Simulation studies of beauty-jet tagging in p-Pb collisions at the LHC with ALICE.
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Physics motivation

➢ Determine beauty (b)-quark production rate via measurements of tagged jets coming from the fragmentation of b-quarks.
➢ unbiased access to the kinematics of the hard scattering, even in the presence of an underlying heavy-ion collision.
➢ Pb-Pb collisions: probe colour-charge and mass dependence of parton energy loss in a Quark-Gluon Plasma (QGP).
➢ p-Pb collisions: Study cold nuclear matter effects, reference for Pb-Pb collisions.

Tracking performance and secondary vertex selection

The Inner Tracking System (ITS) and the Time Projection Chamber (TPC) are used for tracking and SV reconstruction.

Jet reconstruction:
FastJet Anti-kt algorithm [1], R = 0.4

➢ 3-prong SV are reconstructed using tracks (pTcut ≥ 1 GeV/c) in a jet
➢ Jets of different flavours are defined in MC based on the presence of B(D) hadrons

Discrimination variables:
Singed distance of SV w.r.t primary vertex in the XY plane (Lxy) and SV dispersion σLxy

Lxy = Lxy + αxy (Lxy, σLxy)

σLxy = √(σLxy + σxy)

αxy are the distances of tracks from SV

Prospects for Run II and LHC/ALICE upgrades

➢ LHC run II (2015-2017)
   ➢ Higher statistics in pp and Pb-Pb collisions.
   ➢ Commissioning of the ALICE DCA detector.
   ➢ Larger coverage for full jet reconstruction (charged + neutral).

➢ ALICE read-out and LHC upgrades (2019)
   ➢ Higher integrated luminosity:
     ~ 10 fb⁻¹ in pp at s = 14 TeV and ~ 10 fb⁻¹ in Pb-Pb at sNN = 5.5 TeV
   ➢ High precision in heavy-flavour measurements.

➢ ALICE ITS upgrade (2019)
   ➢ Improvement of the track impact parameter resolution by a factor of 3 (8) in XY (Z) direction.
   ➢ Improved light-flavour rejection in b-tagging analysis [4].

Analysis strategy and MC data sample

2. Tag b-jets: secondary vertex (SV) reconstruction using charged tracks in a jet. Explicit long lifetime (τ ≥ 500 µm) and large mass (≈ 5 GeV/c²) of b-hadrons
3. Corrections:
   ➢ b-tagging efficiency and purity (charm/light jet contamination),
   ➢ background fluctuations and detector response (unfolding).
4. Studies based on PYTHIA + HIJING simulations, p-Pb collisions at √sNN = 5.02 TeV.

Secondary vertex tagging performance in p-Pb collisions

Tagging efficiency:

➢ Ratio of unfolded spectra of SV tagging efficiency with different selections on Lxy

MC b-jet pT spectrum is unfolded with the combined matrix: detector response and background fluctuation matrix.
➢ Compatible results when unfolding with detector response matrix of inclusive and b-jets.
➢ No strong influence of different fragmentation pattern of inclusive and b-jets to the detector response.

Summary and next steps

➢ Several selections for SV b-tagging algorithm were studied to obtain a large b-tagging efficiency keeping the charm/light contamination small.
➢ Corrections for background fluctuations as well as detector response are implemented.
➢ MC and data-driven estimation of b-tagging purity is under study.

Goals:
Measure b-jet pT differential cross section in p-Pb collisions at √sNN = 5.02 TeV down to low pT (~ 20 GeV/c), to complement high-pT measurements from CMS.