MPD Polarization meeting

Introducing core-corona effect in the hyperon global polarization

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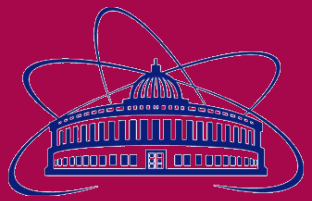
July 26th, 2022



Content

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- Core-Corona with UrQMD
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Motivation

- Hyperon global polarization as a function of energy, can be described with Core-Corona model

$$\mathcal{P}^{\Lambda} = \frac{z\frac{N_{\Lambda\ \mathrm{QGP}}}{N_{\Lambda\ \mathrm{REC}}}}{\left(1+\frac{N_{\Lambda\ \mathrm{QGP}}}{N_{\Lambda\ \mathrm{REC}}}\right)}, \quad \mathcal{P}^{\overline{\Lambda}} = \frac{\bar{z}\left(\frac{w'}{w}\right)\frac{N_{\Lambda\ \mathrm{QGP}}}{N_{\Lambda\ \mathrm{REC}}}}{\left(1+\left(\frac{w'}{w}\right)\frac{N_{\Lambda\ \mathrm{QGP}}}{N_{\Lambda\ \mathrm{REC}}}\right)}$$

- Intrinsic polarization z, $\bar{z}$.
- Ratio w' is $\overline{\Lambda}/\Lambda$ in core
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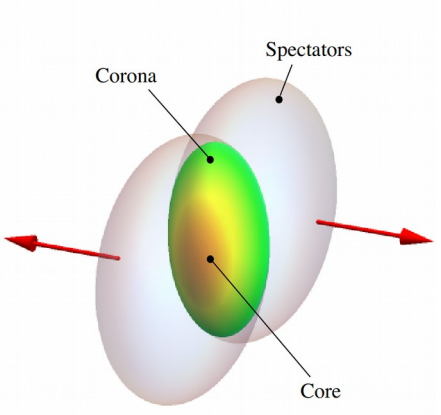
- Centrality dependent model
- Relaxation time



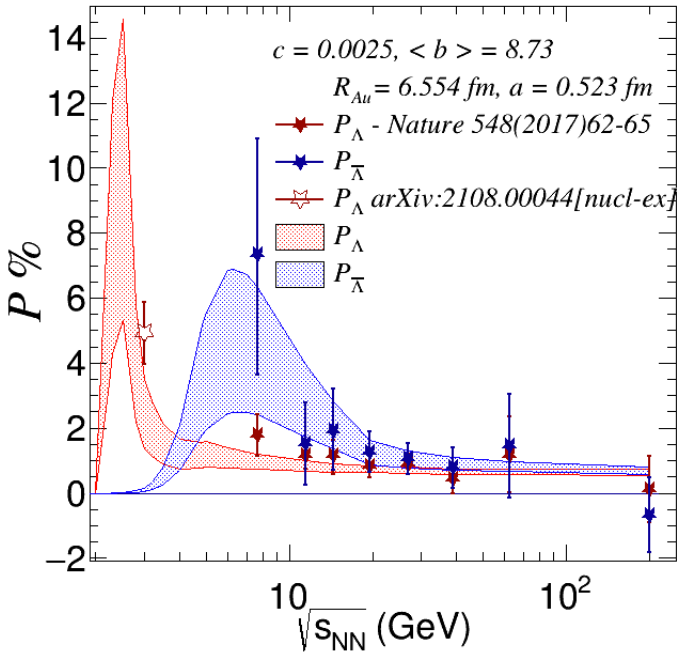
A+A

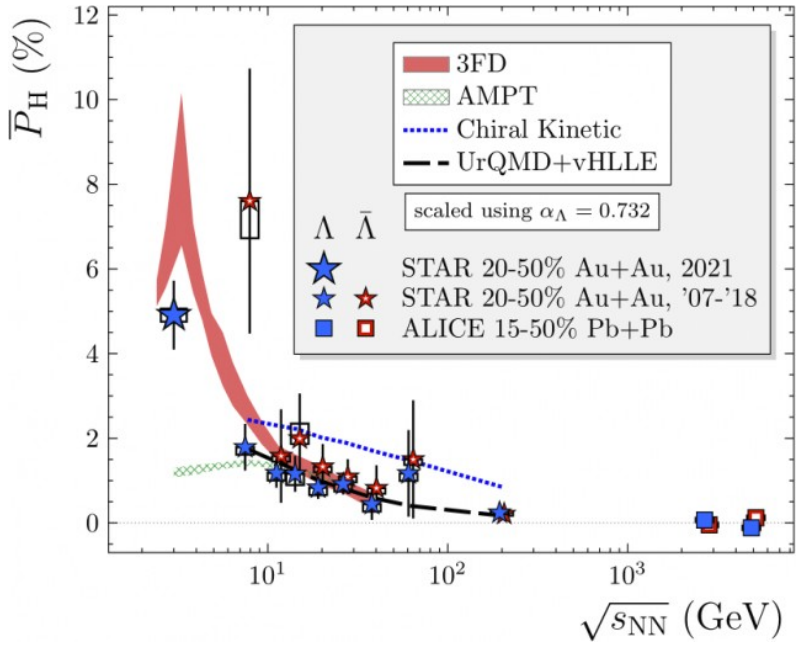
Phys.Lett. B 810 (2020) 135818

Phys.Rev. C 105 (2022) 3, 034907

Model compared with recent data

- Good description with data

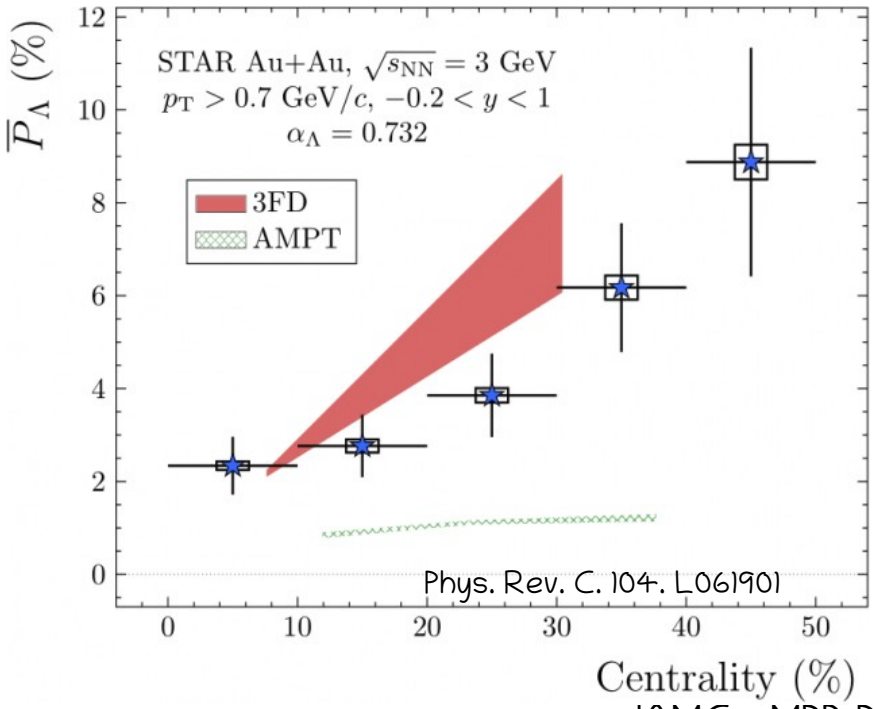


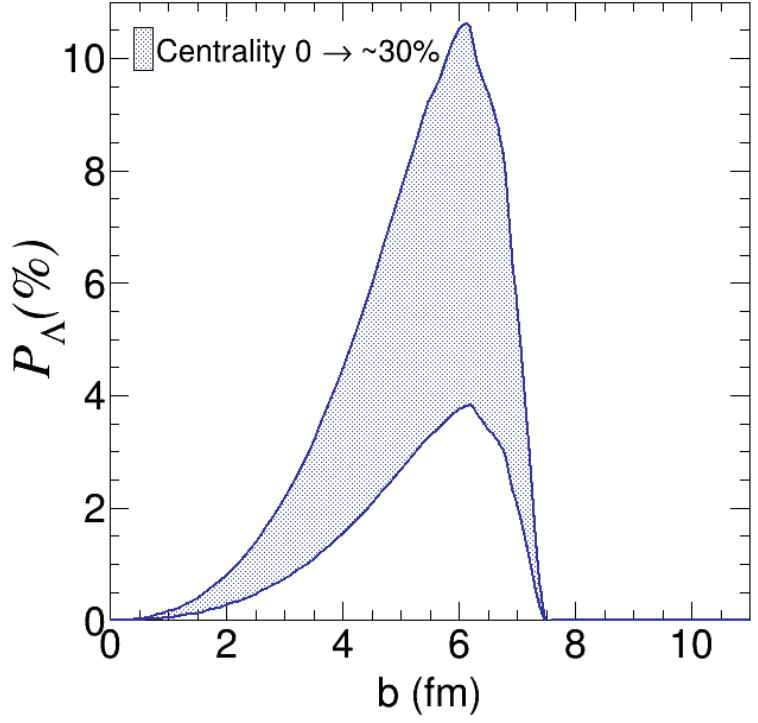


Phys. Rev. C. 104. L061901

As a function of centrality

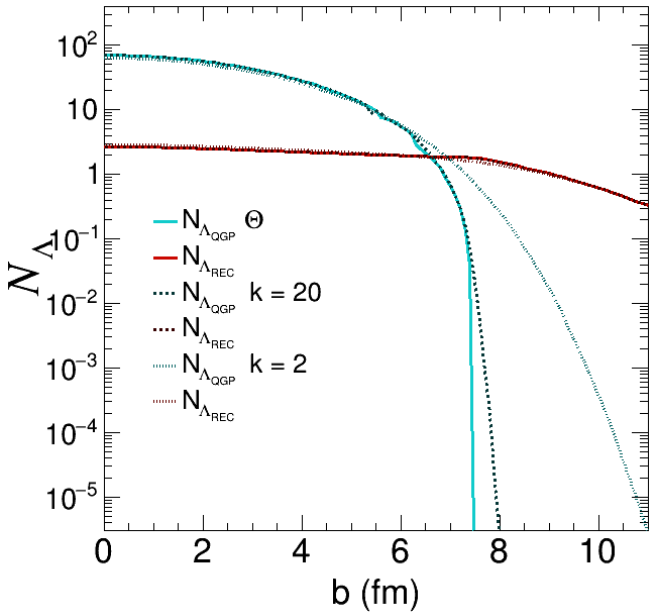
- Not defined for higher centrality

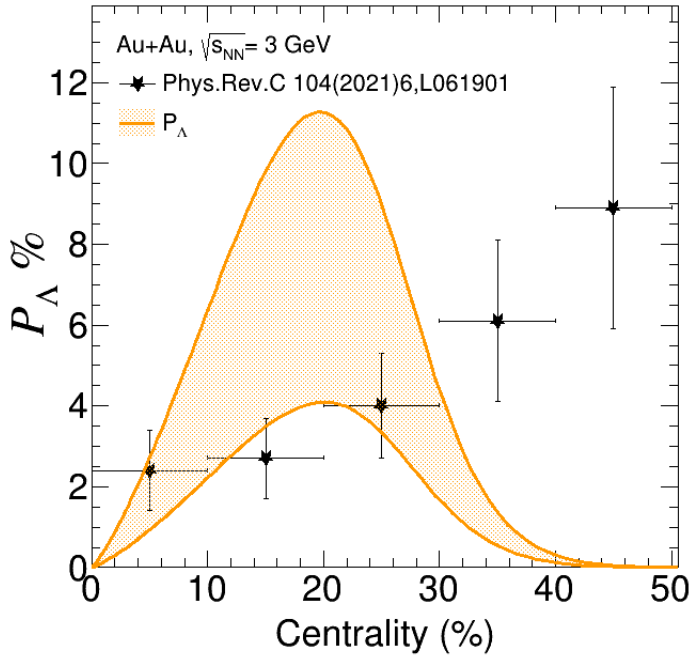




Changing n_c to achieve a QGP

- Not enough to reproduce data ArXiv:2207.10560v1 [hep-ph]





Is P_{REC} negligible?

- What is the effect of transverse polarization of Λ's in the corona?
- Actually, Λ's polarization in p+p is not zero

  - $\sqrt{s} = 19.6\text{GeV}$
    $\rightarrow \mathcal{P} = -0.25 \pm 0.26$
  - $\sqrt{s} = 53\text{GeV}$
    $\rightarrow \mathcal{P} = -0.34 \pm 0.07$
  - $\sqrt{s} = 62\text{GeV}$
    $\rightarrow \mathcal{P} = -0.40 \pm 0.10$

PoS HEP2005 (2006) 122,
V. Blobel et al., Nucl. Phys.B122 (1977) 429,
Phys. Rev.,D11:2405, 1975;

- In peripheral collisions transverse polarization is not diluted in the QGP medium.
- How do we transfer the measurement to have it with respect to total angular momentum?
- With simulations, we can estimate the effect of this in Hyperon Global polarization.

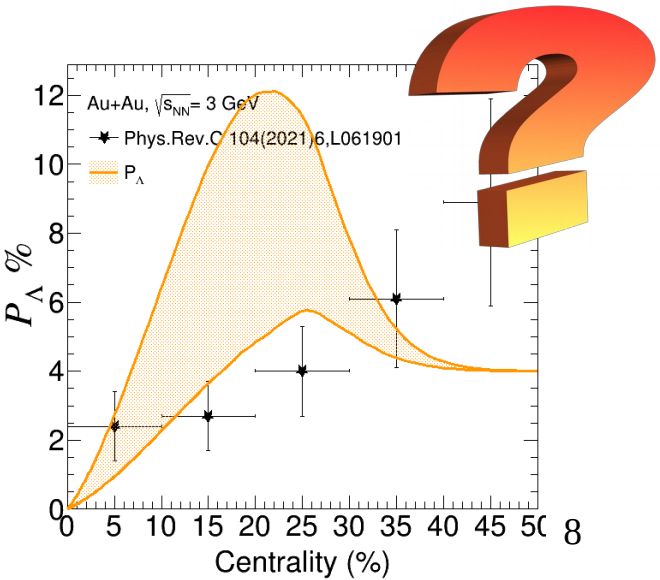
Nazarova, et. al. Phys.Part.Nucl.Lett., 2021, Vol. 18, No. 4, pp. 429-438
Chin.Phys.C 43 (2019) 1, 014103.

Polarization from Corona

- Polarization in peripheral collisions → fit data?
- Contribution of polarization from corona should be considered!

$$\mathcal{P}^{\Lambda} = \frac{\left(\mathcal{P}^{\Lambda}_{REC} + \frac{N^{\uparrow}_{\Lambda_{QGP}} - N^{\downarrow}_{\Lambda_{QGP}}}{N_{\Lambda_{REC}}}\right)}{\left(1 + \frac{N_{\Lambda_{QGP}}}{N_{\Lambda_{REC}}}\right)}$$

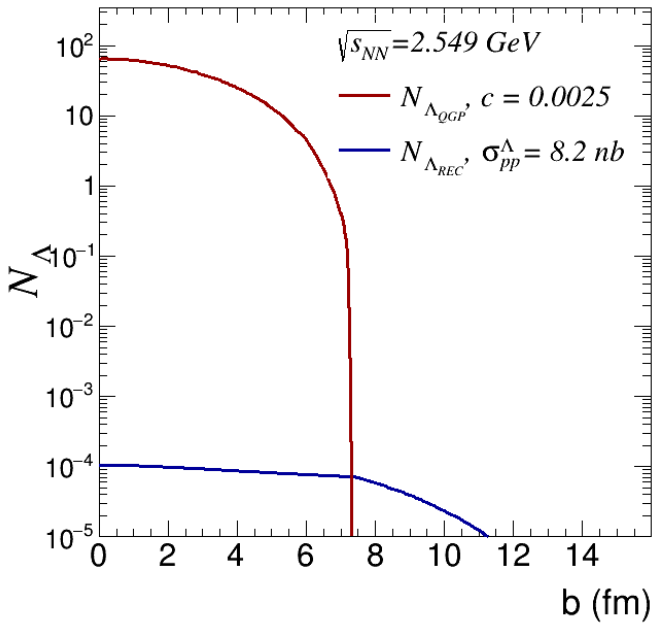
Adding an arbitrary value of P^{Λ}_{REC} → Data could be described?



We want: Λ's in different regions

- One of the main ingredients is the ratio N_{QGP}/N_{REC}
- Dependence on centrality
- Modules the magnitude of polarization

How to reproduce in mpdroot? → UrQMD



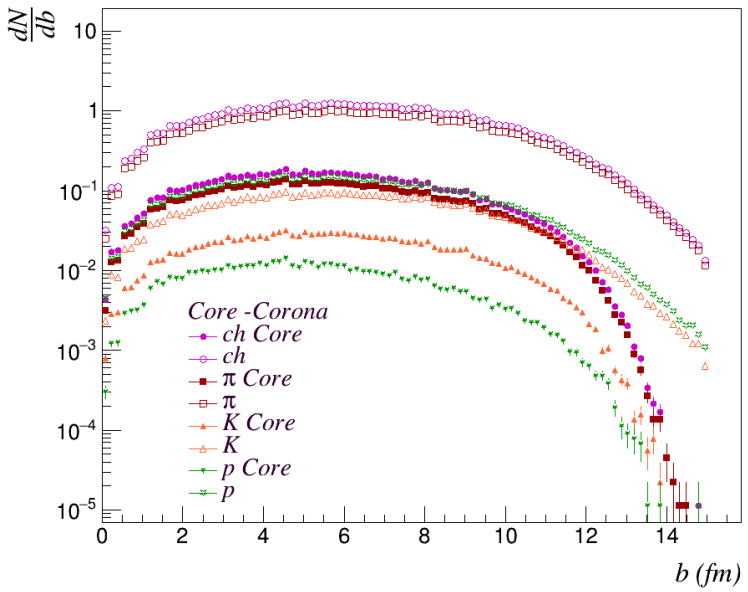
Core-Corona with UrQMD

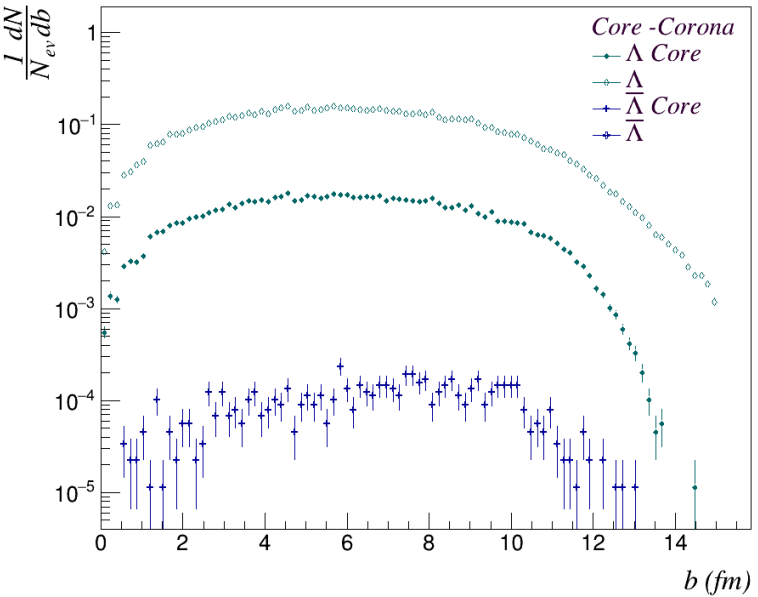
Is it possible to measure this effect in MPD? PHYSICAL REVIEW C 84, 024905 (2011)

- UrQMD → separation between core-corona
  - Core: propagated with fluid dynamics
  - Corona: mixed with spectators, in general particles that are not part of the fluid.
  - Quark-antiquark density, ~transition from the hydrodynamic phase back to the hadronic afterburner.
- Following results 89200 events

dN/db - pure MC

- Parameters used differs → can be used to model different contributions





Core contribution → b < ~ 14 GeV

→

Data could be described? Adding some polarization

Transport to MPD

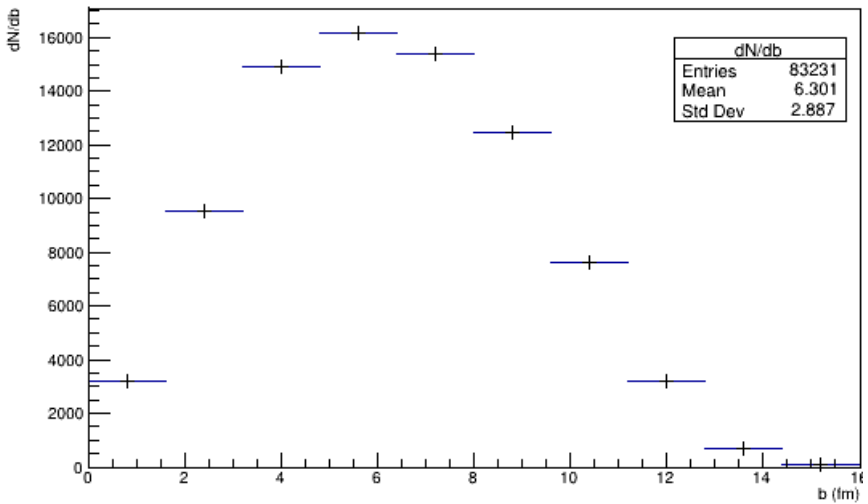
- Assign different values of polarization to particles from
  - Core → w.r.t $\hat{L} = \hat{b} \times \hat{p}_{beam}$
  - Corona → w.r.t $\hat{n} = \frac{\vec{p_{beam}} \times \vec{p}_{\Lambda}}{|\vec{p_{beam}} \times \vec{p}_{\Lambda}|}$
- As a first attempt → assign fixed value only to Corona

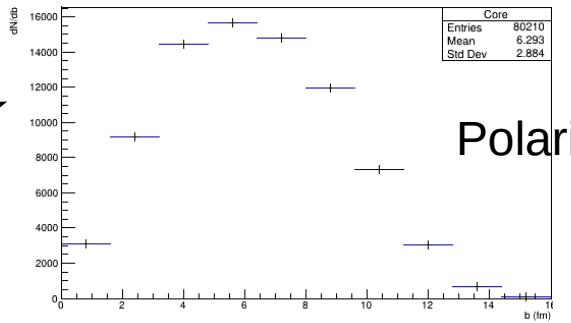
Requirements

- UrQMD sample → with Core-Corona
- Modify classes MpdUrqmdGenerator to include process type
- Assign a fixed polarization value to Λ's in the corona
- Transfer polarization to decay particles
- Reconstruction of polarization with respect L

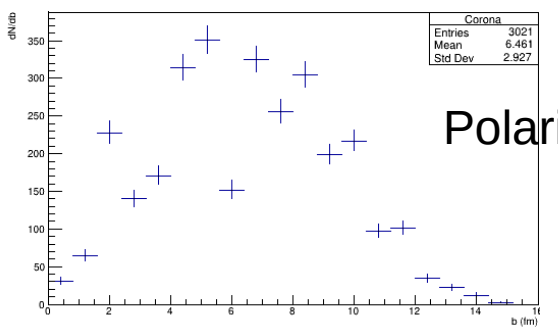
Work in progress

- Analyze sample with core-corona separation
- Reconstruction of polarization from the core





Polarization = 0



Polarization = 1

Summary

- Implementation of Core-corona description with UrQMD.
- Abundances of hyperons, differs from phenomenological model.
- First attempt to introduce corona polarization in mpdroot, and separate core-corona in MCTracks works.
- Polarization reconstruction in corona within mpdroot is work in progress.