



Transverse spherocity dependence of azimuthal anisotropy in heavy-ion collisions at the LHC using a multi-phase transport (AMPT) model

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1. Introduction

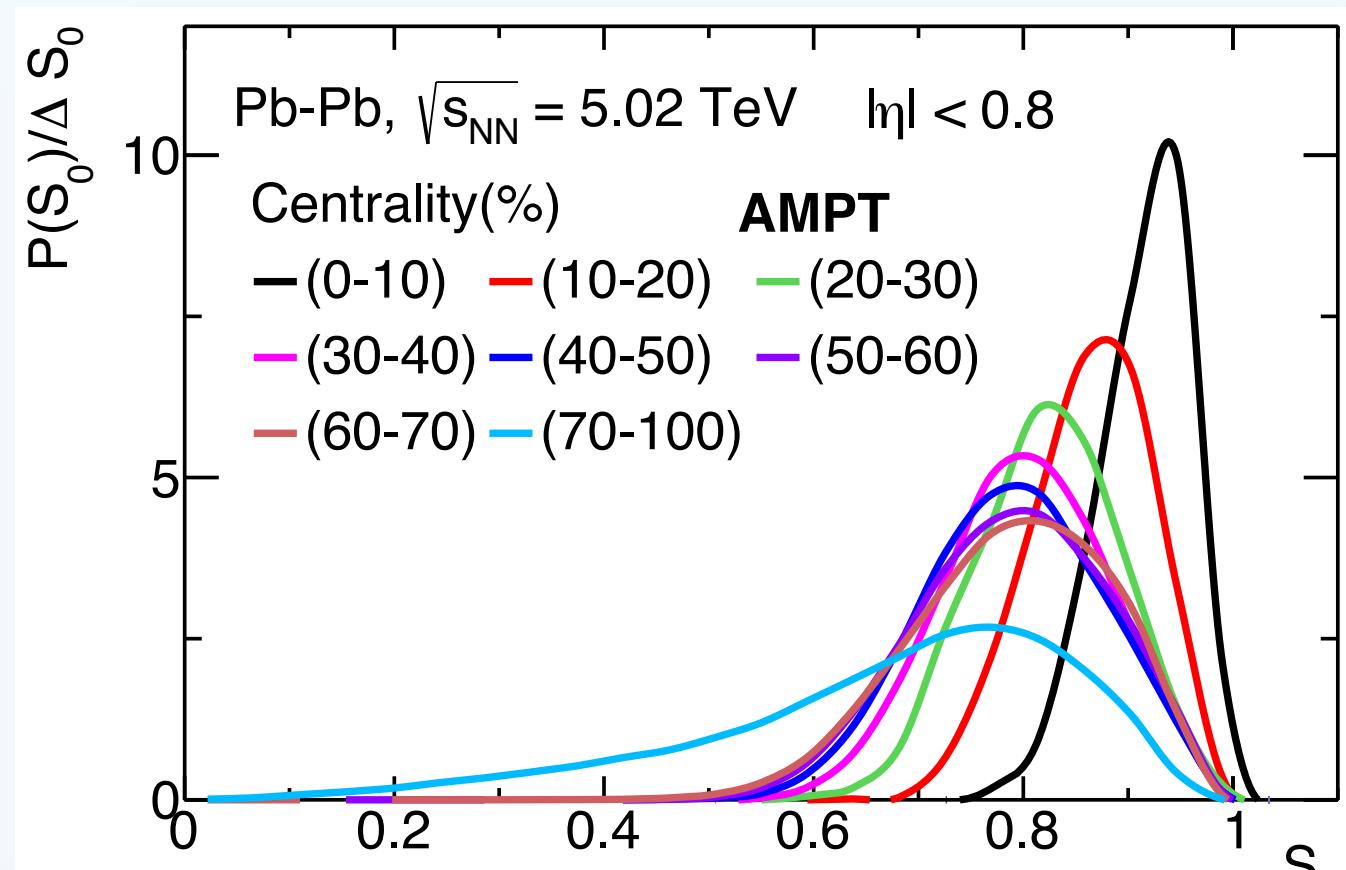
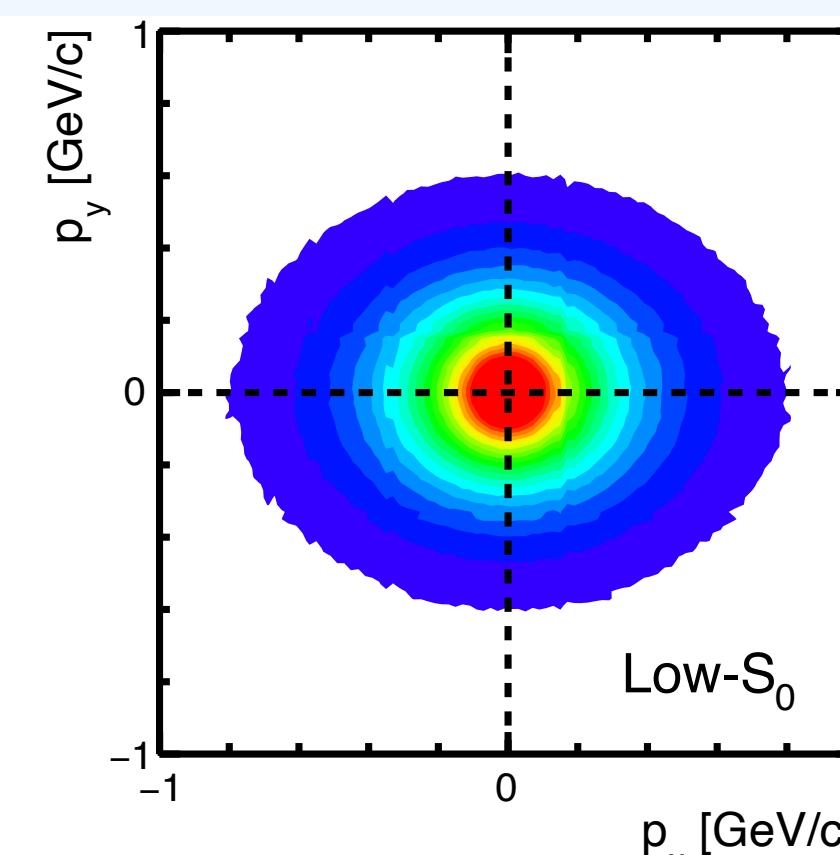
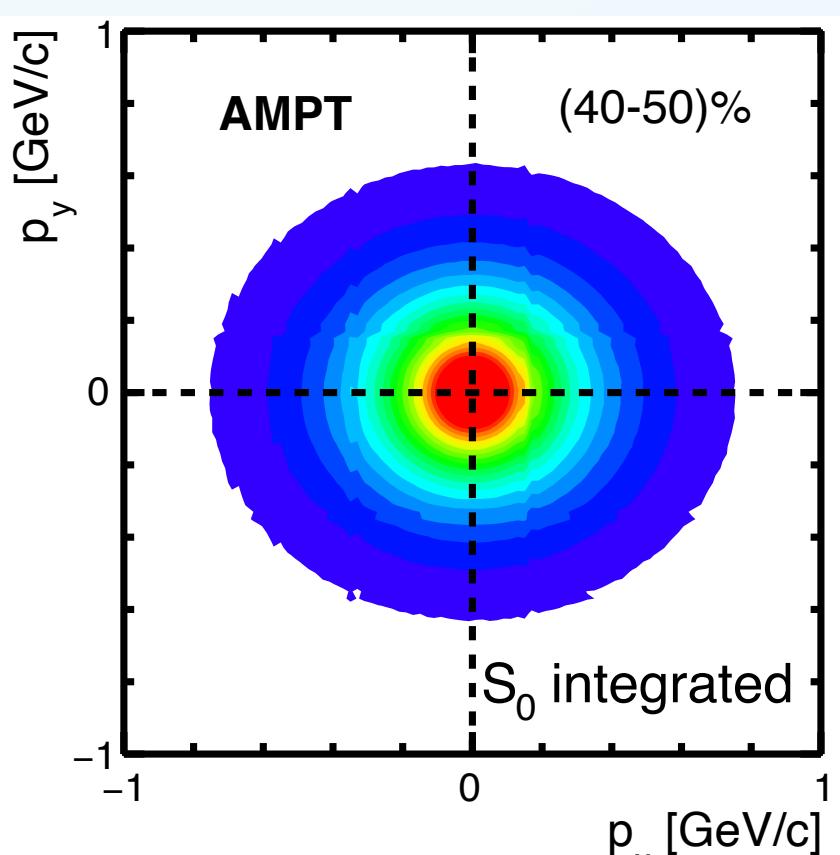
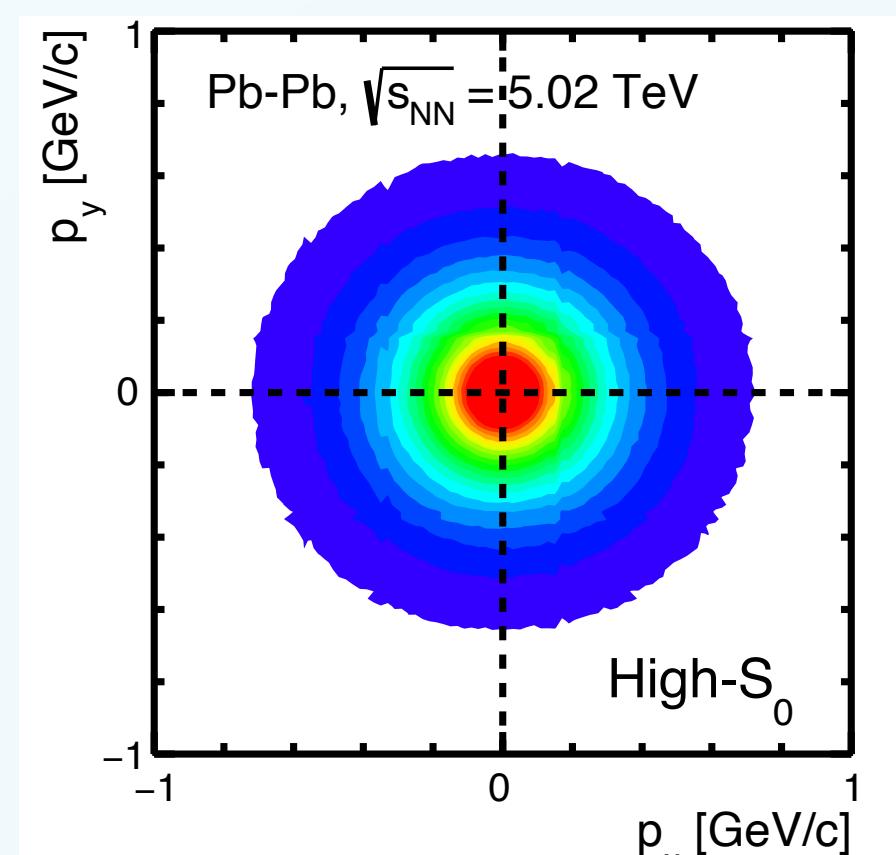
- Transverse spherocity, an event shape observable, has unique capability to separate the events in pp collisions based on their geometrical shapes *i.e.* jetty and isotropic [1]
- First implementation of transverse spherocity in heavy-ion collisions
- Extensive study on azimuthal anisotropy vs. transverse spherocity in Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV using AMPT model

1. S. Tripathy (for the ALICE Collaboration), [J.Phys.Conf.Ser. 1690 \(2020\) 1, 012126](#)

2. Transverse spherocity

- Transverse spherocity is an event property which is defined for a unit vector $\hat{n}(n_T, 0)$ that minimizes the ratio:

$$S_0 = \frac{\pi^2}{4} \left(\frac{\sum_i |\vec{p}_{T_i} \times \hat{n}|}{\sum_i p_{T_i}} \right)^2$$

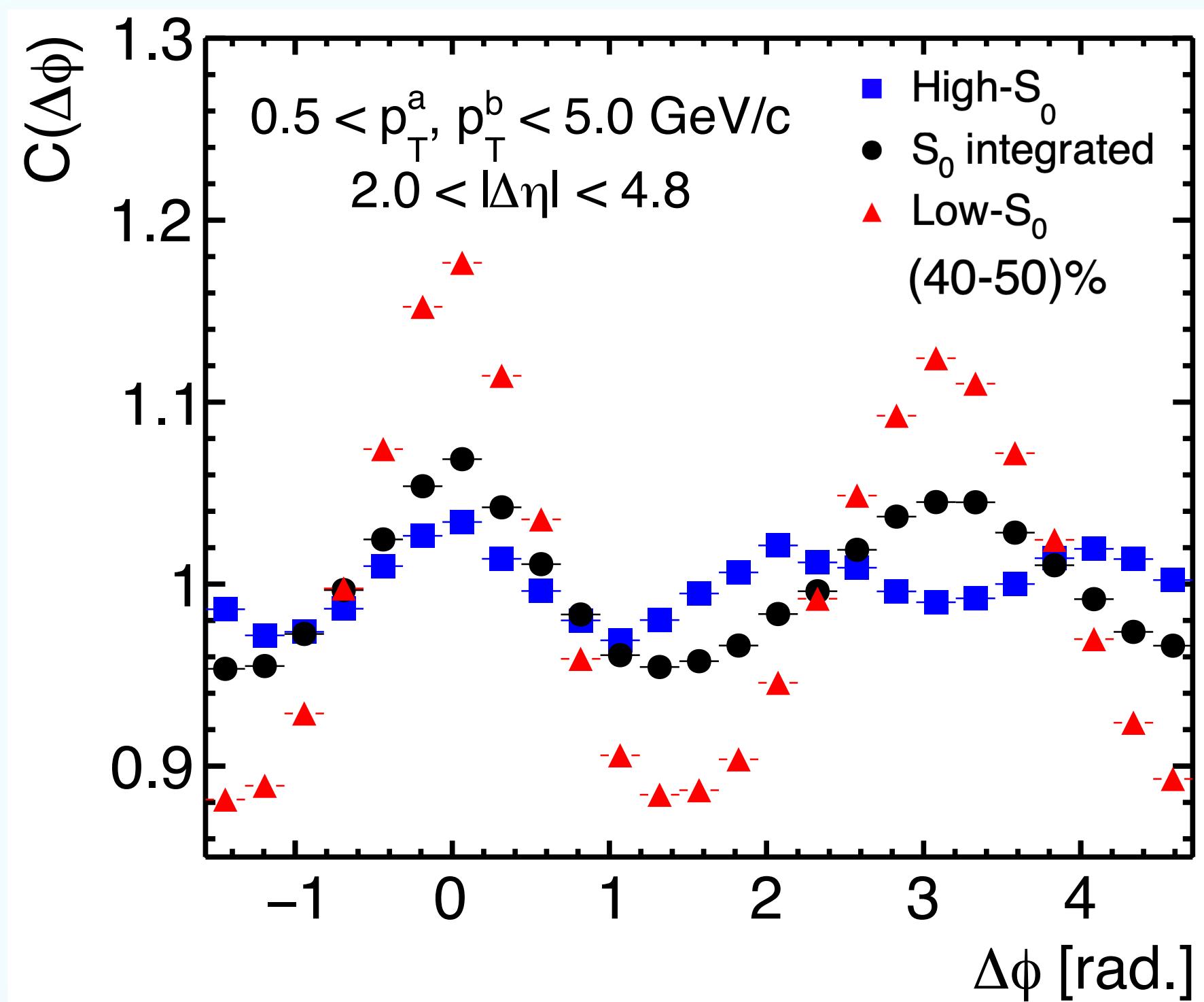


3. Analysis method

- The anisotropic flow is obtained from a Fourier expansion of the momentum distribution of final state particles

$$E \frac{d^3N}{dp^3} = \frac{d^2N}{2\pi p_T dp_T dy} \left(1 + 2 \sum_{n=1}^{\infty} v_n \cos[n(\phi - \psi_n)] \right)$$

ϕ is the azimuthal angle in the transverse plane and ψ_n is the n^{th} harmonic event plane angle.



Two-particle correlation

- The per-trigger-particle-associated yield is given by:

$$C(\Delta\eta, \Delta\phi) = B(0,0) \times \frac{S(\Delta\eta, \Delta\phi)}{B(\Delta\eta, \Delta\phi)}$$

where $B(0,0)$ is the normalisation constant.

- Our analysis focuses mainly on finding the 1D correlation as following:

$$C(\Delta\phi) = \frac{dN_{\text{pairs}}}{d\Delta\phi} = \frac{S(\Delta\phi)}{B(\Delta\phi)}$$

- All the particle pairs are accepted between $2.0 < |\Delta\eta| < 4.8$

This subtracts substantial non-flow effect [2,3]

- Mathematically, this 1D correlation function $C(\Delta\phi)$ can be expressed as a Fourier series :

$$C(\Delta\phi) \propto \left[1 + \sum_n 2v_{n,n}(p_T^a, p_T^b) \cos(n\Delta\phi) \right].$$

where $v_{n,n}$ is called the two-particle flow coefficient.

$$v_{n,n}(p_T^a, p_T^b) = \langle \cos(n\Delta\phi) \rangle = v_n(p_T^a) \cdot v_n(p_T^b)$$

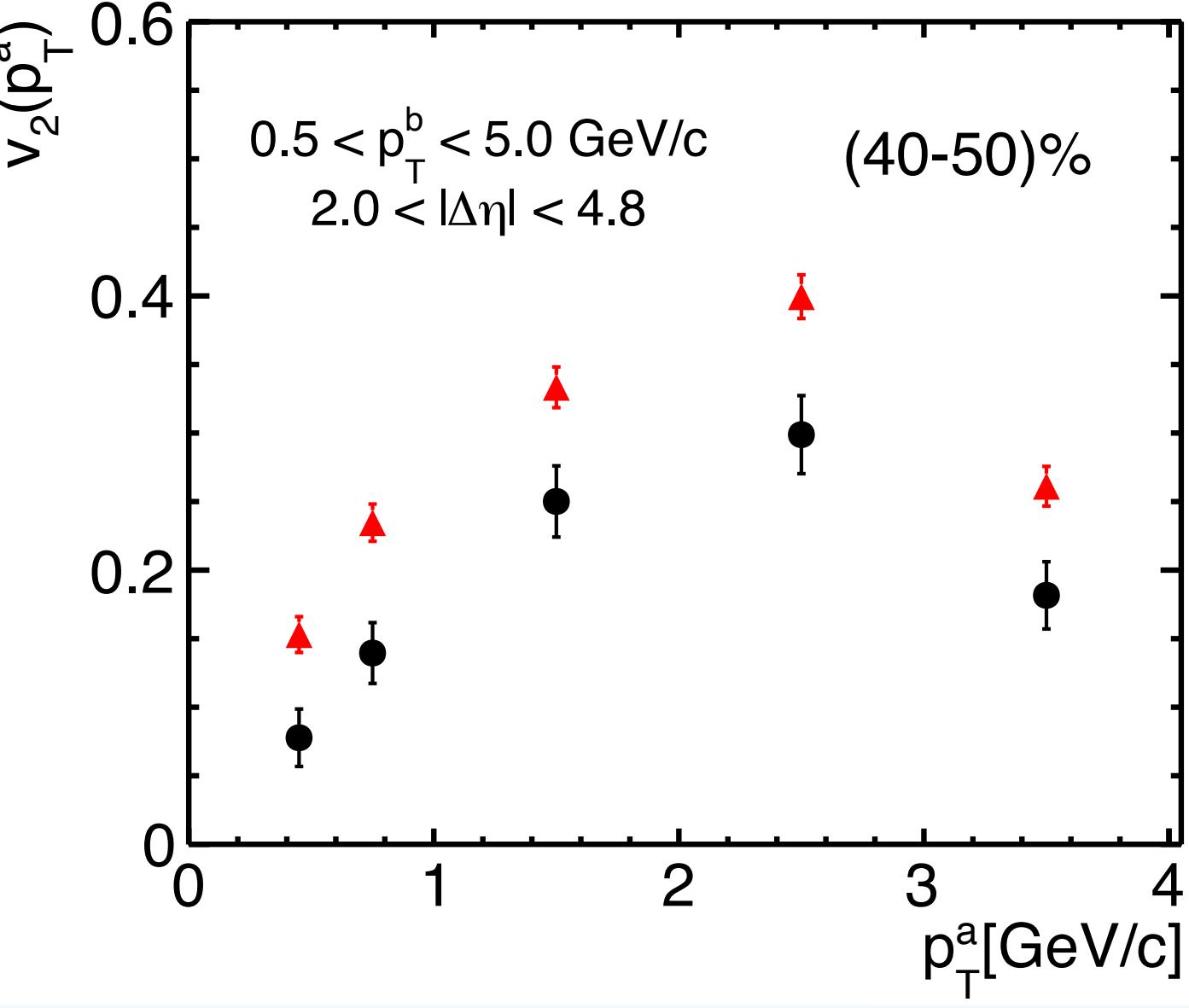
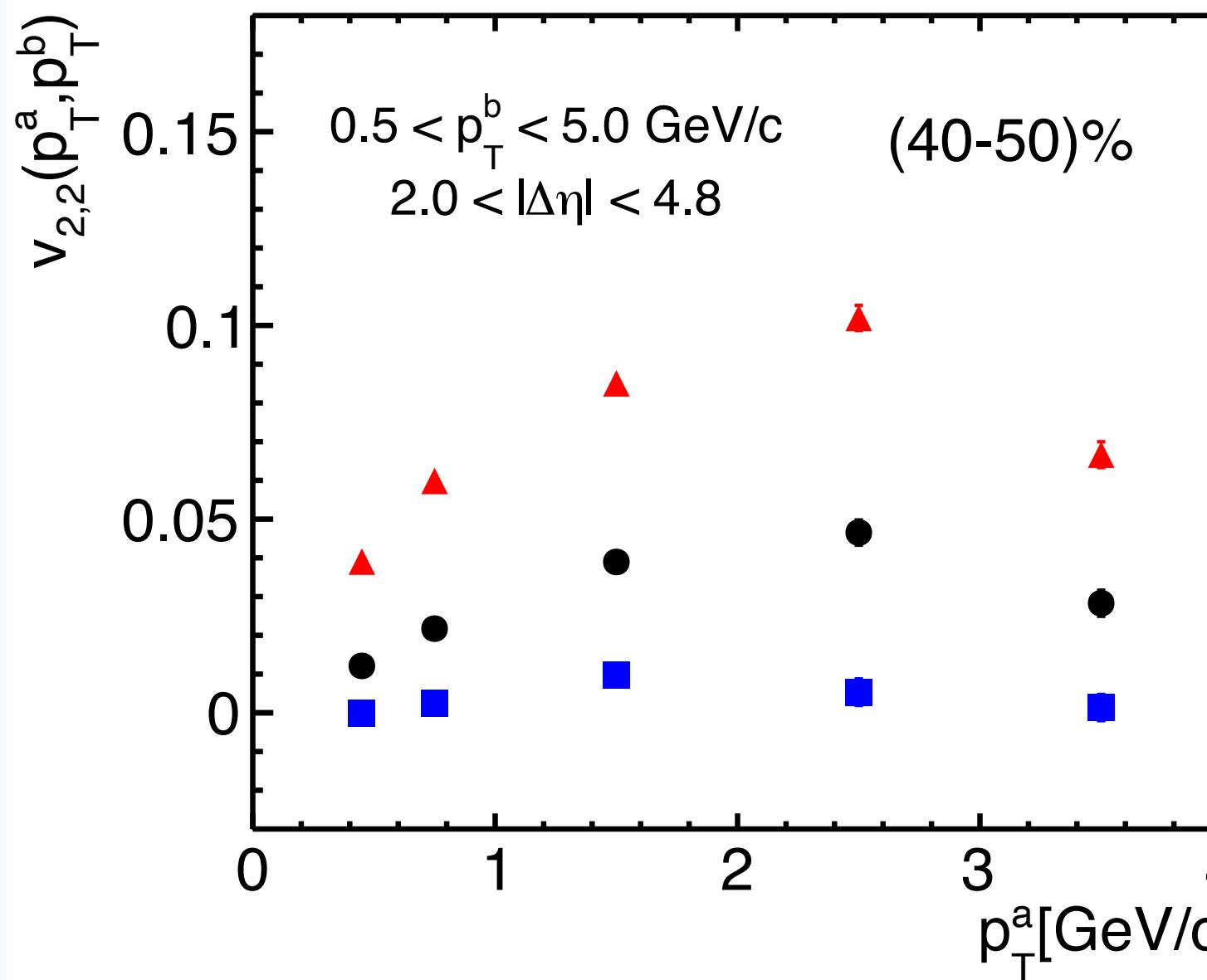
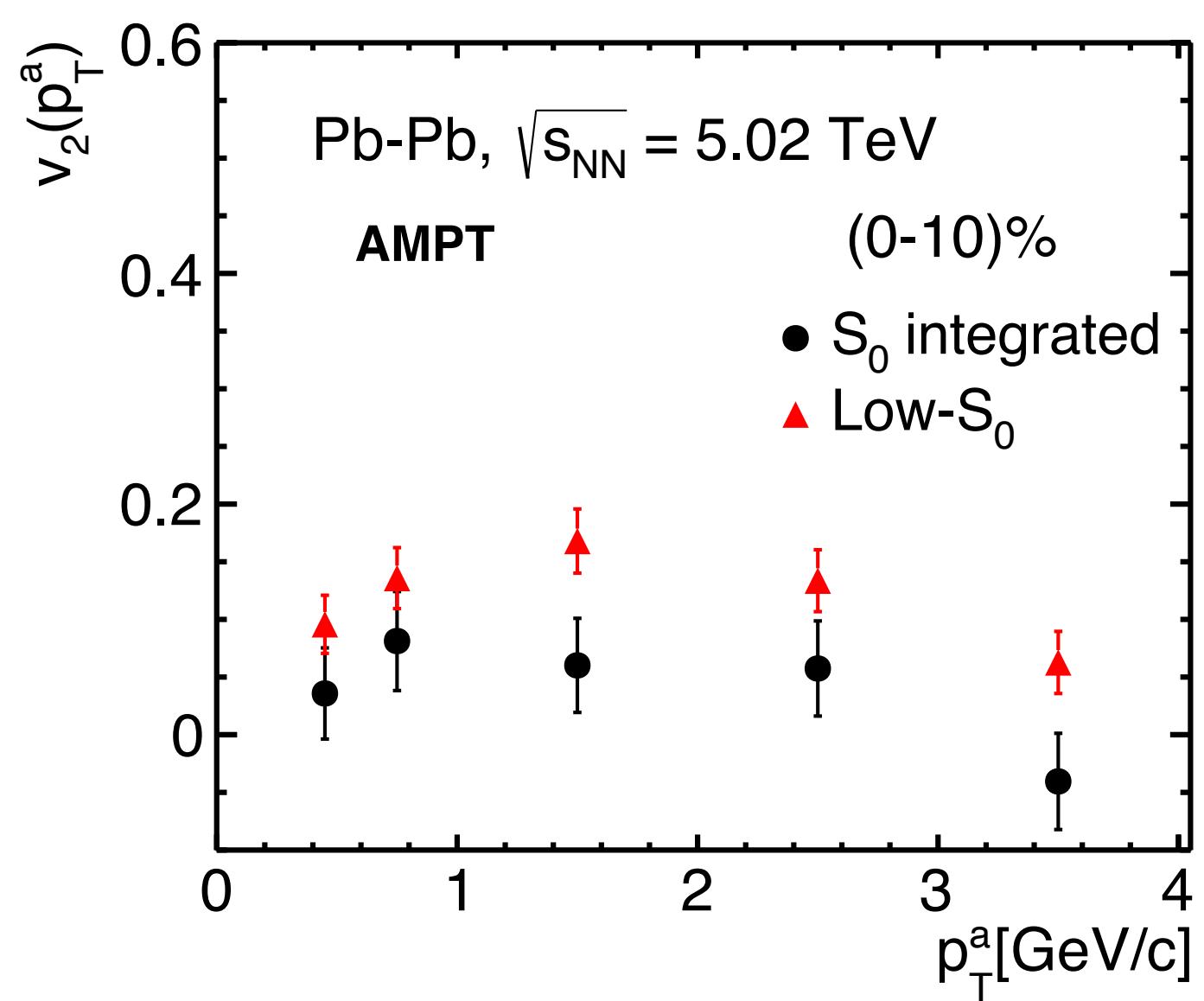
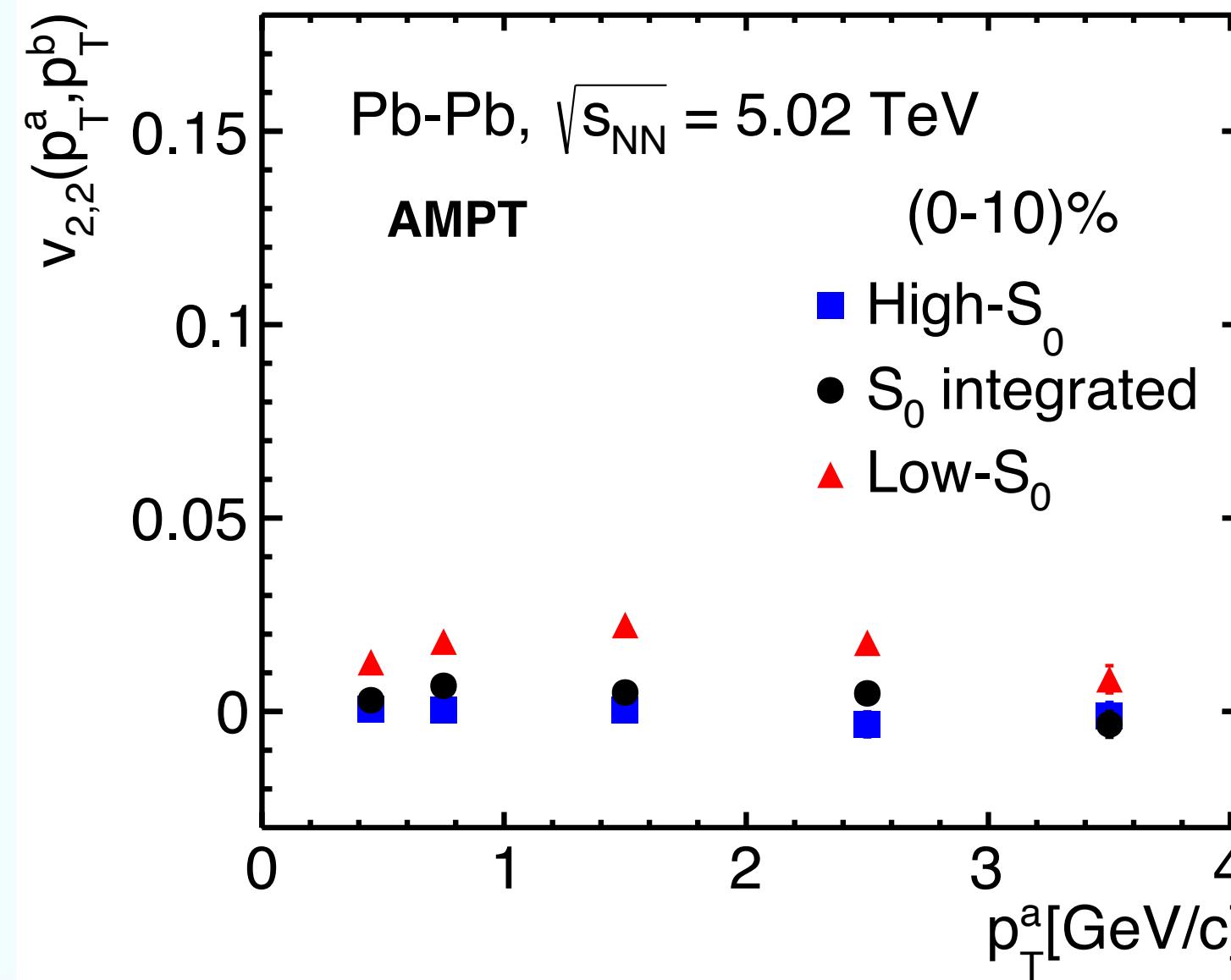
$$v_n(p_T^a) = \frac{v_{n,n}(p_T^a, p_T^b)}{\sqrt{v_{n,n}(p_T^b, p_T^b)}}$$

For $n = 2$, it gives v_2 which is the elliptic flow.

2. G. Aad et al. [ATLAS Collaboration], [Phys. Rev. C 86, 014907 \(2012\)](#).

3. M. Aaboud et al. [ATLAS Collaboration], [Phys. Rev. C 96, 024908 \(2017\)](#).

4. Results and discussions



- Elliptic flow as a function of centrality shows increase in v_2 from central to non-central collisions
- High- S_0 events have nearly zero elliptic flow
- Low- S_0 events contribute significantly towards the elliptic flow of spherocity-integrated events
- Double peaks for the away side ($Δϕ \sim π$) appears in high- S_0 events indicating greater contribution of triangular flow in such events

Elliptic flow is anti-correlated with spherocity

Transverse spherocity successfully differentiates events based on their geometrical shapes i.e. high- S_0 and low- S_0 events.

4. N. Mallick, R. Sahoo, S. Tripathy, and A. Ortiz, [J. Phys. G 48, 045104 \(2021\)](#)