More thoughts on the midpoint algorithm, a continuing discussion

see also presentations at 7/23/04 and 8/6/04 QCD meetings

J. Huston
On left, the ratio of the midpoint to JetClu algorithm is shown plotted vs $E_T$; on the right JetClu is plotted vs $E_T$ and midpoint vs $p_T$. 
Matthias studies

On left, the ratio of the midpoint to JetClu algorithm is shown plotted vs $E_T$; on the right JetClu is plotted vs $E_T$ and midpoint vs $p_T$. 
Matthias studies

On left, the ratio of the midpoint to JetClu algorithm is shown plotted vs $E_T$; on the right JetClu is plotted vs $E_T$ and midpoint vs $p_T$.
At hadron level, with both JetClu and midpoint plotted versus $E_T$ (a bad thing), ratio of JetClu to midpoint increases markedly at low $E_T$.

At hadron level, with JetClu plotted vs $E_T$ and midpoint vs $p_T$ (the correct thing), difference is basically a flat 10%, mostly from kinematic definitions.

- Kinematic difference increases as $p_T/E_T$ increases (see plot) but $\Delta E_T$ (because of algorithm differences) between the two algorithms is basically constant (and thus the effect decreases as $p_T/E_T$ increases).

Difference is smaller (and has a slope) at parton level, but similar to what is observed in EKS predictions (next slide).
Ratio of midpoint/JetClu predictions
Comparing midpoint and JetClu results

…but without underlying event subtraction for midpoint
Gene’s plots correcting for UE

So midpoint seems very consistent with predictions (and more consistent with JetClu); except JetClu turns down at low $E_T$
So at low $E_T/p_T$, after subtracting underlying event, difference in data/theory comparisons is of the order of 10-15%.

Do we accept this 10-15% difference? Any more subtleties with theory comparison/corrections?
Effect of split/merge percentage

50%  

75%
...but some questions for data and theory

- The split/merge criterion is 75% in JetClu and 50% in midpoint
- This affects the cross section in the data/Monte Carlo
- NLO theory doesn’t know about 50% or 75%
  - all of the partons are < 1 fermi in size, so no sharing
- The only thing NLO theory knows about is $R_{sep}$
- Is $R_{sep}$ different for JetClu and midpoint?

Above shows the probability of splitting/merging if 2 stable cones are placed a distance $R$ apart (in units of $R_{cone}$)
Split/merge % does affect curve
Midpoint and JetClu are different
...but some questions for data and theory

- What value of $R_{\text{sep}}$ do we use with JetClu (and midpoint)?
  - 1.3
- That’s not the 50% point for JetClu curve, although close to it for midpoint curve

Above shows the probability of splitting/merging if 2 stable cones are placed a distance $R$ apart (in units of $R_{\text{cone}}$).

Split/merge % does affect curve

Midpoint and JetClu are different
Now JetClu and midpoint are closer to each other and to having a threshold of about $1.3 \times R_{\text{cone}}$

- So if 2 jets are within a $\Delta R$ of $1.3 \times R_{\text{cone}}$ of each other, then they will merge
  - in the case of midpoint, because that’s approximately where there’s a 50% chance of merging
  - in the case of JetClu, because the algorithm will produce no stable cones within a $\Delta R$ of $1.3 \times R_{\text{cone}}$
  - Is this an act of God?
JetClu and Midpoint

The jet separation plots do look different for JetClu and midpoint, so perhaps $R_{\text{sep}}$ should be 0.1-0.2 larger for midpoint (few % effect)
The jet separation plots do look different for JetClu and midpoint, so perhaps $R_{sep}$ should be 0.1-0.2 larger for midpoint (few % effect)
Another subtlety

- JetClu and midpoint split/merge algorithms differ by more than just percentage of overlap
- Midpoint does an iterative splitting/merging
- JetClu has enough after 1 go
- Makes a bit of a difference in merging fraction
Another (related) question: is the UE subtraction the same

- At hadron level, with midpoint jets plotted versus $E_T$, great sensitivity to UE
- Not so much at calorimeter level
- Not so much when plotted versus $p_T$
Midpoint/JetClu

- Ratio of midpoint/JetClu does not seem dependent on UE if
  - work at calorimeter level
  - plot JetClu vs $E_T$, midpoint vs $p_T$
Why?

- Suspect that midpoint splitting/merging algorithm (50% instead of 75% and iterative split/merge procedure) can pull in UE

- Consequences
  - soft UE at periphery of jet contributes to jet mass at particle level
  - $p_T$ variable is insensitive to this effect
  - because of softness of particles, calorimeter level is less sensitive

OK, then?
This is using Herwig UE and no multiple interactions