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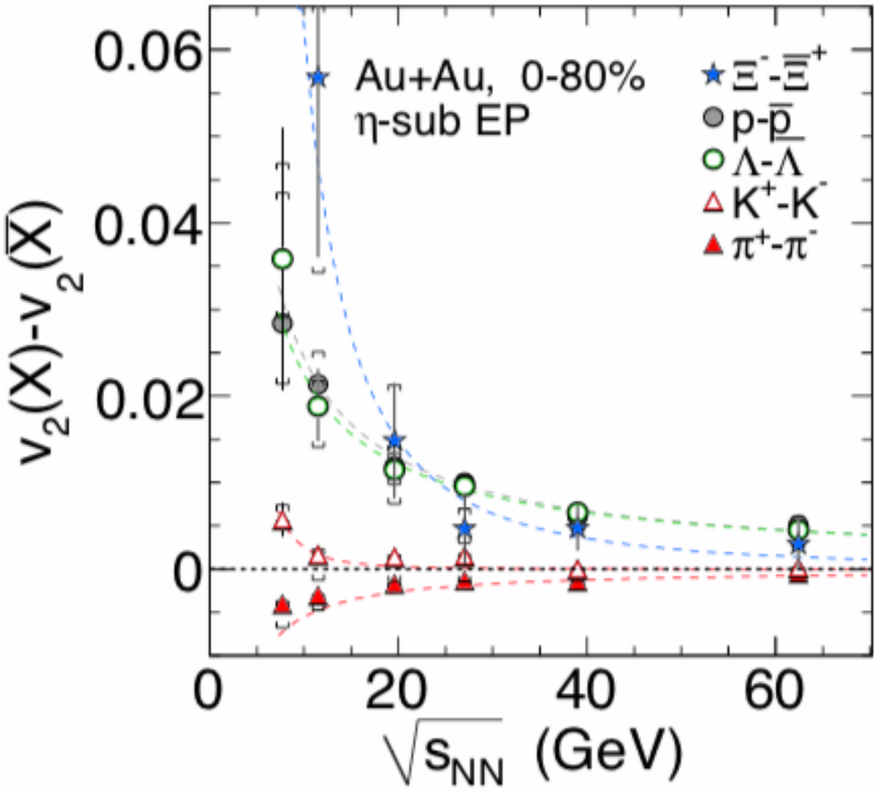
PARTICLES' AND ANTIPARTICLES' FLOW DIFFERENCE STUDIES

MOTIVATION

Differences between particle's and antiparticle's elliptic flow had been observed by the STAR collaboration.

STAR Collaboration: Phys. Rev. C 88 (2013) 14902



STAR Collaboration: Phys. Rev. C 88 (2013) 14902

- Difference of protons - antiprotons elliptic flow increase with decreasing collision energy

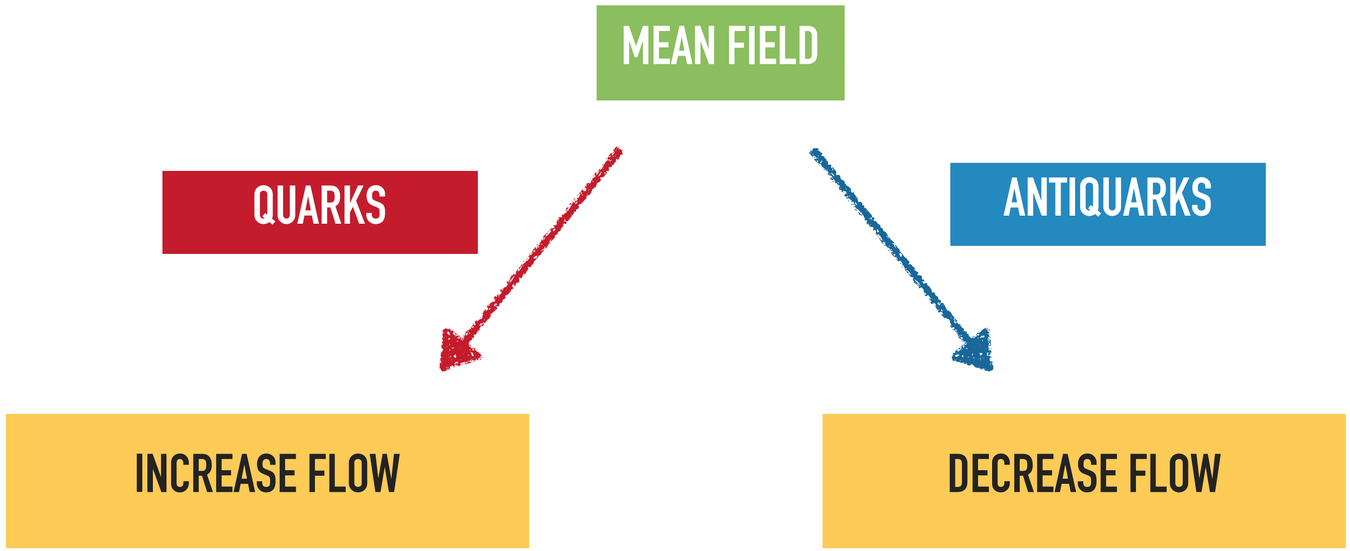
More studies are needed for better understanding

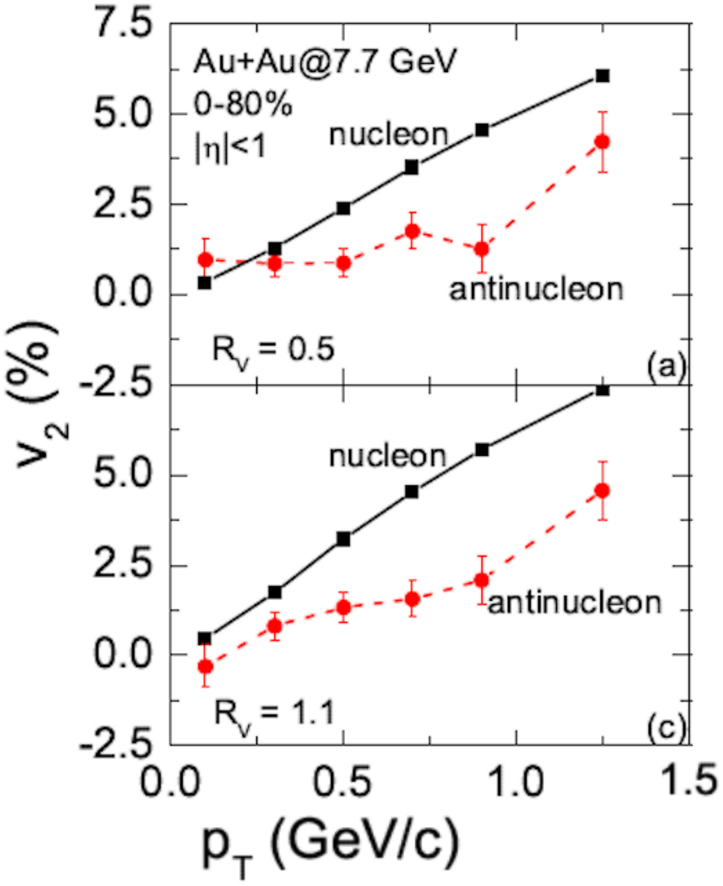
OBSERVATION

Difference between particle's and antiparticle's elliptic flow depending on collision energy.

1. Mean field: repulsive potential for quarks and attractive for antiquarks (Phys. Rev. Lett. 112, 012301 (2014))

repulsive potential - likely to move along to participant plane direction
attractive potential - likely to move in perpendicular to participant plane direction



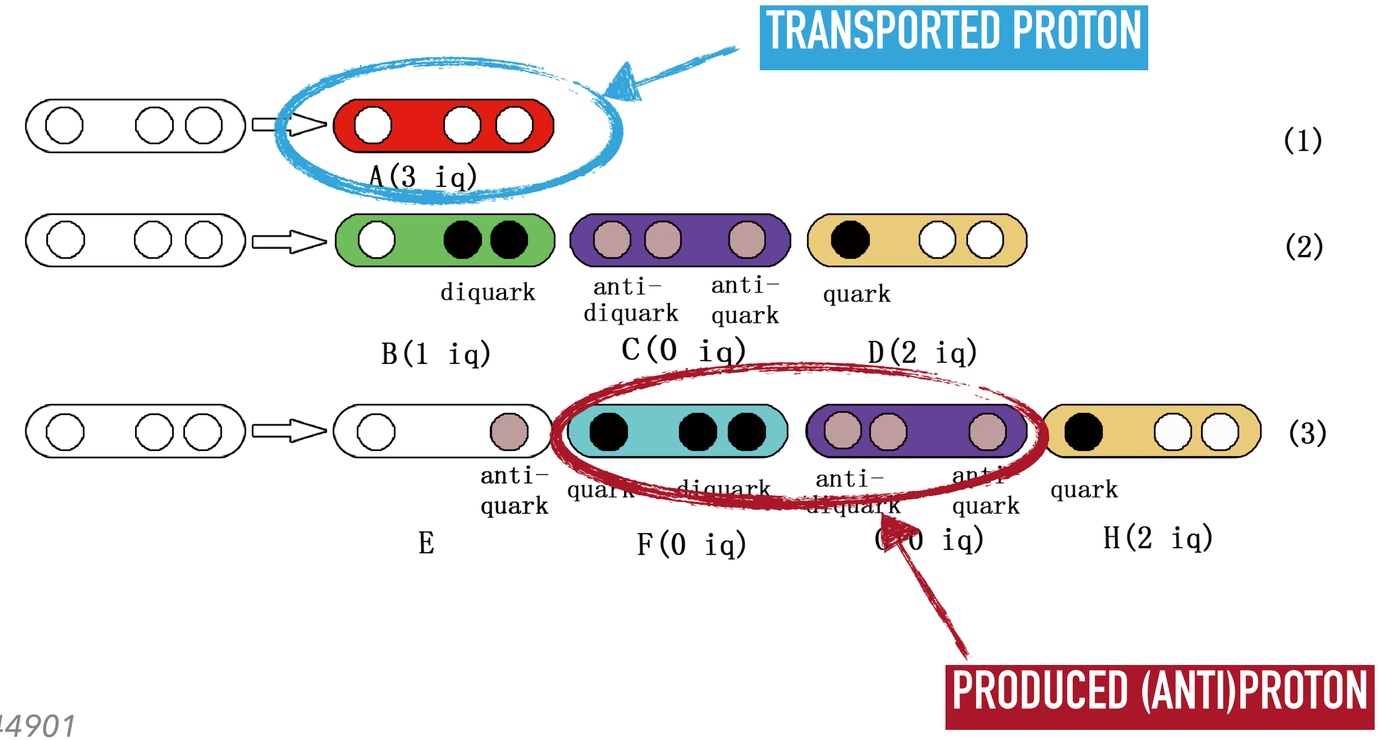


AMPT and 3-flavor Nambu-Jona-Lasinio model

OBSERVATION

Difference between particle's and antiparticle's elliptic flow depending on collision energy.

1. **Mean field**: repulsive potential for quarks and attractive for antiquarks (Phys. Rev. Lett. 112, 012301 (2014)
2. **Transported** (coming from collided nuclei) and **produced protons** (arXiv:1810.07869v1,2018):



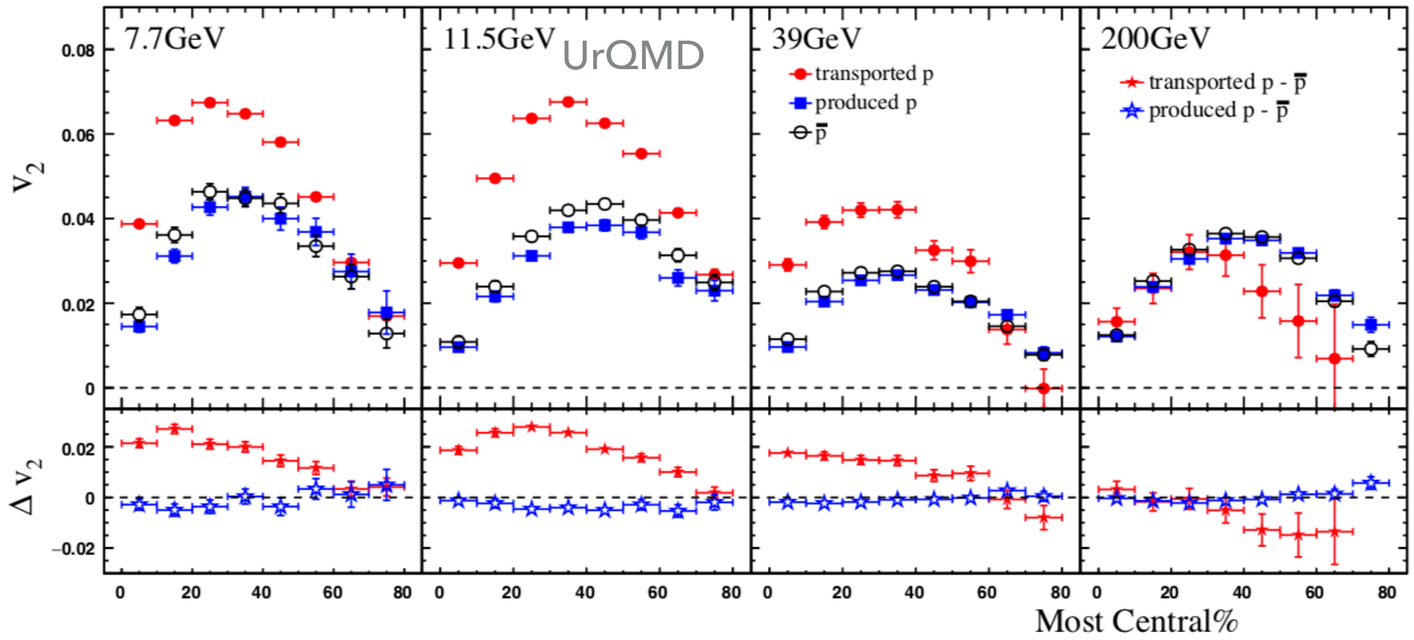
Phys.Rev. C86 (2012) 044901

OBSERVATION

Difference between particle's and antiparticle's elliptic flow depending on collision energy.

1. **Mean field**: repulsive potential for quarks and attractive for antiquarks (Phys. Rev. Lett. 112, 012301 (2014)
2. **Transported** (coming from collided nuclei) and **produced protons** (arXiv:1810.07869v1,2018):

- transported protons have strongly positive correlation in comparison with produced
- both produced protons and antiprotons have similar flow - origin from same part of evolution
- transported *p* go through all evolution process of transformation of initial geometry eccentricities to anisotropy in momentum, produced can commit part of scenario
- energy dependence can be explained by **nuclear stopping**



PROPOSED METHODS

Difference between protons' and antiprotons' elliptic flow:

Proposed studies:

- **NCQ (KE_T) scaling**
  - Scaling cancels the hadrons mass order
  - Gives possibility to verify the *mean-field* scenario.

- **Factorisation in the two-particle correlation**

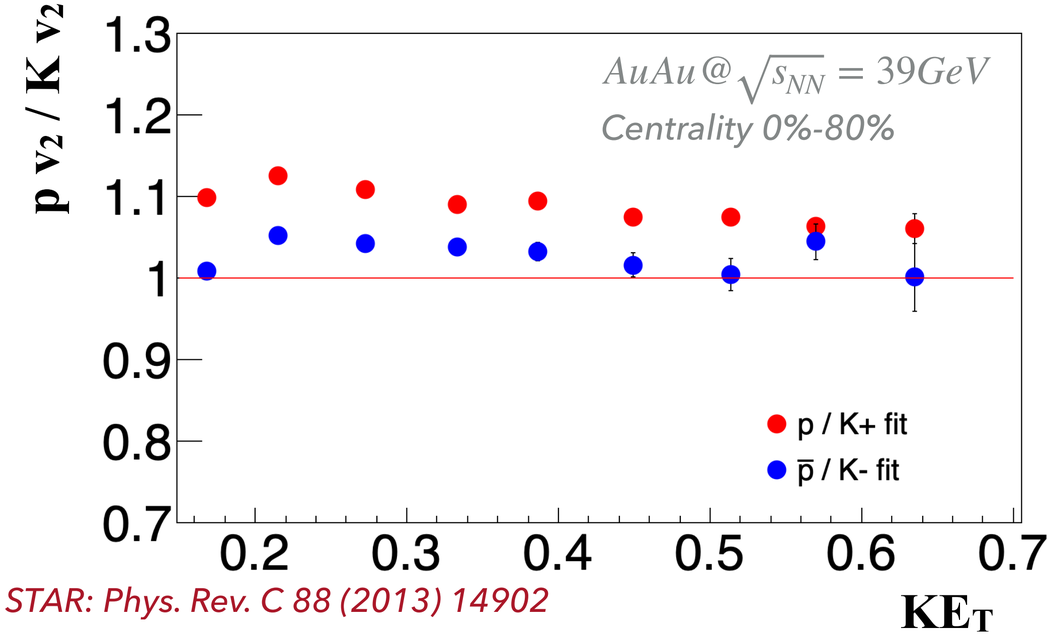
$$v_n = v_n^2(p_1, p^{ref}) / \sqrt{v_n^2(p^{ref}, p^{ref})}$$

  - Selection of different particle species for a reference
  - Flow of produced hadrons is expected to be reference-independent
  - Gives possibility to verify the *produced/transported protons* scenario.

INVESTIGATION OF PARTICLE / ANTIPARTICLE FLOW

Mean field scenario:

- expected proton and antiproton violate NCQ(KE_T) scaling in the same magnitude (but opposite sign)



STAR: Phys. Rev. C 88 (2013) 14902

- Protons and antiprotons break the NCQ(KE_T) scaling
  - ***The mean field scenario not validate***

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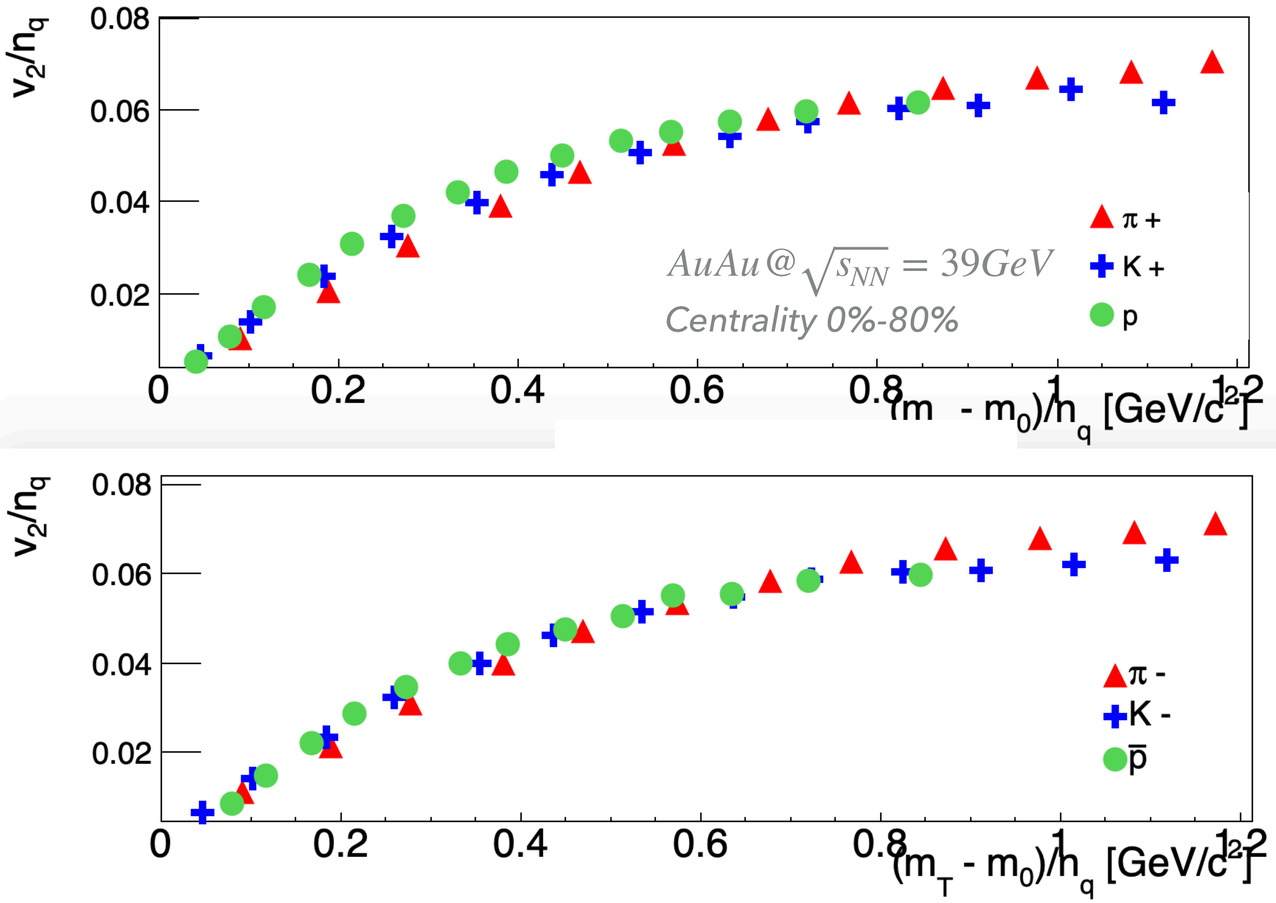

INVESTIGATION OF PARTICLE / ANTIPARTICLE FLOW

- **Factorisation in the two-particle correlation**

$$v_n = v_n^2(p_1, p^{ref}) / \sqrt{v_n^2(p^{ref}, p^{ref})}$$

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  - Gives possibility to verify the *produced/transported protons* scenario.

To learn more the EPOS model will be compared with the STAR data

SUMMARY

- two possible explanations of proton - antiproton flow differences are being studied
- NCQ(KE_T) of v_2 scaling does not validate the *mean field* approach

QUESTIONS

- Should we even take into consideration *„mean field"* approach for such high energies?
- If we see the breaking in factorisation of flow correlations, can we assume presence of transported protons?

Thank you for attention!