Strangeness enhancement at LHCb

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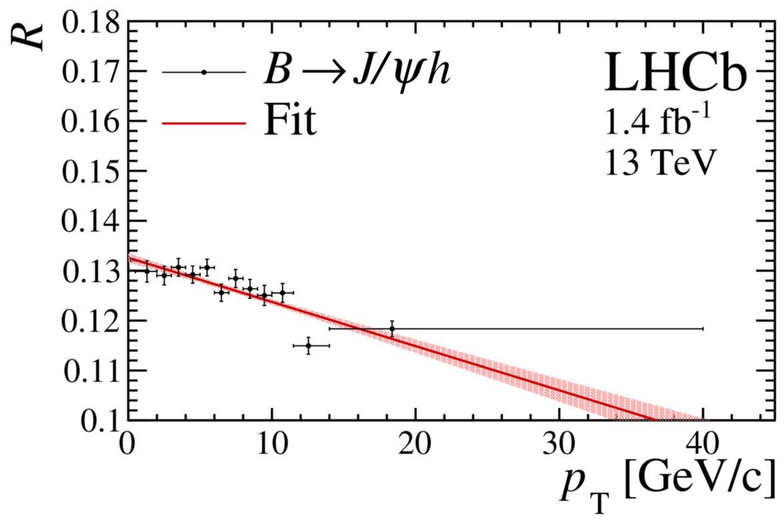
Quark Matter 2023

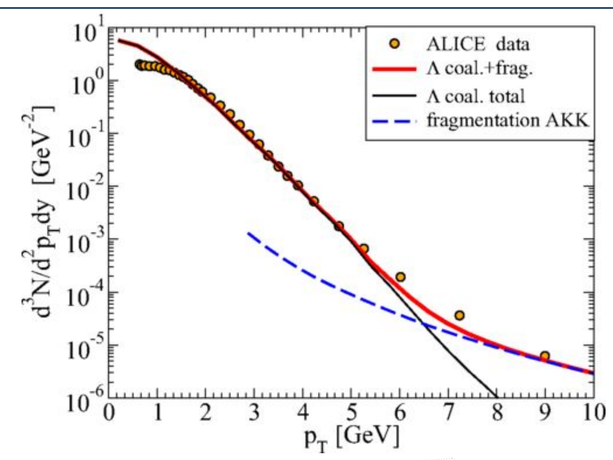
Motivation

- Factorized Lund string fragmentation picture may break even in small systems
- QGP-dependent hadronization mechanisms qualitatively match with data (e.g. enhanced strange hadron production)



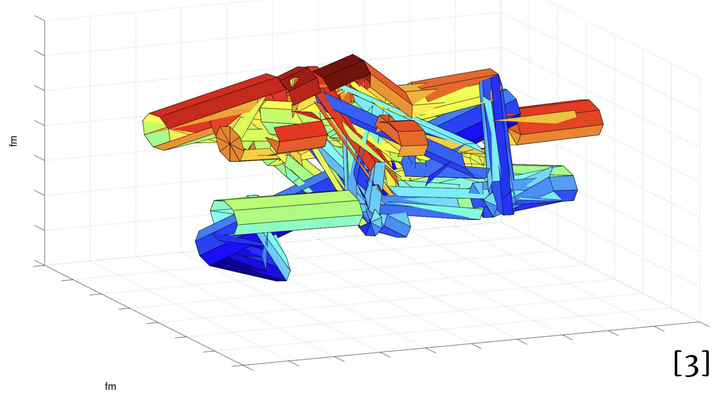
*R is proportional to the relative probability of a b quark to fragment into a B^0_s vs B^0 [1]

- Strangeness enhancement may be explained by modifying hadronization in the following ways:
  - Modifying the behavior of Lund strings in high-density environments
  - Adding a coalescence and/or hydrodynamic contribution following QGP production



[2]

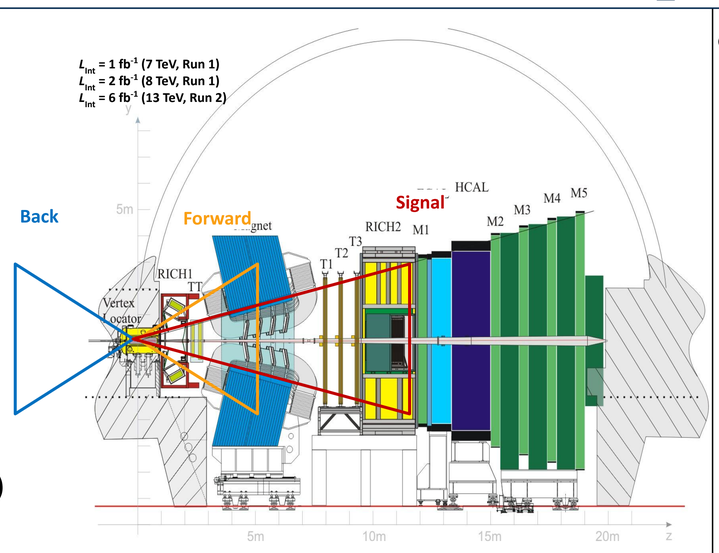
- Hadronization mechanisms may be distinguished by dependencies on multiplicity and kinematics
  - More experimental data in the forward region is needed



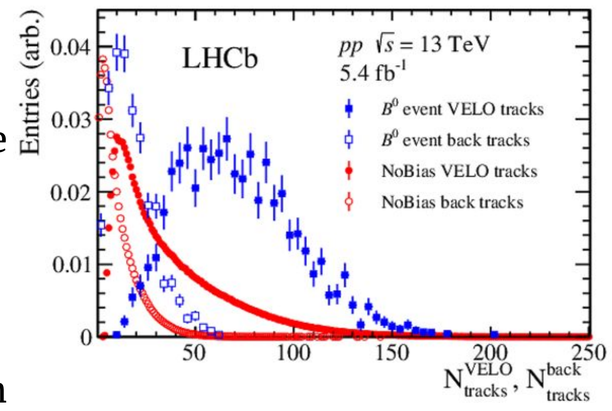
[3]

Detector and Multiplicity Estimation

- The LHCb detector provides access to strangeness enhancement observables in the forward region
- The geometric acceptance of the VErtex LOcator (VELO) subdetector allows for multiple event activity estimators [4]
  - Overall event activity (N^{VELO})
  - Non-local event activity (N^{back})

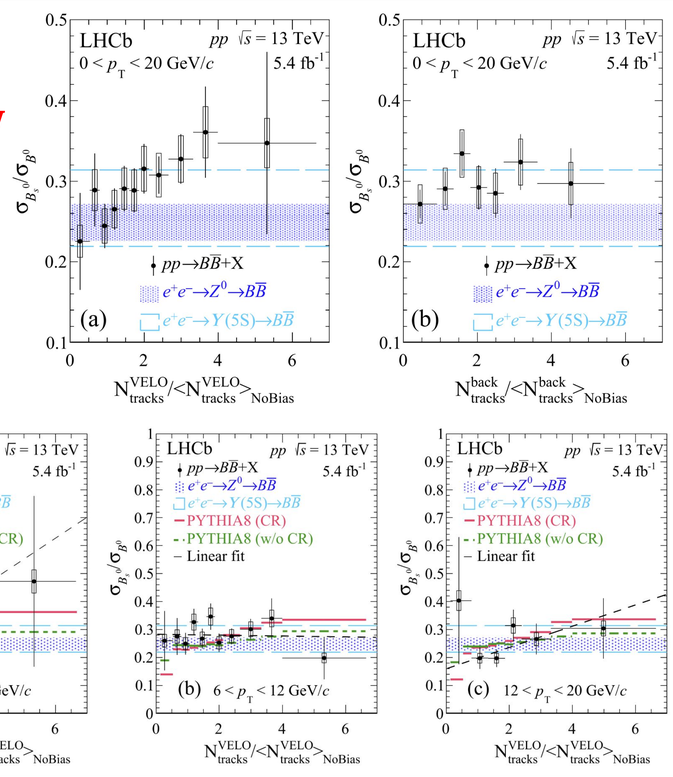


- Discrepancies in behavior between overall and non-local multiplicities may provide qualitative discriminating power
  - Coalescence effects → more sensitive to local particle density (more present in N^{VELO} than N^{back})
  - Fragmentation effects → sensitive to overall event actvity (similar behavior in N^{VELO} and N^{back})

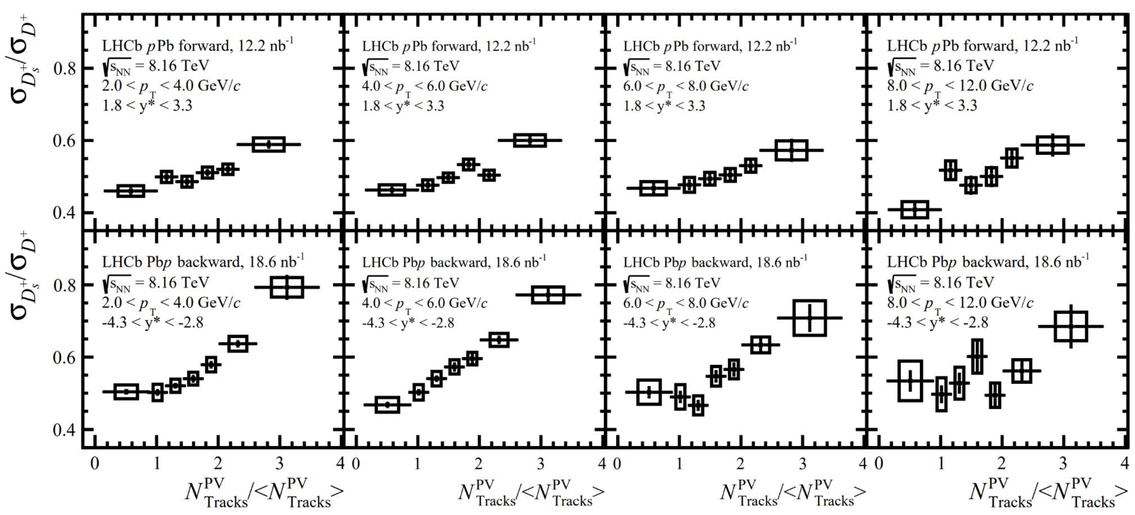


Heavy Flavor Strangeness Production

- Strangeness production in B mesons displays enhancements for low-p_T and high event activity
- Enhancement only observed in N^{VELO}
  - Local particle density dependence
  - Consistent with coalescence effects [5]



- Strangeness enhancement is also observed in D mesons
  - Consistent enhancement across p_T for pPb
  - Enhancement is generally stronger in Pbp
    - In particular at low-p_T
- Also consistent with coalescence effects



*The forward (positive rapidity) direction is defined as the proton-going direction. N^{PV}_{Tracks} corresponds to the multiplicity of reconstructed tracks which are associated with a particular Primary Vertex (PV).

Future Prospects

To further investigate how hadronization is modified in small systems, several analyses are currently underway at LHCb:

- Light flavor strangeness production in pp
- Light flavor strangeness production in pPb
- Light flavor strangeness production in pHe & pNe
- Strangeness production in D mesons in pp
- Baryon-to-meson ratios:
  - Light flavor in pp
  - Charm in pp and pPb
  - Beauty in pp

References

- [1] Phys.Rev.D 104 (2021) 3, 032005
- [2] Phys.Rev.C 92 (2015) 5, 054904
- [3] JHEP 03 (2015) 148
- [4] Int.J.Mod.Phys.A 30 (2015) 07, 1530022
- [5] Phys.Rev.Lett. 131 (2023) 6, 061901