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Event-activity dependence of the beauty production in the enhanced color reconnection model at LHC energies

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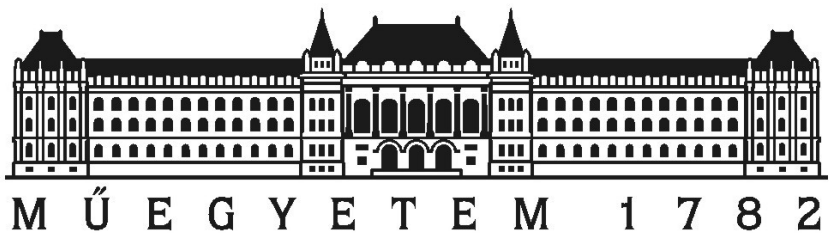
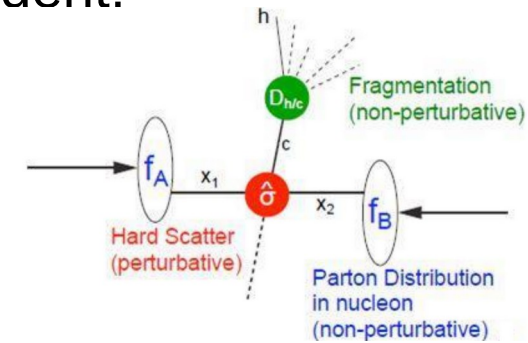


Motivation

- **Heavy-flavor** production can be described with the factorization approach, in which the **incoming hadron PDFs**, **the parton-parton scattering cross-section** and the **fragmentation function (FF)** are independent:

$$d\sigma^{hard}_{AB\to C} = \sum_{a,b} f_{a/A}(x_a, Q^2) \otimes f_{b/B}(x_b, Q^2) \otimes d\sigma^{hard}_{ab\to c}(x_a, x_b, Q^2) \otimes D_{c\to C}(z, Q^2)$$

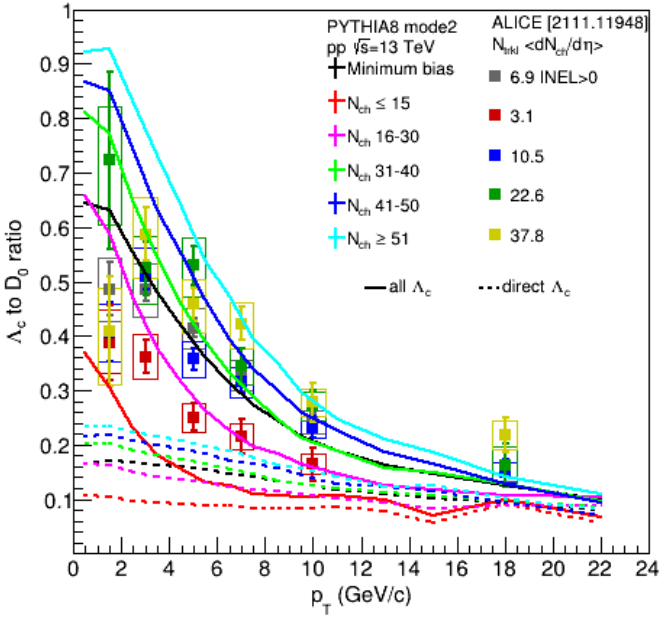
Parton Distribution Function (PDF) | Partonic hard scattering cross-section | Fragmentation Function (FF)

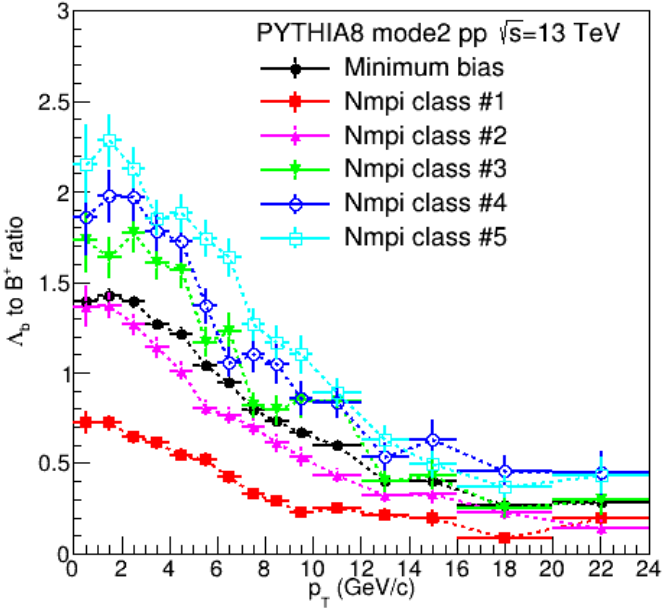


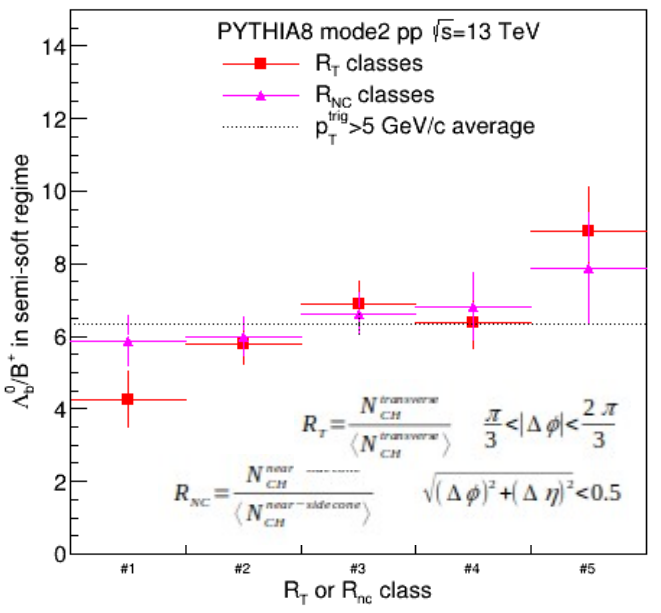
- Traditional assumption: fragmentation is **universal** for different collision systems
  - **FF** often determined from e^-e^+ (or e^-p) collisions, where **PDF** plays no (or less important) role
- Recent experimental results (ALICE, CMS, LHCb) on charmed baryon production **do not support** this assumption!

Charm and Beauty baryon enhancement

Z.V., R.V., J. Phys. G: Nucl. Part. Phys. 49 (2022) 075005 [arXiv:2111.00060] Z.V., A.M., R.V., J. Phys. G: Nucl. Part. Phys. 50 (2023) 075002 [arXiv:2302.09740]







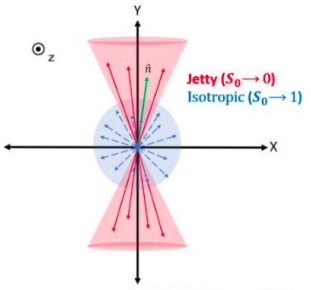
- **Experimental results: significant enhancement in the Λ_c/D^0 ratio** in the low p_T range compared to predictions from e^+e^-: **no universality!**
- **Multiplicity dependence**: connected to the event activity. Needs to be better understood!
- **Figure 1: String formation beyond leading color** (CR-BLC) (arXiv:1505.01681 [hep-ph]) can describe the Λ_c/D^0 enhancement in simulations.
- The Λ_c/D^0 ratio in the CR-BLC model depends on the event-activity, and the enhancement is connected to the underlying event activity, and does not depend significantly on the processes inside the jet region. What is the prediction for the Λ_b/B^+ ratio?
- **Figure 2:** The Λ_b/B^+ ratio increases with the number of MPI.
- **Figure 3:** Using event classifiers we showed that the **beauty enhancement** is **connected to the underlying event activity (R_T)**, and **not to the jet region activity (R_{NC})**!

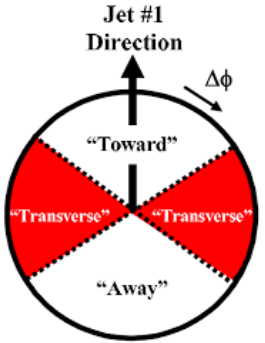
Many different event-activity classifiers can be utilized!

- **N_{CH}** – multiplicity at mid-rapidity ($|\eta| < 1$): number of final state charged particles, describing the activity of the whole event.
- **N_{fw}** - forward multiplicity at forward rapidity ($2 < \eta < 5$),
- **R_T** = $N_{CH}^{transverse}$ / $\langle N_{CH}^{transverse} \rangle$: **underlying event** activity,

  region excluding jets from the leading process. ($\pi/3 < |\Delta\phi| < 2\pi/3$)
- **R_{NC}** = $N_{CH}^{near\text{-}side\ cone}$ / $\langle N_{CH}^{near\text{-}side\ cone} \rangle$: activity connected to

  the **jet region**, containing the leading process. $\sqrt{(\Delta\phi^2+\Delta\eta^2)} < 0.5$
- **S_0**: **spherocity**, measures how spherical or jet-like the event is.





$$S_0 = \frac{\pi^2}{4} \times \min_{\hat{n}=(n_x,n_y,0)} \left(\frac{\Sigma_i \, | \vec{p}_{T_i} \times \hat{n} |}{\Sigma_i \, \vec{p}_{T_i}} \right)^2$$

- **Flatenicity** (**ρ**): the relative standard deviation of the p_T^{cell} distribution (event-by-event):

  $\rho = \sigma_{pT}^{cell} / \langle p_T^{cell} \rangle$

On the poster: many interesting results on the other event classifiers!

Thank you for your attention!