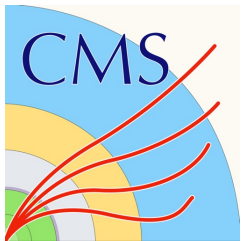


CORRELATIONS BETWEEN MULTIPARTICLE CUMULANTS AND MEAN TRANSVERSE MOMENTUM IN SMALL COLLISION SYSTEMS WITH THE CMS DETECTOR



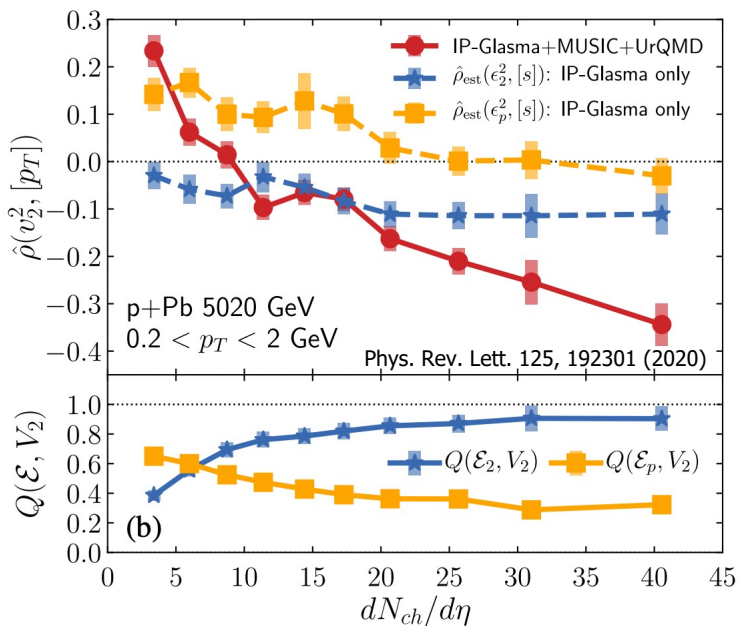
Shengquan Tuo
(Vanderbilt University)
for the CMS Collaboration

June 14, 2022

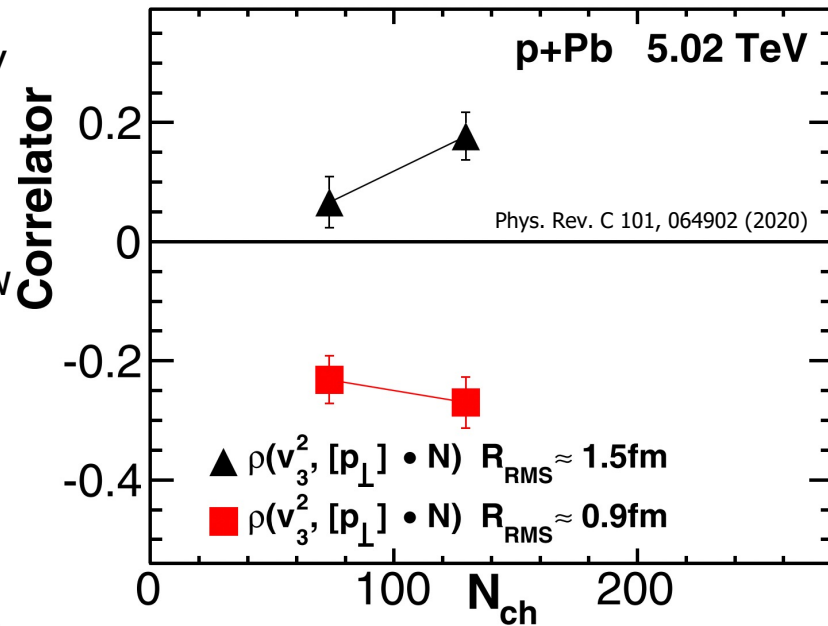


SQM 2022
The 20th International Conference on Strangeness in Quark Matter
13-17 June 2022 Busan, Republic of Korea

MOTIVATIONS AND ANALYSIS METHOD



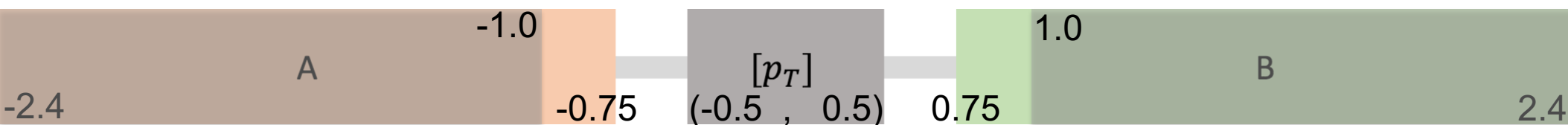
- The correlations carry information about the origin of the observed momentum anisotropy
- No sign change at low multiplicity without initial v_2 from CGC
- Sensitive to the transverse size of the initial fireball



$$\rho(v_2^2, [p_T]) = \frac{\text{cov}(v_2^2, [p_T])}{\sqrt{\text{Var}(v_2^2)_{\text{dyn}}} \sqrt{\text{Var}([p_T])_{\text{dyn}}}}$$

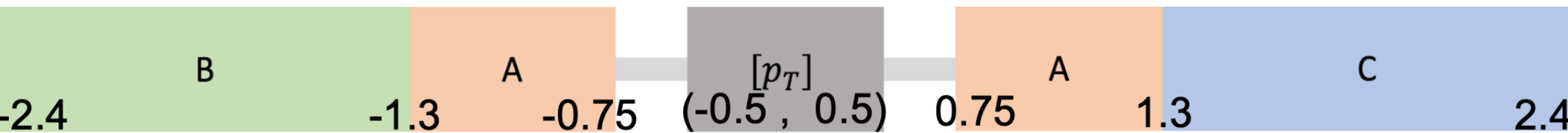
↓

$$\rho(c_2\{2\}, [p_T])$$



Extend and study the new variable to remove more nonflow

$$\rho(c_2\{2\}, [p_T]) \quad \longrightarrow \quad \rho(c_2\{4\}, [p_T])$$



$$c_2\{4\} \text{ is analyzed with three subevent method: } c_2\{4\}_{3\text{-sub}} = \langle 4 \rangle_{a,a|b,c} - 2\langle 2 \rangle_{a|b}\langle 2 \rangle_{a|c}$$

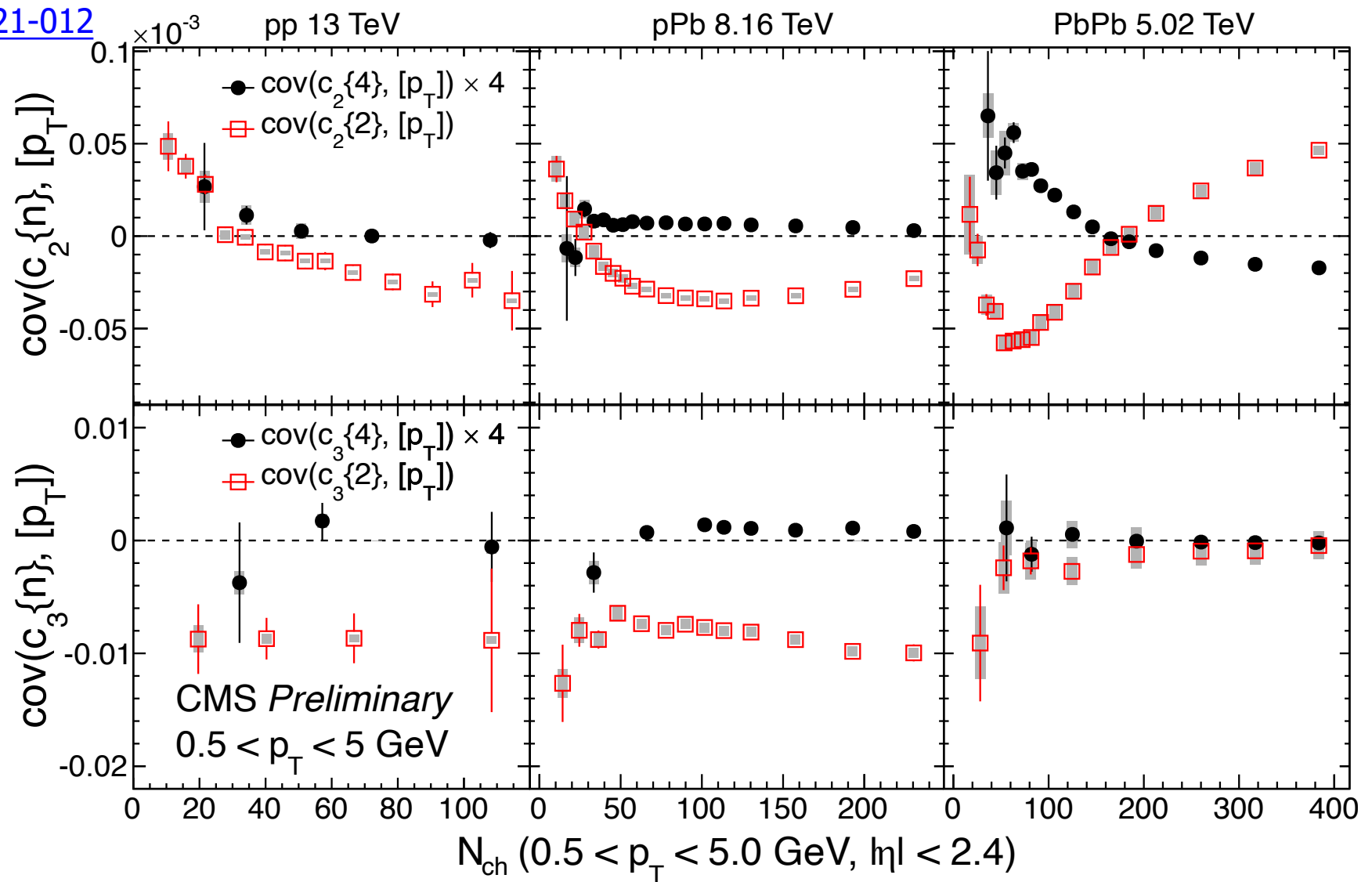
RESULTS FOR COVARIANCE

[CMS-PAS-HIN-21-012](#)



$n=2$

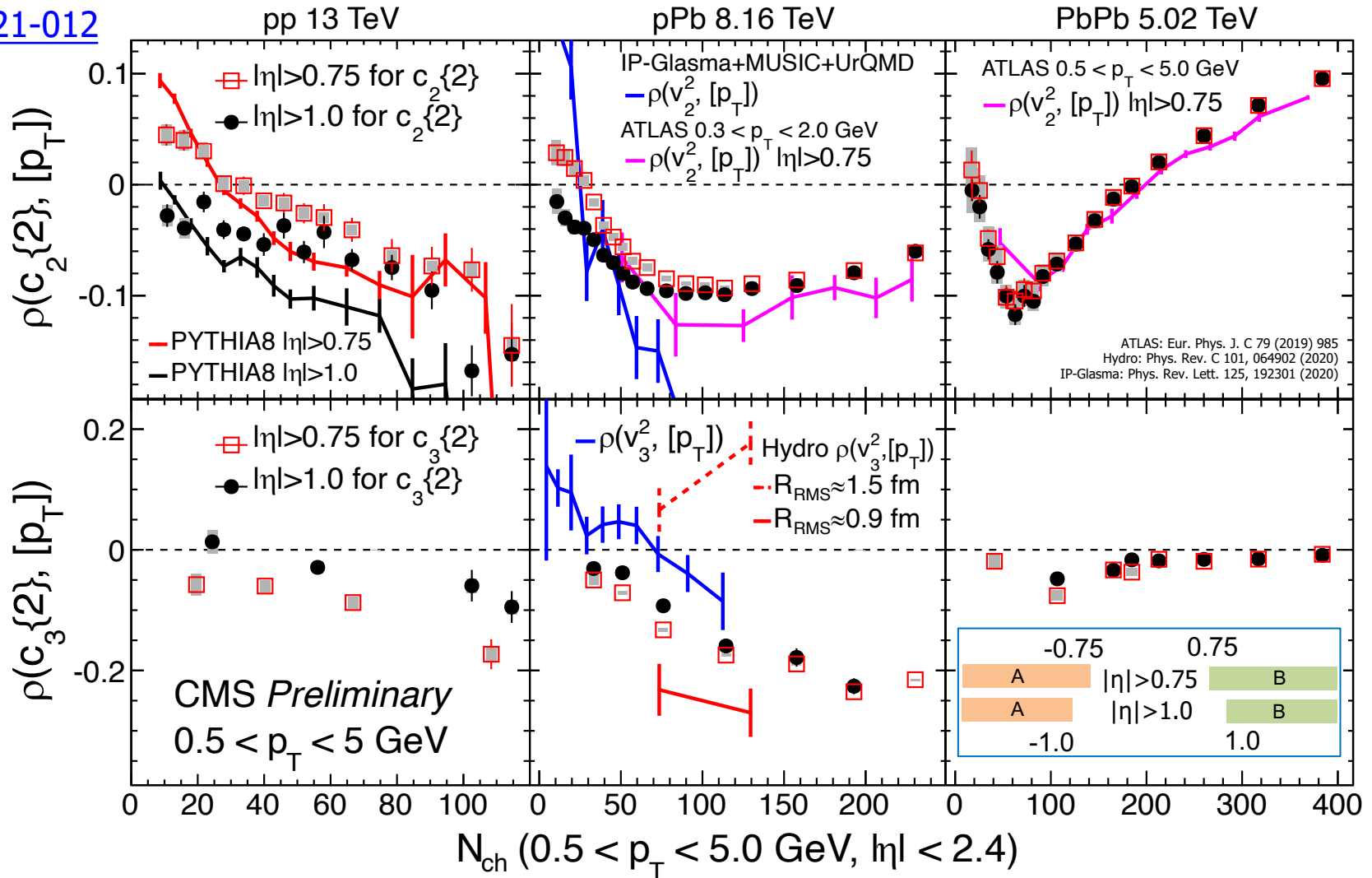
$n=3$



- Clear sign change for pp and pPb collisions with $c_2\{2\}$
- No sign change at low N_{ch} using multiparticle correlations with current statistics
- The sign of the normalized correlator is determined by the covariance

RESULTS FOR THE CORRELATOR

CMS-PAS-HIN-21-012



- Apparent sign change for $\rho(c_2\{2\}, [p_T])$ in pPb -> agree with IP-Glasma+hydro
- However, no sign change is observed when using $|\eta| > 1.0$ for $c_2\{2\}$
- After removing nonflow with larger η gap, no evidence of CGC in data
- Data better described by the smaller initial fireball $R_{RMS} = 0.9$ fm in hydro

SUMMARY

- The correlations between $[p_T]$ and cumulants from both two- and four-particle correlations in small systems are presented
- Apparent sign change is observed for $\rho(c_2\{2\}, [p_T])$ in pp and pPb
- However, no sign change is observed with larger η gap in $c_2\{2\}$
 - ATLAS default is $|\eta| > 0.75$, with $|\Delta\eta| > 1.5$
 - ALICE default is $|\eta| > 0.4$, with $|\Delta\eta| > 0.8$
 - CMS is studying both $|\eta| > 0.75$ ($|\Delta\eta| > 1.5$) and $|\eta| > 1.0$ ($|\Delta\eta| > 2.0$)
- After removing more nonflow with both two- and four-particle correlation cumulants, there is no evidence of CGC in data
- These high-precision data and the observables employing multiparticle correlations provide new insight into the origin of azimuthal anisotropy in small collision systems

