet pT



Relative contribution of Second Pass Jets with more than 40% of pT is very small (except lowest pT).

Second Pass Jets carrying more than 40% of First Pass Jet pT





Contribution to the cross-section is negligible

Summary

- DØ defines Second Pass Jet to quantitatively study the unclustered energy
  - negligible effect on QCD cross-sections
- To be studied:
  - effects on multi-jet production
  - effects on top, W/Z, ... physics
- So far, we don't see a motivation for a major change of the jet algorithm ('search cone'), which introduces a chain of questions:
  - more overlapping jets $\Longrightarrow$ can lead to fat jets
  - increase overlap fraction $\Longrightarrow$ allows largely overlapping jets to be resolved $\Longrightarrow$ distance between jets can be very small $\Longrightarrow$ small pT jet can eat significant pT from high pT jet

Conclusion

- More studies and comparisons between algorithms are needed

- We would like to see corresponding results from CDF using the Search Cone Algorithm
  - Search Cone should remove large part of these Second Pass Jets

- Can CDF show a plot with distance between jets?