# Light Nuclei and Hyper-Nuclei Directed Flow in $\sqrt{s_{NN}}$ = 3.0-4.5 GeV Au+Au Collisions at STAR

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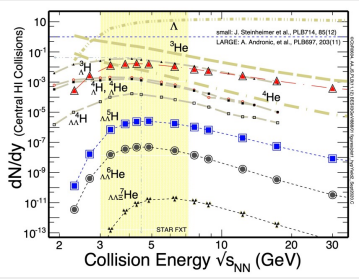
## Abstract

Measurements of collective flow of light and hyper-nuclei in heavy-ion collisions at high baryon density are important for understanding the formation mechanism of light nuclei and hyper-nuclei.

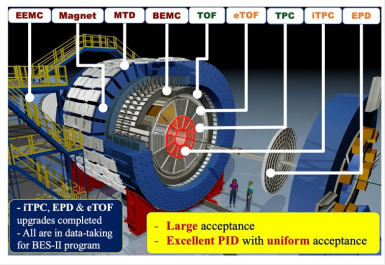
In this poster, we will present the results on energy and particle mass dependence of mid-rapidity directed flow ($v_1$) of hyper-nuclei($\Lambda$, $^3_\Lambda$H, $^4_\Lambda$H) and light nuclei(p, d, t, $^3$He, $^4$He) in mid-central Au+Au collisions at $\sqrt{s_{NN}}$ from 3.0 to 4.5 GeV. The mid-rapidity $v_1$ slope of hyper-nuclei shows a similar energy and particle mass dependence to that of light nuclei. These new results are compared to hadronic transport model calculations.

## Motivation



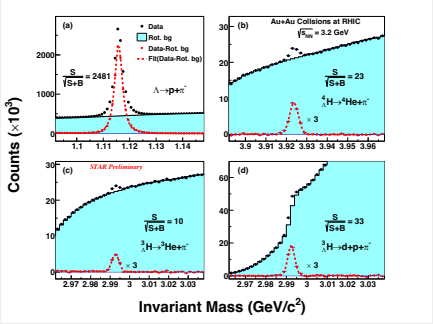

- Light nuclei and hyper-nuclei production are enhanced in the high baryon density region.[1][2]
- Light nuclei and hyper-nuclei properties provide important information about N(nucleon)-N and Y(hyperon)-N interactions.

## STAR Detector



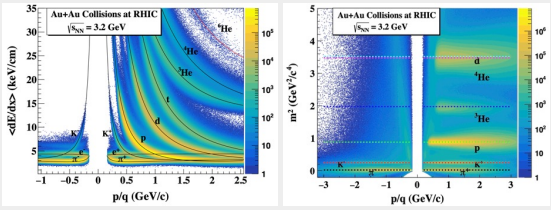

- The STAR detector has full azimuthal coverage, and tracking and PID coverage for $|\eta|<1.5$ with the iTPC and eTOF upgrades. The EPD, which is used for event-plane reconstruction covers $2.1<|\eta|<5.1$ .

## Hyper-Nuclei Reconstruction




- Hyper-Nuclei are reconstructed with KFParticle package[4] based on Kalman filter method to improve signal significance.

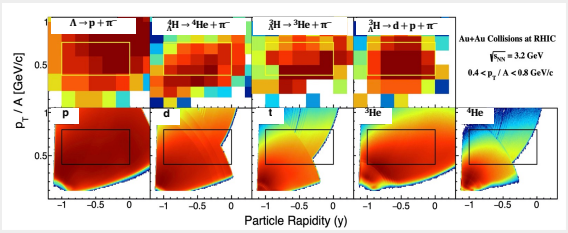
## Particle Identification



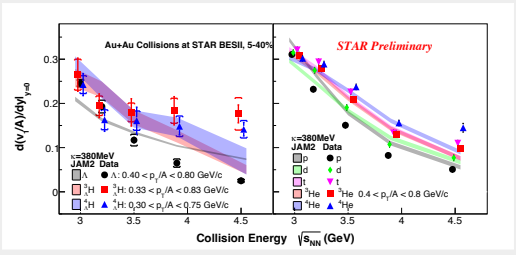

- Good PID capability based on TPC and TOF information.

## Acceptance

- Collective flow of light- and hyper-nuclei are calculated within the selected $p_T$/A range as indicated by the boxes.
- Light nuclei and hyper-nuclei have good acceptance in mid-rapidity region.



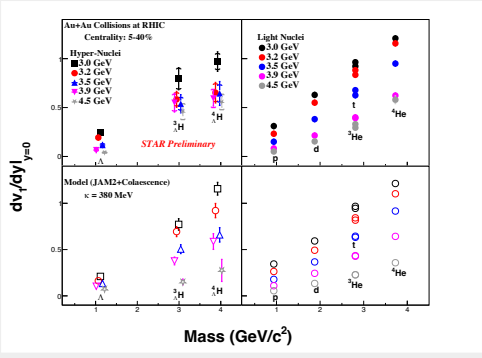

## Energy dependence of $v_1$




- As the collision energy increases, the mid-rapidity $v_1$ slope of light nuclei and hyper-nuclei decreases, but hyper-nuclei does not have strong energy dependence.

## Mass dependence of $v_1$

- The $dv_1/dy|_{y=0}$ of the light nuclei is obtained by fitting $v_1(y)$ with a first-order plus third-order function, while that of the hyper-nuclei is obtained by fitting a first-order function.
- The $v_1$ slope $dv_1/dy$ at y=0 for both light and hyper-nuclei(solid markers) are scaled with atomic mass number(A) and/or particle mass.




## Conclusion

- Light nuclei and hyper-nuclei $dv_1/dy$ exhibits a clear dependence on mass dependence.
- Hadronic transport model (JAM2 mean field + Coalescence) calculations for mid-rapidity $v_1$ are consistent with observed dependences on both mass and collision energy.

## Reference

[1] Phys. Lett. B697,203(2011) [2] Phys. Lett. B714, 85(2012) [3] Phys. Rev. C 58, 1671 (1998).
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