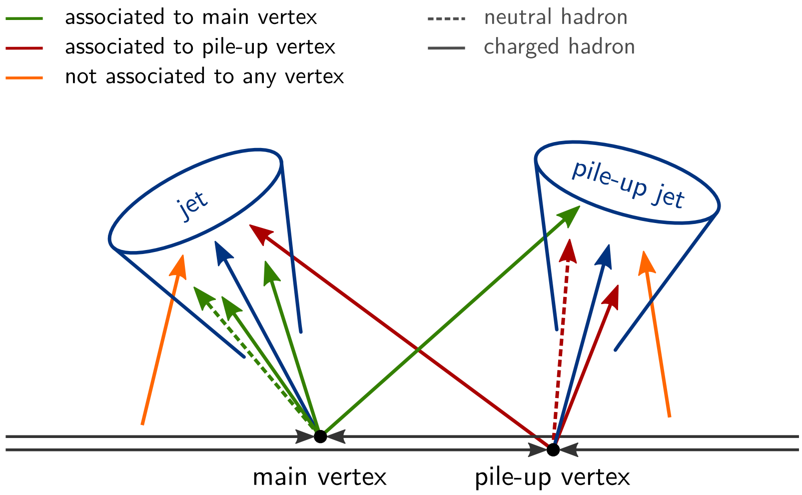

Figure 4.8: Association of particle tracks with primary vertices. Particles clustered into a jet from the hard interaction (jet) can emerge from the main vertex or from pile-up vertices. The Charged Hadron Subtraction (CHS) removes hadrons from pile-up vertices (red, dashed) prior to jet clustering. The pile-up jet identification removes an entire jet if it has a dominating contribution from pile-up hadrons.

sorted into three categories: the set of tracks coming from the same vertex as the jet M, tracks from other vertices P and tracks that can not unambiguously associated to one of the vertices N. This is illustrated in Figure 4.8. β-variables are calculated as the p_T-weighted fraction of tracks in this category, such that $\beta_M + \beta_P + \beta_N = 1$.

$$\beta = \beta_M = \frac{\sum_{i \in M} p_{\mathrm{T},i}}{\sum_i p_{\mathrm{T},i}} \qquad \beta^* = \beta_P = \frac{\sum_{i \in P} p_{\mathrm{T},i}}{\sum_i p_{\mathrm{T},i}} \tag{4.12}$$

d_z is defined as the distance between the track and the jet along the z-axis.

$$d_z = |z_\mathrm{track} - z_\mathrm{jet}|$$

These variables β, β^*, d_z and the number of primary vertices n_PV are able to discriminate between pile-up jets and jets from the hard interaction within the reach of the tracking detector.

Outside the tracker coverage, the identification of pile-up jets has to be based on shape variables. The mean width of a jet can be defined as

$$\langle \Delta R^2 \rangle = \frac{\sum_i \Delta R_i^2 p_{\mathrm{T},i}^2}{\sum_i p_{\mathrm{T},i}^2}$$

with $\Delta R_i = \Delta R_{\mathrm{jet},i}$ for all jet constituents i. In addition, the momentum sum in