Definition of variables

Thrust T: The thrust axis $\vec{n}_T$ maximises the following quantity:

$$T = \max_{\vec{n}_T} \left(\frac{\sum_i |\vec{p}_i \cdot \vec{n}_T|}{\sum_i |\vec{p}_i|} \right) \quad ,$$

where the sum extends over all particles in the event.

Thrust Major T_{Ma}: The thrust major vector, $\vec{n}_{\mathrm{Ma}}$, is defined in the same way as the thrust vector, but with the additional condition that $\vec{n}_{\mathrm{Ma}}$ must lie in the plane perpendicular to $\vec{n}_T$:

$$T_{\mathrm{Ma}} = \max_{\vec{n}_{\mathrm{Ma}} \perp \vec{n}_T} \left(\frac{\sum_i |\vec{p}_i \cdot \vec{n}_{\mathrm{Ma}}|}{\sum_i |\vec{p}_i|} \right) \quad .$$

Thrust Minor T_{Mi}: The minor axis is perpendicular to both the thrust axis and the major axis $\vec{n}_{\mathrm{Mi}} = \vec{n}_T \times \vec{n}_{\mathrm{Ma}}$. The value of thrust minor is given by:

$$T_{\mathrm{Mi}} = \frac{\sum_i |\vec{p}_i \cdot \vec{n}_{\mathrm{Mi}}|}{\sum_i |\vec{p}_i|} \quad .$$

Oblateness O: The oblateness is defined as the difference between thrust major and thrust minor:

$$O = T_{\mathrm{Ma}} - T_{\mathrm{Mi}} \quad .$$

Sphericity S: The sphericity is calculated from the ordered eigenvalues of the quadratic momentum tensor:

$$\begin{aligned} M^{\alpha\beta} &= \frac{\sum_i p_i^\alpha p_i^\beta}{\sum_i |\vec{p}_i|^2} \;,\; \alpha, \beta = 1, 2, 3 \quad ; \\ \lambda_1 &\geq \lambda_2 \geq \lambda_3 \;,\; \lambda_1 + \lambda_2 + \lambda_3 = 1 \;; \\ S &= \frac{3}{2}(\lambda_2 + \lambda_3) \quad . \end{aligned}$$

The sphericity axis $\vec{n}_S$ is defined along the direction of the eigenvector associated to λ_1.

Aplanarity A: The aplanarity is calculated from the third eigenvalues of the quadratic momentum tensor

$$A = \frac{3}{2}\lambda_3 \quad .$$

Planarity P: The planarity a linear combination of sphericity and aplanarity

$$P = \frac{2}{3}(S - 2A) \quad .$$

Heavy Jet Mass M_H: A plane through the origin and perpendicular to $\vec{n}_T$ divides the event into two hemispheres, H_1 and H_2, from which one obtains the corresponding normalised hemisphere invariant masses:

$$M_i = \frac{1}{E_{vis}^2} \left(\sum_{k \in H_i} p_k \right)^2 \quad , \ i = 1, 2 \ ,$$

where E_{vis} is the total visible energy in the event. The larger of the two hemisphere masses is called the heavy jet mass :

$$M_H = \max(M_1, M_2) \ .$$

Light Jet Mass M_L: Similarly, the light jet mass is the smaller of the two normalised hemisphere masses:

$$M_L = \min(M_1, M_2) \ .$$

Jet Mass Difference M_D: The difference between M_H and M_L is called the jet mass difference:

$$M_D = M_H - M_L \ .$$

Single Inclusive Jet Mass M_S: Each event has two entries in the single inclusive jet mass distribution: The heavy jet mass M_H and the light jet mass M_L. The integral of the distribution is normalised to the 'hemisphere multiplicity', i.e. 2.

Wide Jet Broadening B_W: A measure of the broadening of particles in transverse momentum with respect to the thrust axis can be calculated for each hemisphere H_i using the relation:

$$B_i = \frac{\sum_{k \in H_i} |\vec{p}_k \times \vec{n}_T|}{2 \sum_j |\vec{p}_j|} \quad , \ i = 1, 2 \quad ,$$

where j runs over all of the particles in the event. The wide jet broadening is the larger of the two hemisphere broadenings:

$$B_W = \max(B_1, B_2) \ .$$

Narrow Jet Broadening B_N: The narrow jet broadening is the smaller of the two hemisphere broadenings:

$$B_N = \min(B_1, B_2) \ .$$

Total Jet Broadening B_T: The total jet broadening is the sum of the wide jet broadening and the narrow jet broadening:

$$B_T = B_W + B_N \ .$$

Single Inclusive Jet Broadening B_S: Similar to the single inclusive jet mass, each event has two entries in the single inclusive jet broadening distribution: the wide jet broadening B_W and the narrow jet broadening B_N.

C-parameter C: The C-parameter is derived from the eigenvalues of the linearised momentum tensor $\Theta^{\alpha\beta}$:

$$\Theta^{\alpha\beta} = \frac{1}{\sum_i |\vec{p}_i|} \sum_i \frac{p_i^\alpha p_i^\beta}{|\vec{p}_i|} \quad , \; \alpha, \beta = 1, 2, 3 \quad .$$

The three eigenvalues λ_j of this tensor define C with:

$$C = 3 \cdot (\lambda_1\lambda_2 + \lambda_2\lambda_3 + \lambda_3\lambda_1) \quad .$$

D-parameter D: The D-parameter is calculated with the eigenvalues of the linearised momentum tensor:

$$D = 27\, \lambda_1\lambda_2\lambda_3 \quad .$$

Jet Rates R_n: Jet rates are defined my means of a clustering algorithm. For each pair of particles i and j in an event one computes:

$$y_{ij} = \frac{2\min(E_i^2, E_j^2)(1 - \cos\theta_{ij})}{E_{vis}^2} \quad \text{(Durham algorithm)} \quad .$$

The pair of particles with the smallest value of y_{ij} is replaced by a pseudo-particle (cluster). The four-momentum of the cluster is taken to be the sum of the four momenta of particles i and j, $p^\mu = p_i^\mu + p_j^\mu$ ('E' recombination scheme). The clustering procedure is repeated until all y_{ij} values exceed a given threshold y_{cut}. The number of clusters remaining at this point is defined to be the number of jets. For each value of y_{cut} the number of n-jet events is normalised to the total number of events to give the jet rates, i.e. $\sum_{n=1}^{\infty} R_n(y_{cut}) = 1$.

Jet resolution parameter y_n: The jet resolution parameters y_n are defined as the particular values of y_{cut} at which an event switches from a n-1-jet configuration to a n-jet configuration. The same clustering algorithm as for jet rates is applied.

Energy-Energy-Correlation EEC: Two-particle correlation defined in terms of the angle χ_{ij} between two particles, weighted with their scaled energy:

$$EEC(\chi) = \frac{1}{N}\frac{1}{\Delta\chi} \sum_N \sum_{i,j} \frac{E_i E_j}{E_{vis}^2} \int_{\chi-\frac{\Delta\chi}{2}}^{\chi+\frac{\Delta\chi}{2}} \delta\,(\chi' - \chi_{ij})\, d\chi' \quad ,$$

where N is the number of events and $\Delta\chi$ is the angular bin width. The range of χ is taken from 0° to 180°.

Energy-Energy-Correlation Asymmetry AEC: The asymmetry of the energy-energy correlation is defined as:

$$AEC(\chi) = EEC(108^\circ - \chi) - EEC(\chi) \quad .$$

Charged Particle Momentum ξ: The inclusive charged particle momentum distribution is presented in terms of the logarithmic variable ξ :

$$\xi = -\log(x_p) \quad , \quad x_p = \frac{p}{p_{beam}} \quad .$$

The energy evolution of the peak position $\xi^\star$ of the ξ distribution is predicted in modified leading-log approximation, the integral of the ξ distribution is equal to the mean charged particle multiplicity $< N_{ch} >$.