Performance of the ALICE secondary vertex b-tagging algorithm

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**Motivation**

- Determine b-quark production via the measurements of beauty(b)-jets.
- Jets vs. heavy-flavor hadrons: access the kinematics of hard scattering in an unbiased way.
- Color and mass dependence of parton energy loss in the Quark-Gluon Plasma (QGP).

**Secondary vertex (SV) tagging algorithm**

Benefits from long lifetime ($\tau \sim 500 \mu$m) of beauty hadrons.

The Inner Tracking System (ITS) and Time Projection Chamber (TPC) are used for tracking and secondary vertex reconstruction. For all collision systems ALICE measures the track impact parameter $d_0$ with a resolution better than 70 $\mu$m for $p_\perp > 1$ GeV/c.

- Jet reconstruction: FastJet Anti-kt, $R = 0.4$ $p_\perp, \text{track} > 0.15$ GeV/c
- 3-prong SV are reconstructed using tracks in a jet $p_\perp, \text{track} > 1$ GeV/c
- Discriminating variables: significance of signed SV distance of flight $L_{/2}^0$ in a transverse plane and SV dispersion $\sigma_0$

**3-prong vertex resolution in the (xy) plane.**

**Track impact parameter resolution**

$\sigma = \sqrt{\sigma_{\text{fit}}^2 + \sigma_{\text{res}}^2}$

$\sigma_{\text{fit}}$ is the impact parameter resolution of tracks from SV.

**Prospects with LHC/ALICE upgrades**

- Upgrade of ITS (2018):
  - Improvement of the track impact parameter resolutions by a factor 3 (6) in the transverse (longitudinal) direction.
  - Better light flavor rejection in b-tagging analysis.
- ALICE read-out and LHC upgrades (2018):
  - Higher integrated luminosities: $-10$ pb$^{-1}$ for pp collisions at $\sqrt{s} = 14$ TeV and $-10$ nb$^{-1}$ for Pb-Pb collisions at $\sqrt{s}_{NN} = 5.5$ TeV required by the ALICE upgrade program.

**Analysis steps**

- Jet-finding: jet reconstruction with charged tracks.
- Jet b-tagging: exploit long lifetime and large mass of beauty hadrons.
- Corrections: correction of jet transverse momentum $p_T$ (or jet energy) for background and detector response (unfolding), corrections for b-tagging efficiency and charm/ light jet contamination.
- Studies presented in this poster are MC based.

**Secondary vertex algorithm performance in p-Pb collisions**

$T = \frac{dN_{\text{gen}}}{dx} \frac{d^3p_T}{dp_T}$

- Tagging efficiency: the ratio of properly tagged jets vs all jets.
- Detector response function $f(dN(x)/dx)$.
- The true jet spectrum is found via unfolding procedure.

$\delta p_T = \frac{dN_{\text{gen}}}{dx} \frac{d^3p_T}{dp_T}$

$\delta p_T = R_{\text{tagged}} - R_{\text{unb}}$

**Summary and ongoing studies**

- The tagging cuts for SV algorithms are optimized for keeping beauty efficiencies as large as possible and at the same time charm and light-jet contamination small.
- Corrections for background and background fluctuations as well as for detector response are implemented. It was found that the b-jet spectrum can be corrected with a detector response matrix for all inclusive jets.
- The order of corrections (tagging efficiency vs unfolding) gives compatible results.
- MC and data-driven estimation of tagging purity is under study.
- Study of track cuts and selection for SV reconstruction in order to obtain higher purity is ongoing.

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