Strangeness Enhancement in Small System at LHCb

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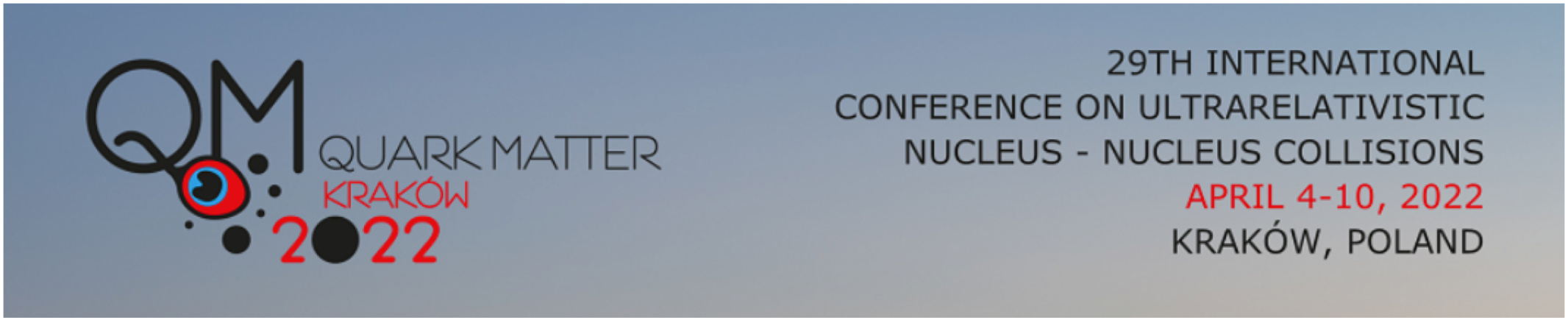
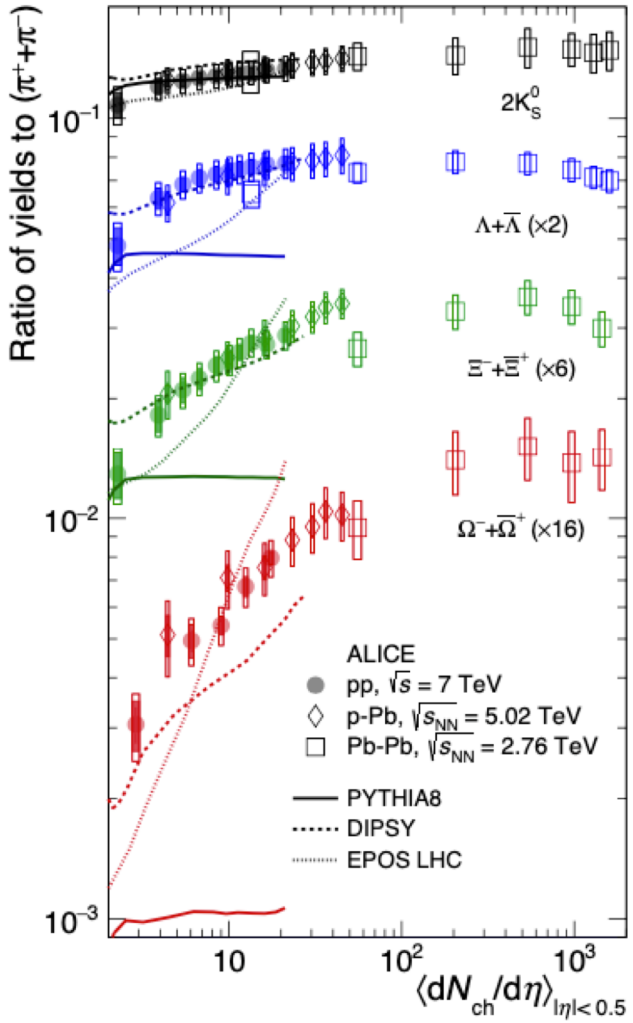
on behalf of the LHCb collaboration



Motivation

- Strangeness enhancement was one of the first proposed signatures of quark-gluon plasma(QGP) formation in heavy ion collisions
  - ➢strangeness production proceeds mainly via gluons in QGP.
  - ➢ s quark mass lower than QGP critical temperature T_c, $s\bar{s}$ quark pairs can be produced thermally.
- Recently, enhanced strangeness production is observed in high multiplicity *pp* and *p*Pb collisions.



A significant enhancement of strange to non-strange hadron production is observed with increasing particle multiplicity in *pp* *p*-Pb Pb-Pb collisions.

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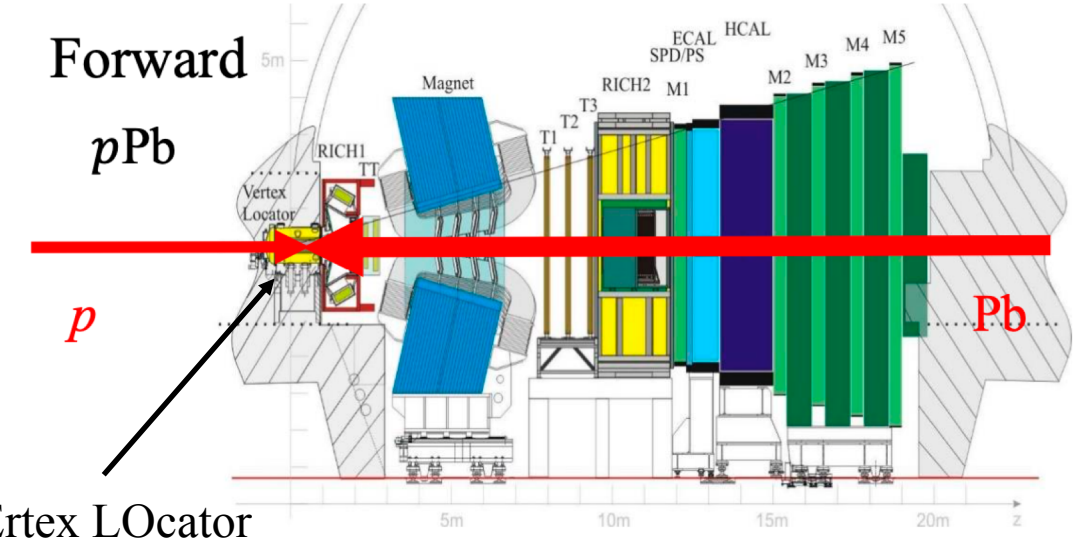
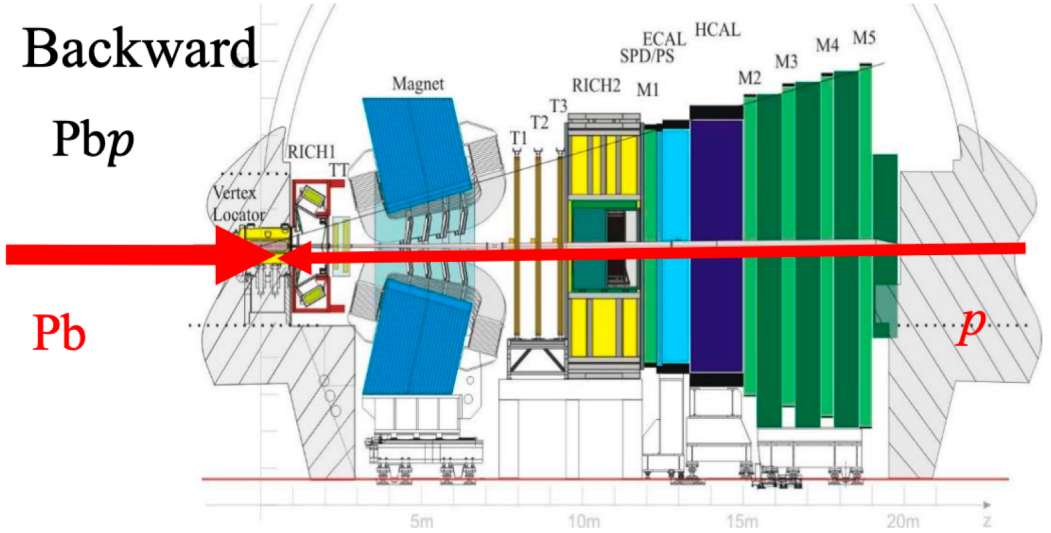
LHCb detector and Datasets

- A single-arm spectrometer in the forward direction, charm & beauty factory
  - Vertex Locator (20 μm IP resolution)
  - Tracking system ($\Delta p/p = 0.5 - 1.0\%$)
  - RICH: p/K/π separation
  - Flexible software trigger
- pp data was taken in 2016+2017+2018 with 5.4 fb^{-1}.
- pPb data was taken in 2016 with asymmetric collision configuration.
  - Forward (pPb)
  - Backward (Pbp)
  - Luminosity : 13.6 nb^{-1}(pPb) + 20.8 nb^{-1}(Pbp)
- Beam characteristics
  - 6500 GeV proton beam and 2560 GeV/nucleon Pb beam
  - Center of mass rapidity shift $y^* - y_{\mathrm{lab}} = -0.465$ in direction of proton



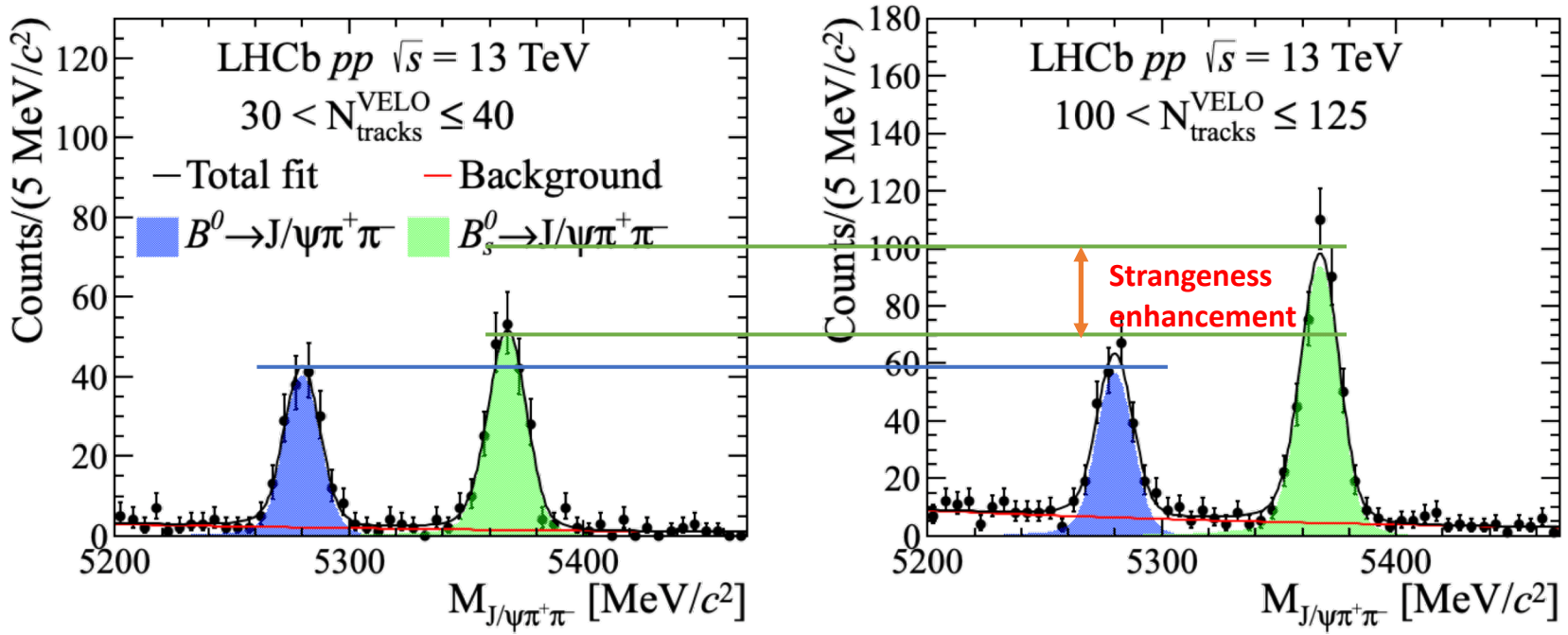


LHCb, JINST 3 (2008) S08005
LHCb, IJMPA 30 (2015) 1530022

Strangeness enhancement with B mesons in *pp* collisions at 8.16TeV

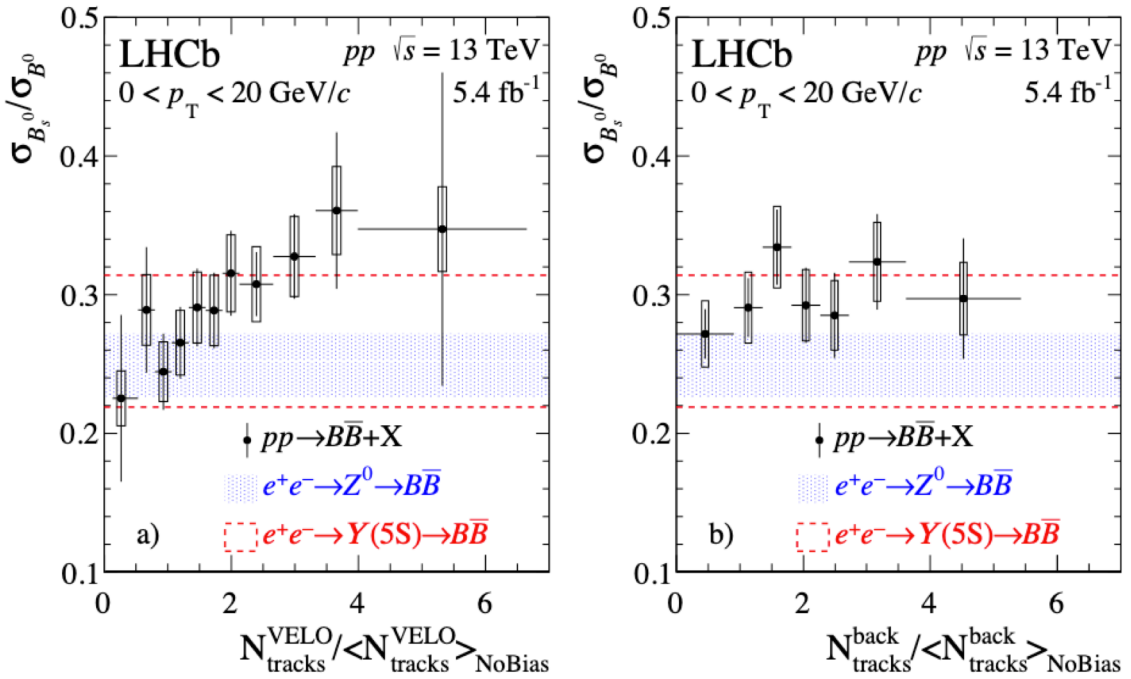
- Ratio of B_s^0/B^0 cross sections versus multiplicity, in several pt bins
  - Both states are simultaneously accessible in $J/\psi\pi^+\pi^-$.

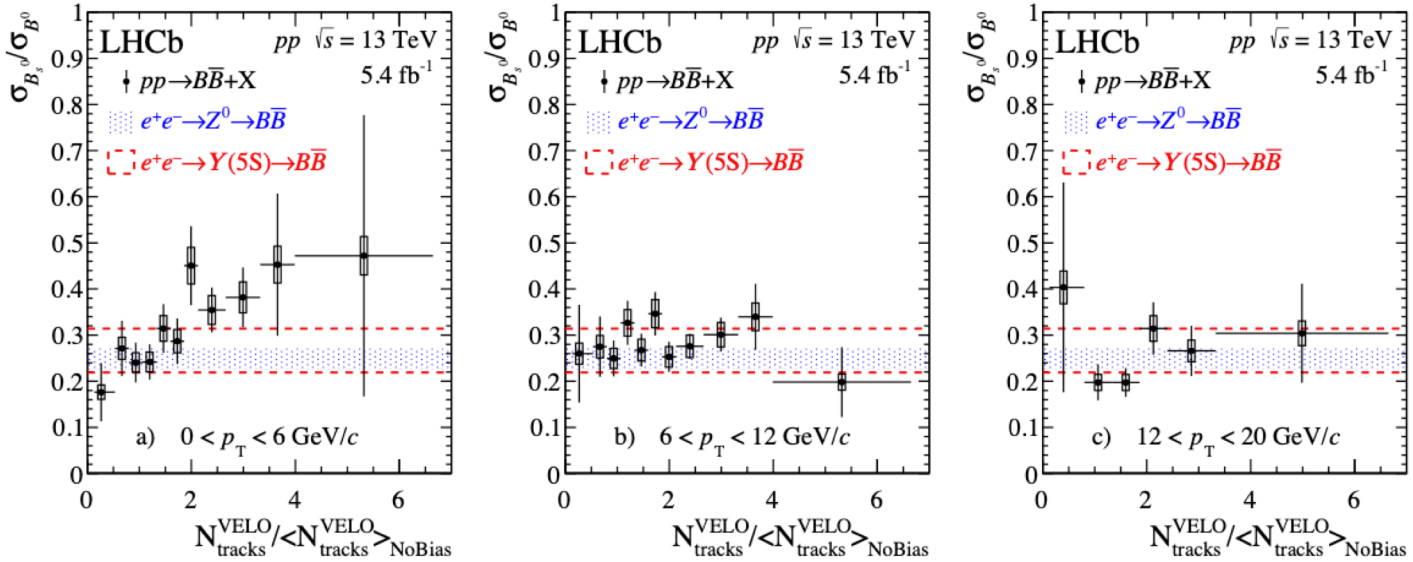
$$\frac{BR(B_s^0 \to J/\psi\pi^+\pi^-)}{BR(B^0 \to J/\psi\pi^+\pi^-)} \times \frac{\sigma_{B_s^0}}{\sigma_{B^0}} = \frac{N_{B_s^0}}{N_{B^0}} \times \frac{\varepsilon_{B^0}^{acc}}{\varepsilon_{B_s^0}^{acc}} \times \frac{\varepsilon_{B^0}^{trig}}{\varepsilon_{B_s^0}^{trig}} \times \frac{\varepsilon_{B^0}^{reco}}{\varepsilon_{B_s^0}^{reco}} \times \frac{\varepsilon_{B^0}^{PID}}{\varepsilon_{B_s^0}^{PID}}$$



Results: B_s^0/B^0 vs multiplicity

- Ratio increases with total multiplicity. At low multiplicity, consistent with fragmentation in vacuum.
- No significant dependence of forward B_s^0/B^0 production on backwards multiplicity. (Effect depends on local particle density)
- Modification mostly occurs at low pt, where most of the bulk particles are produced. High pt are unaffected and consistent with ee result.



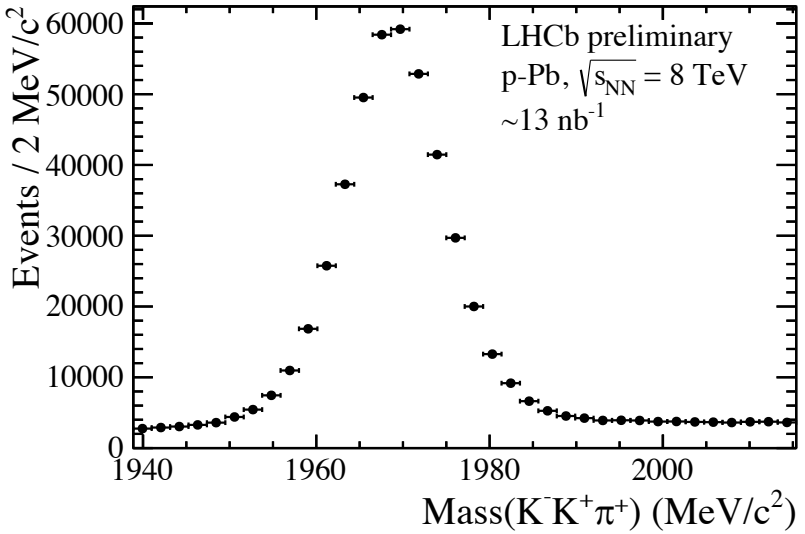


Work in progress: D_s^+/D^+ ratio in pPb collisions at 8.16TeV

- We are studying strangeness enhancement in pPb collision by D_s^+/D^+ ratio, some clues have been seen.
  - Compared with B mesons, the statistics of D mesons are larger.

$$R_{D_s^+/D^+}(p_{\mathrm{T}}, y^*, \mathrm{PV\ nTracks}) = \frac{N(D_s^\pm \to K^\mp K^\pm \pi^\pm)}{N(D^\pm \to K^\mp \pi^\pm \pi^\pm)} \times \frac{\mathcal{B}(D^\pm \to K^\mp \pi^\pm \pi^\pm)}{\mathcal{B}(D_s^\pm \to K^\mp K^\pm \pi^\pm)} \times \frac{\epsilon_{D^+}}{\epsilon_{D_s^+}}$$

$D_s^+ \to K^+K^-\pi^+$



$D^+ \to K^-\pi^+\pi^+$