Few equations for subjets

IPN Lyon (France) : Maxime Gouzevitch
3.4) Few words about the jet algorithms

\[ d_{ij} = \min(k_{ti}^n, k_{tj}^n) \Delta R_{ij}^2 / R^2 \]

N = 1: \( k_T \) - “Small fish eat first”
N = 0: CA - “Closest fish eat first”
N = -1: anti-\( k_T \) “Big fish eat first”
3.5) Few words about the jet algorithms

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Cacciari, Salam, Soyez

Gouzevitch 25/04/13
3.6) Tagging : $\Delta R – z$ definition

- All taggers might be described in the plane:
  
  $$
  z = \frac{p_{T,1}}{p_T} \quad \Delta R = \sqrt{(\phi_2 - \phi_1)^2 + (\eta_2 - \eta_1)^2}
  $$

- In Y rest frame: 1 degrees of freedom $\theta^*$ and $\phi$ symmetry.

- Boost: 1 degree of freedom $r_M$.

  → For each $r_M$: $\Delta R = f(\theta)$ is uniquely defined.

![Diagram showing $\Delta R = f(z)$ for $|\eta| < 0.3$, Madgraph]
3.7) Tagging : relevant splitting

- A jets $\neq$ 2 partons.
- Define the « relevant » splitting: jet separated to 2 subjets (from partons).

- $k_T$: « small eat first »
Relevant splitting is the last merging step.
- CA: « closest eat first »
3.8) Tagging: taggers on $\Delta R - z$

$$m_{J,app4}^2 = z(1-z)p_{T,J}^2 \Delta^2$$

$$M_{\text{part.jet}}^2 = \tilde{C} \left( \frac{p_{J}}{\sqrt{S}} \right) \alpha_s \left( \frac{p_{J}}{2} \right) p^2 R_{\text{part.jet}}^2$$

- Signal: ZZ; Background: Z+jets.
- TOY-TAG tool useful to optimise the different tiggers.
- All formulas (simple) provided by P. Quiroga-Arias and S. Sapieta
1.2) Where do the substructure appears?

1) **Substructure**: $\Delta R < R_j$

2) **Transition region**: $\Delta R \sim R_j$

3) **Separated jets**: $\Delta R > R_j$
1.3) Where do the substructure appears?

1) Substructure: \( \Delta R < R_j \)

2) Transition region: \( \Delta R \sim R_j \)

3) Separated jets: \( \Delta R > R_j \)

- Naturally you know that if you want to privilege the substructure you have to take a larger radius.

- More generically there is a smooth transition between sub-jets and jets!