

Elliptic flow of light nuclei in Au+Au collisions at $\sqrt{s_{NN}} = 14.6, 19.6, 27, \text{ and } 54.4 \text{ GeV}$ using the STAR detector

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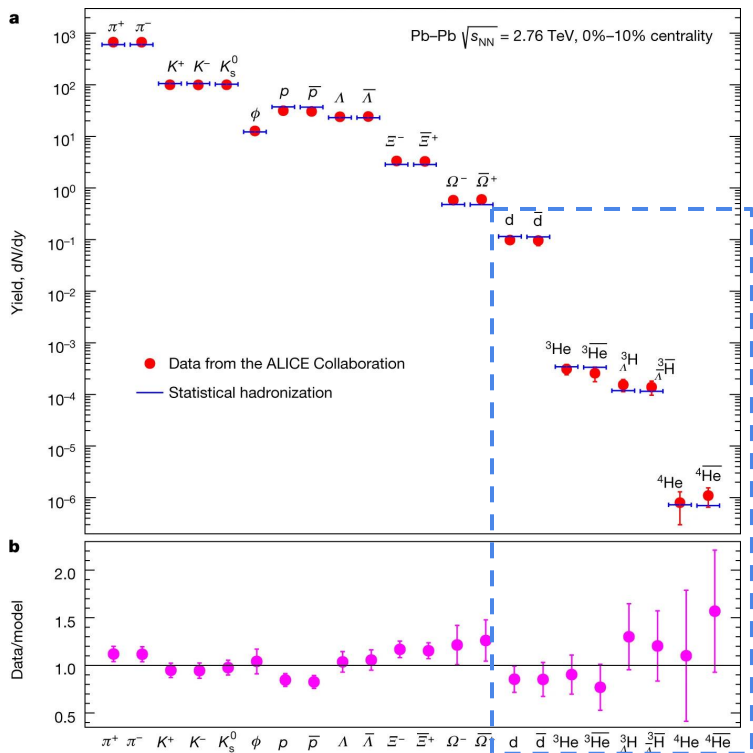


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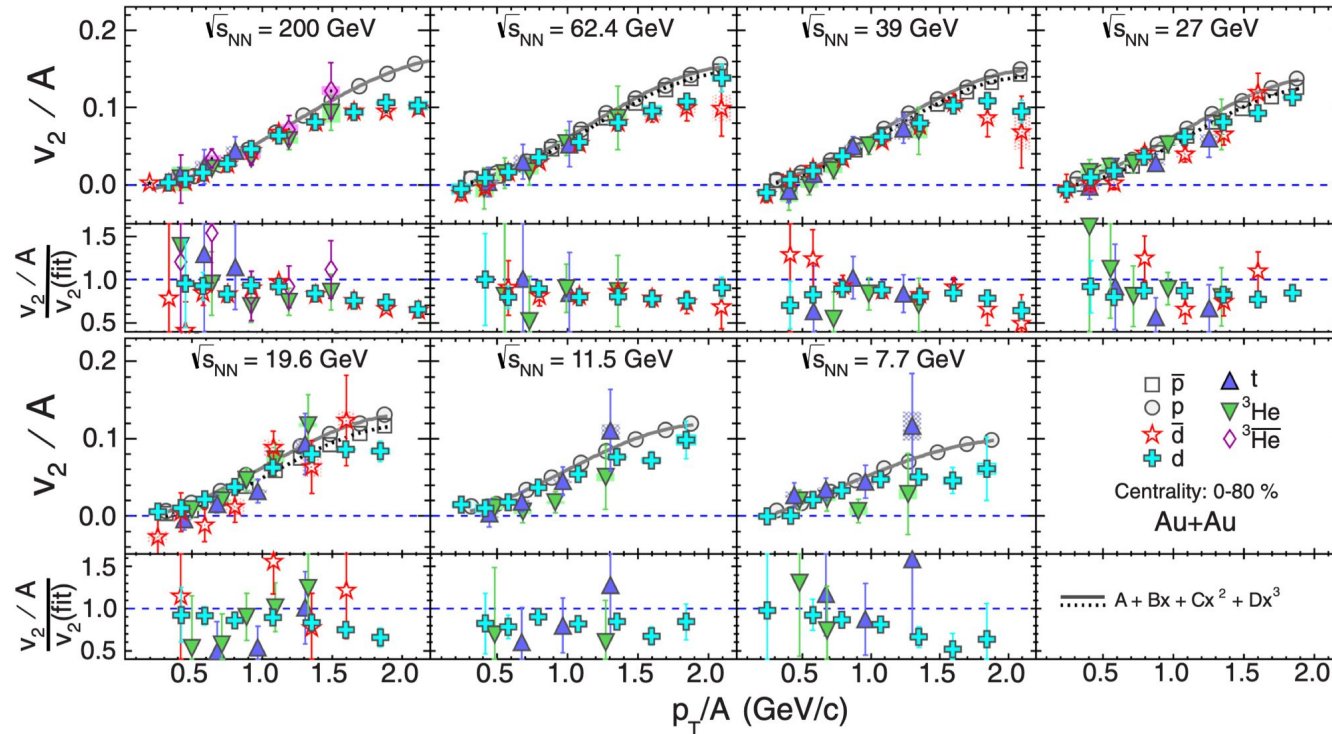
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- ★ Motivation
- ★ The STAR experiment
 - Analysis details
- ★ Results
 - p_T and centrality dependence of elliptic flow of d, t, and ^3He
 - Mass number scaling of elliptic flow
- ★ Summary

Motivation



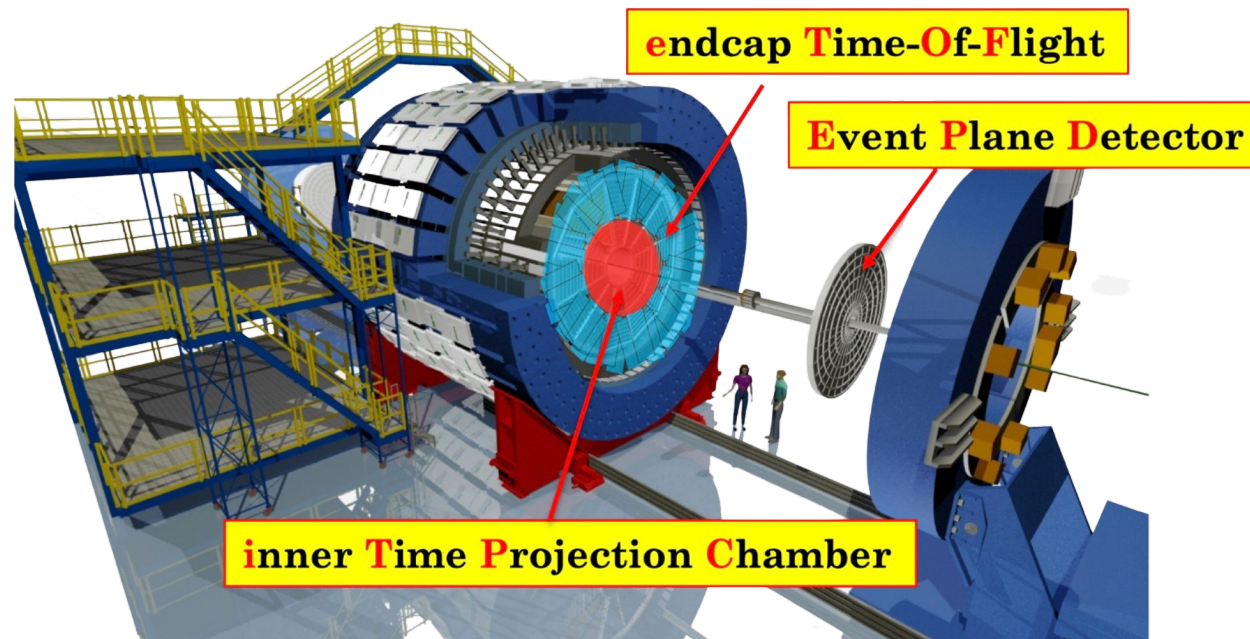
A. Andronic *et al.*, Nature 561 321–330 (2018)



STAR, PRC 94, 034908 (2016)

- ★ **Thermal model:** Light nuclei are produced near the CFO along with other hadrons
- ★ **Coalescence model:** Light nuclei are produced near KFO by the coalescence of final state nucleons
 - **Mass number scaling** of light nuclei v_2
- ★ v_2/A of light nuclei was observed to be close to v_2 of protons for $p_T/A < 1.5$ GeV/c in BES-I data
- ★ Higher statistics dataset in BES-II program will allow us to better understand the production mechanism of light nuclei

The STAR Experiment

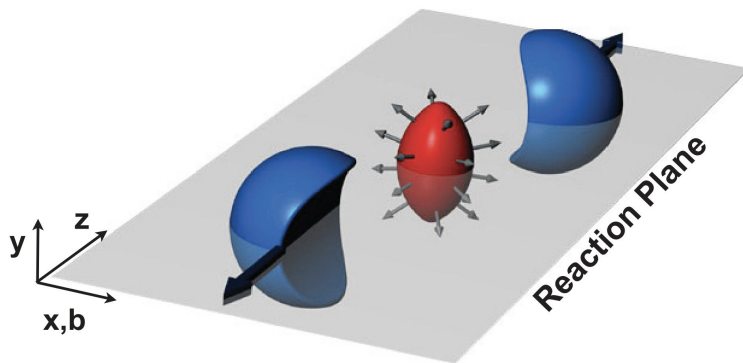


C. Yang *et al.*, JINST 15 C07040 (2020)

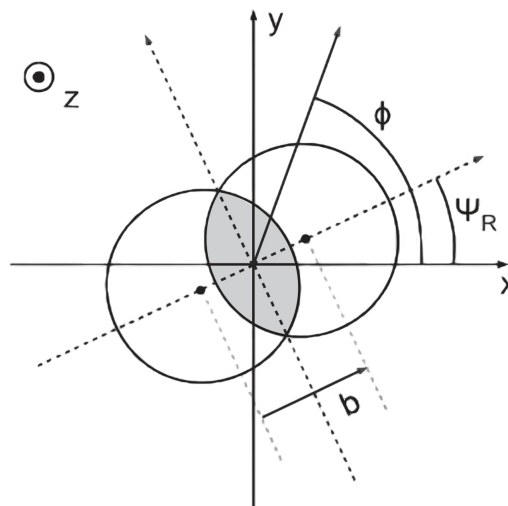
Solenoidal Tracker At RHIC

- ★ Particle identification is performed using
 - dE/dx information from **Time Projection Chamber (TPC)**
 - m^2 information from **Time of Flight (TOF)**
- ★ BES-II upgrades:
 - iTPC: Large pseudorapidity coverage ($|\eta| < 1.5$)
 - Better track resolution
- ★ Datasets
 - **BES-II**: Au+Au collisions at $\sqrt{s_{NN}} = 14.6, 19.6, 27, \text{ and } 54.4 \text{ GeV}$

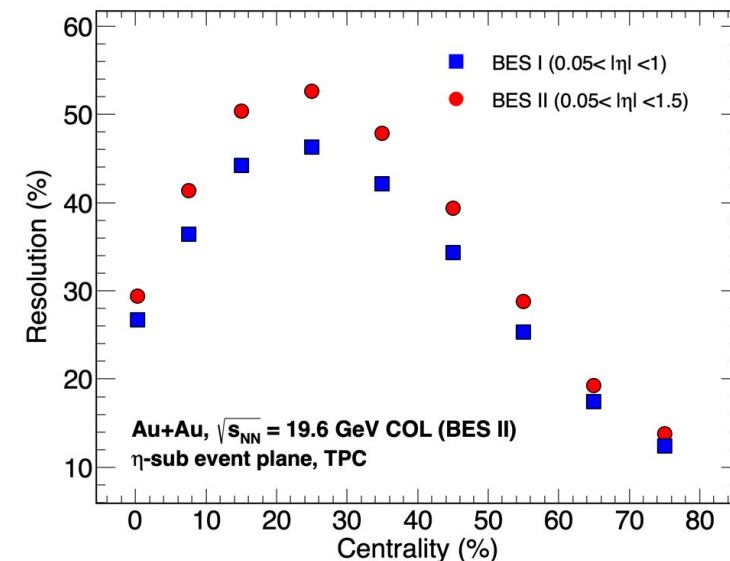
Analysis Details



R. Snellings, *New J.Phys.*13:055008 (2011)



CMS, *PRC* 87 014902 (2013)



Improvement of resolution by ~10% from BES-I

- ★ The particle azimuthal distribution can be written as:

$$E \frac{d^3 N}{d^3 p} = \frac{1}{2\pi} \frac{d^2 N}{p_T dp_T dy} \left\{ 1 + \sum_{n=1}^{\infty} 2v_n \cos(n(\phi - \Psi_R)) \right\} \quad v_n = \langle \cos(n(\phi - \Psi_R)) \rangle$$

- ★ n^{th} harmonic plane is calculated using the Q-vector:

$$Q_x = Q_n \cos(n\Psi_n) = \sum_i w_i \cos(n\phi_i)$$

$$Q_y = Q_n \sin(n\Psi_n) = \sum_i w_i \sin(n\phi_i)$$

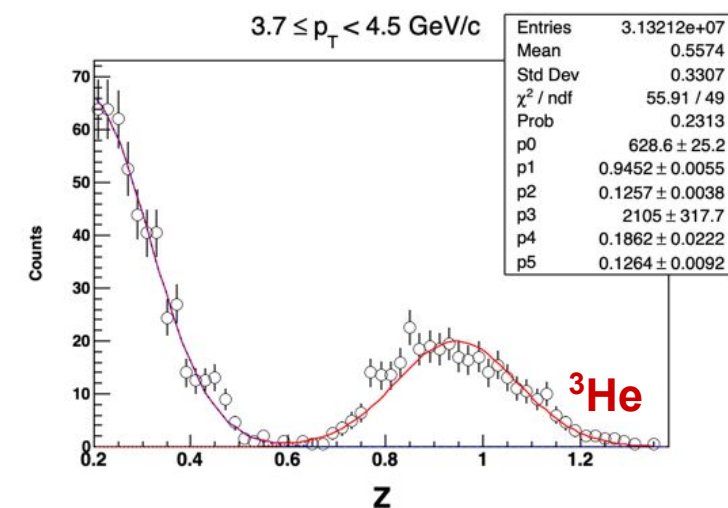
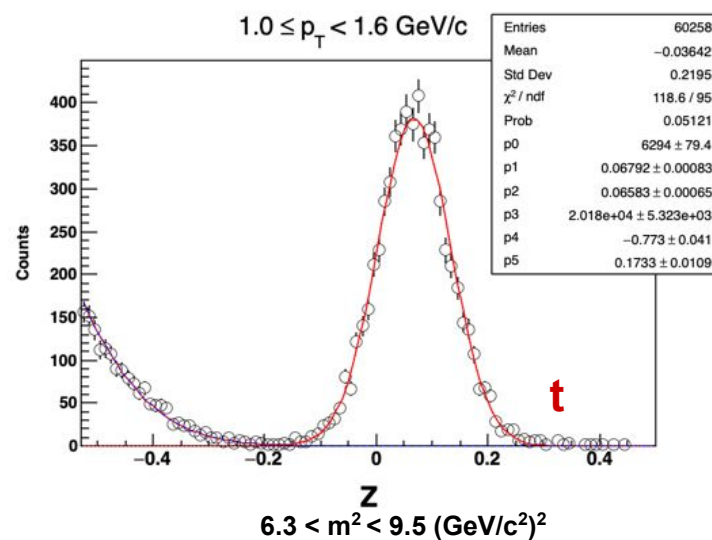
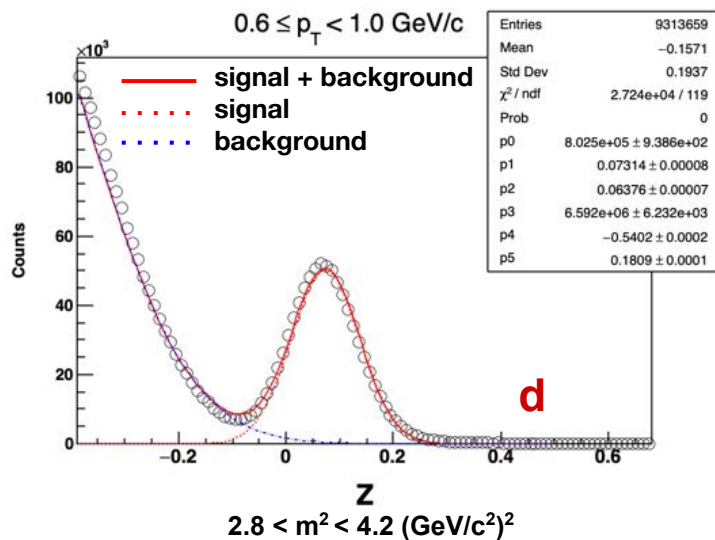
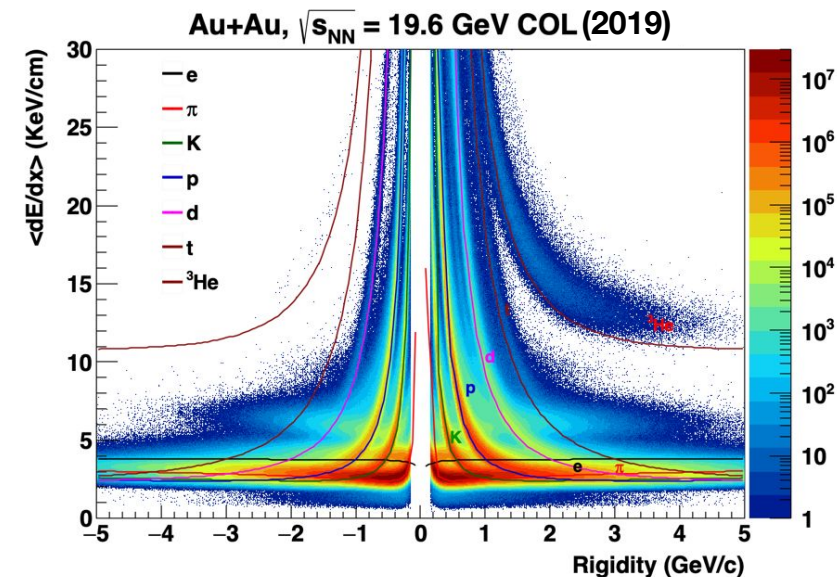
$$\Psi_n = \frac{1}{n} \tan^{-1} \frac{Q_y}{Q_x}$$

- ★ Particles are identified using dE/dx information from TPC in the range $|\eta| \leq 1.0$

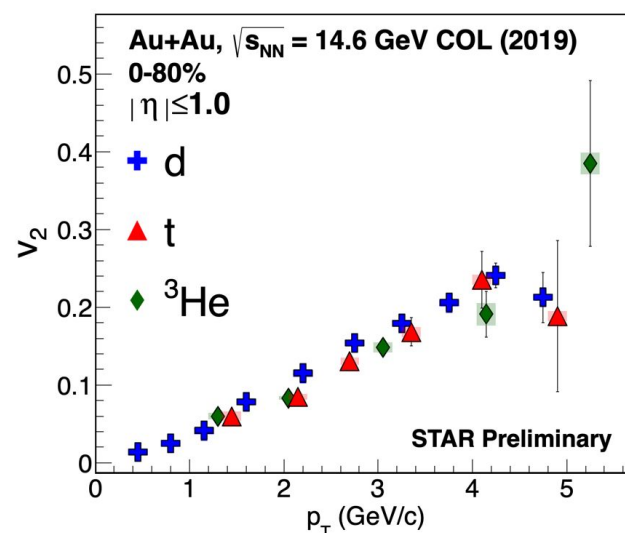
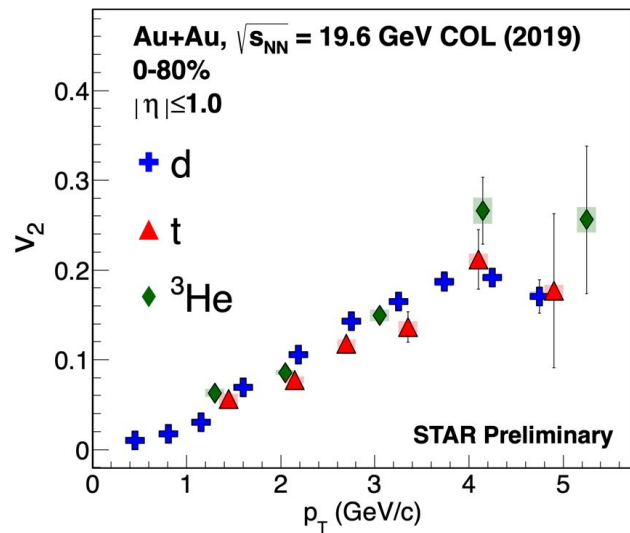
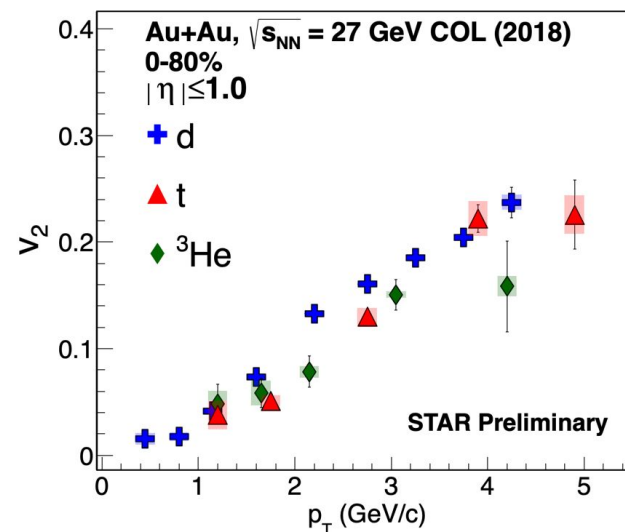
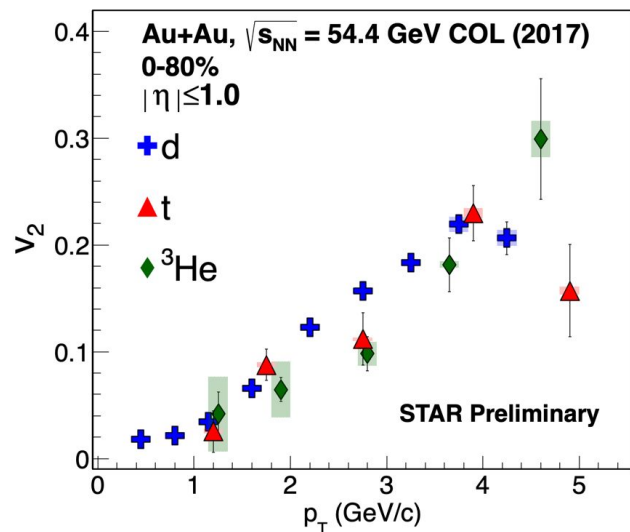
$$z = \ln \left(\frac{\langle dE/dx \rangle_{\text{measured}}}{\langle dE/dx \rangle_{\text{theory}}} \right)$$

- ★ $\langle dE/dx \rangle_{\text{theory}}$ is calculated using Bichsel function

- ★ Double Gaussian fit is done to calculate yield in each p_T and $\phi-\Psi_2$ bin

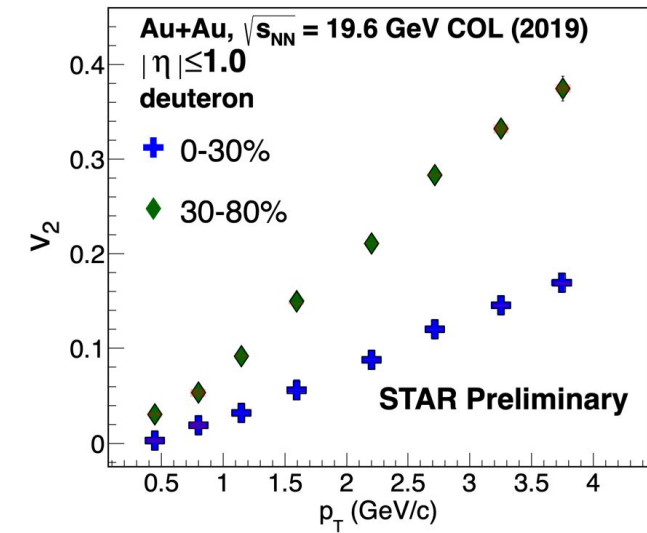
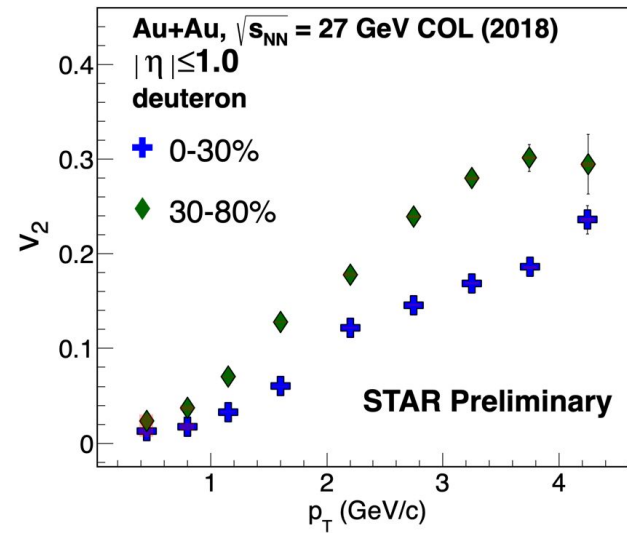
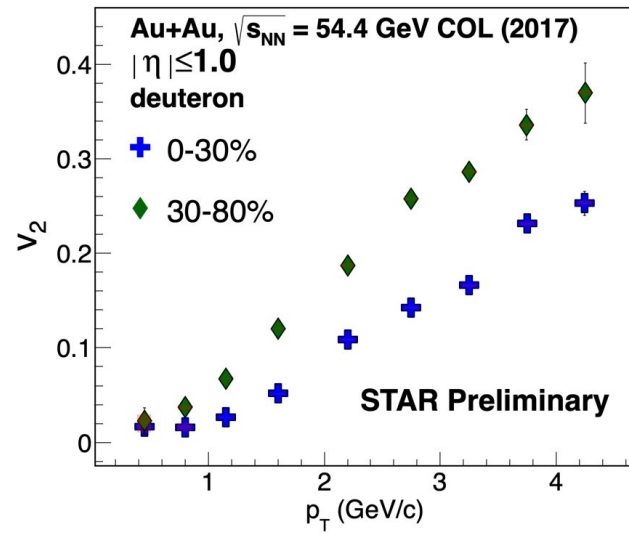


Elliptic flow of light nuclei



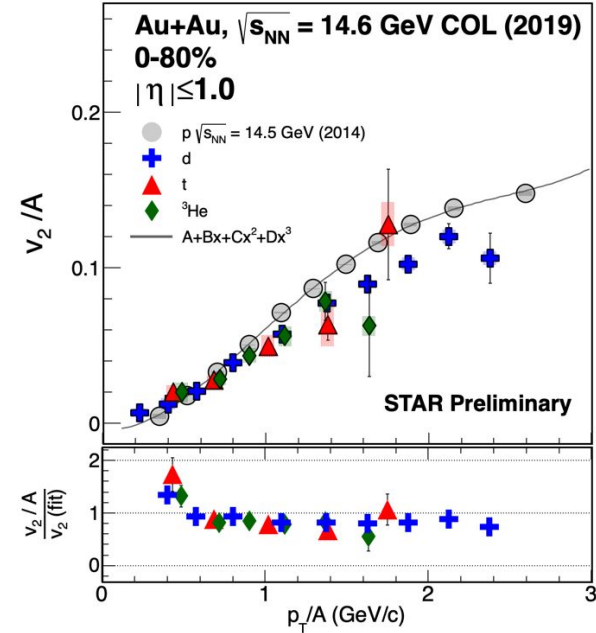
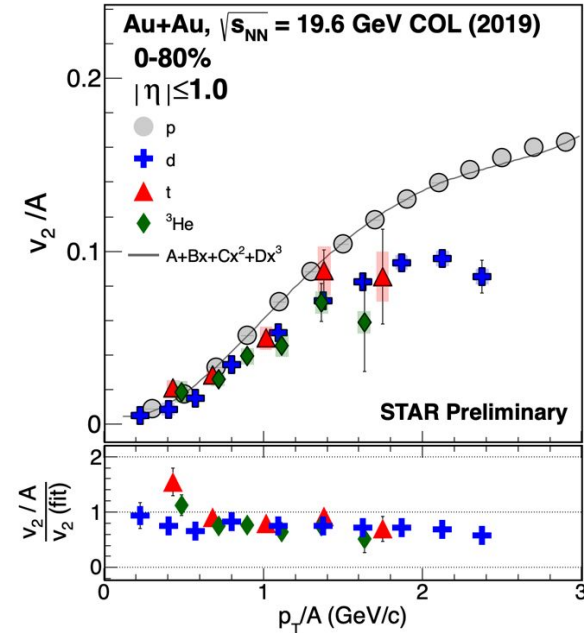
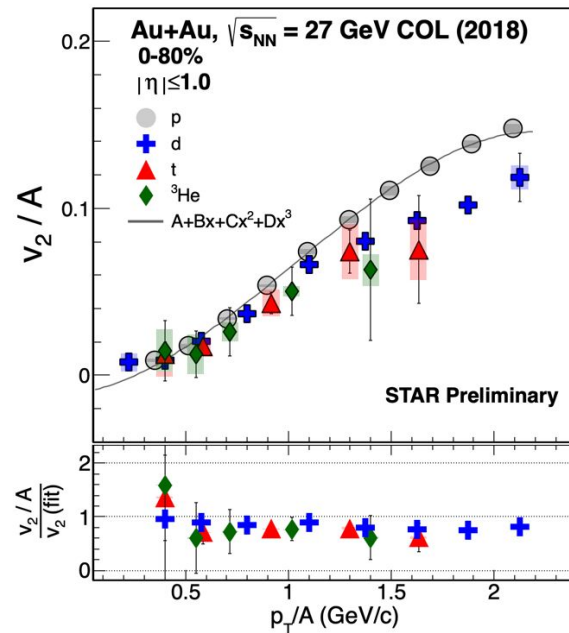
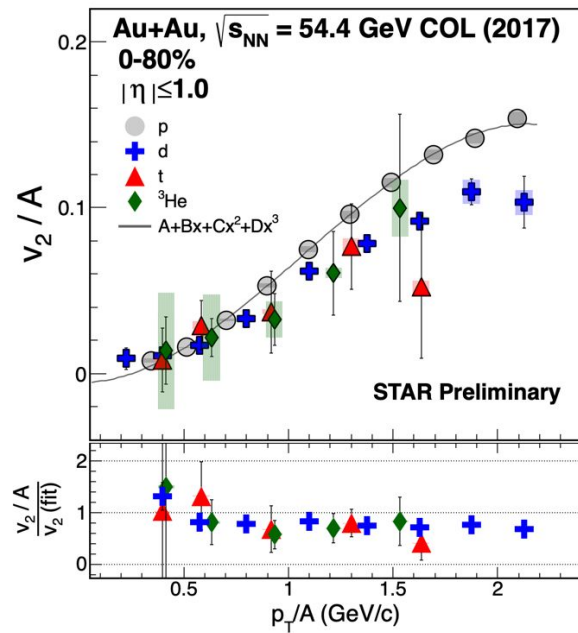
★ The $v_2(p_T)$ for all nuclei species increases with increasing p_T for all collision energies

Centrality dependence



- ★ v_2 of deuterons shows a strong centrality dependence
 - Peripheral collisions have relatively larger v_2 due to their larger initial spatial anisotropy

Mass number scaling



*lines correspond to 3rd order fit to the proton v_2 data

★ v_2 of light nuclei obeys the mass number scaling within 20-30%

- ★ v_2 of d, t, and ^3He is measured in Au+Au collisions at $\sqrt{s_{\text{NN}}} = 14.6, 19.6, 27, \text{ and } 54.4 \text{ GeV}$ (Collider)
 - Clear centrality dependence is observed for deuterons for all collision energies
 - Light nuclei v_2 seems to be obeying mass number scaling within 20-30%

Outlook

- ★ Stay tuned for more exciting results on light nuclei flow from BES II energies

Thank you