Thesis Overview Talk

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  - In particular, as a function of p_T and centrality

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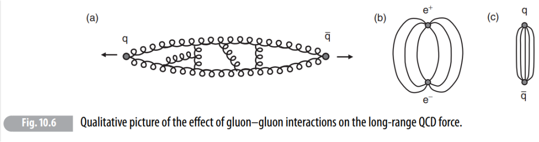

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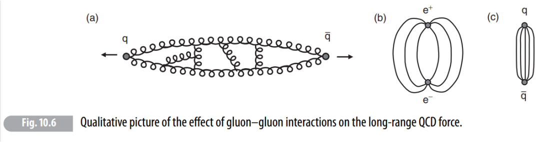

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Background
Basic QGP

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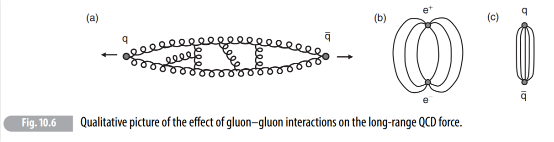

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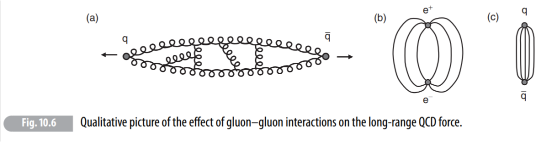

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- However, with more quarks, gluon exchange is not constrained to a long, 1D tube
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- But can be further mediated by intermediate quarks; a large system can find low(er) energy configurations of gluon exchange

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- First measurements of Λ_c production at $\sqrt{s} = 200\text{GeV}$ by STAR show Λ_c/D_0 production is higher than PYTHIA 8.2 predicts [1]

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Motivation

Overview

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  - At 3.1σ without CR (Color Reconnection)
  - At 2.1σ with CR
- Because the measurement is different than the prediction, it's important to study

Results

STAR

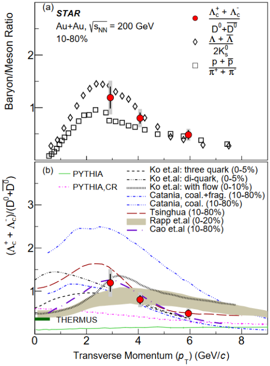

Figure: (Top) The Λ_c/D^0 ratio as a function of p_T, compared to other hadronization ratios. (Bottom) Same ratio vs different analytic models [1]

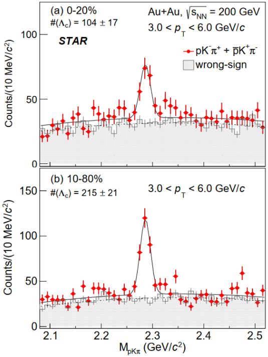

Figure: The Λ_c recombination mass spectrum as total mass of $pK\pi$ candidates in $0-20\%$ centrality (Top) and $10-80\%$ centrality (Bottom) [1]

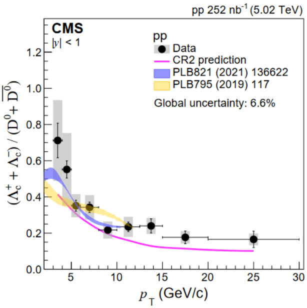

Figure: Λ_c/D^0 ratio in pp as a function of p_T, compared to PYTHIA with CR2 [2]

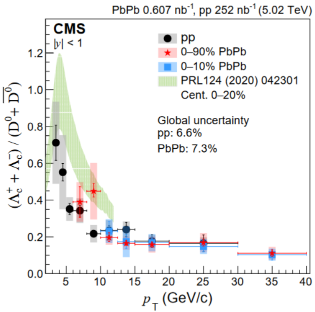

Figure: Λ_c/D^0 ratio in PbPb as a function of p_T [2]

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  - This is $\langle N_{\mathrm{coll}} \rangle$ divided by the *pp* inelastic cross section
  - It is a normalization factor, since there are more partons involved in PbPb than in *pp*

- These together are used to define the nuclear modification factor

$$R^{\Lambda_c}_{\mathrm{PbPb}}(p_T) = \frac{1}{\langle T_{\mathrm{PbPb}} \rangle} \frac{\mathrm{d}\ N^{\Lambda_c}_{\mathrm{PbPb}}}{\mathrm{d}\ p_T} \bigg/ \frac{\mathrm{d}\ \sigma^{\Lambda_c}_{pp}}{\mathrm{d}\ p_T} \tag{6}$$

Procedure

Nuclear modification factor

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- In general, you can define an $R^{\mathrm{C}}_{\mathrm{AB}}$ for C production from collisions of species A, B
  - Most notations do not specify the production particle as a superscript; I do so on only this slide for emphasis
- This gives the suppression factor in particle production (Λ_c) for atom-atom collisions (PbPb), relative to its production in *pp*.

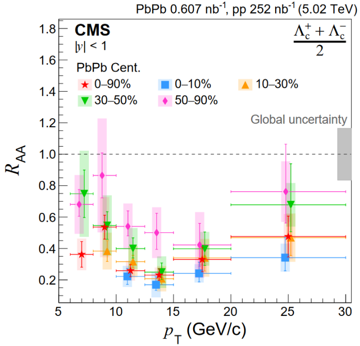
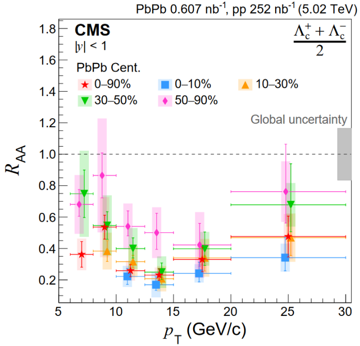


Figure: R_{PbPb} as a function of p_T for different centrality bins [2]

- R_{PbPb} for prompt Λ_c is shown to the left



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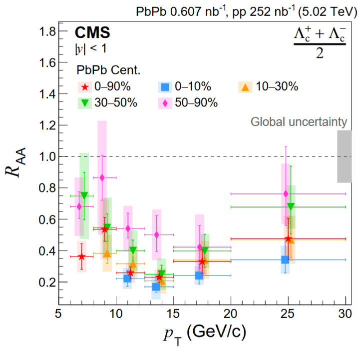

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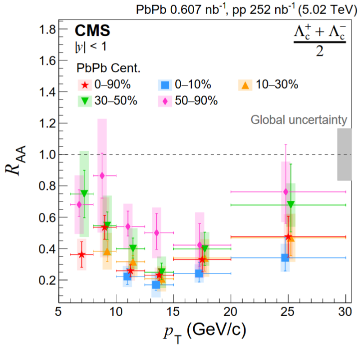

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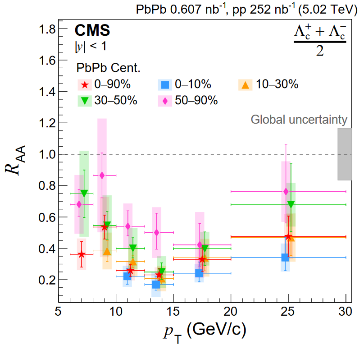

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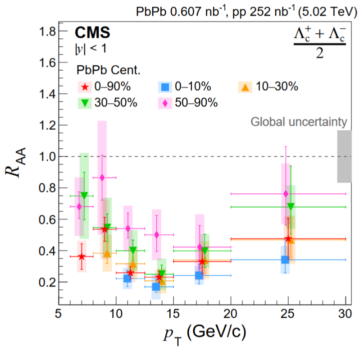

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  - The $0 - 10\%$ most central collisions have the largest suppression effect

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  - Gives charm quark hadronization as function of centrality
- Understanding hadronization gives insight into the nature of deconfinement in QGP
- Understanding deconfinement in QGP allows to understand QCD and conditions of the early universe

References

[1] STAR Collaboration, (2020), arXiv:1910.14628 [nucl-ex]

[2] CMS Collaboration, (2023), arXiv:2307.11186 [nucl-ex]

[3] Particle Data Group, *Particle Physics Booklet*, (2018).

[4] Thomson, Mark, *Modern Particle Physics*, Cambridge University Press, (2013).

Backup Slides

Standard Model

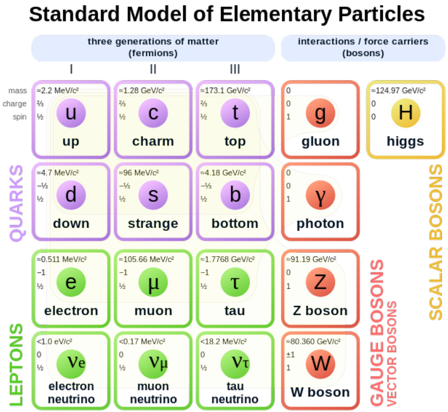

Figure: Standard model of particles. Image source: https://en.wikipedia.org/wiki/File:Standard_Model_of_Elementary_Particles.svg