Heavy-Ion Cafe / Pub 合同研究会　post-QM19報告会

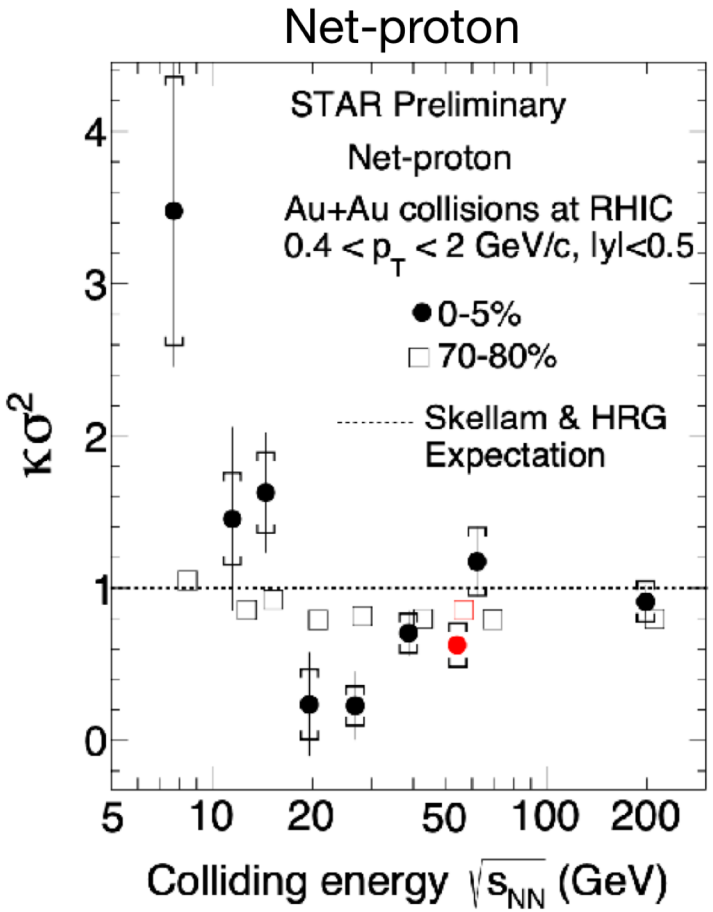
ソフト、小さい系から（実験）

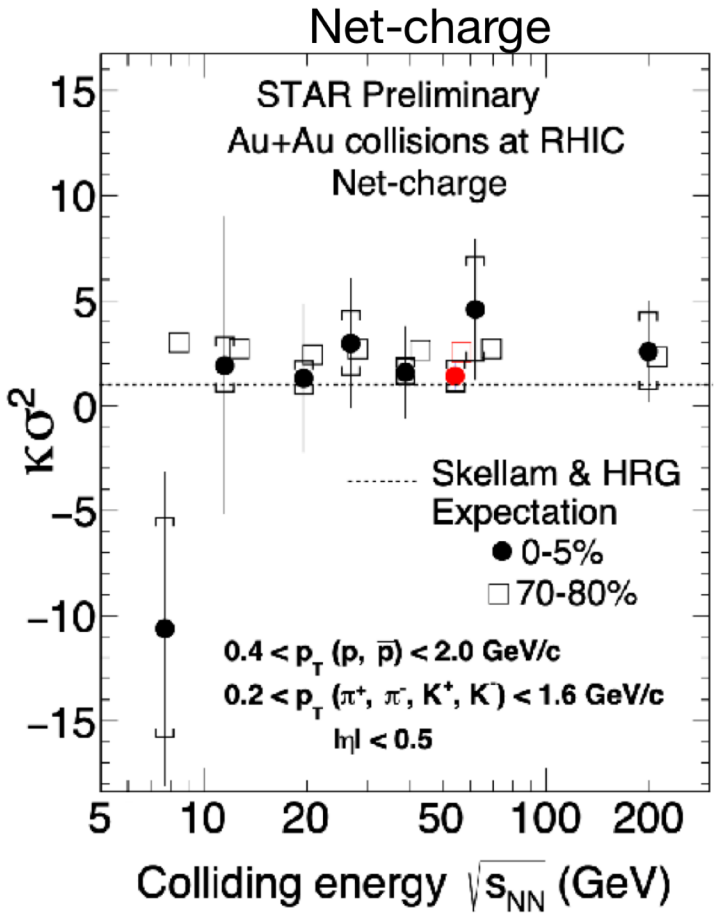
筑波大学 数理物質系 物理学域
宇宙史研究センター　江角晋一

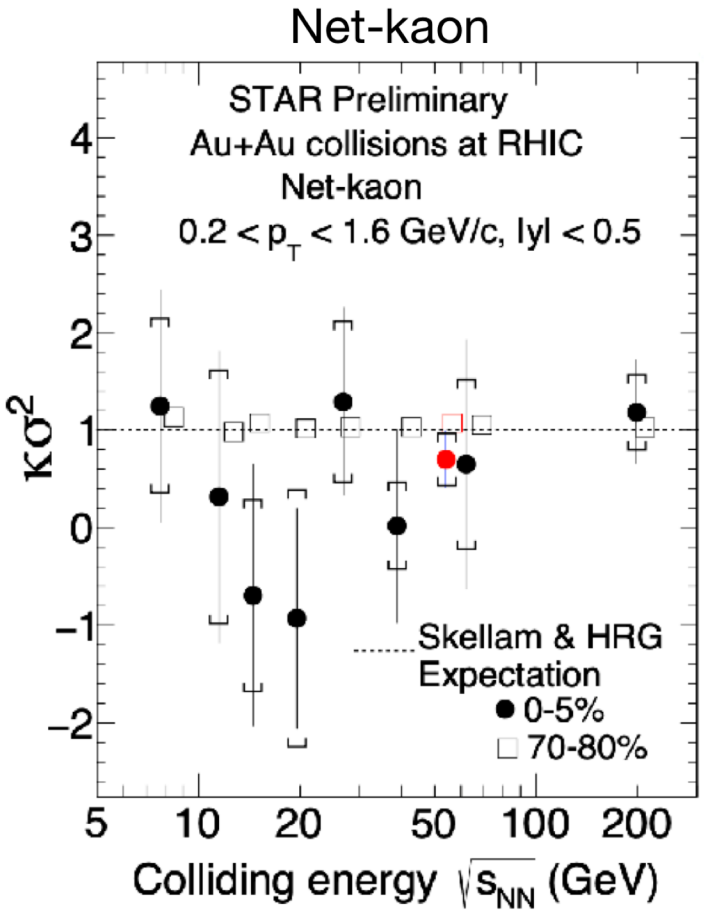
・揺らぎ、フリーズアウト
・v1, v2 フロー、小さい系
・渦、磁場

4 次揺らぎ

$C_4/C_2 = \kappa\sigma^2$

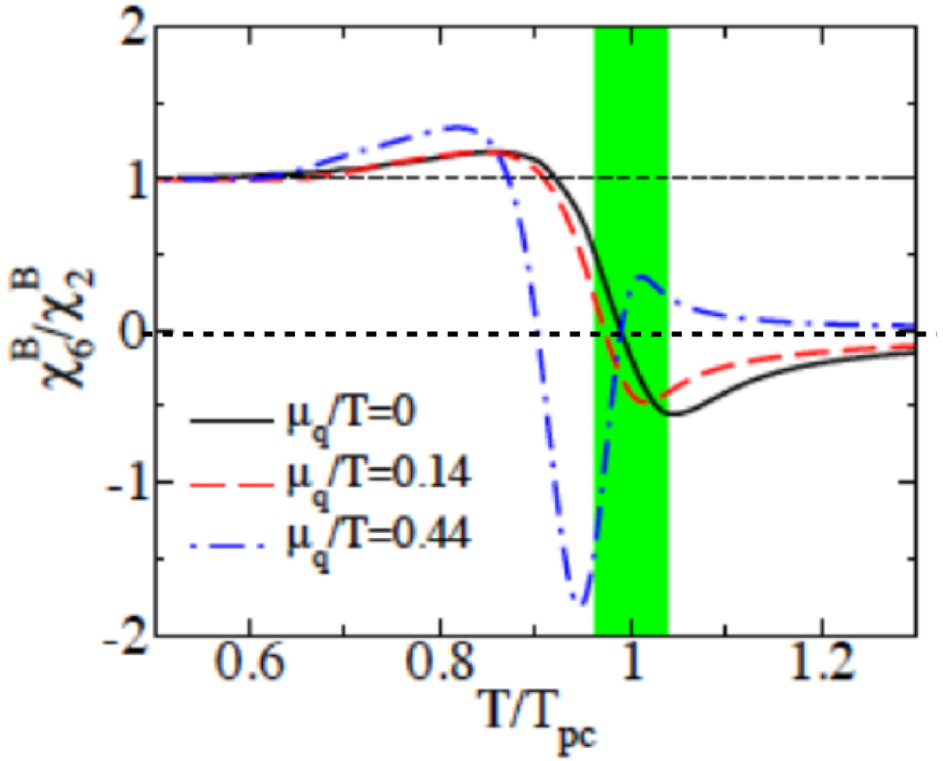




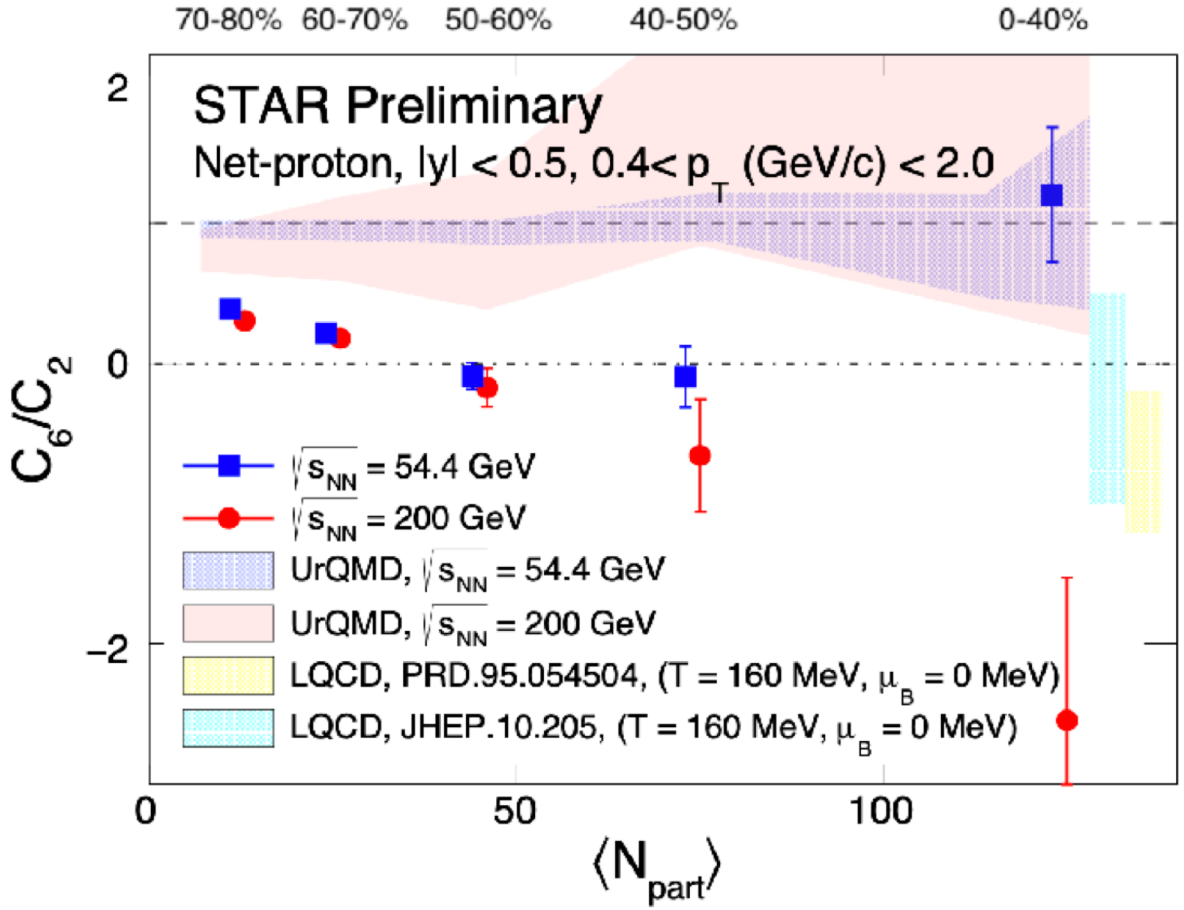


6 次揺らぎ

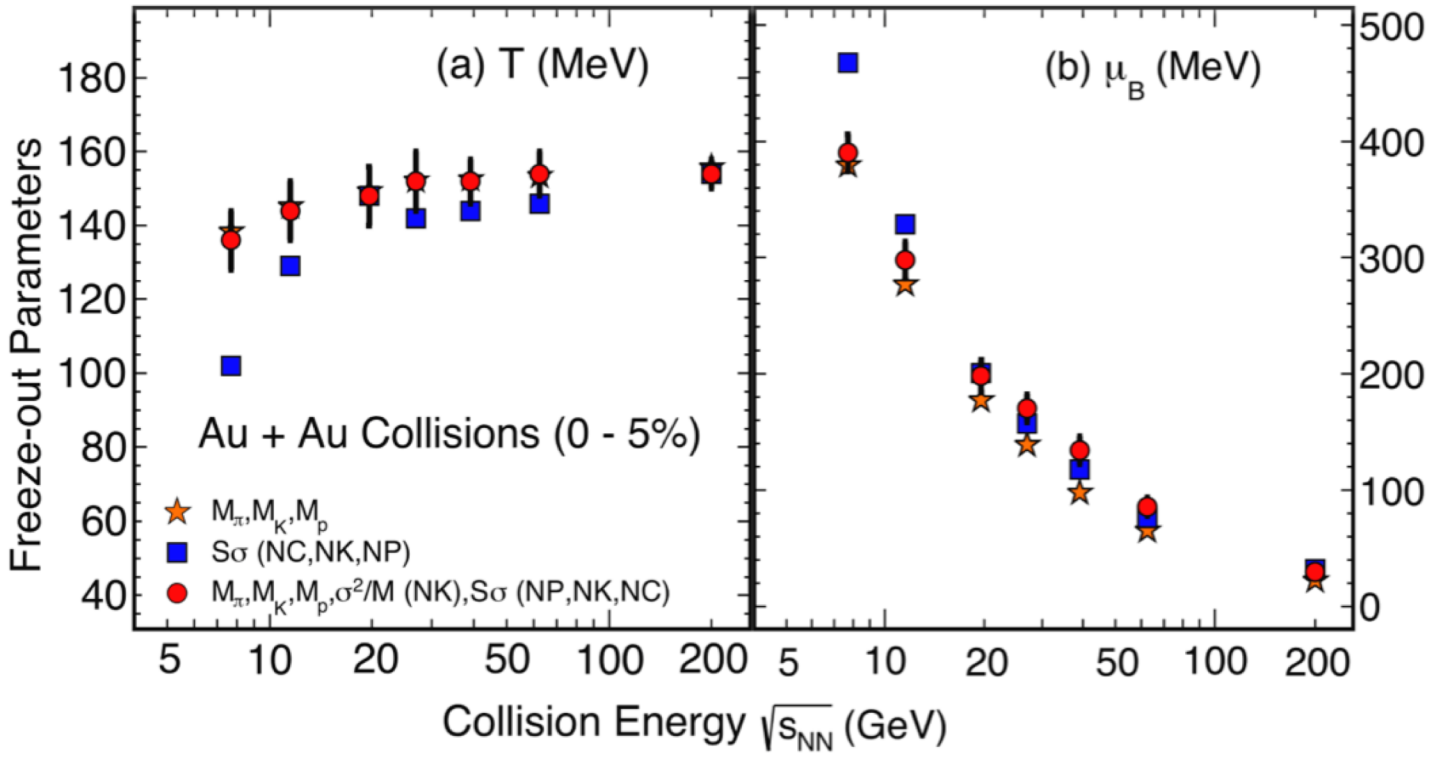
B. Friman et al., EPJC 71 (2011) 1694

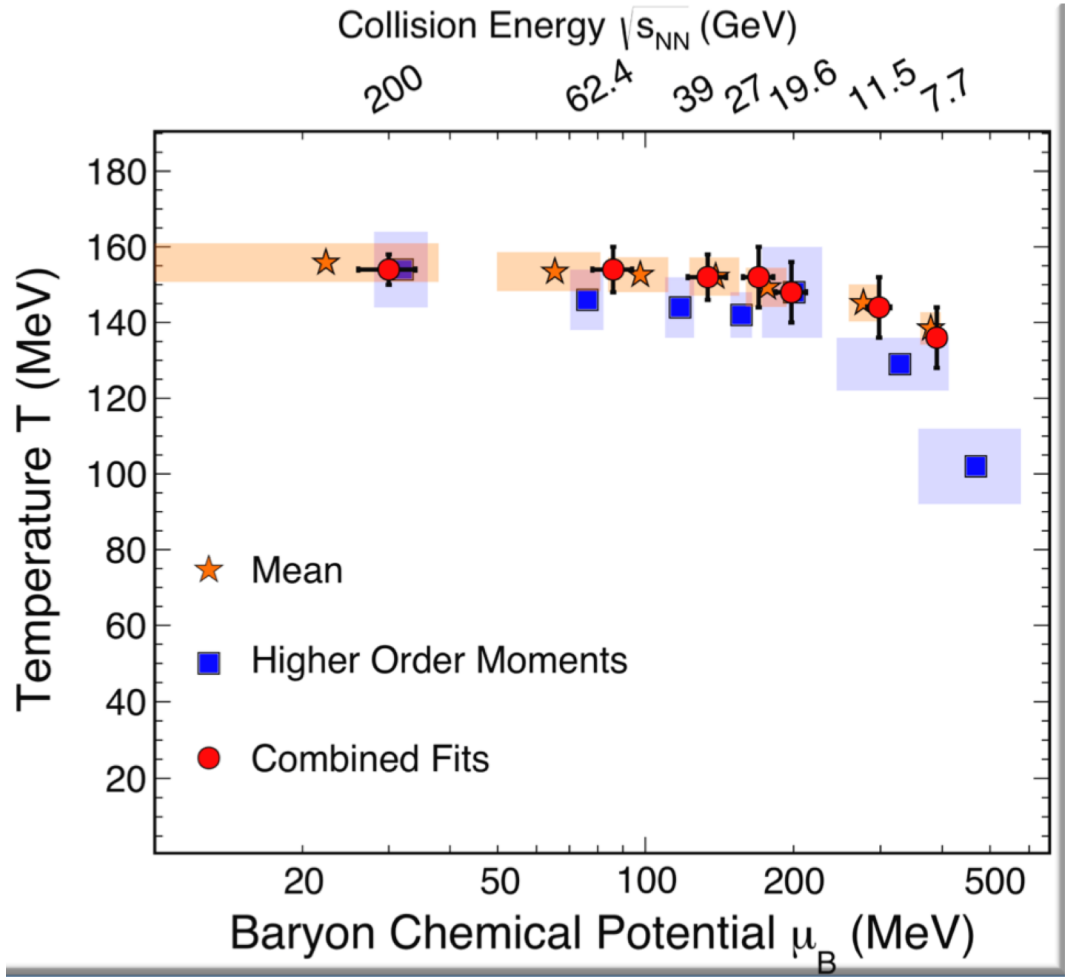


Above $\sqrt{s_{NN}}$>60 GeV, predicted $C_6/C_2 < 0$ for B (and Q)



化学凍結温度（平均値、幅、非対称度）

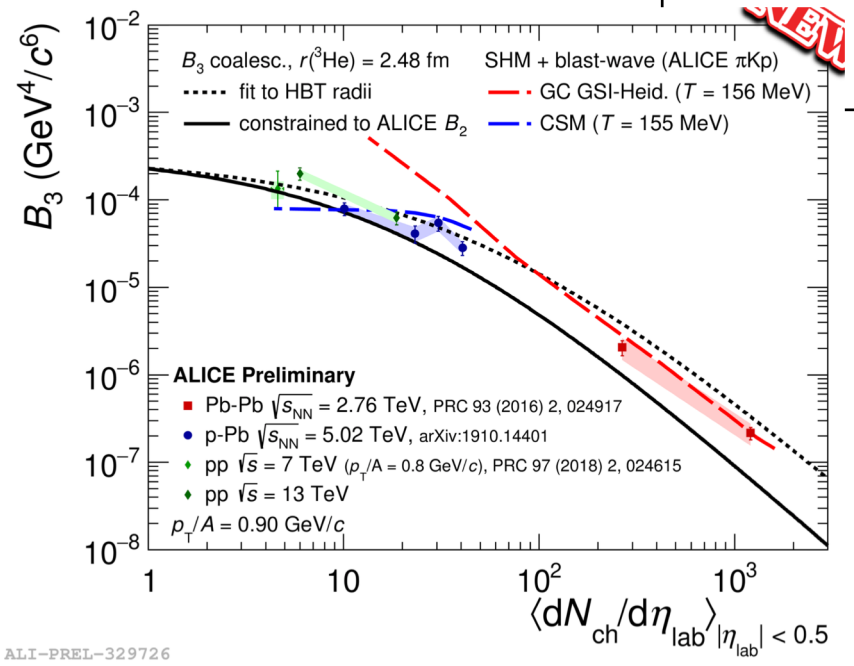


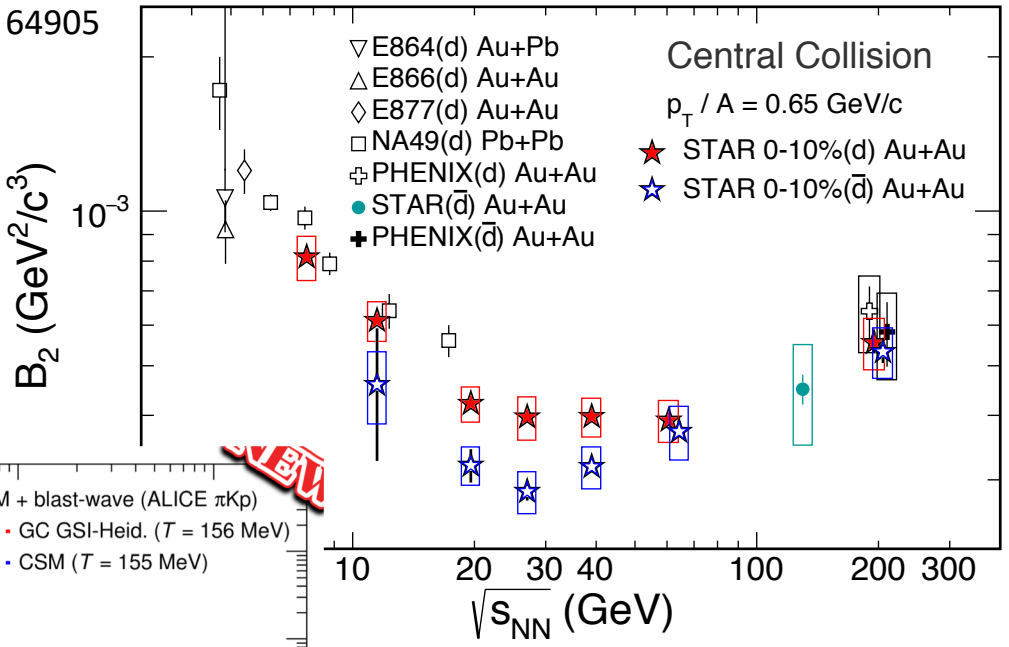


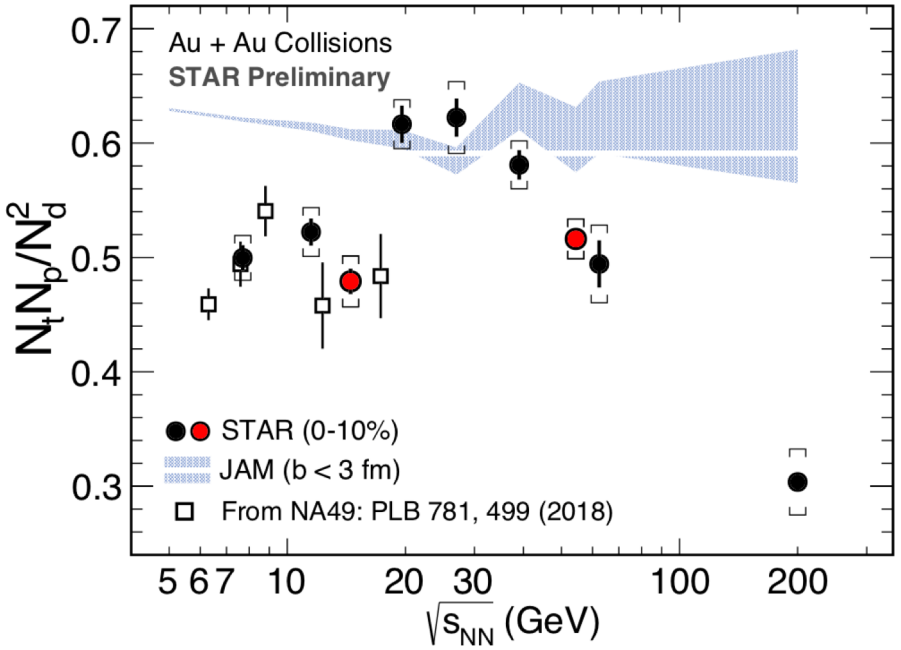
D. Mallick, QM19

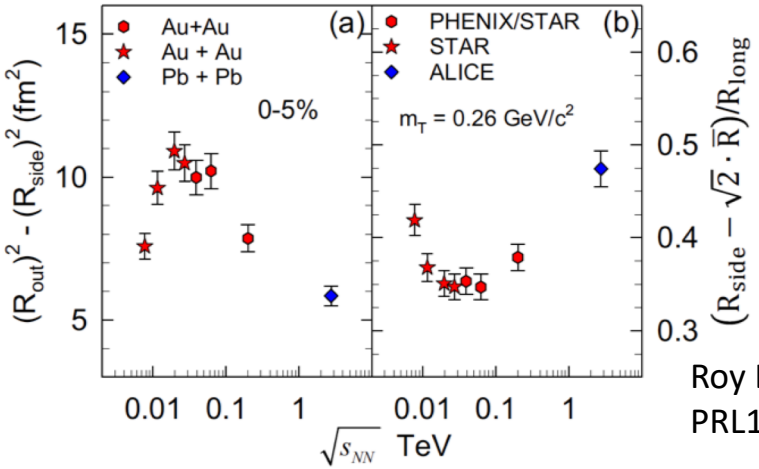
コアレッセンス体積、中性子密度揺らぎ

STAR, PRC 99 (2019) 64905



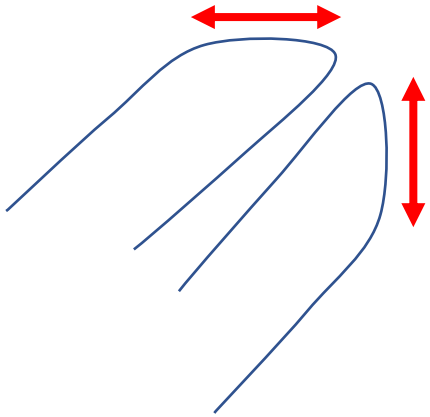


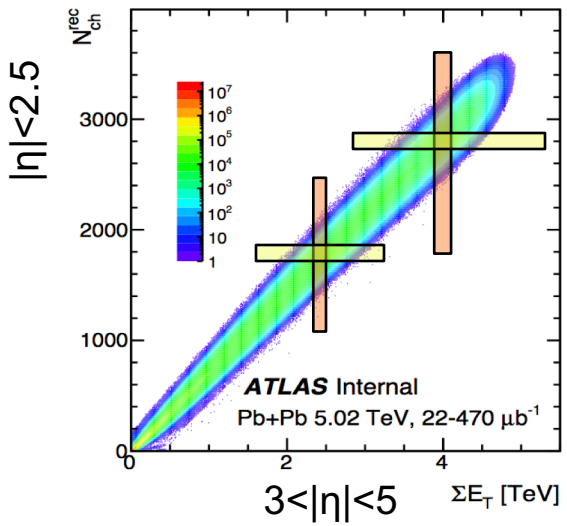




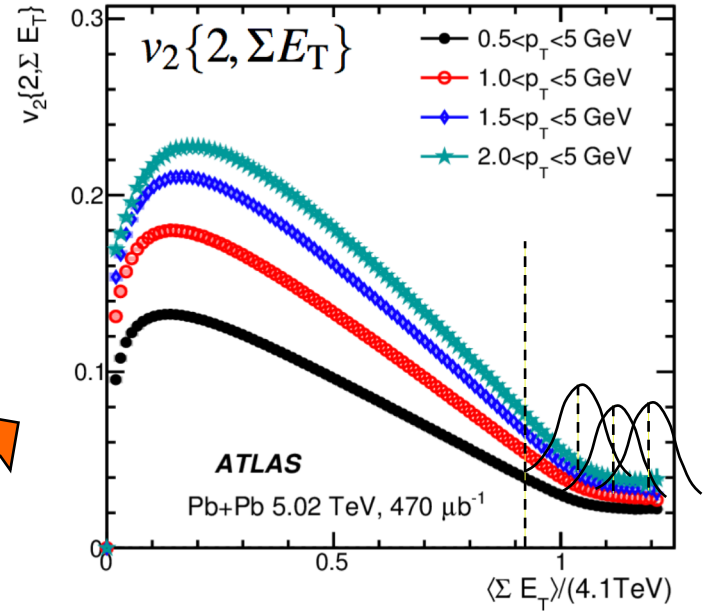
Roy Lacey
PRL114, 142301 (2015)

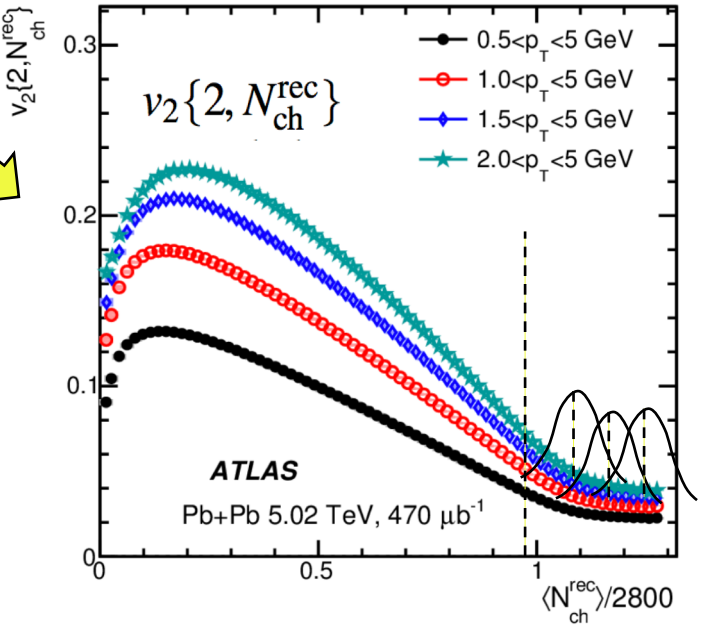
中心衝突度分解能、体積揺らぎの理解へ向けて



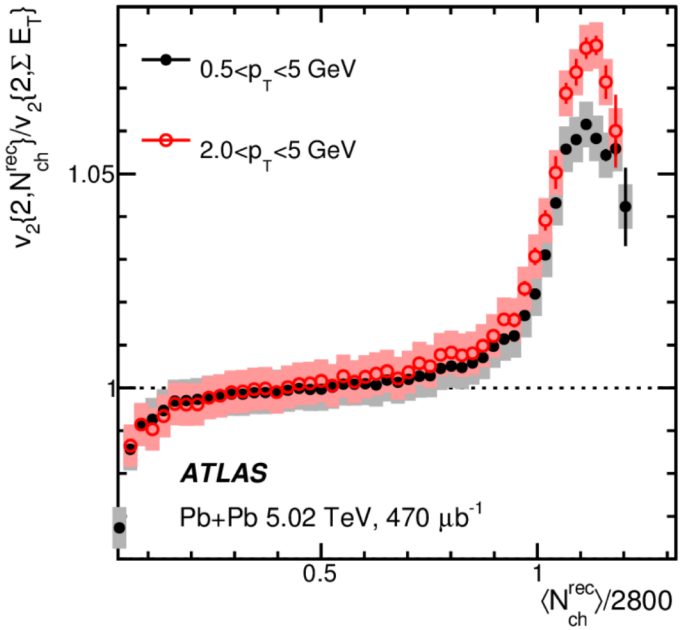


arXiv:1803.01812
M. Zhou and J. Jia



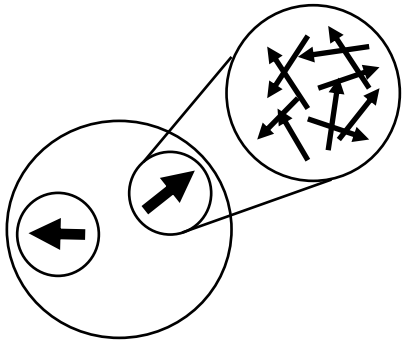


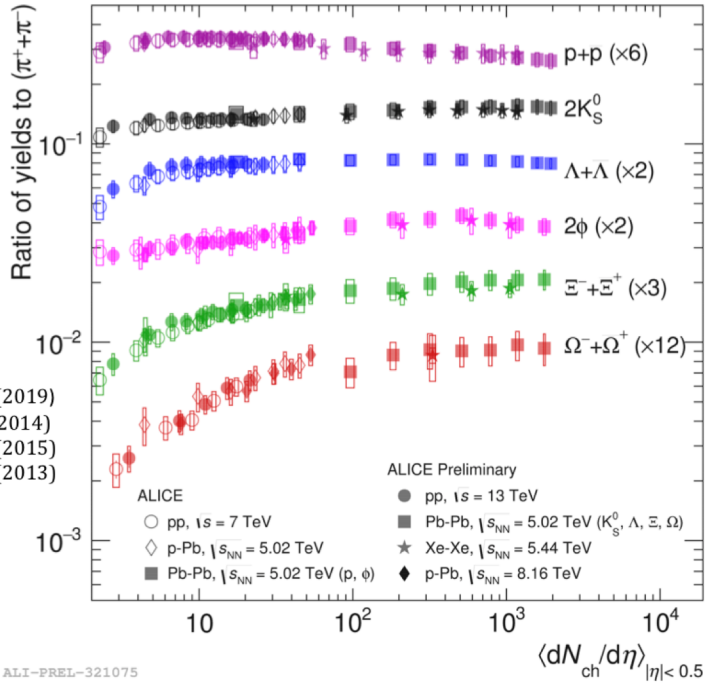
$$\frac{v_2\{2, N_{\mathrm{ch}}^{\mathrm{rec}}\}}{v_2\{2, \Sigma E_{\mathrm{T}}\}}$$ at same N_{ch}



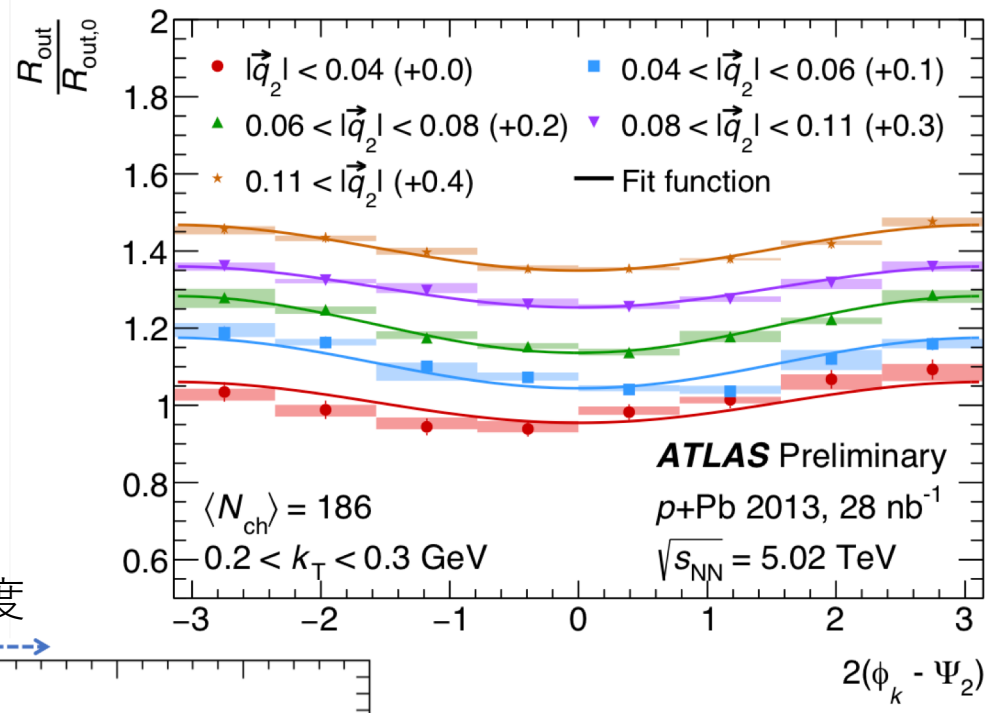
Larger centrality fluctuation for
N_{ch}-bin (mid-η) than for E_T-bin (forward-η)
Significant centrality de-correlation along η

ストレンジネス増大、半径方向・楕円膨張

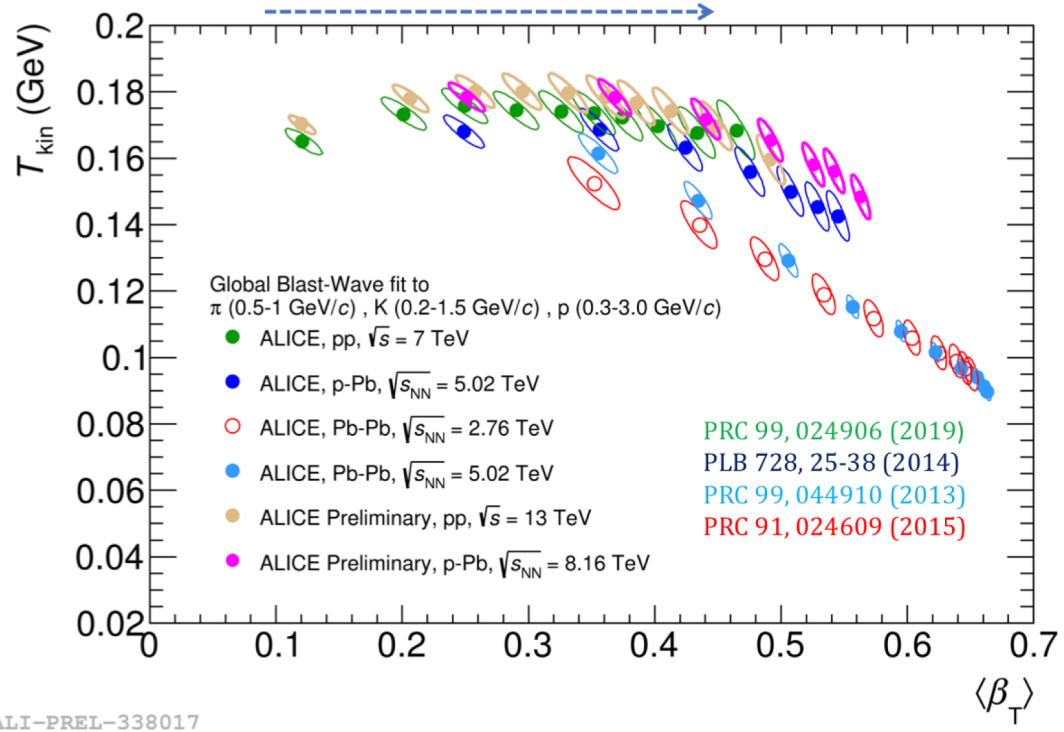


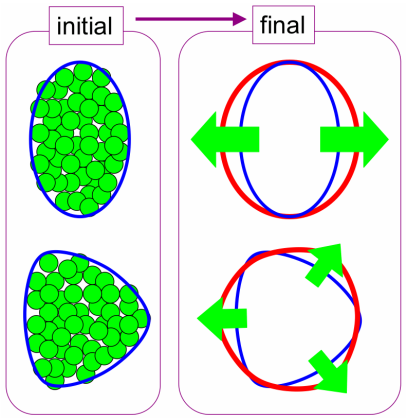


PRC 99, 024906 (2019)
PLB 728, 25-38 (2014)
PRC 91, 024609 (2015)
PRC 99, 044910 (2013)

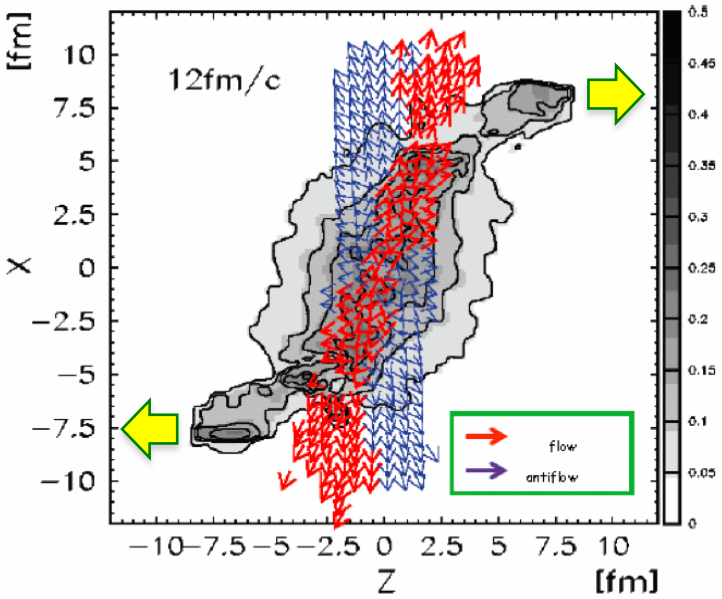


多重度、中心衝突度



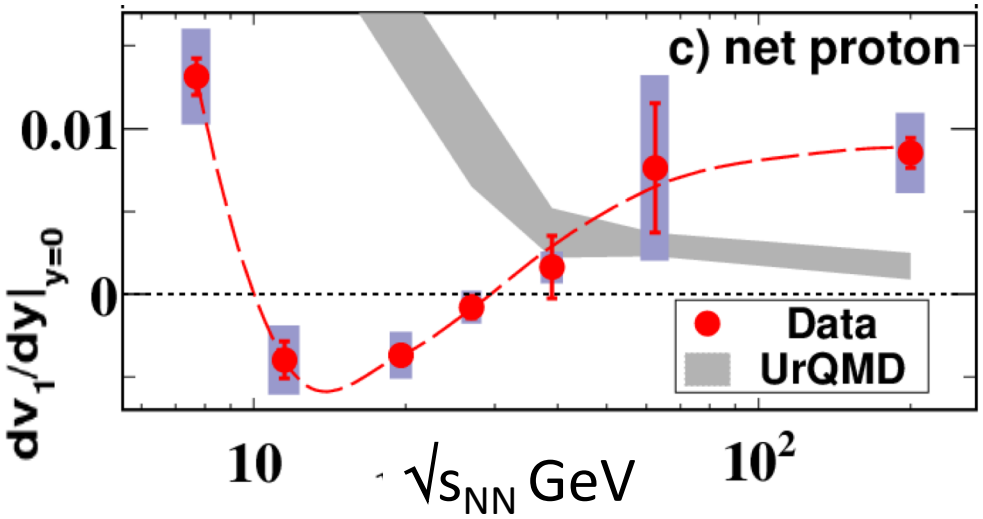


ネット陽子の dv_1/dy

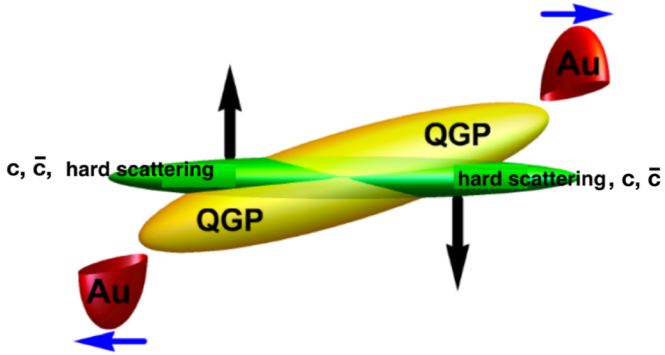


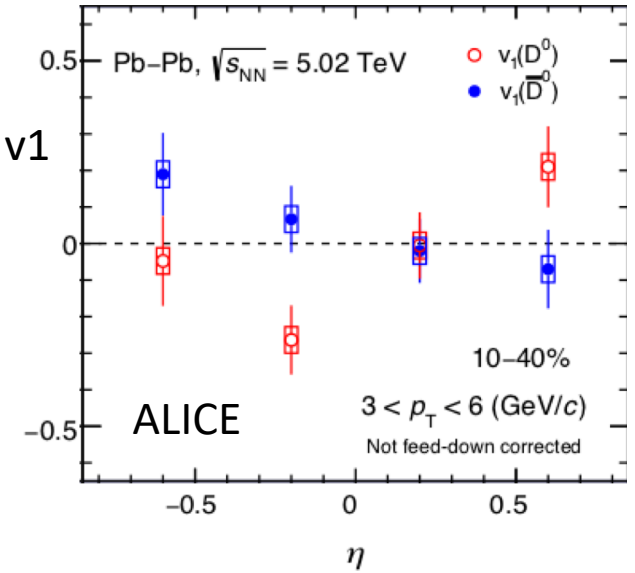
J. Brachmann et al., PRC 61, 24909 (2000).

STAR, PRL 112, 032302 (2014)

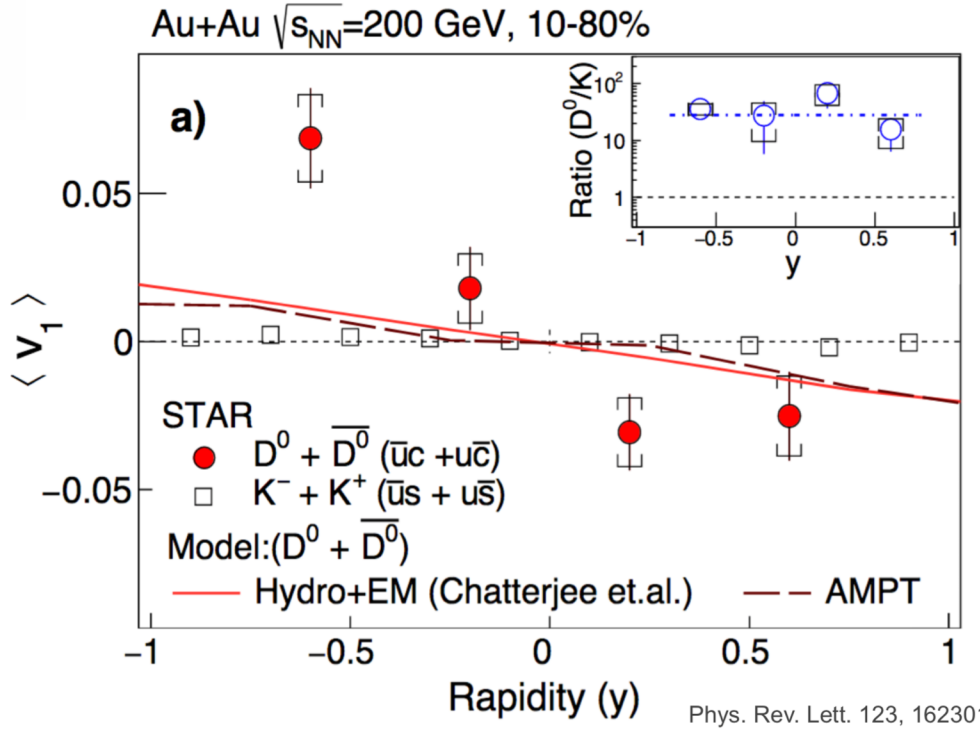


D^0中間子 v1



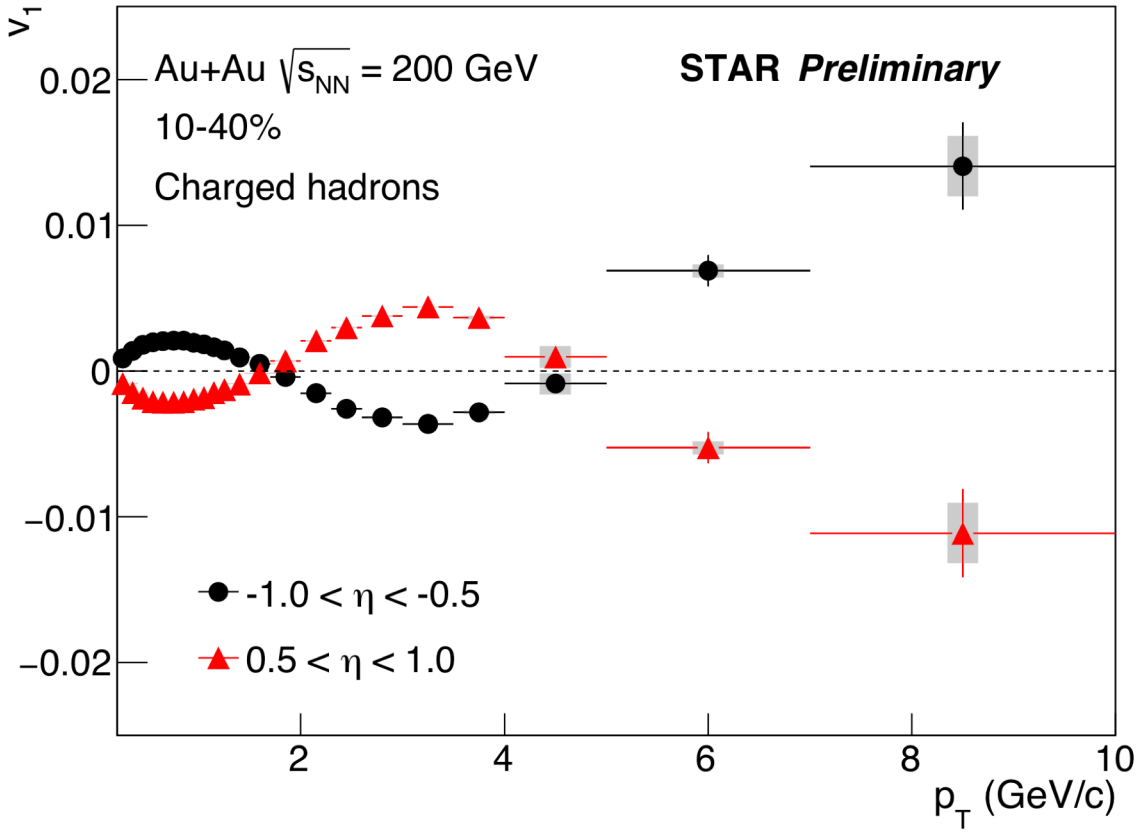


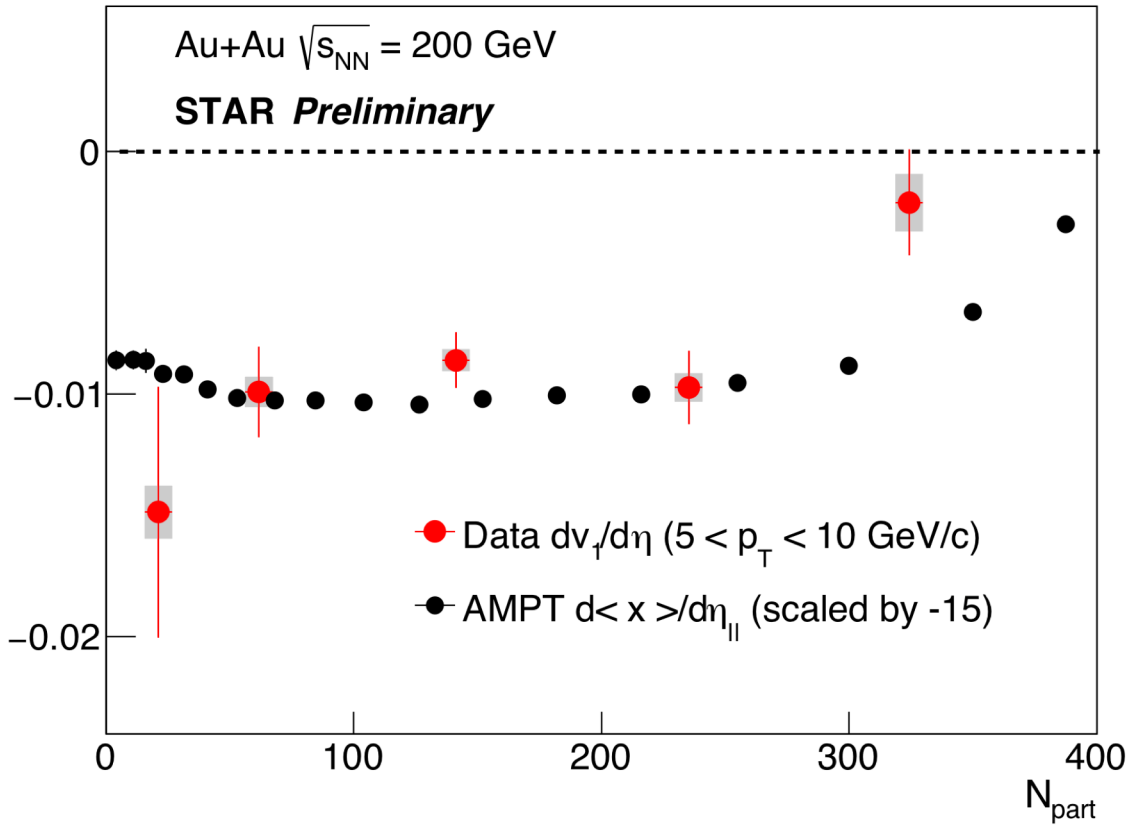
arXiv:1910.14406



Phys. Rev. Lett. 123, 162301 (2019)

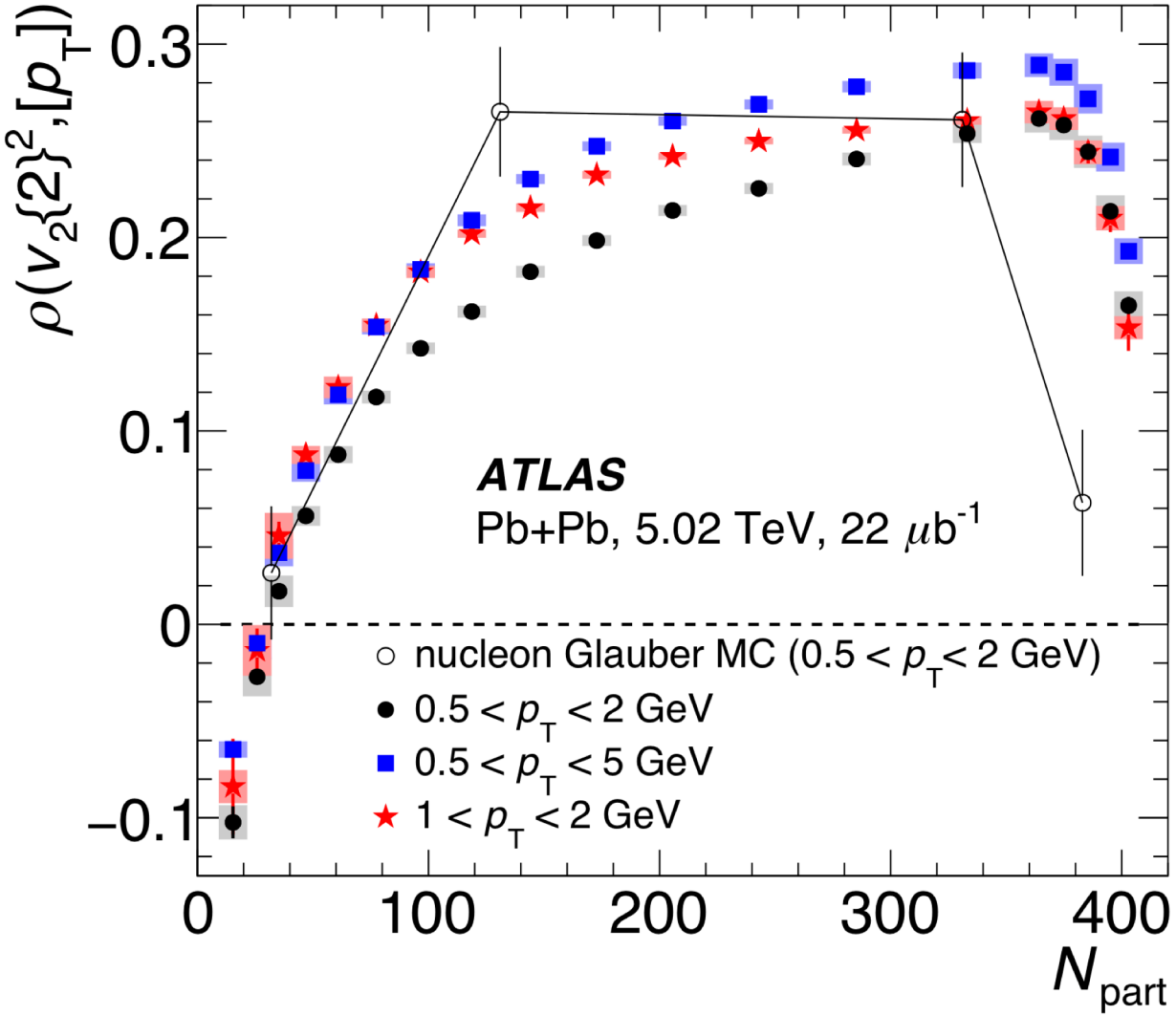
高い横運動量領域のv1

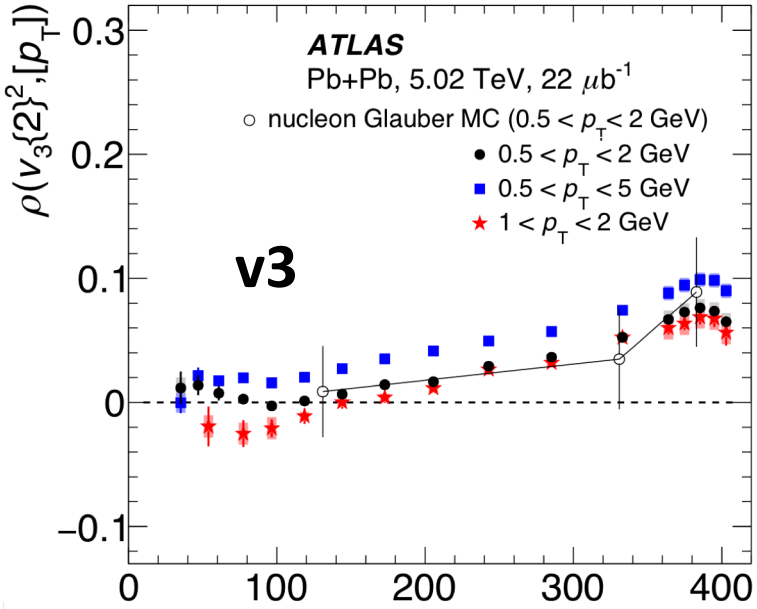


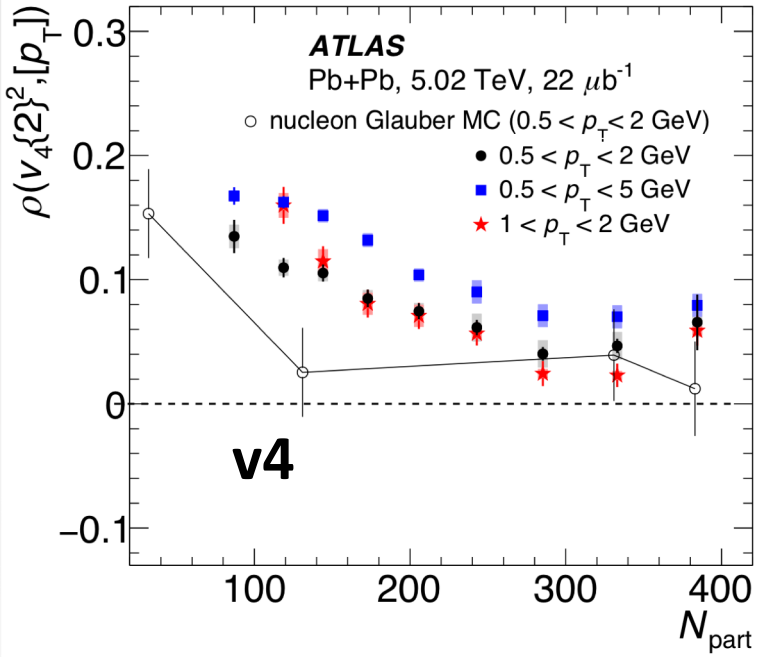


v2(q2) と共にradialフロー増大
(first ESE paper from ALICE)

v2 - pT 相関

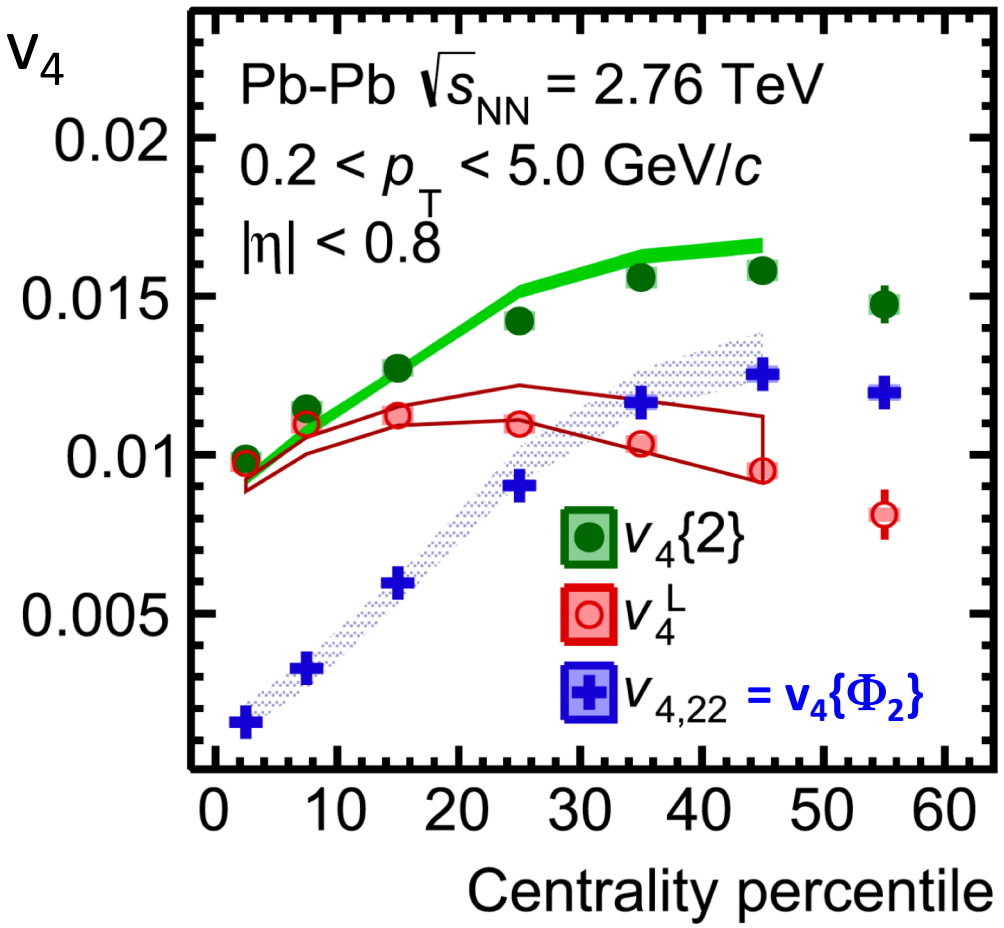






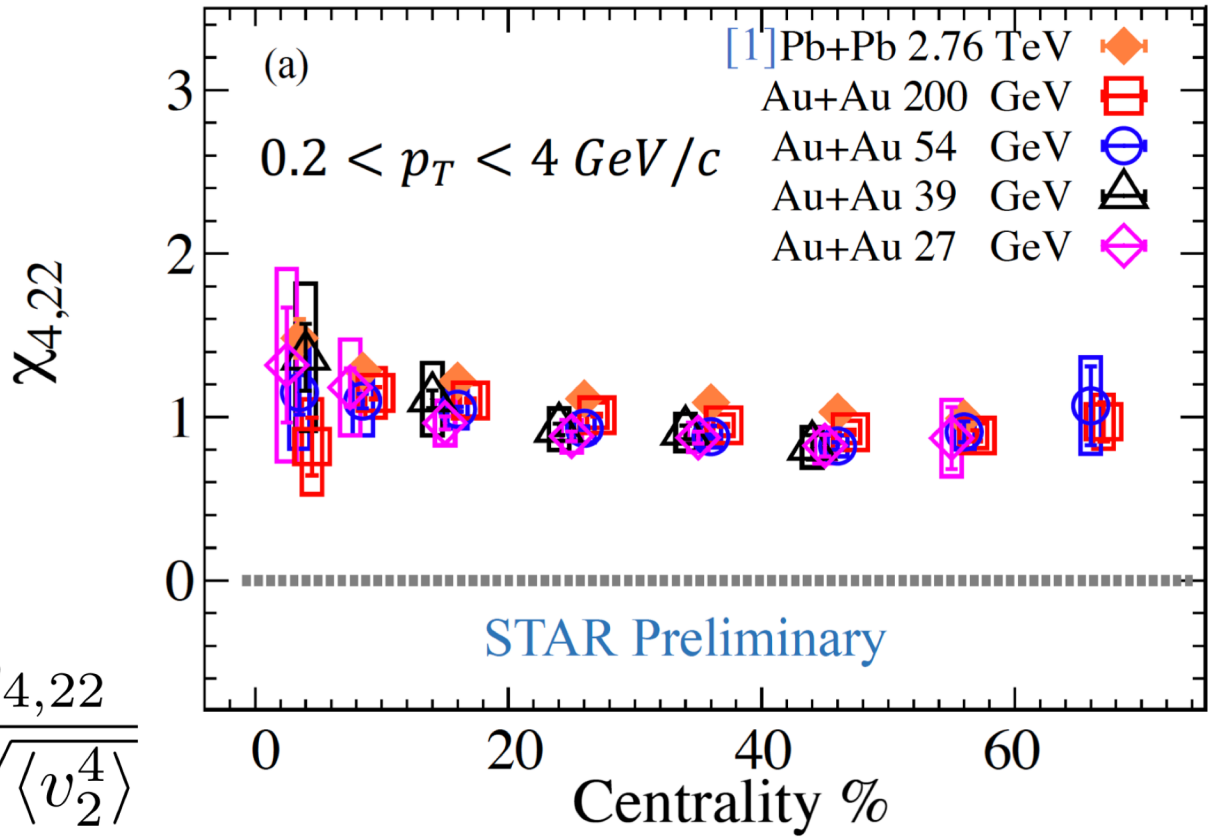
Linear and non-linear flow correlation/decomposition

ALICE, PLB 773 (2017) 68-80



$$\frac{v_{4,22}}{\sqrt{\langle v_2^4 \rangle}}$$

非線形係数（４次ー２次）

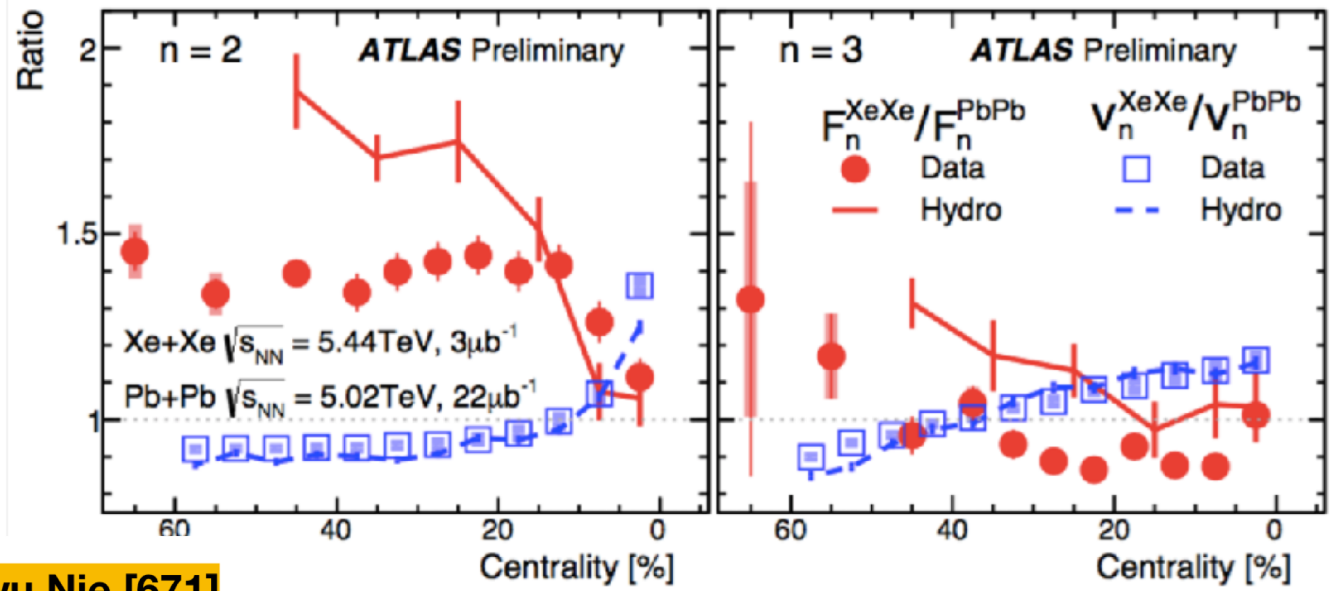


Longitudinal v2 and v3 decorrelation

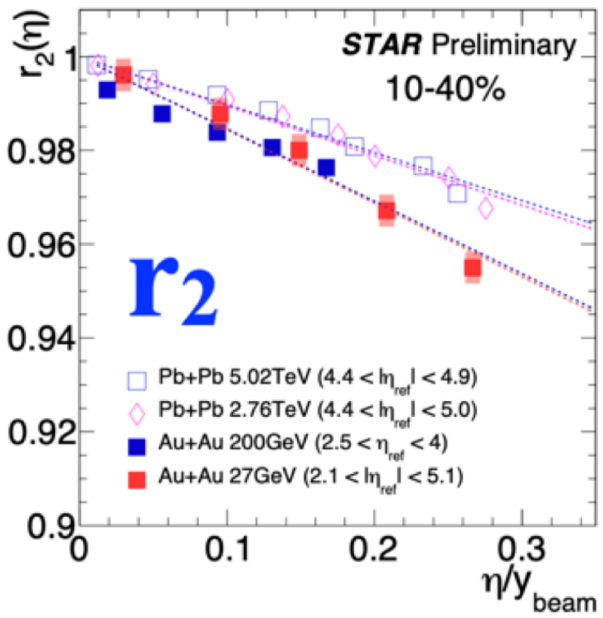
$$r_n(\eta) = \frac{\langle V_n(-\eta) V_n^*(\eta_{\rm ref})\rangle}{\langle V_n(\ \eta) V_n^*(\eta_{\rm ref})\rangle}$$

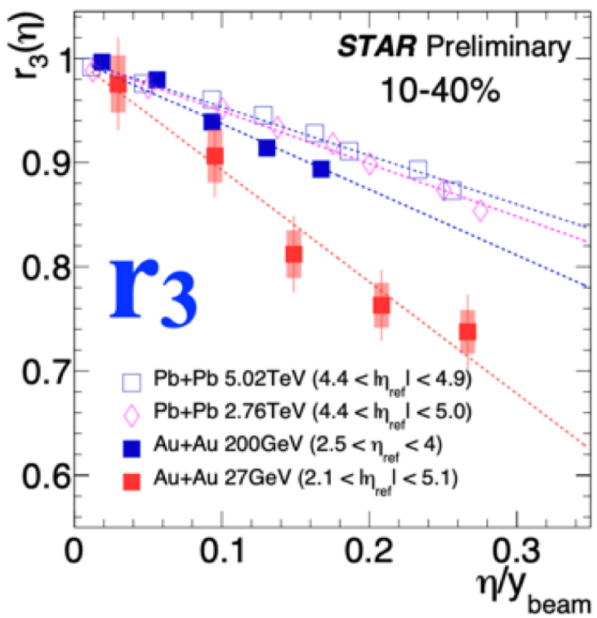
$r_{n|n}(\eta)=1-2F_n\eta$

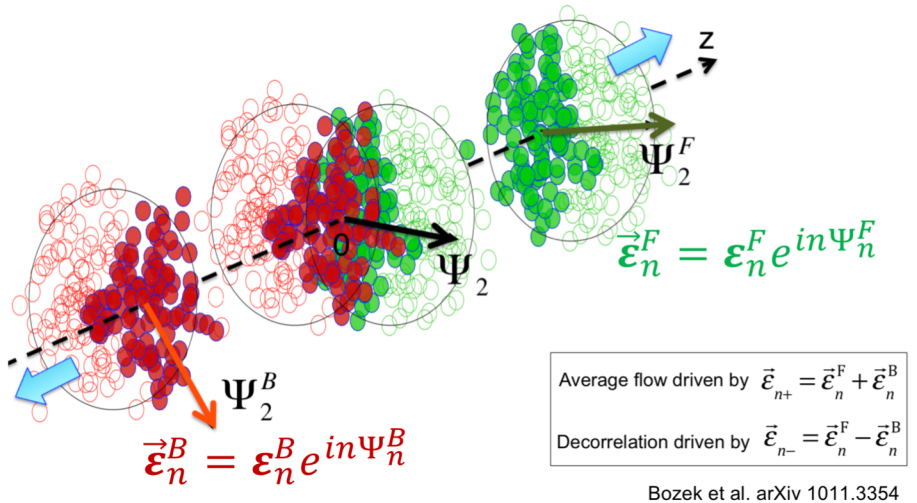
Soumya Mohapatra [127]



Maowu Nie [671]

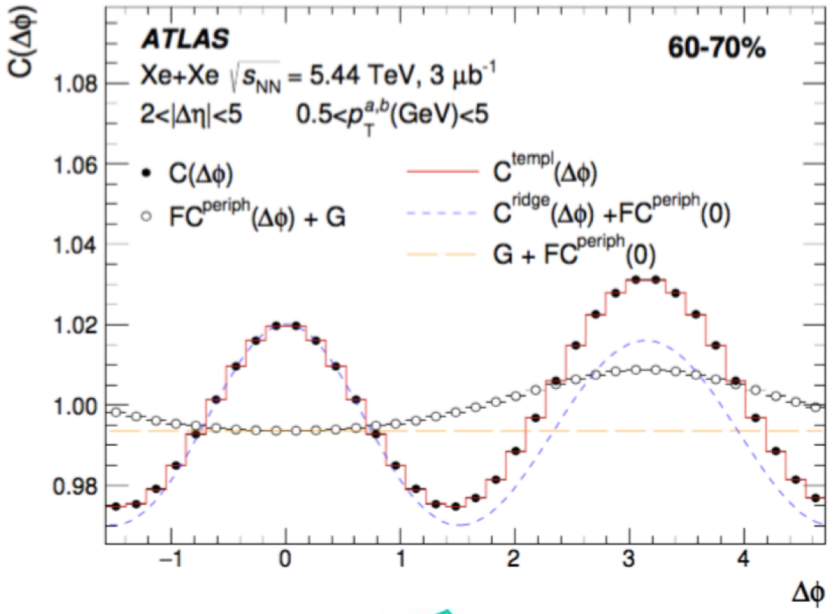


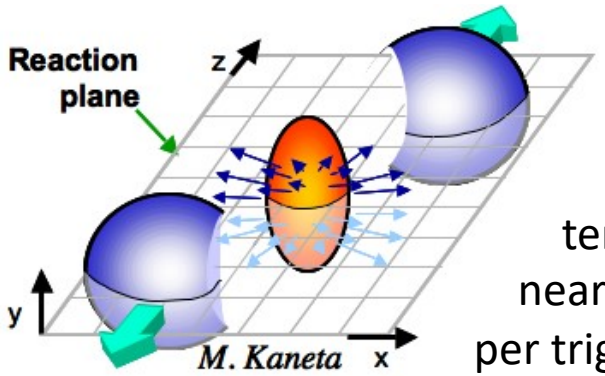




Bozek et al. arXiv 1011.3354

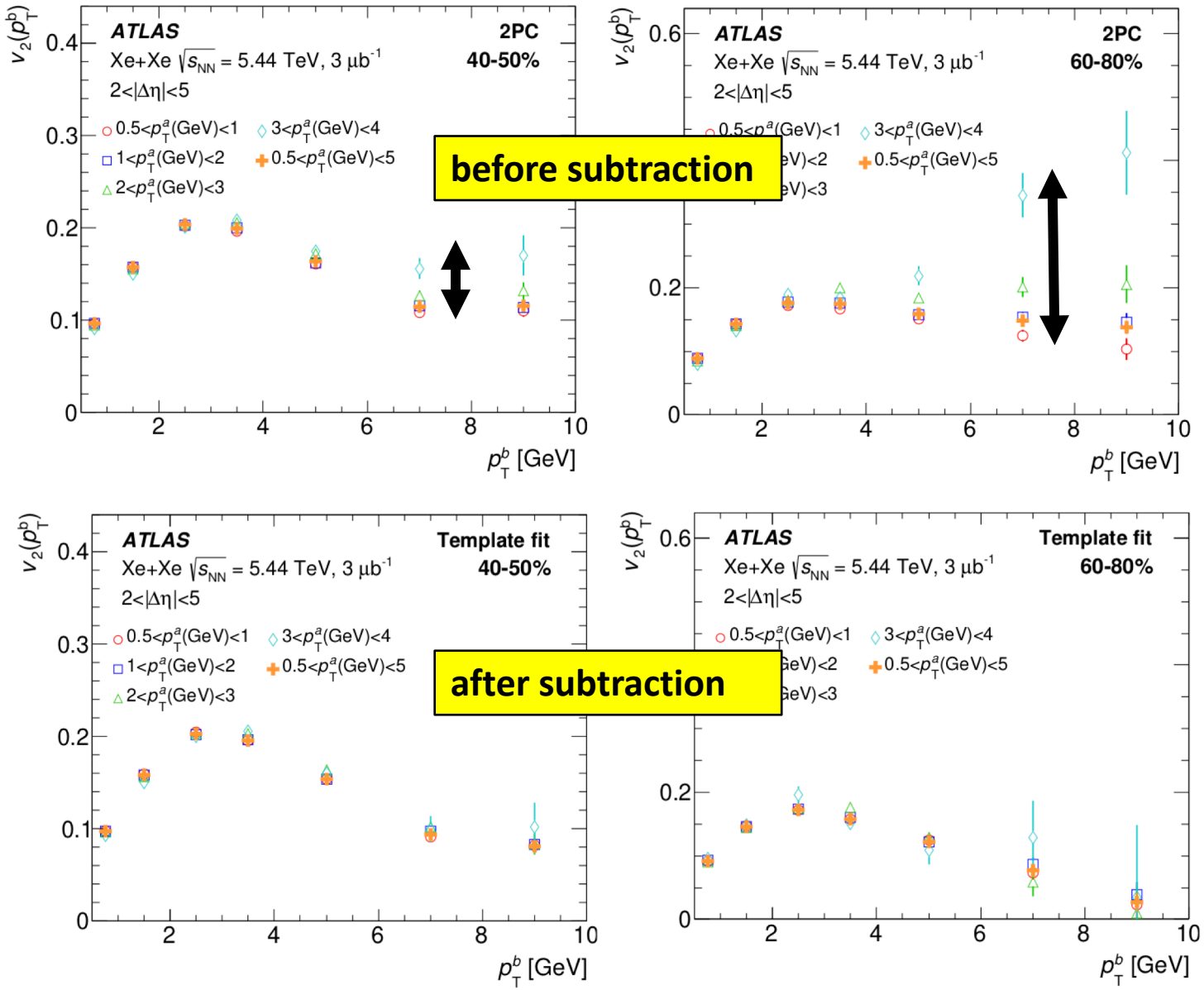
v2 at 5.44 TeV Xe+Xe



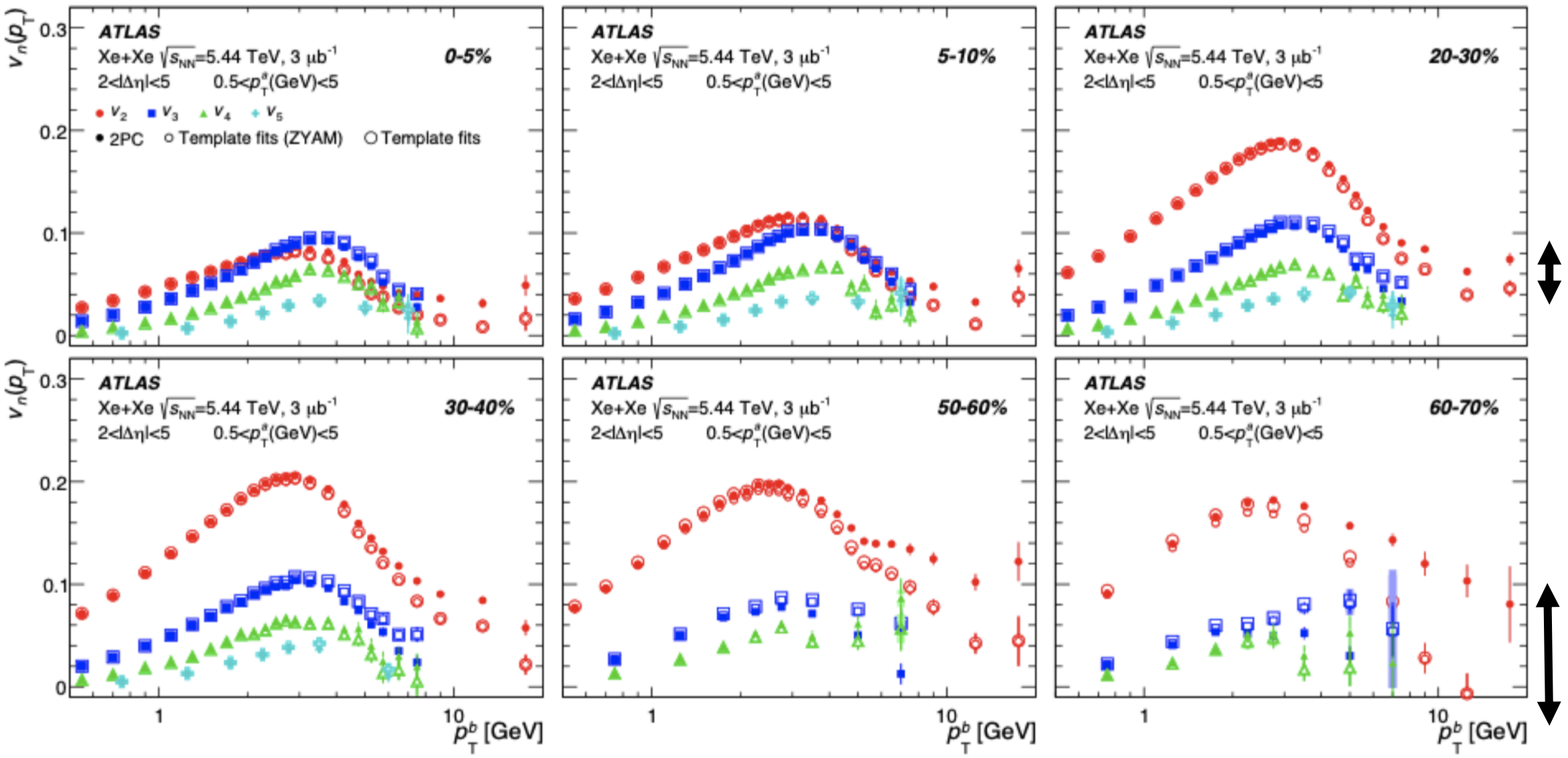


mult.-scaled
c1-scaled
reference fitting
template fitting
near-side jet scaled
per trigger yield sub.

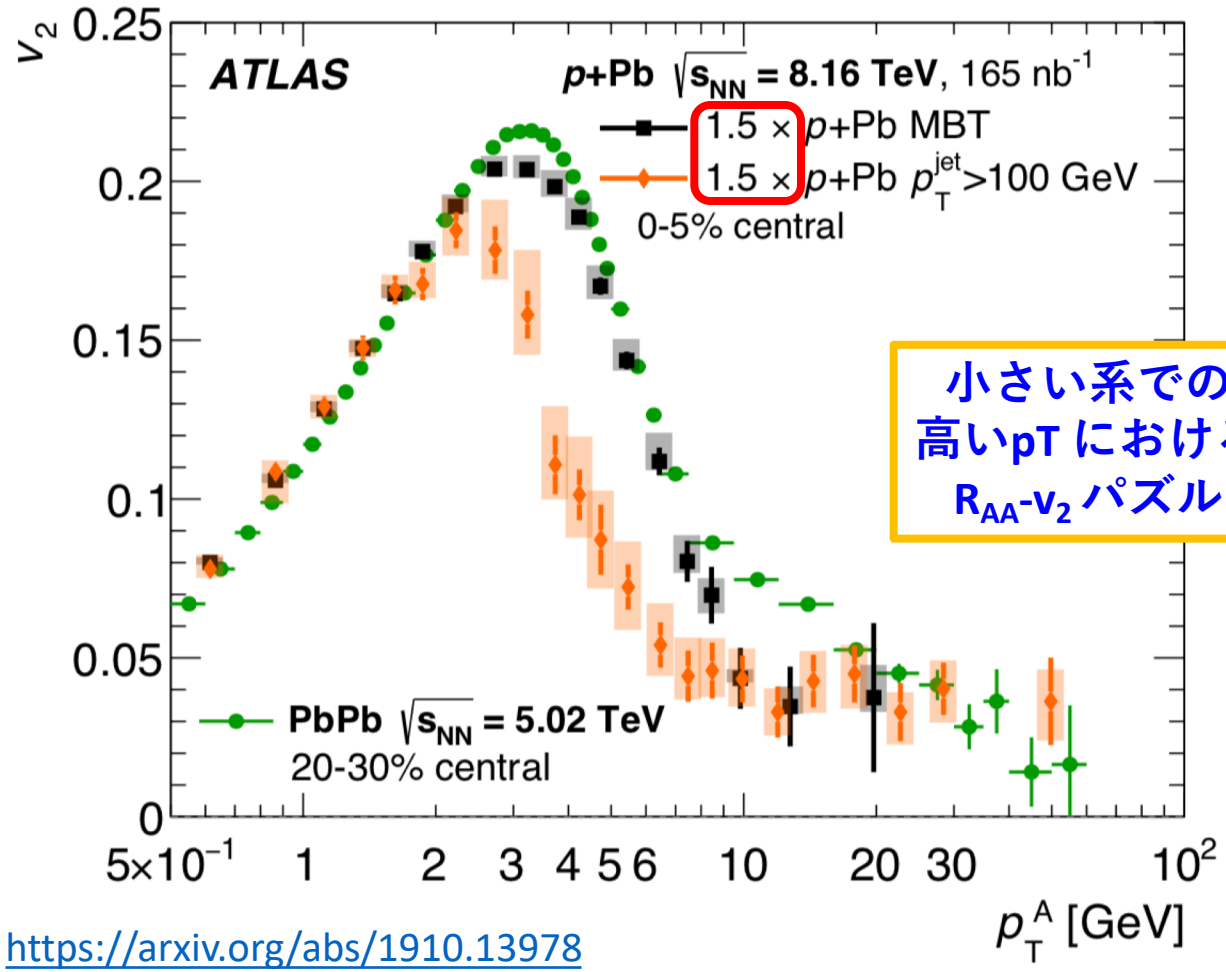
non-flow 引き算の効果　template fitting法



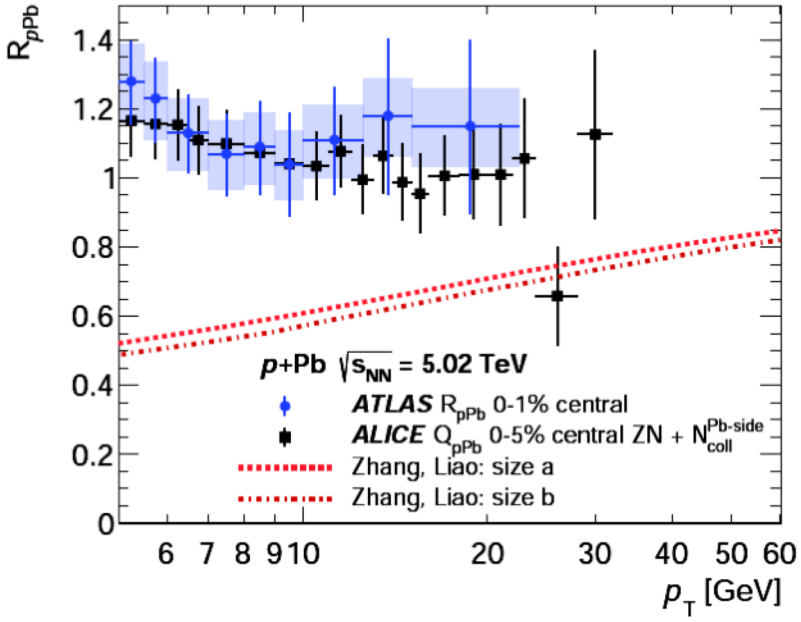
無視できない non-flow ：重イオン衝突においても

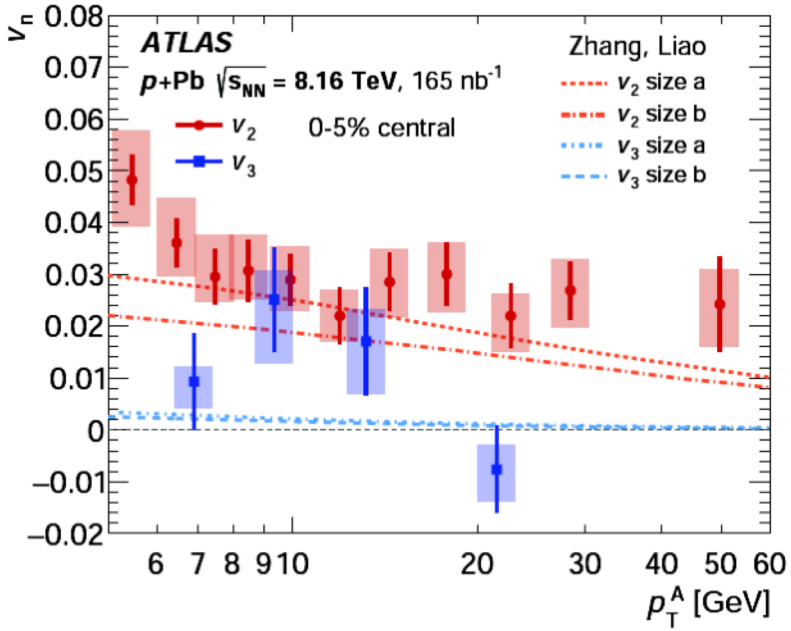


v2 at 8.16 TeV p+Pb (template fitting)

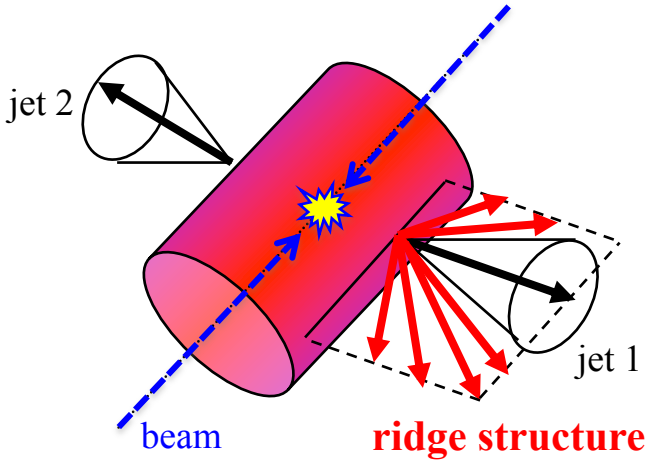


小さい系での
高いpT における
R_{AA}-v_2 パズル



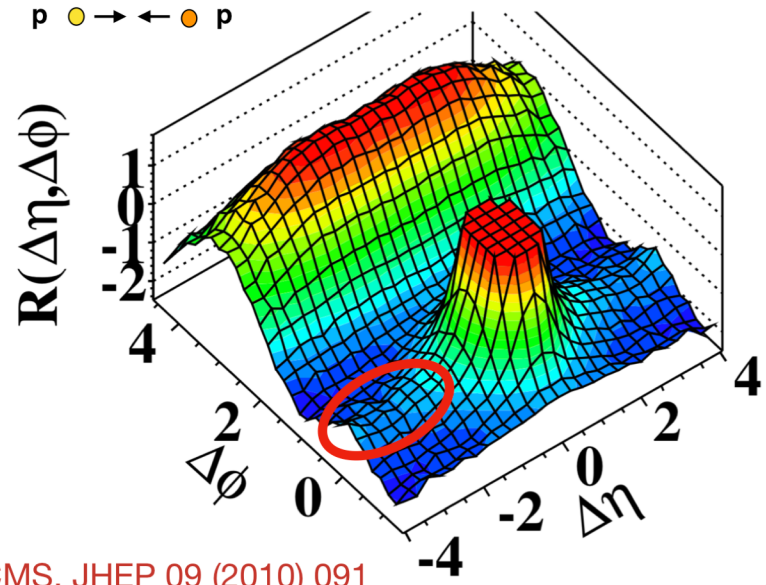


https://arxiv.org/abs/1910.13978



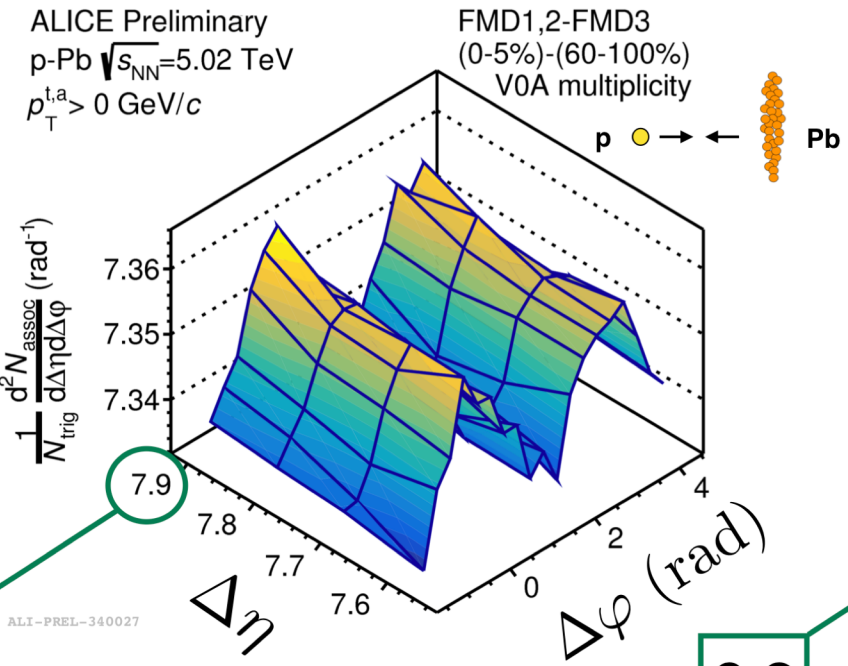
小さい系におけるリッジ (vn)

(d) CMS N ≥ 110, 1.0GeV/c<p_T<3.0GeV/c

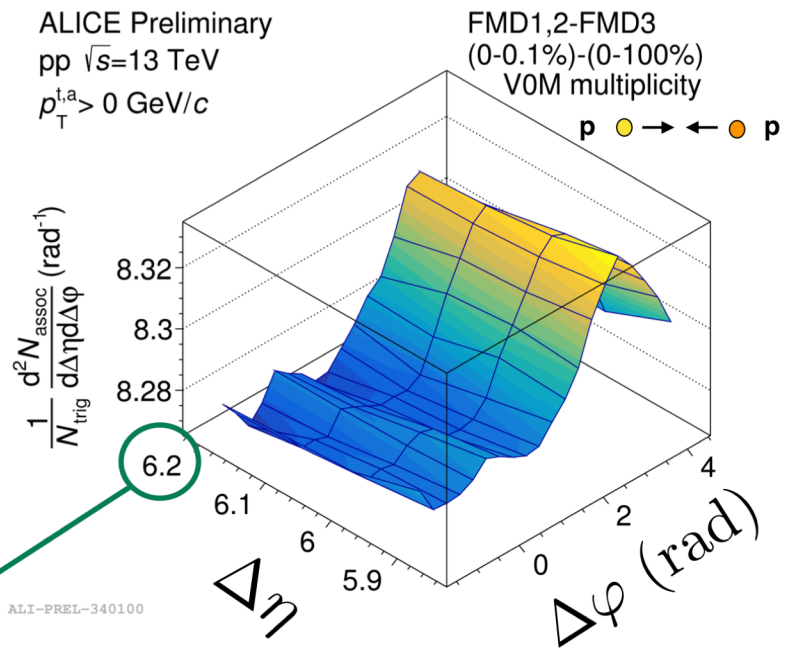


CMS, JHEP 09 (2010) 091

ALICE 5TeV p+Pb



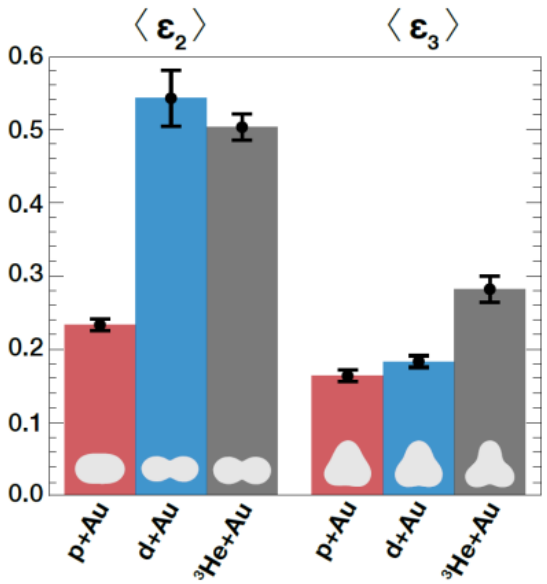
ALICE 13TeV p+p

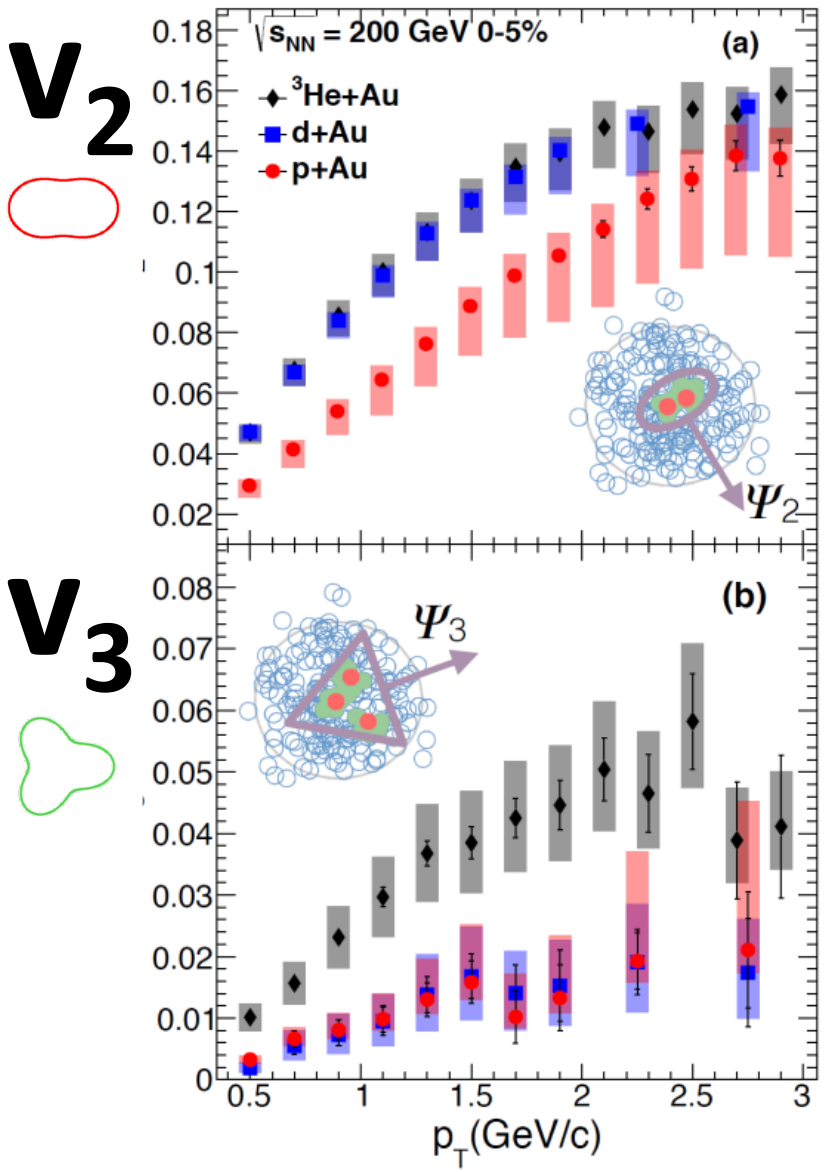


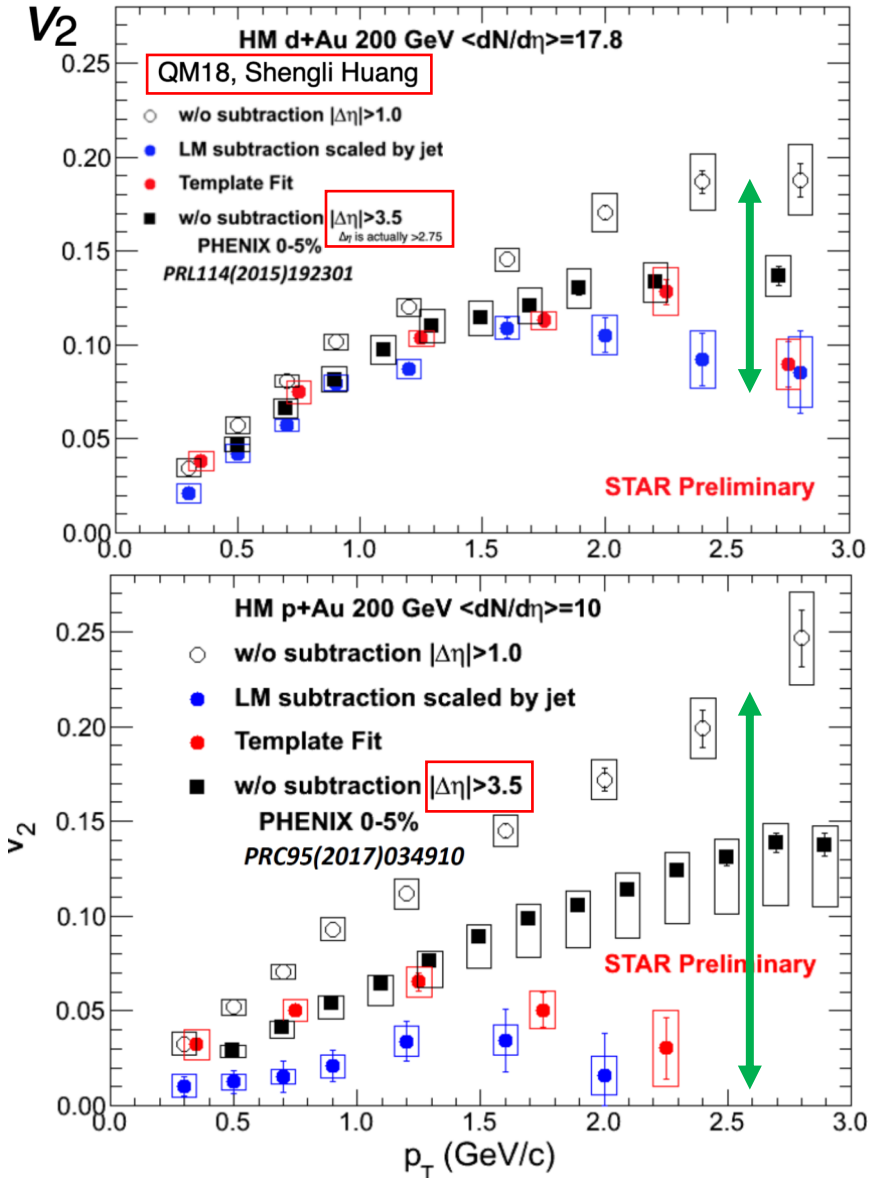
7.9 ⟷ 6.2

関口さん、なんで違う？

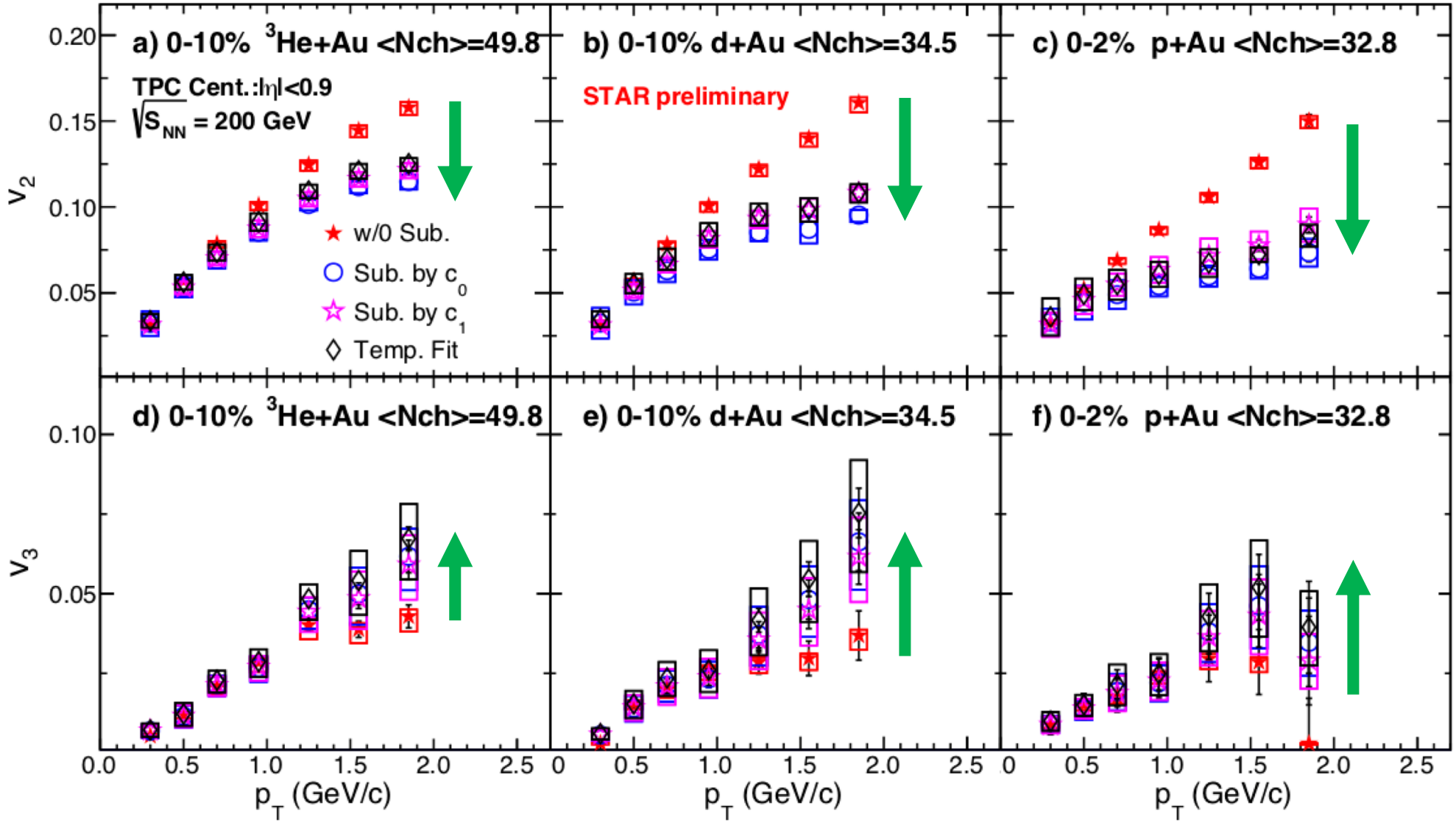
PHENIX Nature
（形状の寄与）





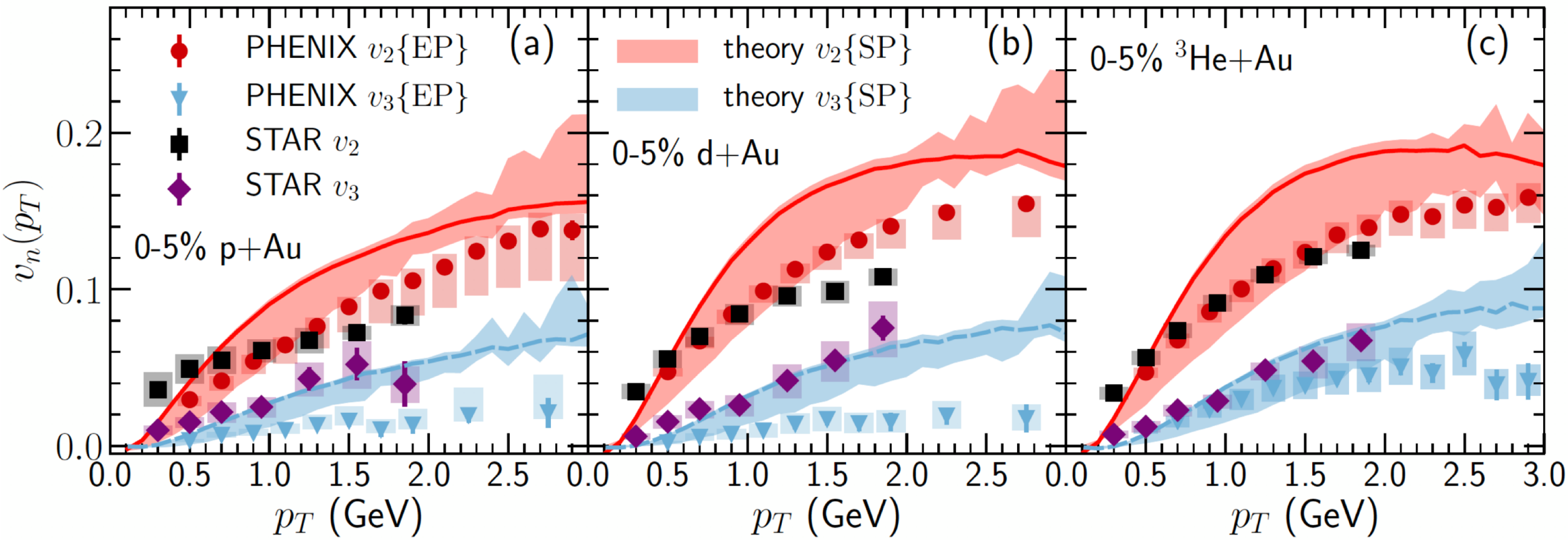


STAR QM19 （多重度の寄与）

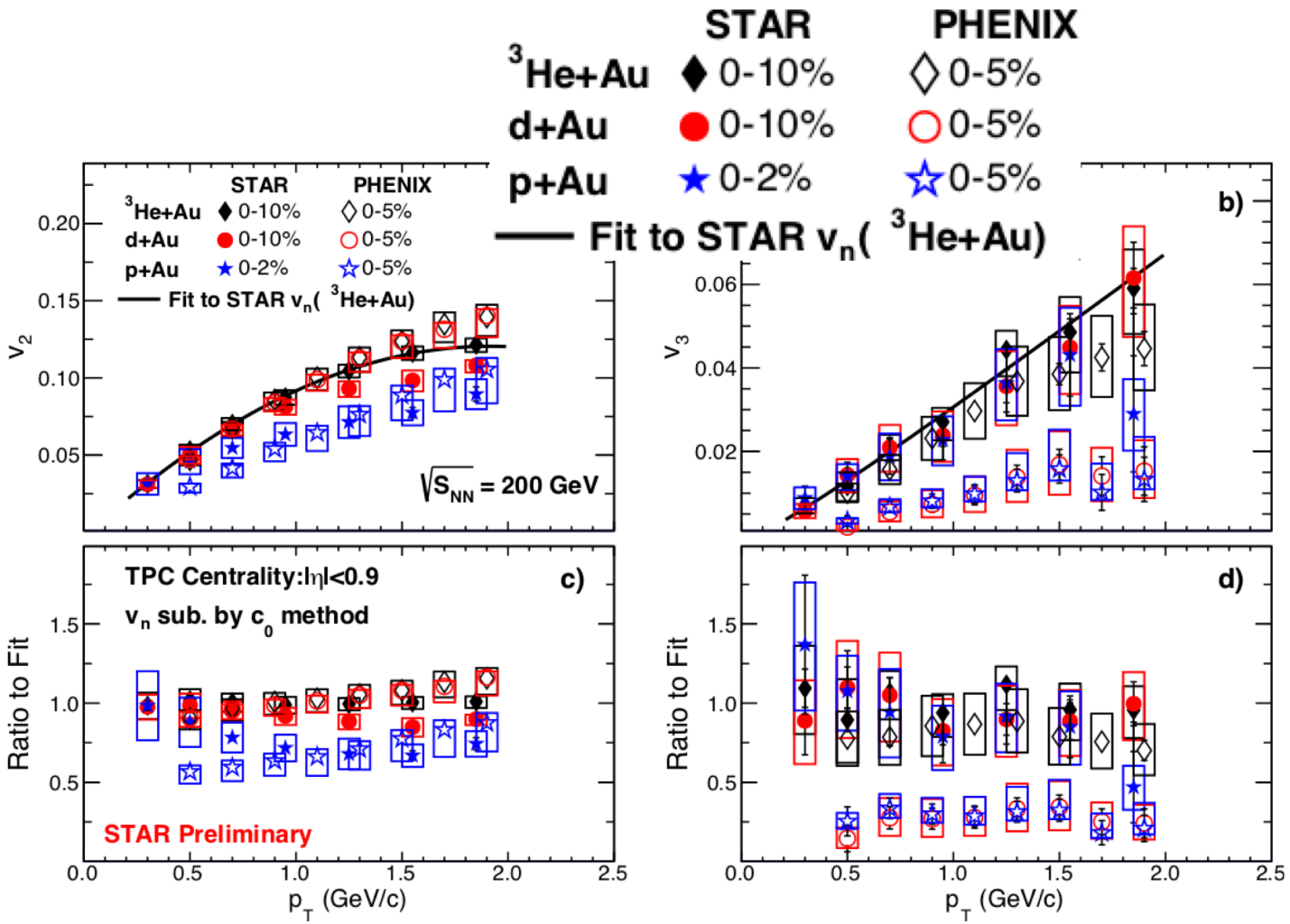


PHENIX, STAR, モデルの比較

B. Schenke, C. Shen, P. Tribedy, arXiv: 1908.06212



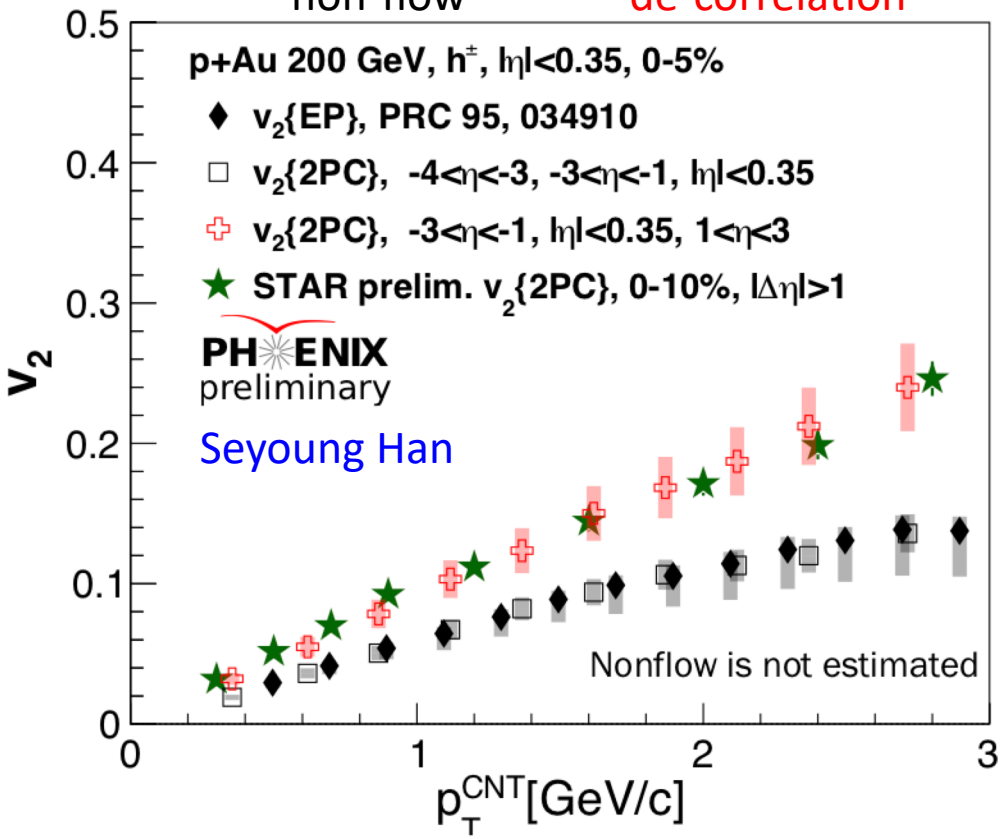
PHENIX, STARの争い　（それぞれの実験内部での争いの方が大変）



v_3 (p+Au, d+Au)に違い

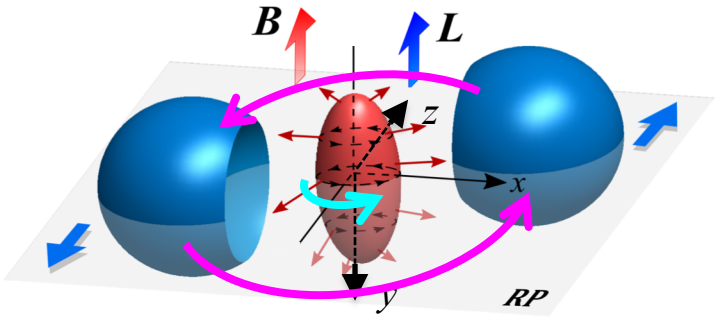
$$\sqrt{\frac{(B1\text{-}C)\,(B2\text{-}C)}{(B1\text{-}B2)}} \quad \text{non-flow}$$

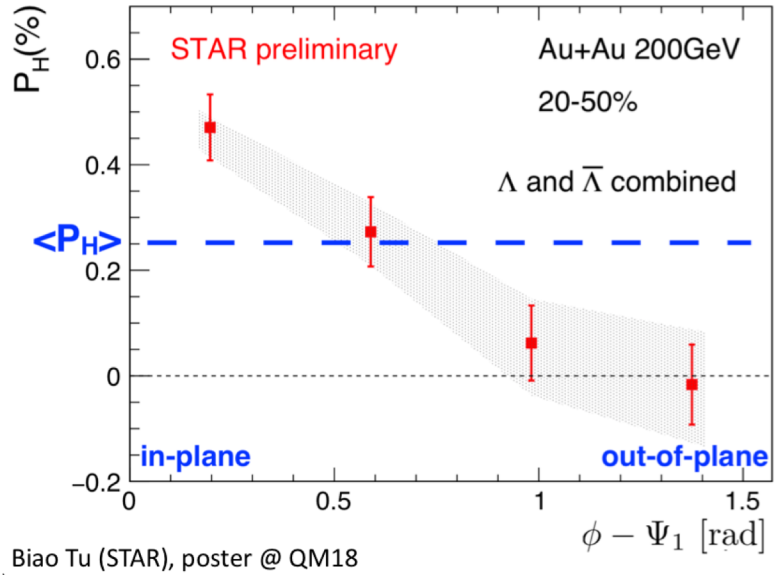
$$\sqrt{\frac{(B2\text{-}C)\,(F2\text{-}C)}{(B2\text{-}F2)}} \quad \text{de-correlation}$$



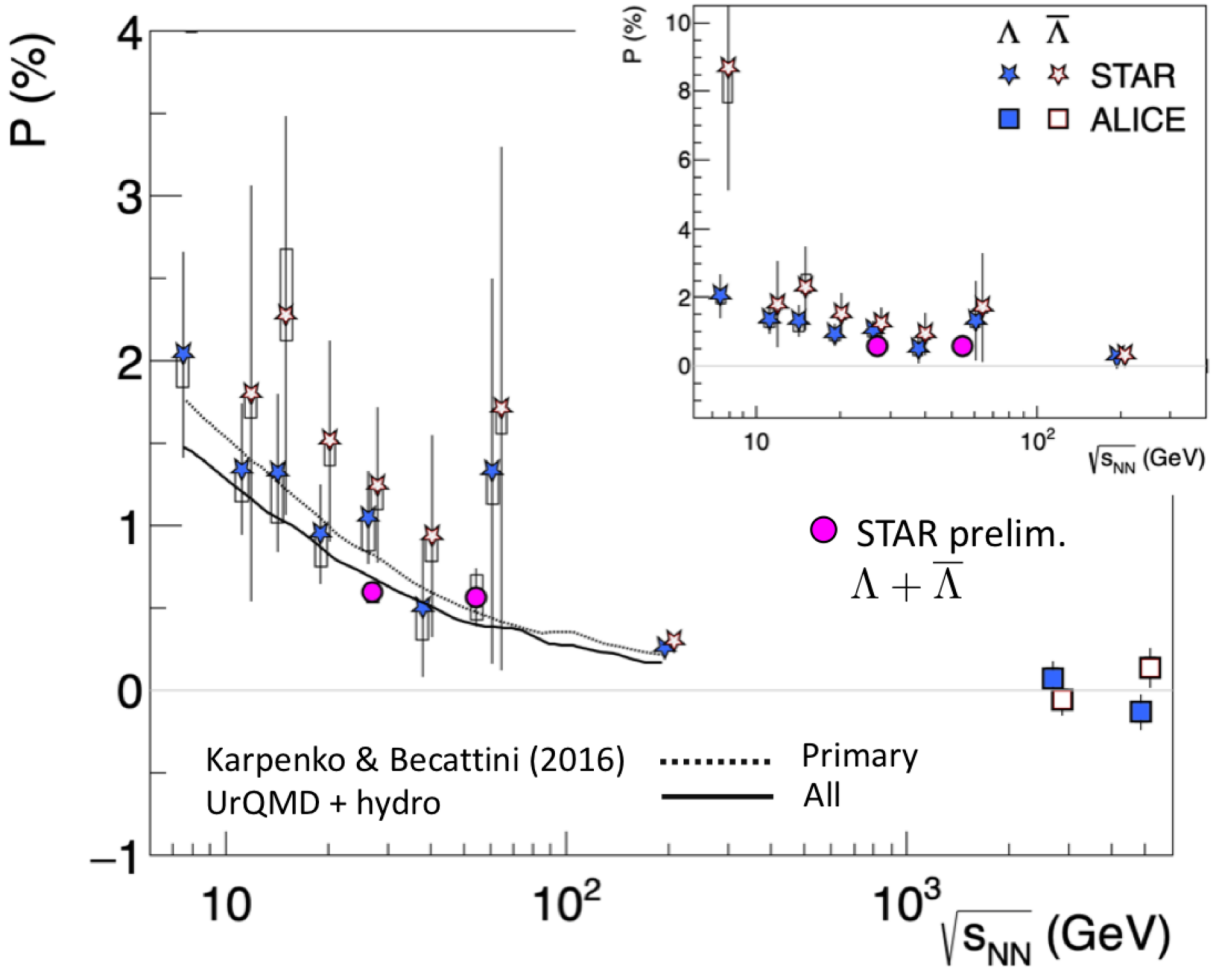
先ずは、v_2の決着を！

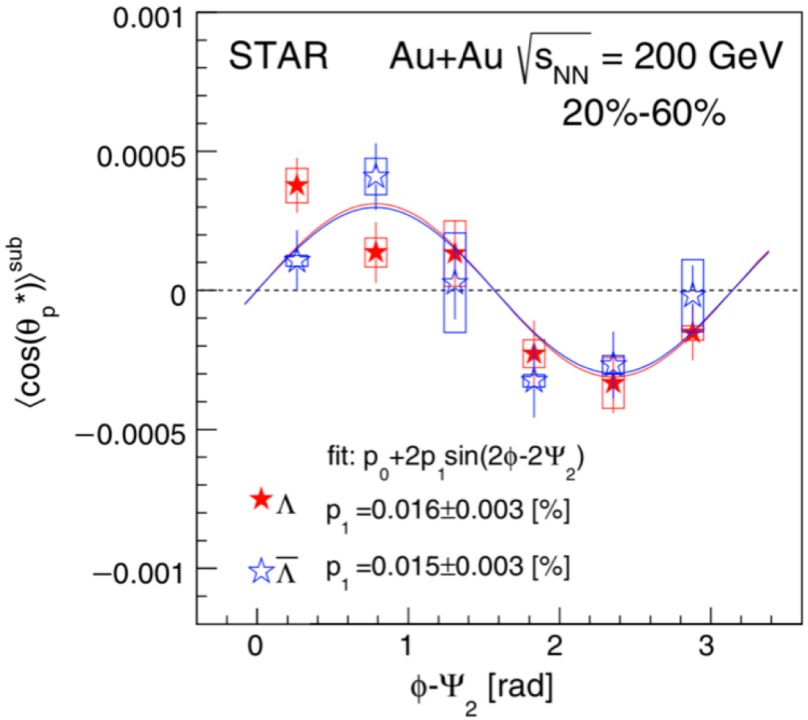
系の渦とラムダ偏極

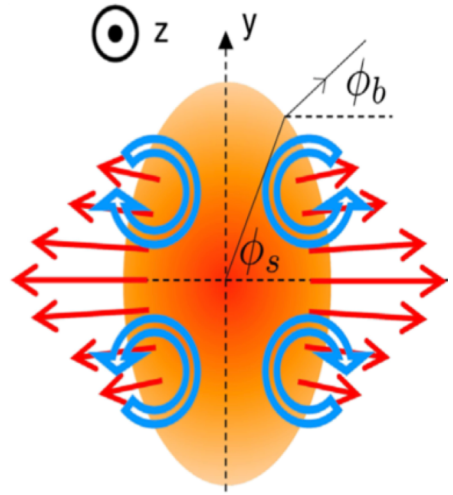




Biao Tu (STAR), poster @ QM18

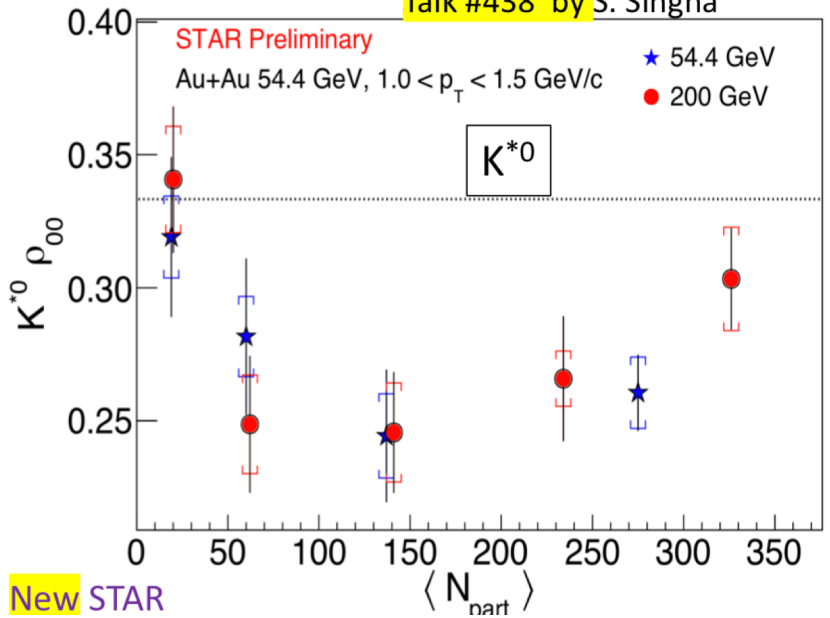






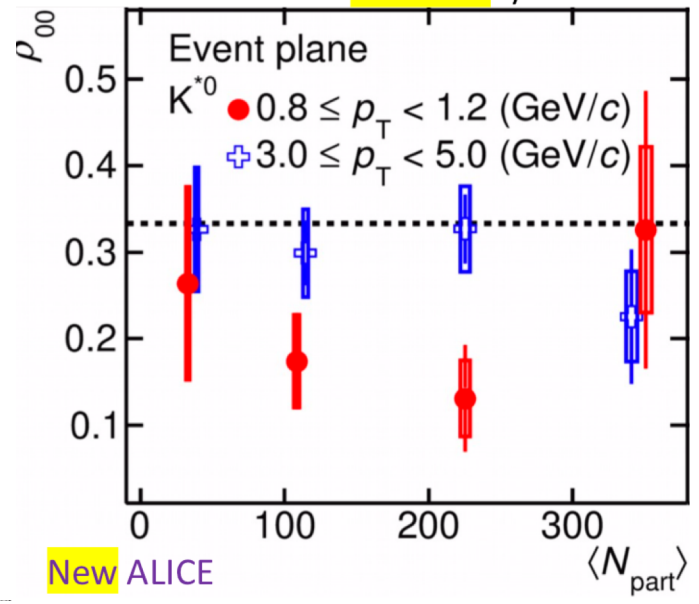
K^{*0}, ϕのスピン整列

Talk #438 by S. Singha

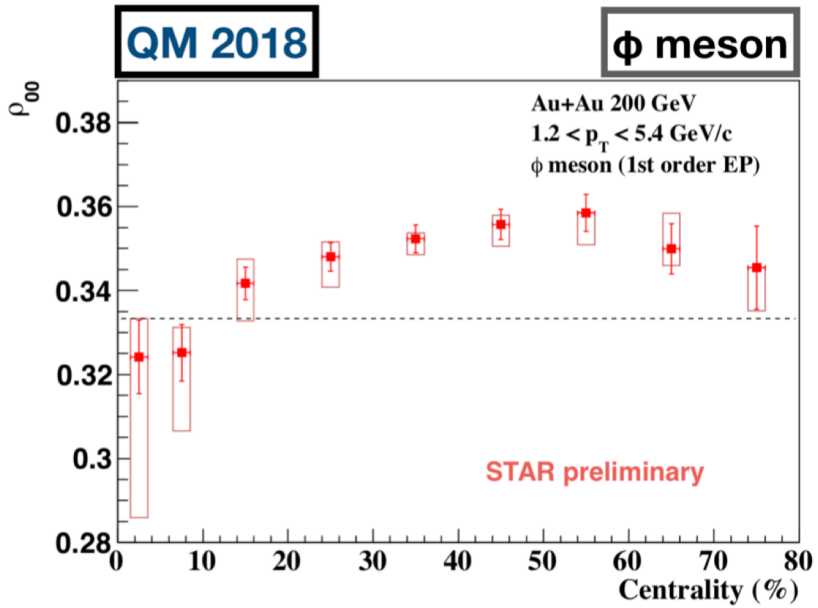


New STAR

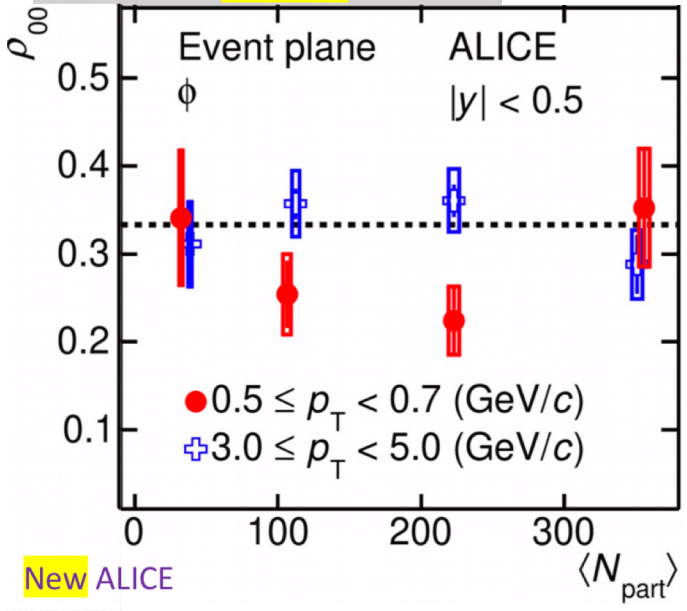
1910.14408 Talk #169 by S. Kundu



New ALICE

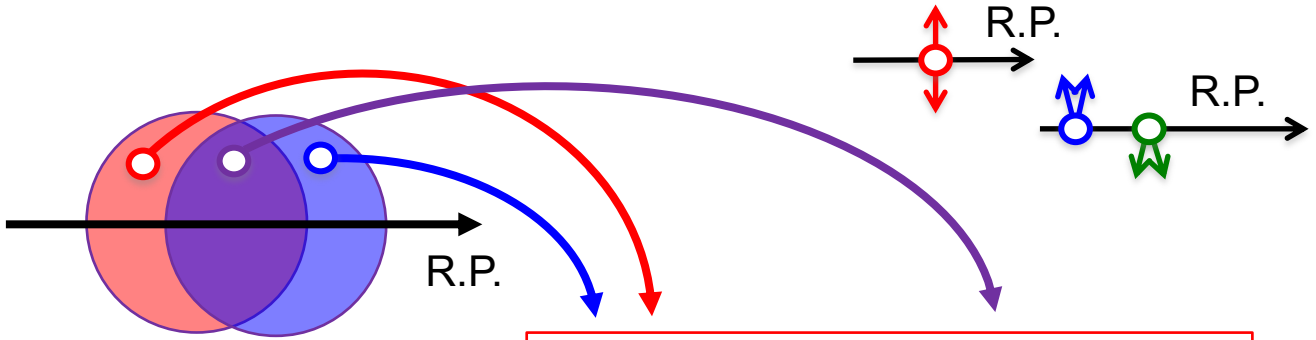


1910.14408 Talk #169 by S. Kundu

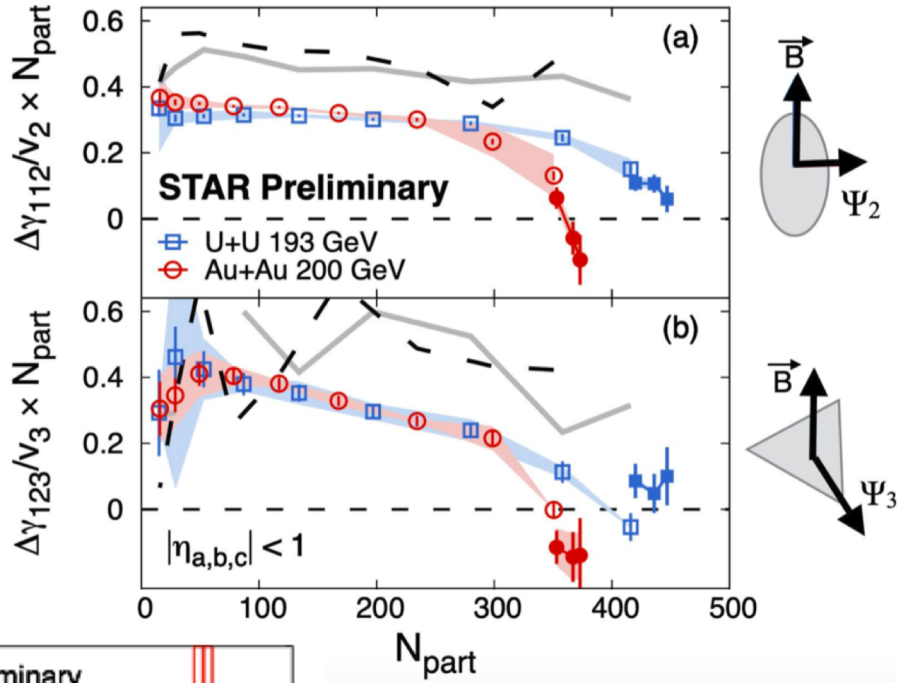


New ALICE

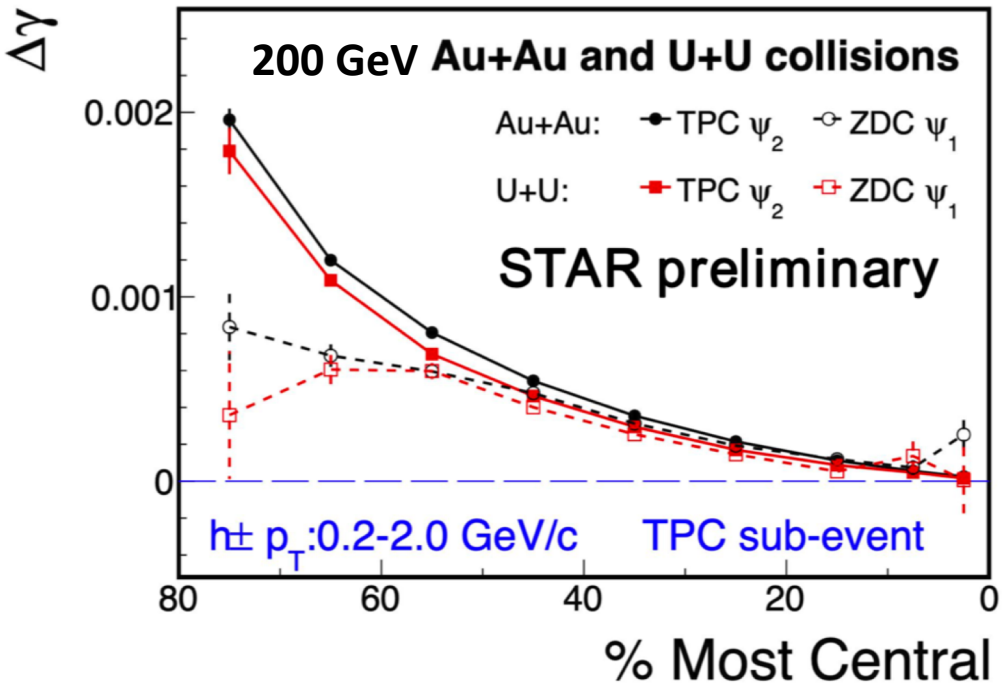
カイラル磁場効果（CME）

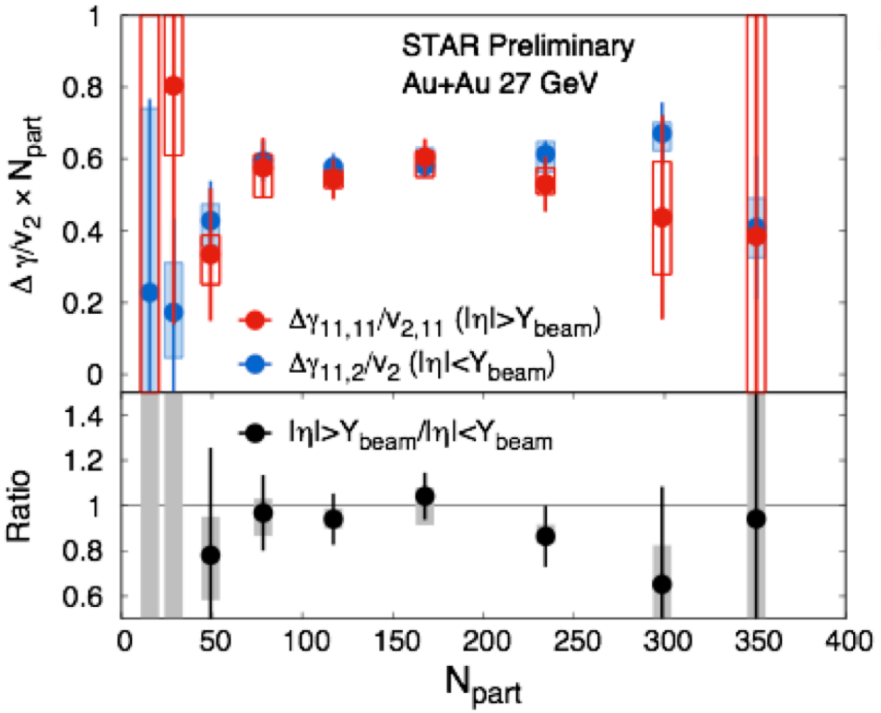


Spectator 平面 と Participant平面



Jie Zhao talk #667

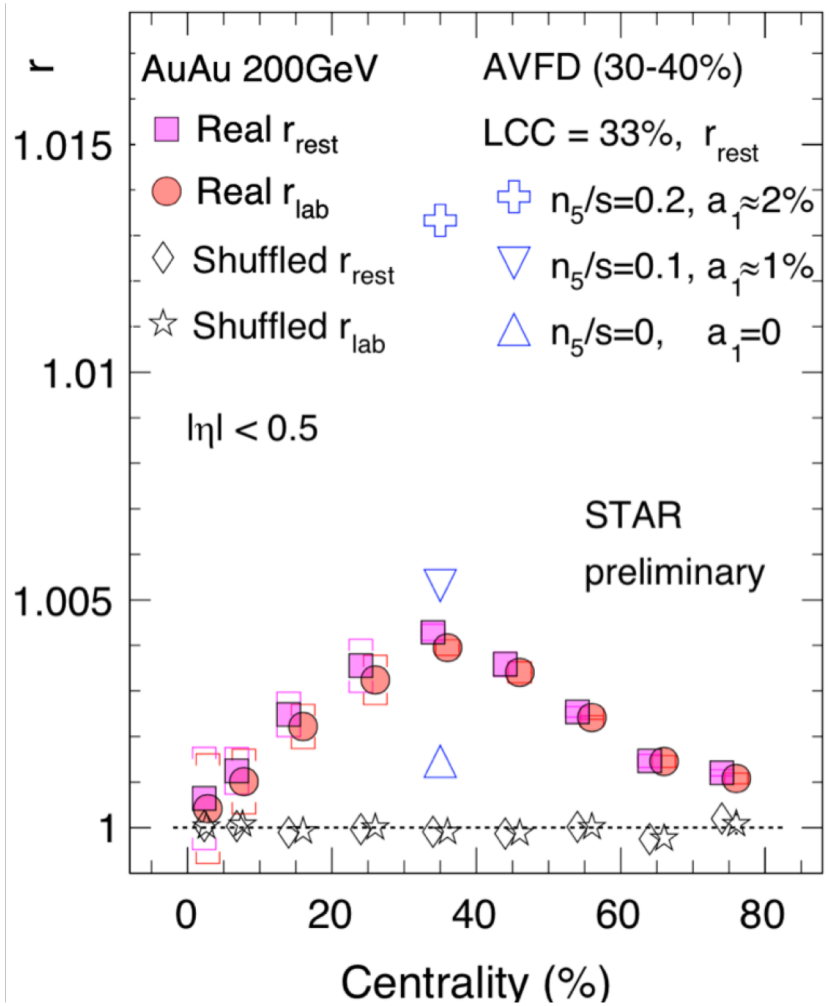


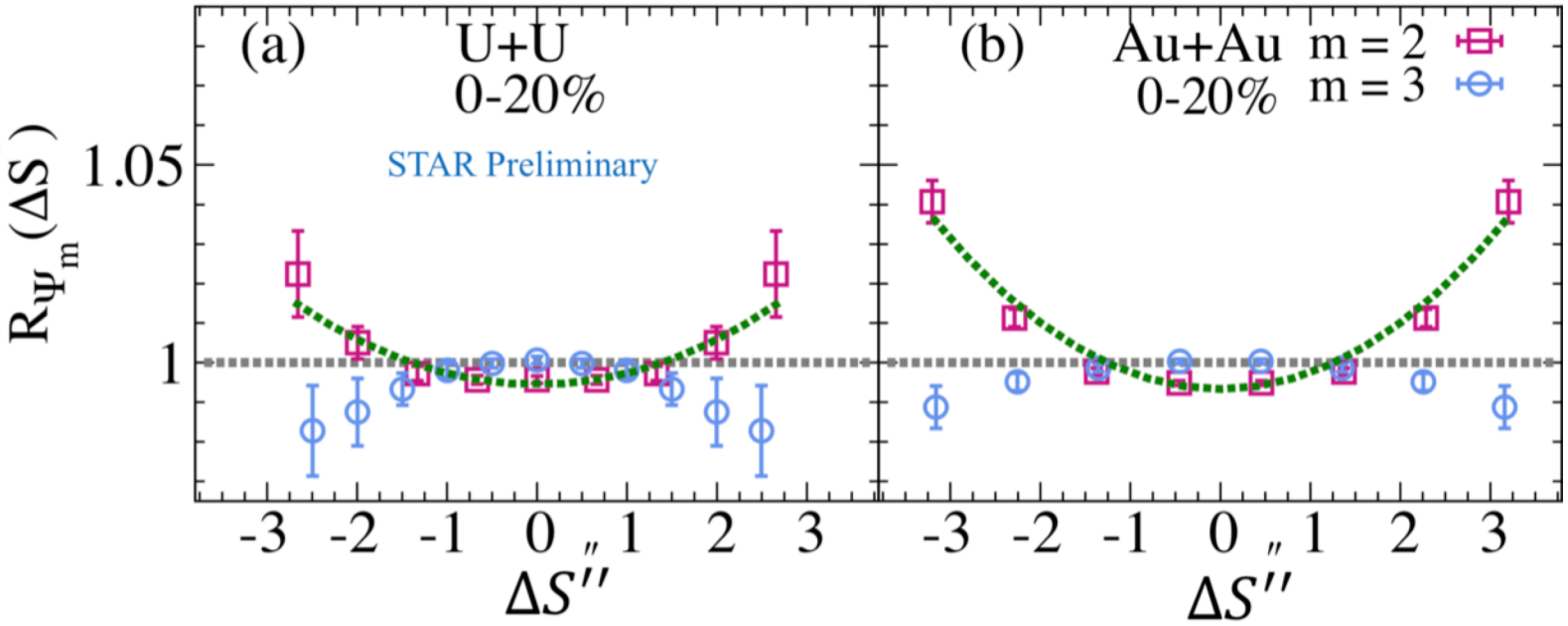


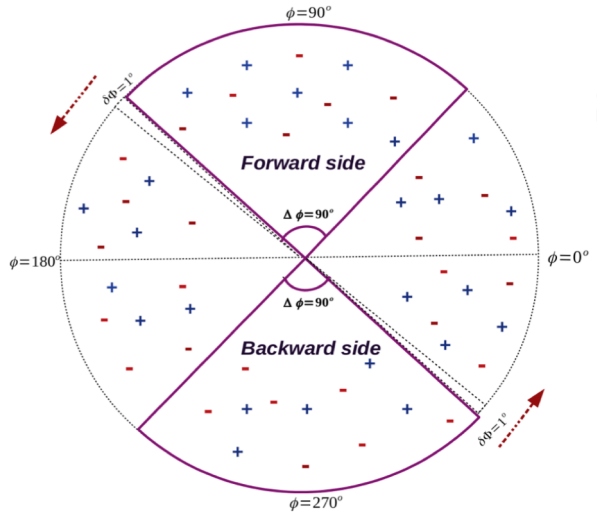
with new EPD
($|\eta|$ = 2 ~ 5)

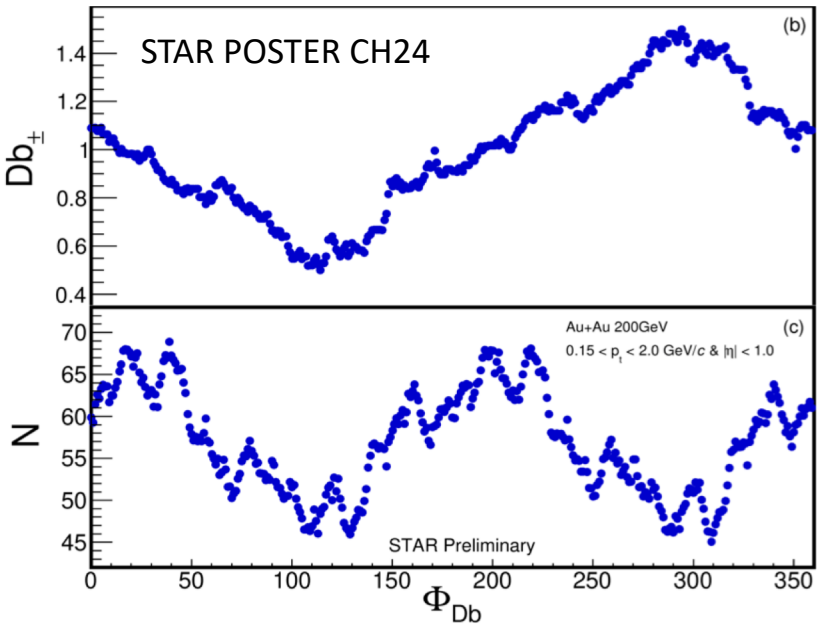
カイラル磁場効果（CME）

blind analysis with Isobar
to come soon

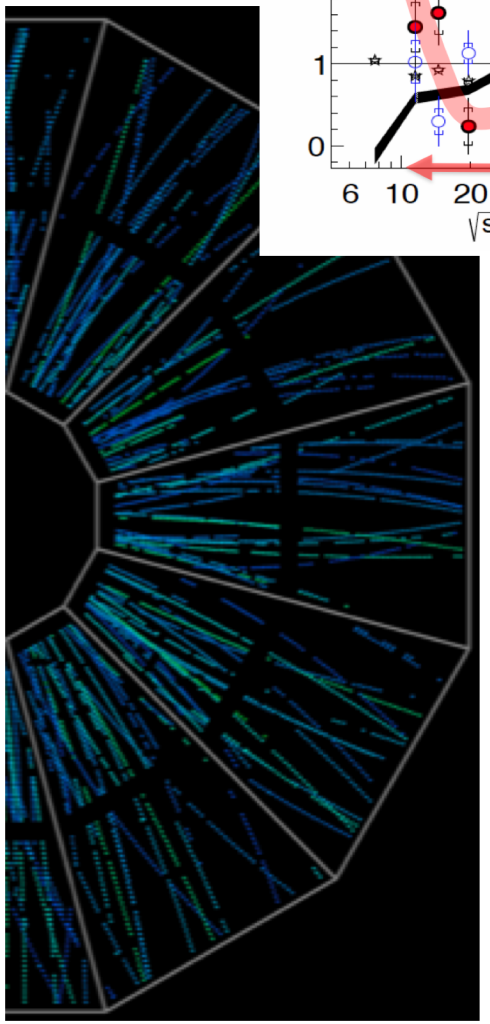


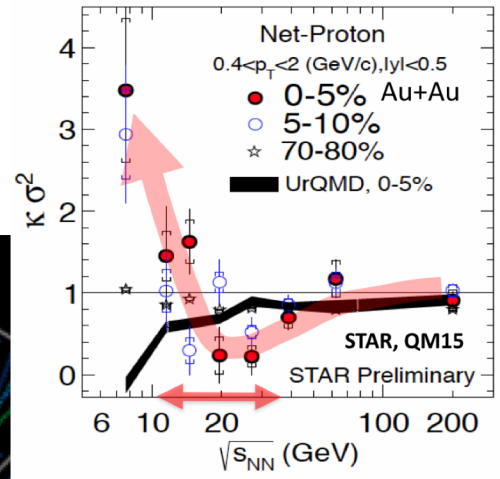


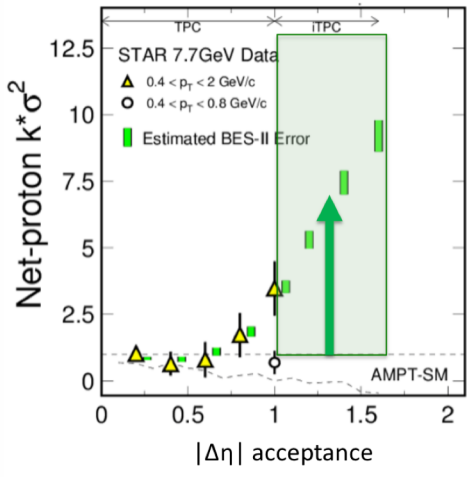




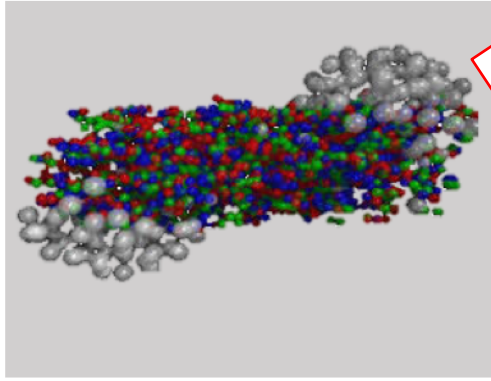
new STAR detectors for BES2

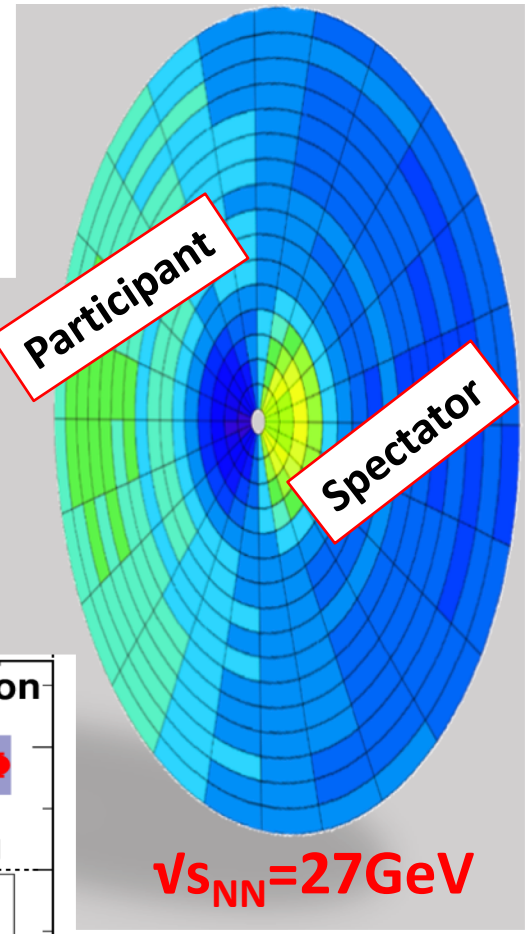


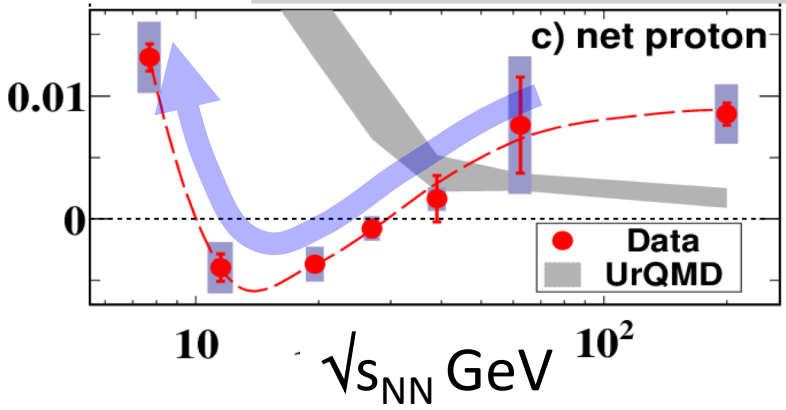




New EPD (|η| = 2 ~ 5)







まとめ

・揺らぎ、フリーズアウト
・v1, v2 フロー、小さい系
・渦、磁場