Monte Carlo Simulations of Upsilon Meson Production

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Motivation

Production mechanism:

- hard scattering - $b\bar{b}$ production
- bound state formation - colour singlet, colour octet channels

Sensitive to:

- interplay of soft and hard processes
- multiple parton interaction
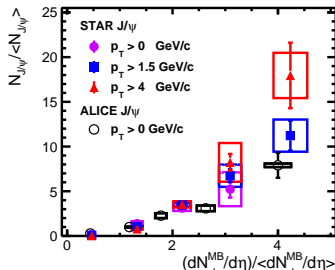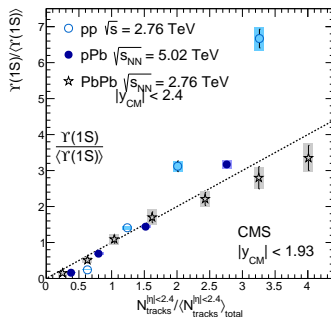- parton saturation signatures

Study of:

- Normalised Upsilon yield $N_{\Upsilon} / \langle N_{\Upsilon} \rangle$ in dependence on self-normalised event multiplicity $N_{ch} / \langle N_{ch} \rangle$
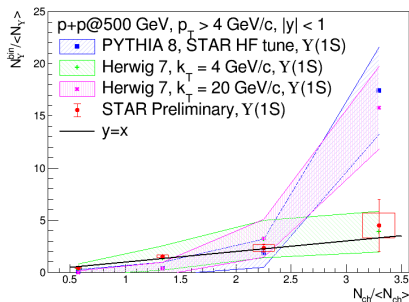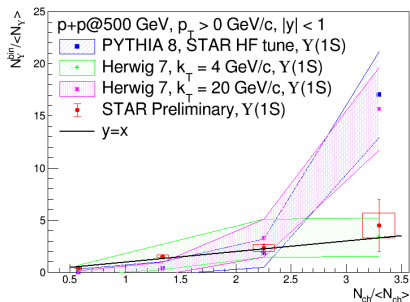
[S. Chatrchyan et al. [CMS], JHEP **04** (2014), 103]

[J. Adam, et al. [STAR], Phys. Lett. B **786** (2018), 87-93]

Both PYTHIA and Herwig with $k_\perp = 20$ GeV/c describe a stronger than linear increase in in normalised Upsilon yield dependence on normalised charged particle multiplicity.

Herwig with $k_\perp = 4$ GeV/c predicts a closer to linear development in higher multiplicities.

STAR preliminary data taken from:

[L. Kosarzewski [STAR]: Overview of quarkonium production studies in the STAR experiment,

Presented at FAIRness 2019]

Conclusion

- The minimum bias spectra differ significantly for PYTHIA and Herwig in larger multiplicities

- Upsilon production in Herwig has limited validity

- Both PYTHIA and Herwig ($k_\perp = 20$ GeV/c) predict stronger than linear increase in normalised Upsilon yield in dependence on normalised multiplicity

- In comparison to STAR preliminary data both PYTHIA and Herwig ($k_\perp = 20$ GeV/c) predict higher values for larger multiplicities, while underestimating smaller multiplicity values

- The data suggests, that Upsilon mesons are produced in multi-parton collisions, due to stronger than linear increase predicted by PYTHIA and Herwig ($k_\perp = 20$ GeV/c)