LCFIPlus

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- Jet Clustering algorithms in LCFIPlus

- Consideration for coming training samples for flavour tagging

Jet Clustering Algorithms

Siblings

	w/ Vertex info (LCFPlus Default)	w/o Vertex info (Original)	Beam Jet Distance
Durham	DurhamVertex	Durham	on/off
kt	KtVertex	Kt	on/off
Valencia	ValenciaVertex	Valencia	on/off

Jet Clustering Type = Base + Vertex(on/off) + BeamJet(on/off)

How to configure?

Related setting parameters in Marlin steering file

Parameter Name	Examples
JetClustering.JetAlgorithm	Durham, DurhamVertex, Kt, KtVertex, Valencia, ValenciaVertex
JetClustering.UseBeamJets	0, 1
JetClustering.RParameter	1.0, ⋯
JetClustering.AlphParameter	1.0, ⋯
JetClustering.BetaParameter	1.0, ⋯
JetClustering.GammaParameter	1.0, ⋯

Controllable from steering file

How Jet Clustering proceeds?

1) Define a distance between two tracks (or "pseudo tracks" : a bunch of tracks).
2) Combine two tracks if they give a minimum distance in all combinations.
3) Repeat 1) and 2) until when you are satisfied.

Remark 1)

"w/ Vertex" clustering feature is realized by adding a large value
when you try to combine two pseudo tracks that have secondary vertices
—>This prevents breaking secondary vertices during jet clustering.

Remark 2)

Concurrently compute so-called "beam distance" (if UseBeamJets=1), which is
similar to the above distance but the one beteen each jet and beam axis.
—> This allows to make jets aligning to beam axis and can be recognized as beam
background jets

Distance : Durham/DurhamVertex

parameter : α

$$d_{ij} := 2\frac{\min(E_i^2, E_j^2)}{E_{\text{visible}}^2}(1 - \cos\theta_{ij})$$

$$d_{iB} := 2\alpha^2 \frac{E_i^2}{E_{\text{visible}}^2}(1 - |\cos\theta_{iB}|)$$

(beam distance)

small α = strong beam jet rejection

Distance : Kt/KtVertex

parameter : R

$$d_{ij} := \min((p_t^2)_i, (p_t^2)_j)\frac{\Delta R_{ij}^2}{R^2}$$

$$\Delta R_{ij}^2 := (\eta_i - \eta_j)^2 + (\phi_i - \phi_j)^2$$

η : rapidity
ϕ : azimuthal angle

$$d_{iB} := (p_t^2)_i$$

(beam distance)

Distance : Valencia/ValenciaVertex

parameter : R, β, γ

$$d_{ij} := 2\min(E_i^{2\beta}, E_j^{2\beta})\frac{(1 - \cos\theta_{ij})}{R^2}$$

$$d_{iB} := E_i^{2\beta}\left(\frac{(p_t)_i}{E_i}\right)^{2\gamma}$$

(beam distance)

Training samples

What training samples needed?

High priority

① **vvbb/vvcc/vvss/vvgg/vvuu/vvdd (ZH) at 250 GeV**

    500 k events for each mode

    ISR on/off probably does not matter

② **bb/cc/ss/uu/dd at 91 GeV**

    500 k events for each mode

    ISR off (back-to-back events)

uu/dd may not be necessarily separated, but ss would be convenient to work on s-tagging.

What training samples needed?

Lower priority

① **bb/cc/ss/uu/dd at 250 GeV**

ISR off to remove radiative return events

② **Multi-tag samples at 250 GeV**

Any motivations?