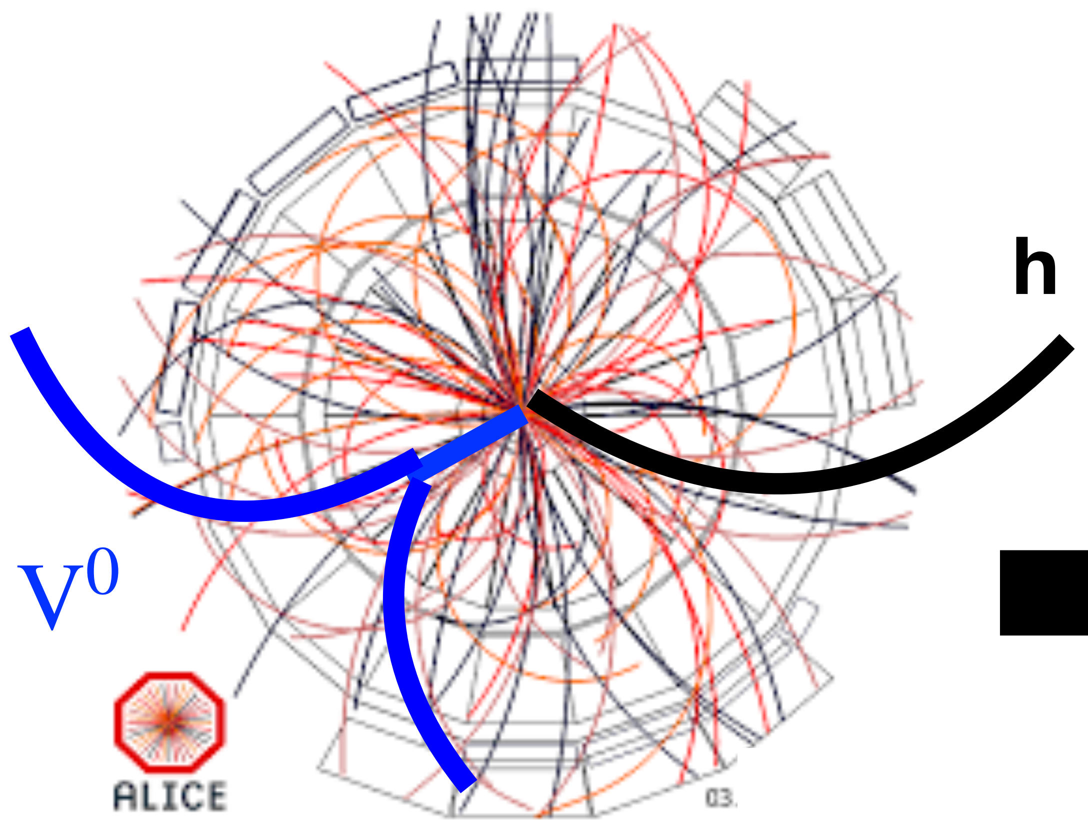
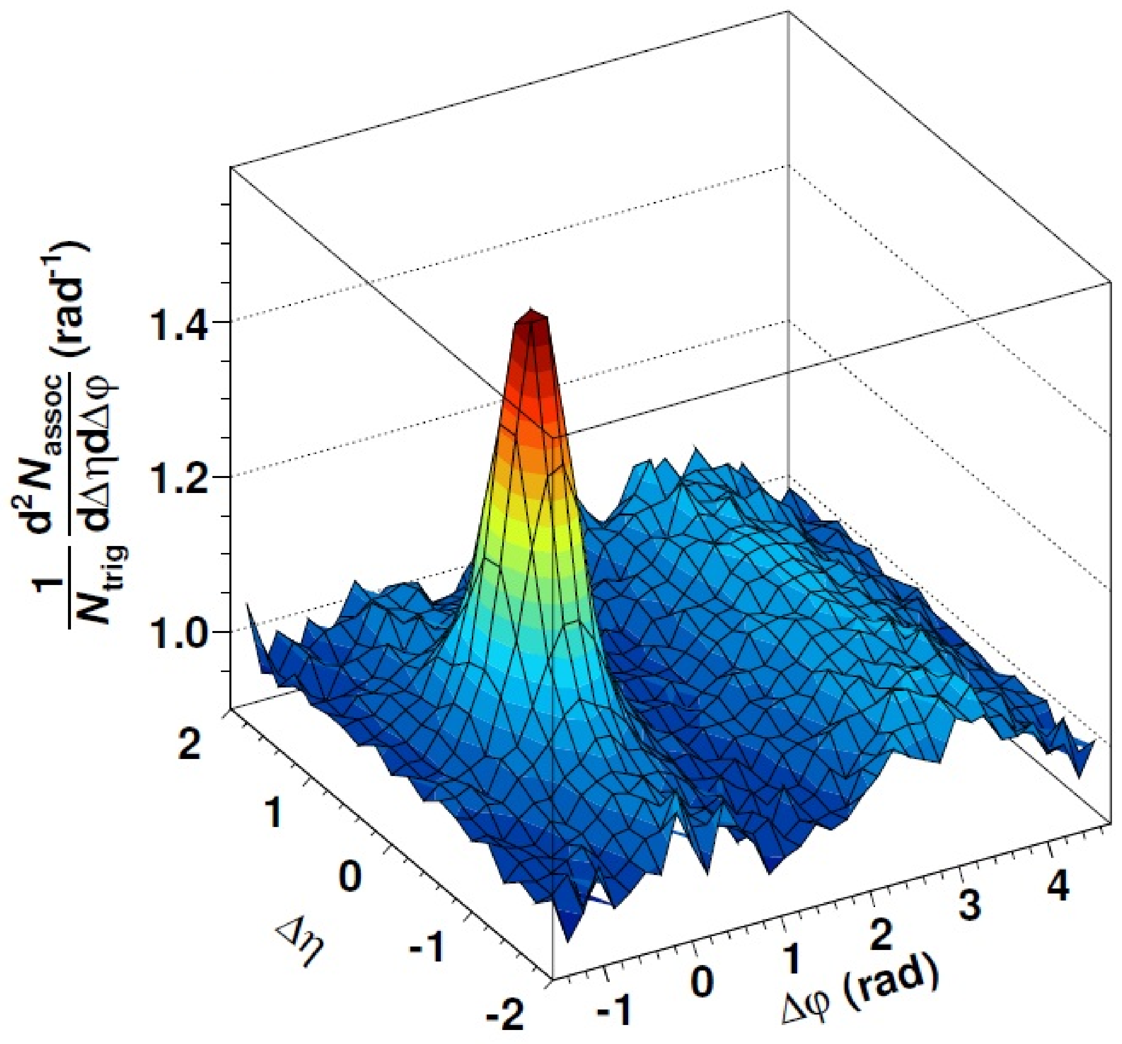
Exploring jet fragmentation using two-particle correlations with Λ and K^0_S as trigger particles in pp and Pb–Pb collisions with ALICE

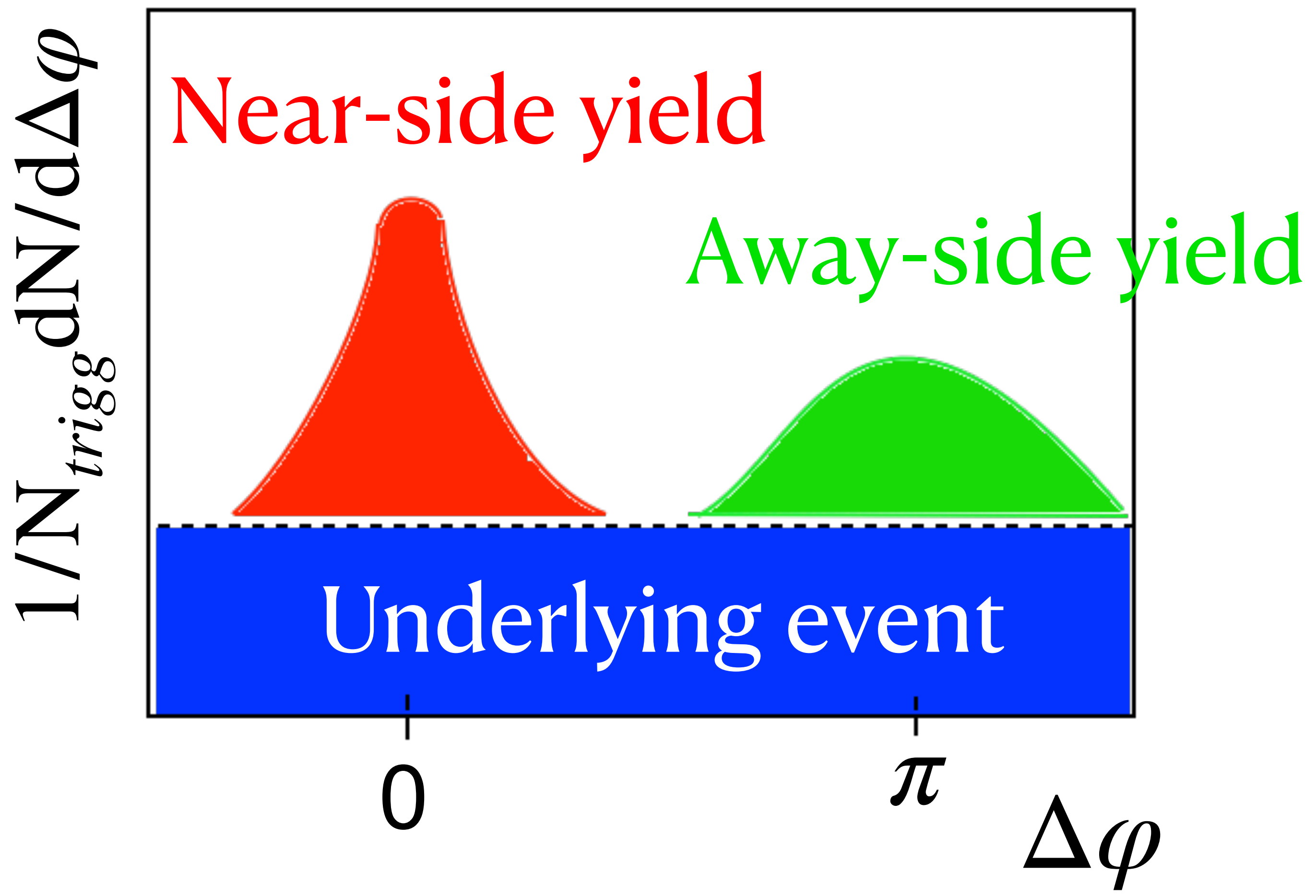
Lucia Anna Tarasovičová
Westfälische Wilhelms-Universität Münster
on behalf of ALICE Collaboration

European Physical Society conference on high energy physics 2021
Online conference, July 26-30, 2021

Correlations with strange hadrons







$$\frac{1}{N_{\text{trig}}}\frac{d^2N_{\text{assoc}}}{d\Delta\varphi d\Delta\eta}$$

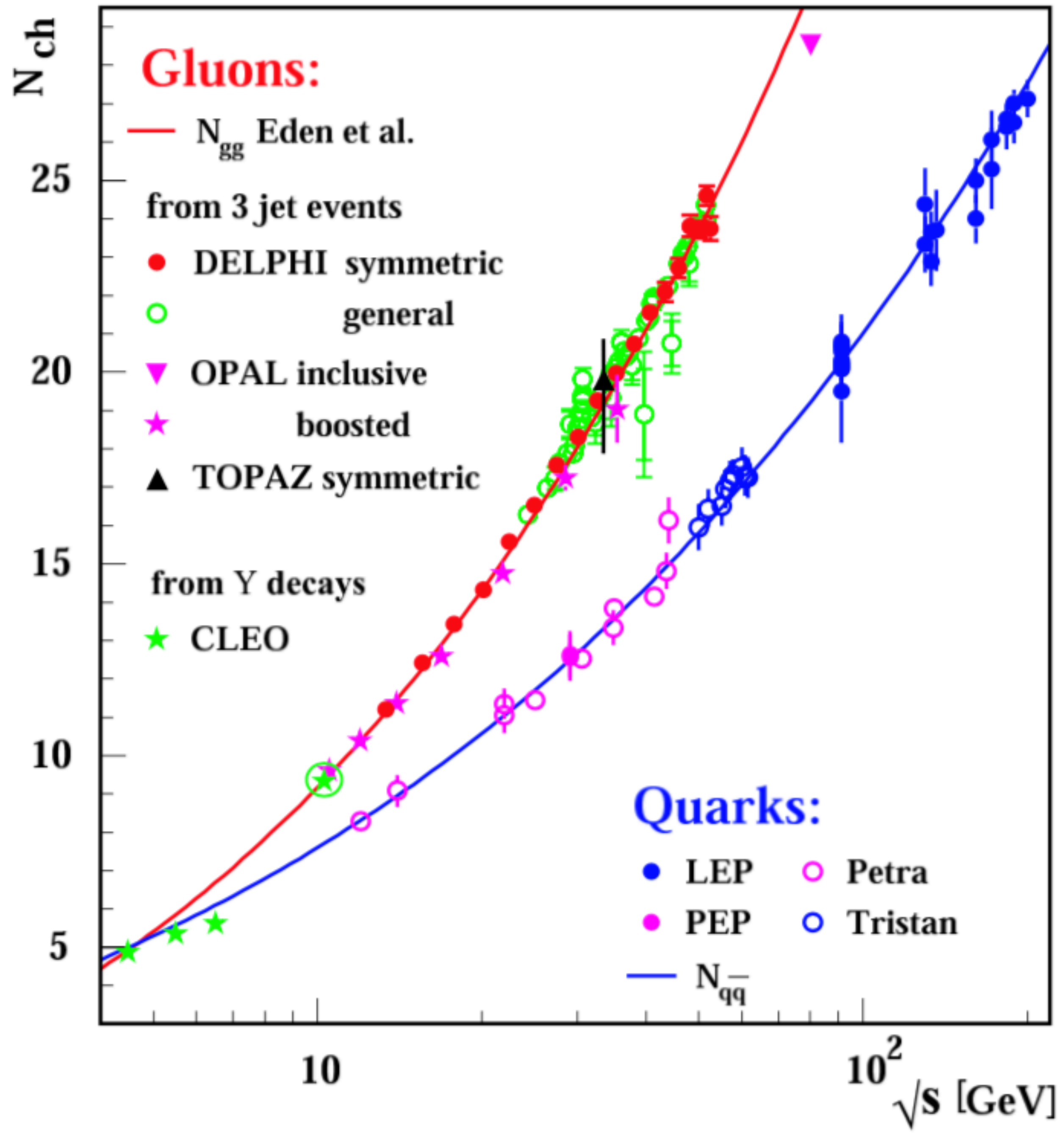
ALI-PUB-46228

$$Y_J^{\Delta\varphi} = \int_{\Delta\varphi_1}^{\Delta\varphi_2} \frac{dN}{d\Delta\varphi} d\Delta\varphi$$

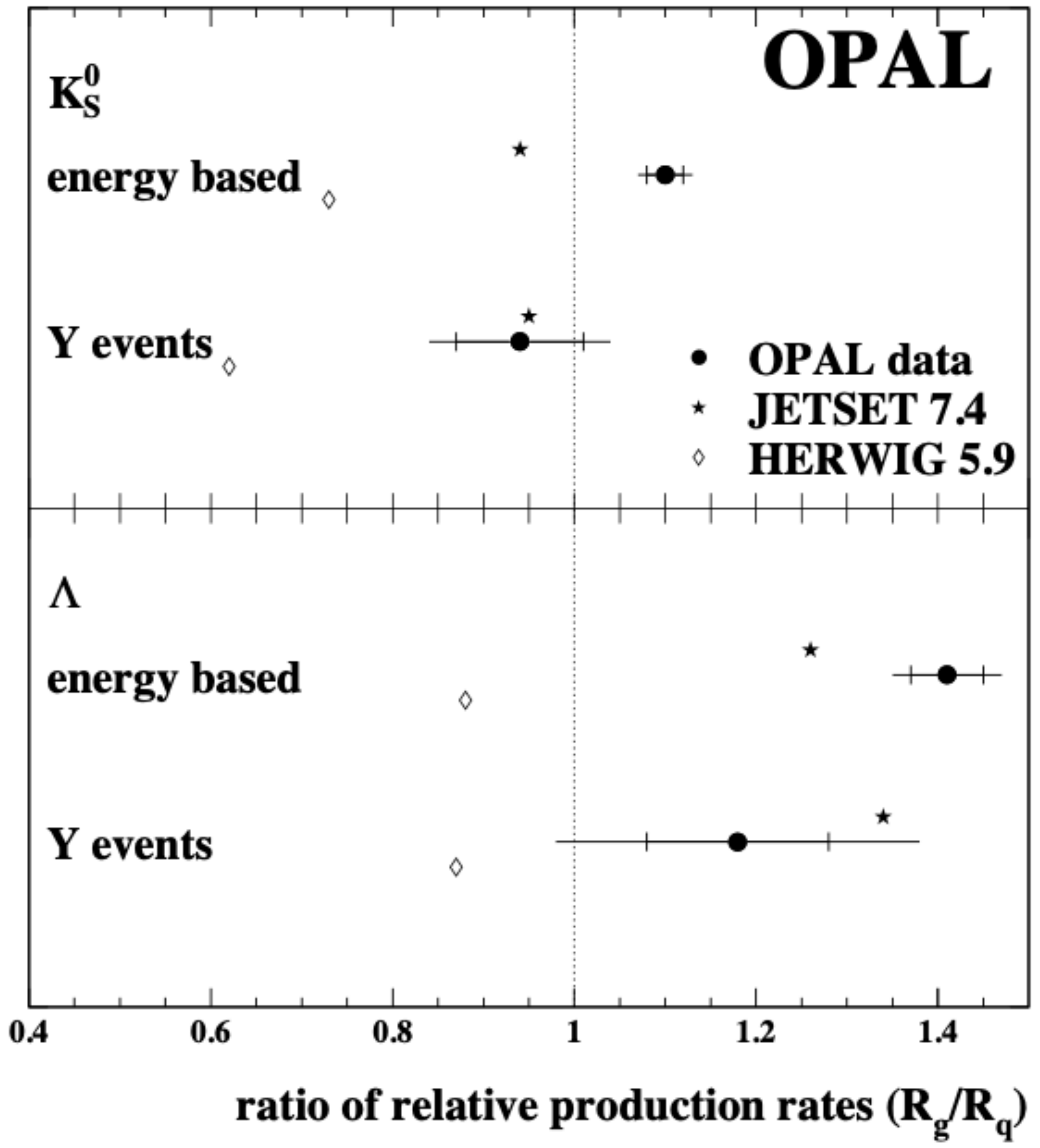
How does the presence of a strange particle change the jet-peak yield in small and large systems?

Motivation

ACTA PHYSICA POLONICA B, No 2, Vol. 36 (2005), page 433



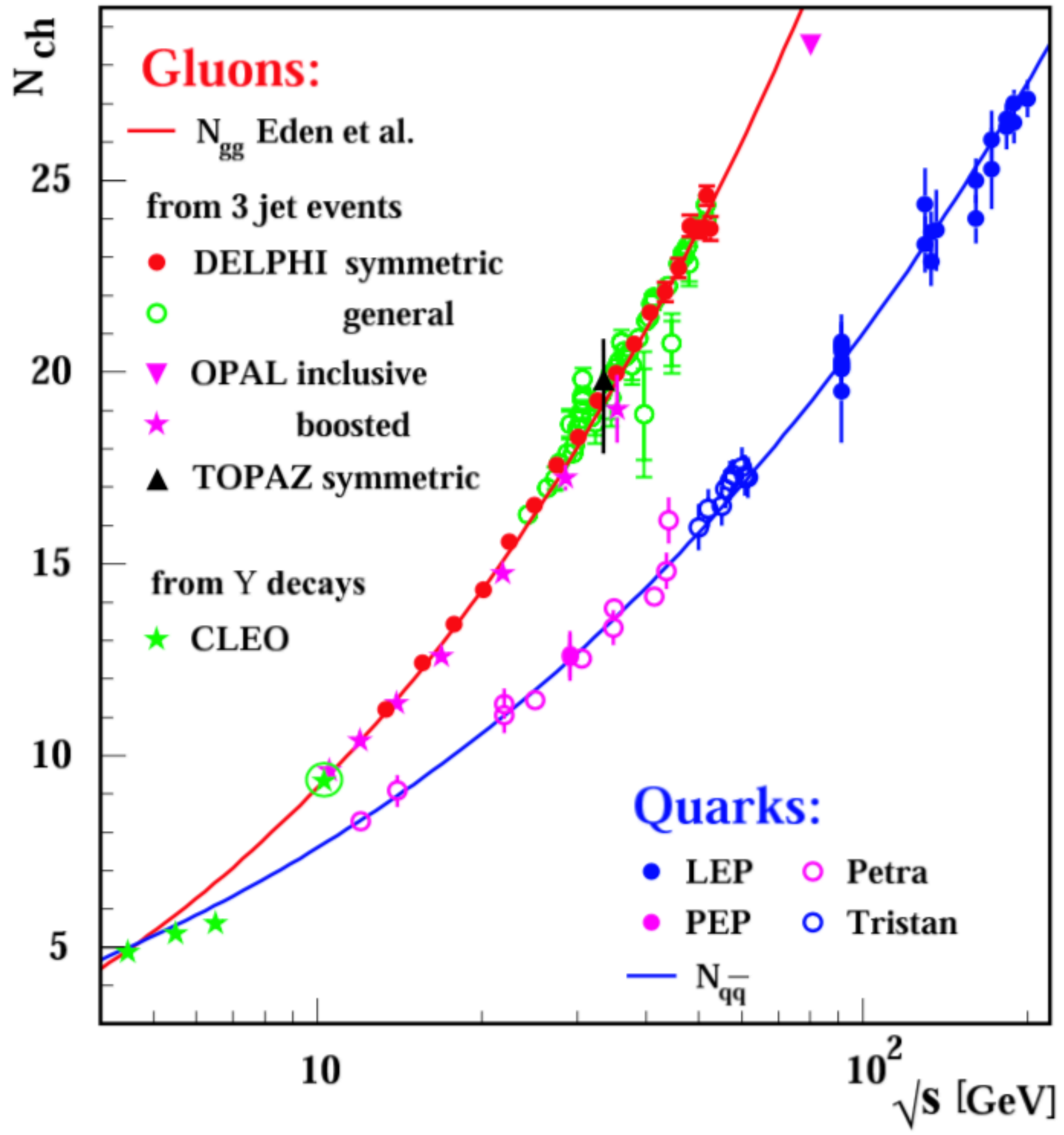
$e^+ + e^-$



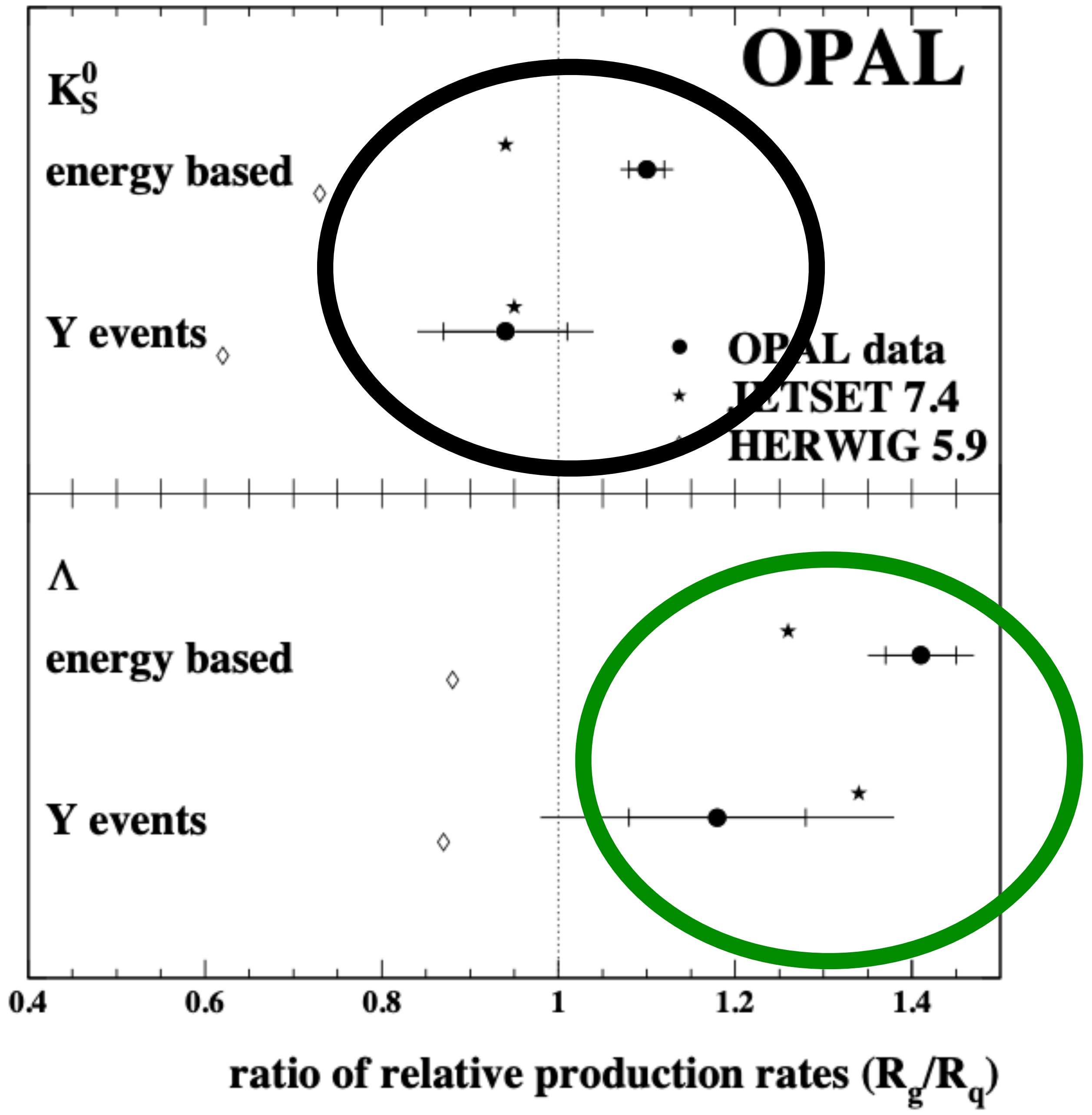
- Gluon jets in contrast to quark jets:
  - Higher multiplicity
  - Wider

Motivation

ACTA PHYSICA POLONICA B, No 2, Vol. 36 (2005), page 433



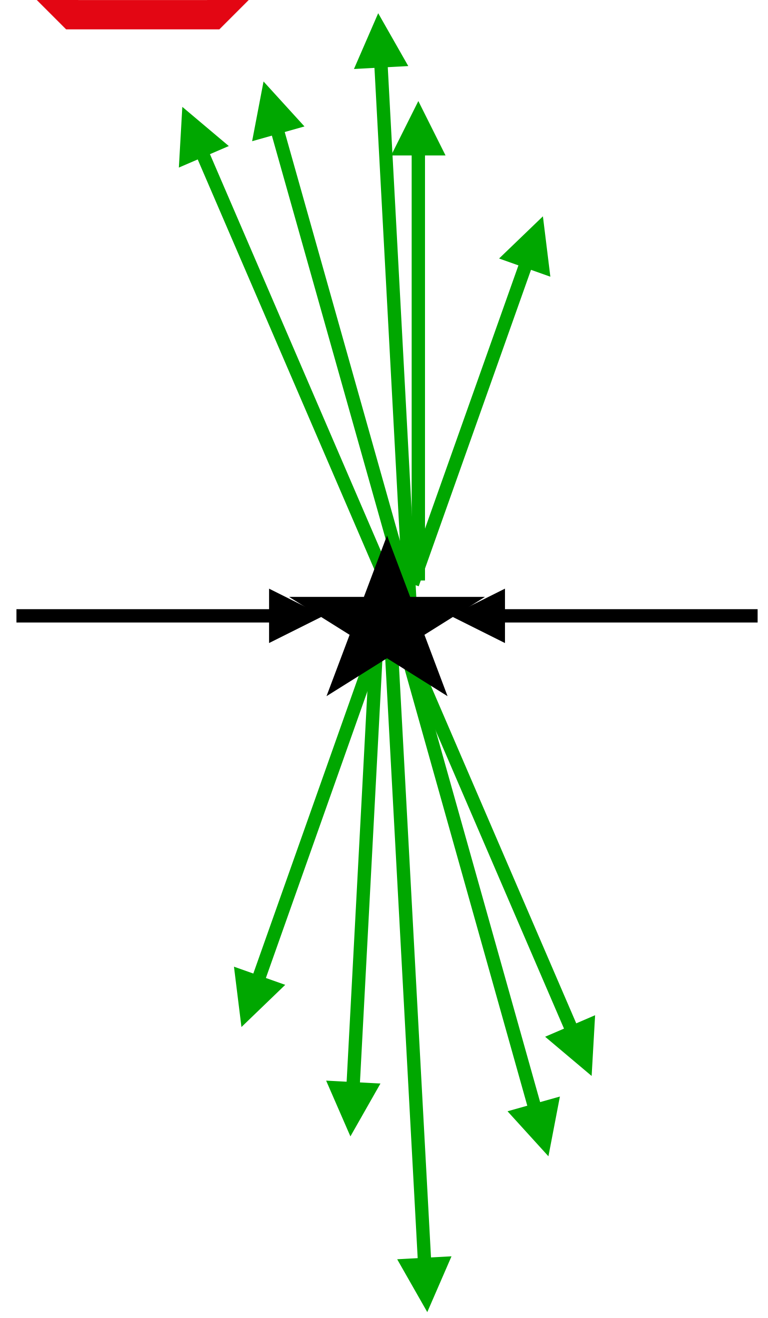
$e^+ + e^-$



- Gluon jets in contrast to quark jets:
  - Higher multiplicity
  - Wider
  - Higher production of Λ baryons, equal production of K^0_S mesons

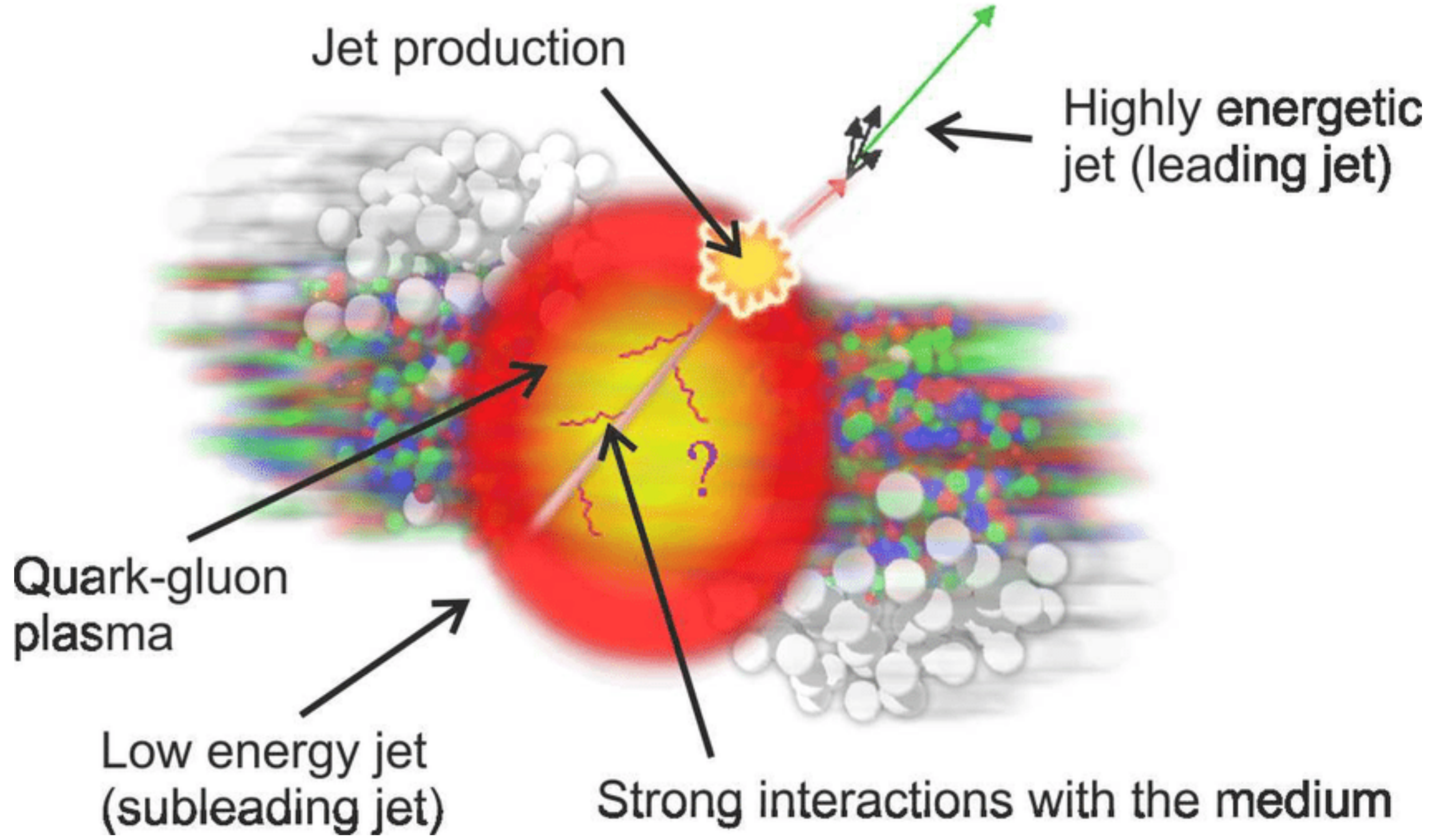
How does the jet-peak yield depend on the trigger particle selection in small and large systems?

Motivation



pp

Vs.



Pb−Pb

$$I_{AA} = \frac{Y_{\Delta\varphi}^{Pb-Pb}}{Y_{\Delta\varphi}^{pp}}$$

Is the I_{AA} different for different trigger particles?

- Correlations in Pb−Pb:
  - Near-side jet is more biased to the surface of the QGP - should be more pronounced for gluon jets [1]
  - The yield enhancement for low $p_{\mathrm{T}}^{\mathrm{assoc}}$ at the near side is a measure of this bias [2]
  - The yield suppression at the away side - due to the energy loss in the QGP

[1] S.Wick *et al.*, Nucl.Phys.A7
[2] ALICE, Phys. Rev. Lett. 108

ALICE detector and data sets

Pb–Pb, pp, $\sqrt{s_{NN}} = 5.02$ TeV

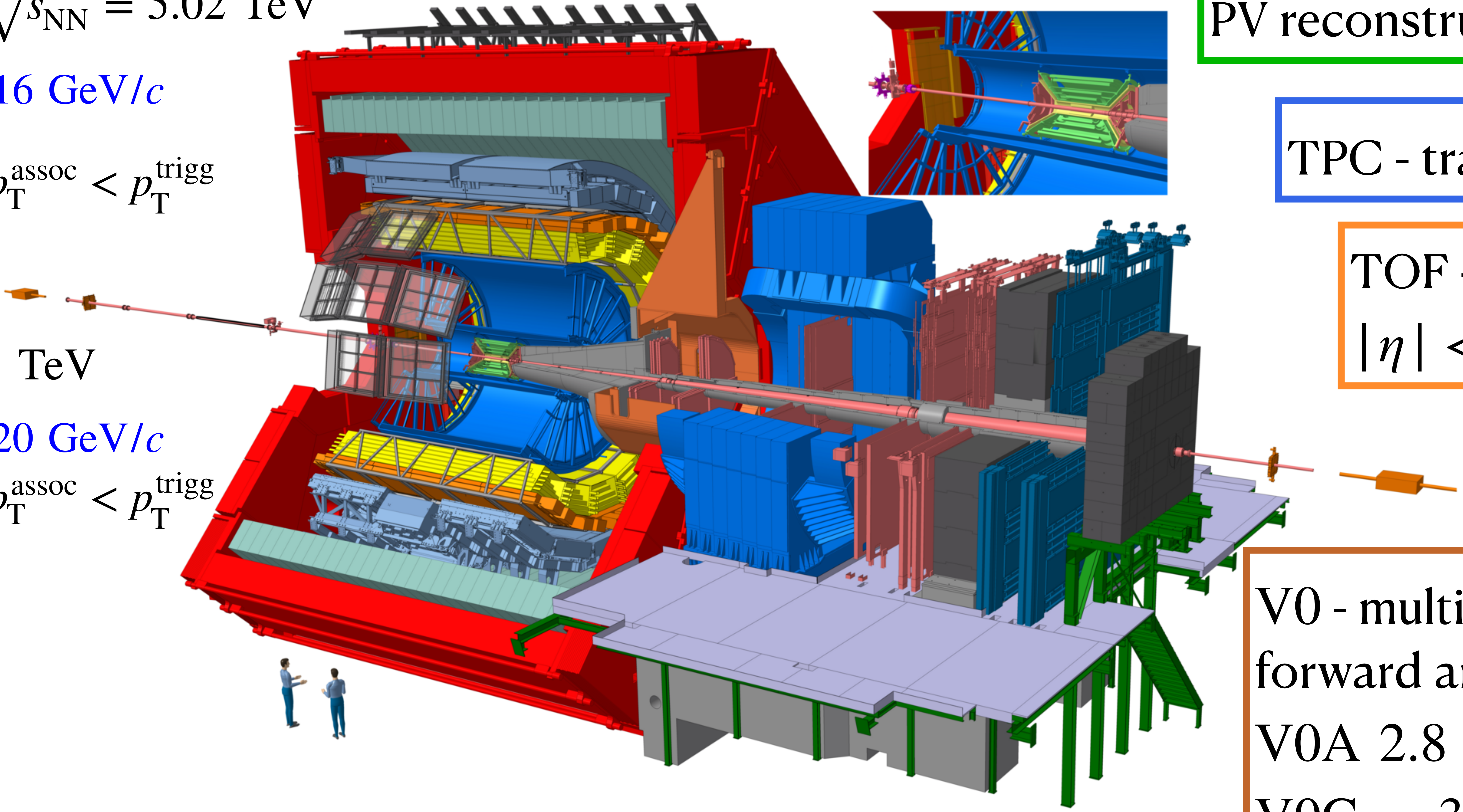
$8 < p_T^{trigg} < 16$ GeV/c

1 GeV/$c < p_T^{assoc} < p_T^{trigg}$

pp, $\sqrt{s} = 13$ TeV

$3 < p_T^{trigg} < 20$ GeV/c

1 GeV/$c < p_T^{assoc} < p_T^{trigg}$



ITS - tracking, pile-up rejection, PV reconstruction, $|\eta| < 0.9$

TPC - tracking, PID, $|\eta| < 0.9$

TOF - pileup rejection, PID, $|\eta| < 0.9$

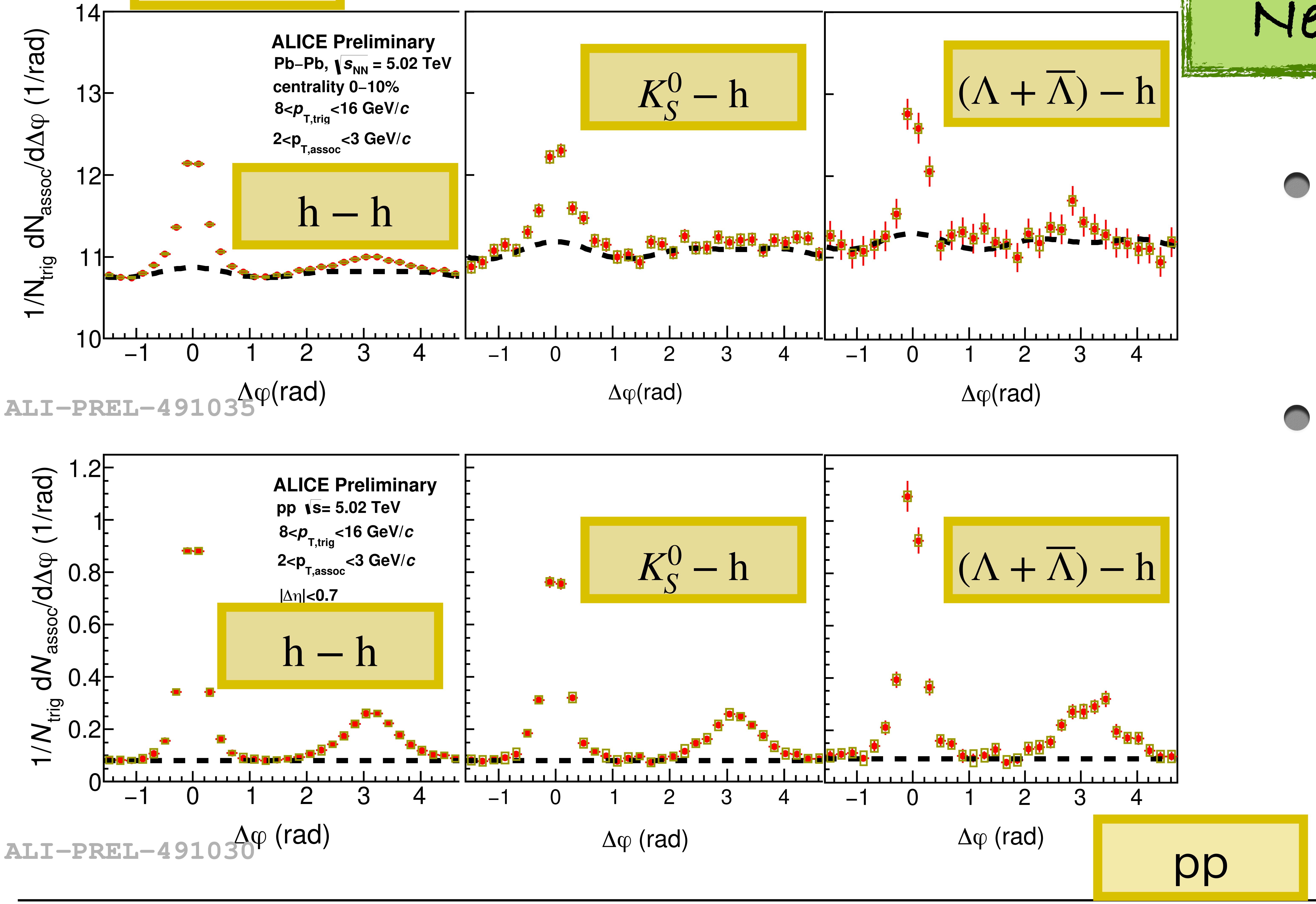
V0 - multiplicity estimation in forward and backward direction

V0A $2.8 < \eta < 5.1$

V0C $-3.7 < \eta < -1.7$

Δφ projections at 5.02 TeV

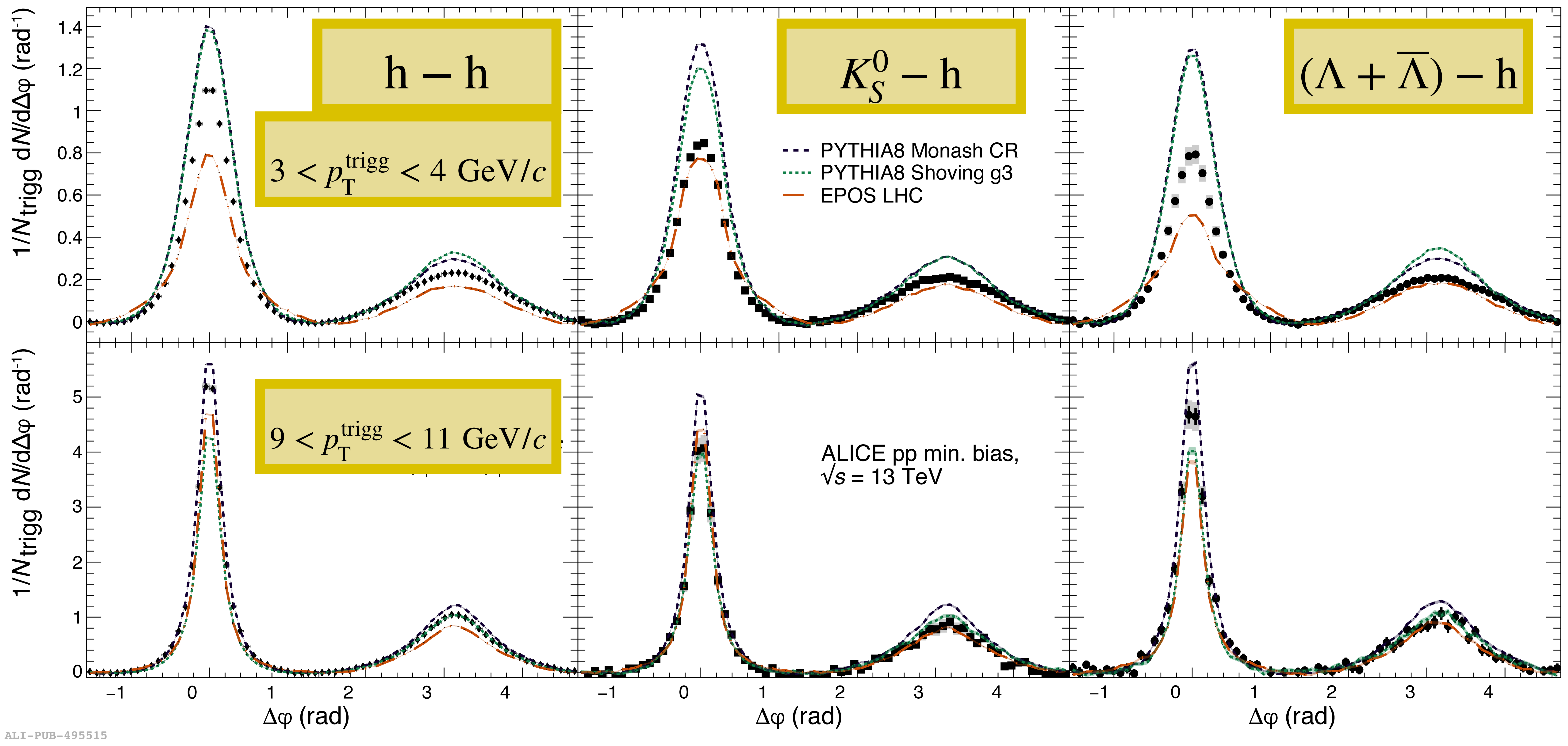
New



- The near-side peak size is slightly bigger for the Pb–Pb collisions
- Away-side peak strongly suppressed in the Pb–Pb collisions in contrast to the pp

$\Delta\varphi$ projections at 13 TeV

New

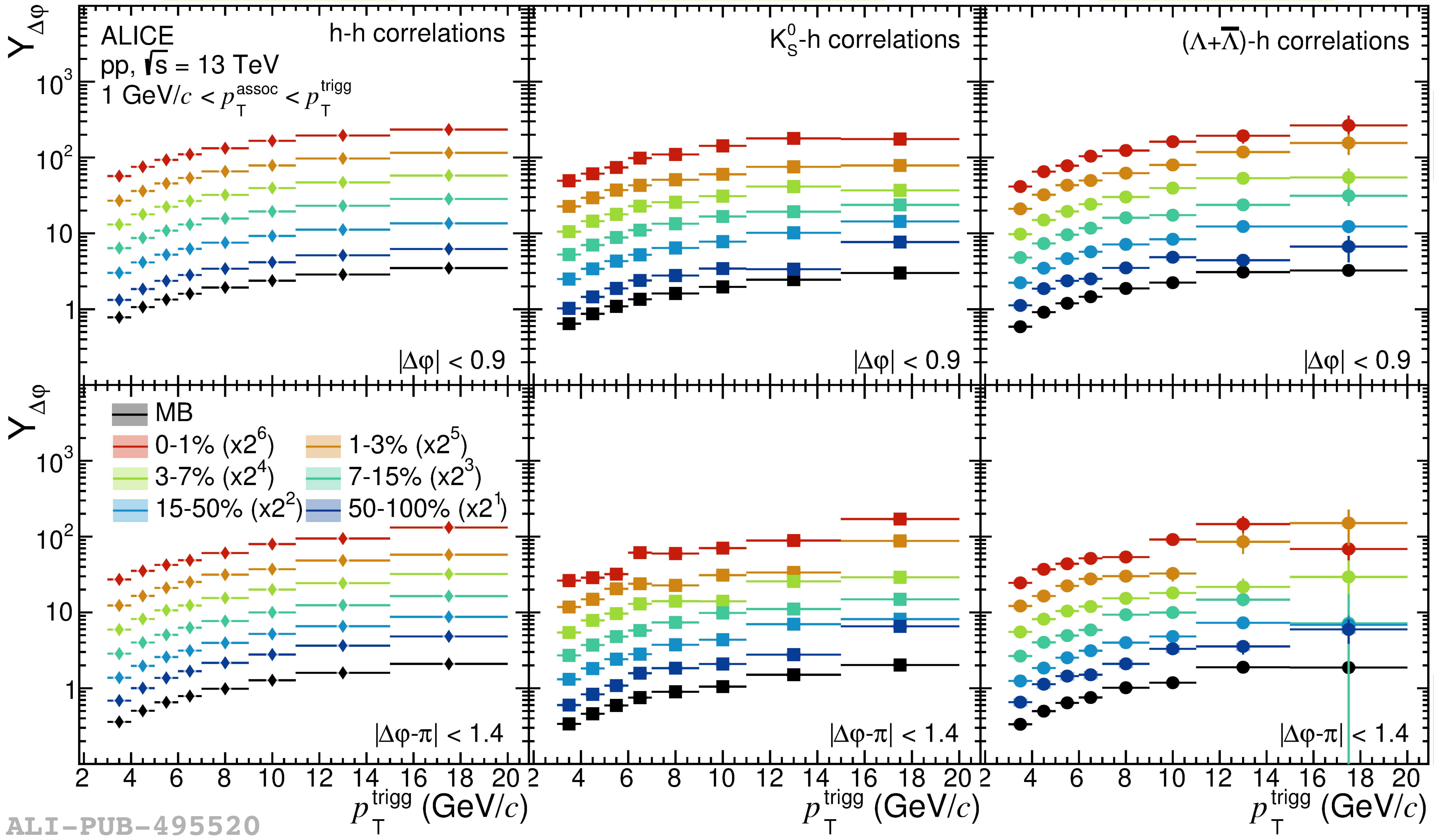


- No model can give a proper description
- EPOS underestimates both peaks for all trigger particles except for K^0_S at higher p_T
- Bigger difference between PYTHIA Monash and shoving at higher p_T

Jet-like particle yield in pp at 13 TeV

h − h | K_S^0 − h | $(\Lambda + \overline{\Lambda})$ − h

New



near-side

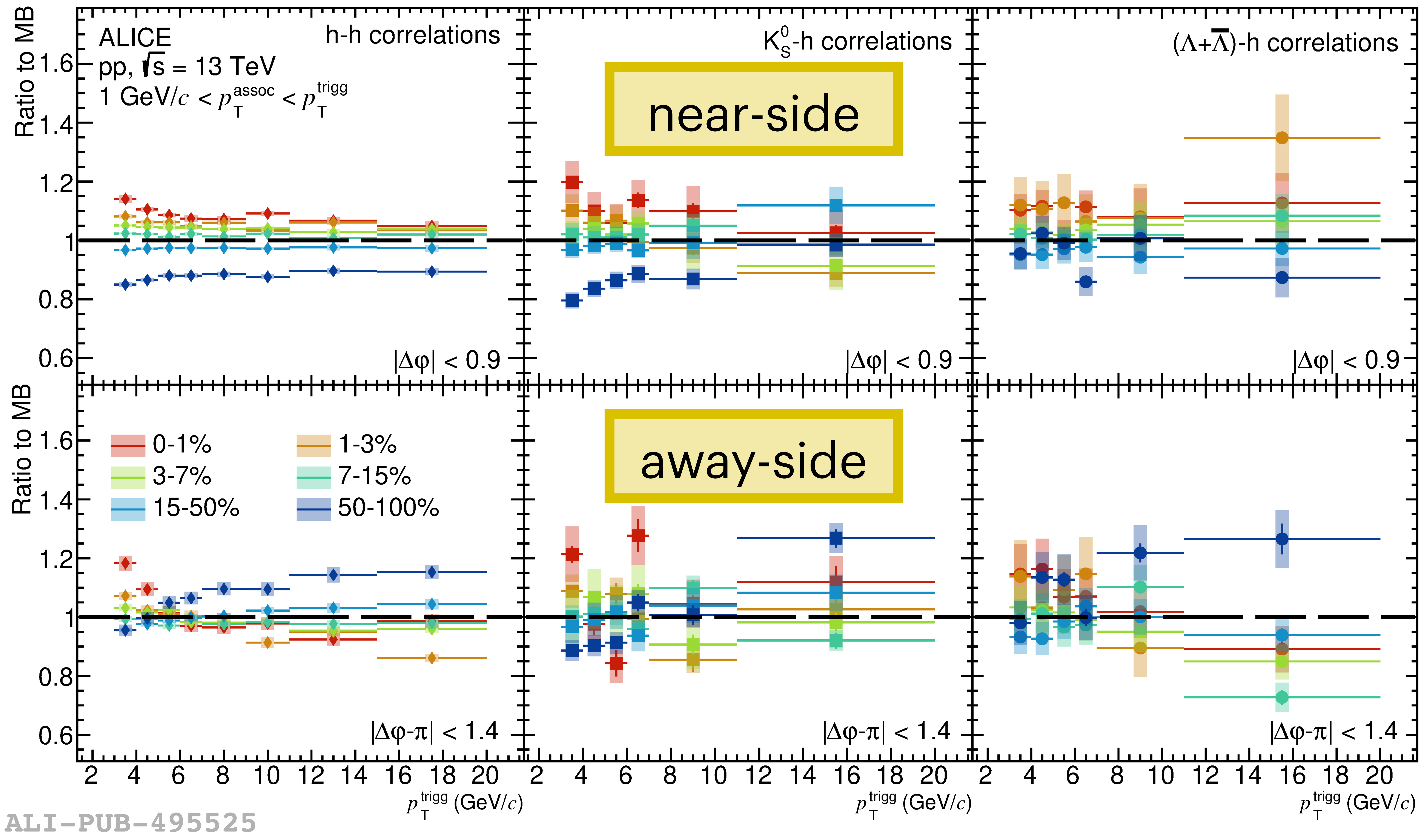
- An increasing trend with p_T^{trigg} caused by more available energy
- Quantitatively similar yields for all 3 trigger particles at both sides

away-side

Jet-like particle yield ratios in pp at 13 TeV

h – h | K^0_S – h | $(\Lambda + \overline{\Lambda})$ – h

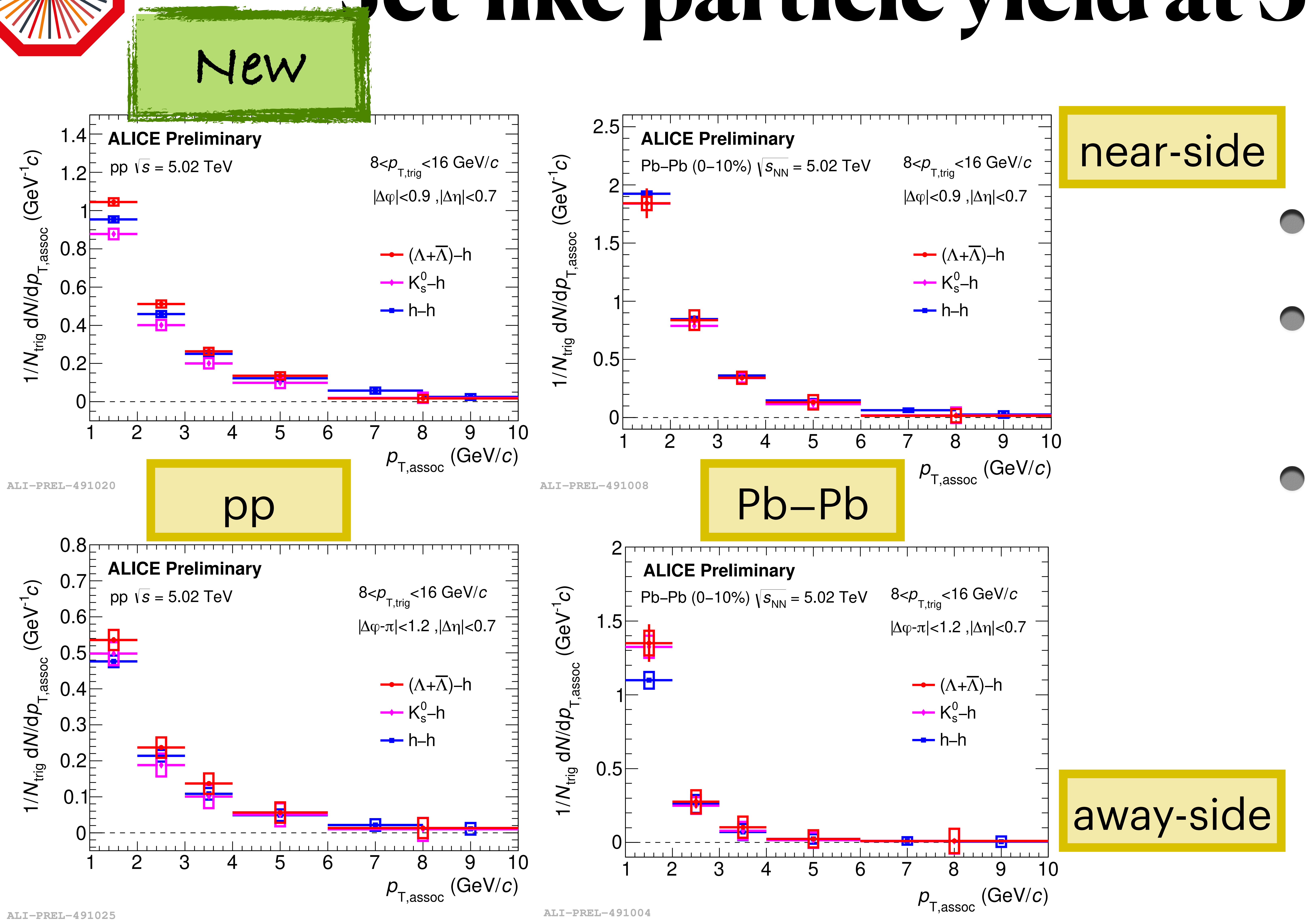
New



Clear multiplicity ordering in h-h, a hint of similar behaviour visible also in V^0-h

- At the near side - collective ridge-like structure ?
- At the away side - caused by multiplicity selection bias

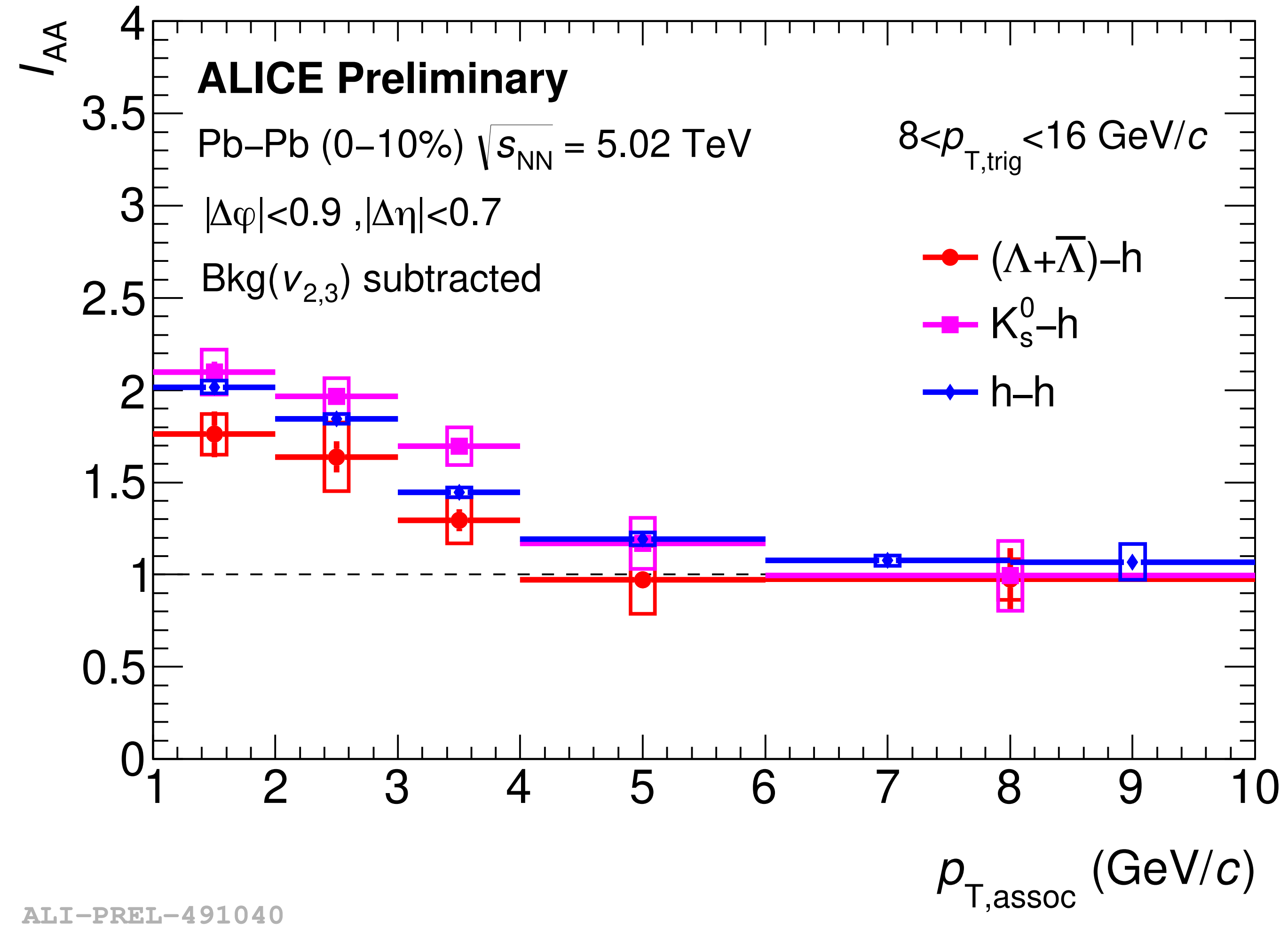
Jet-like particle yield at 5.02 TeV

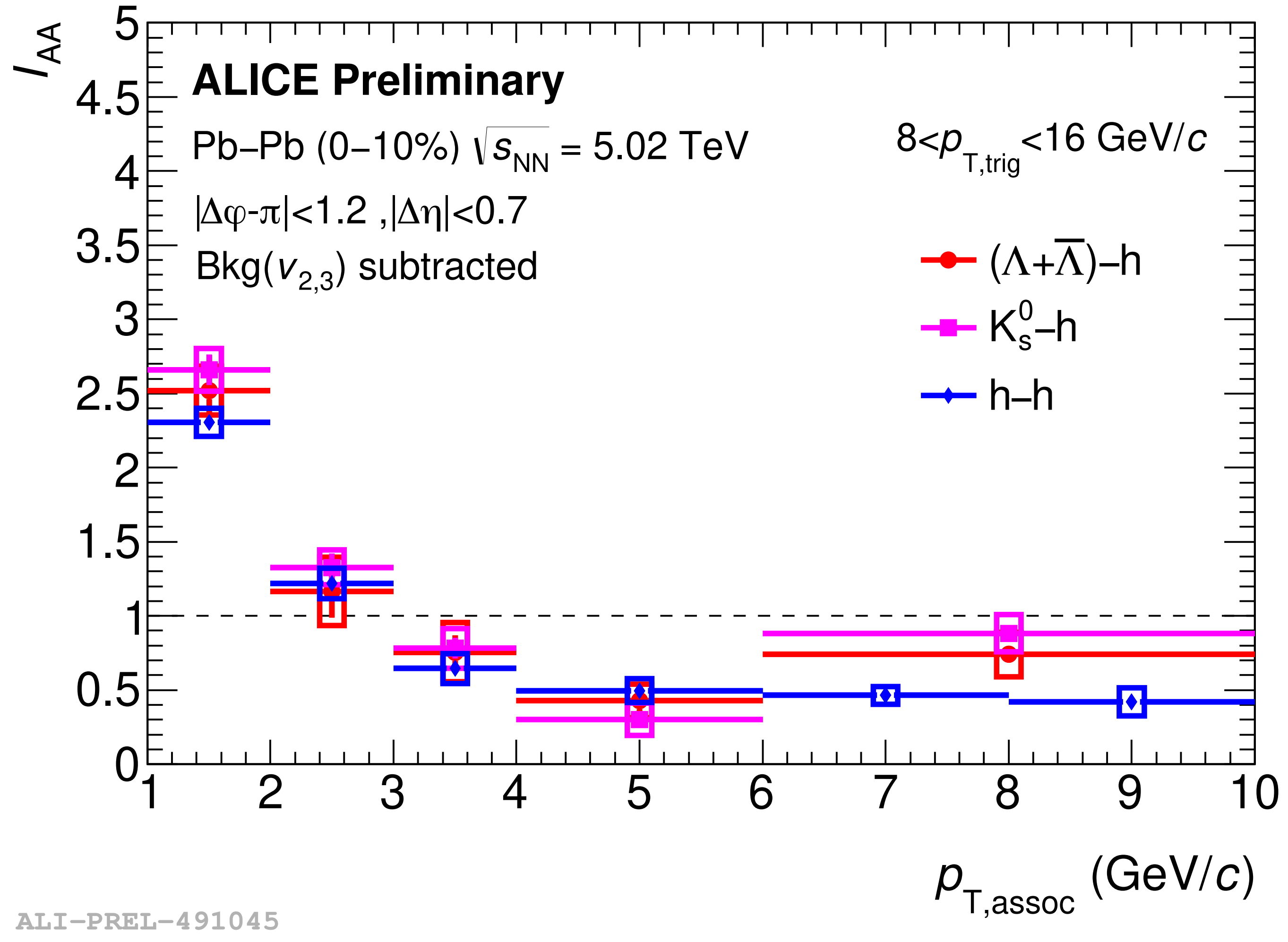


- Jump to most central Pb—Pb
- Higher yields on the near-side in the Pb—Pb collisions
- No strong trigger particle dependence on the away-side, but clear ordering on the near-side in pp

New

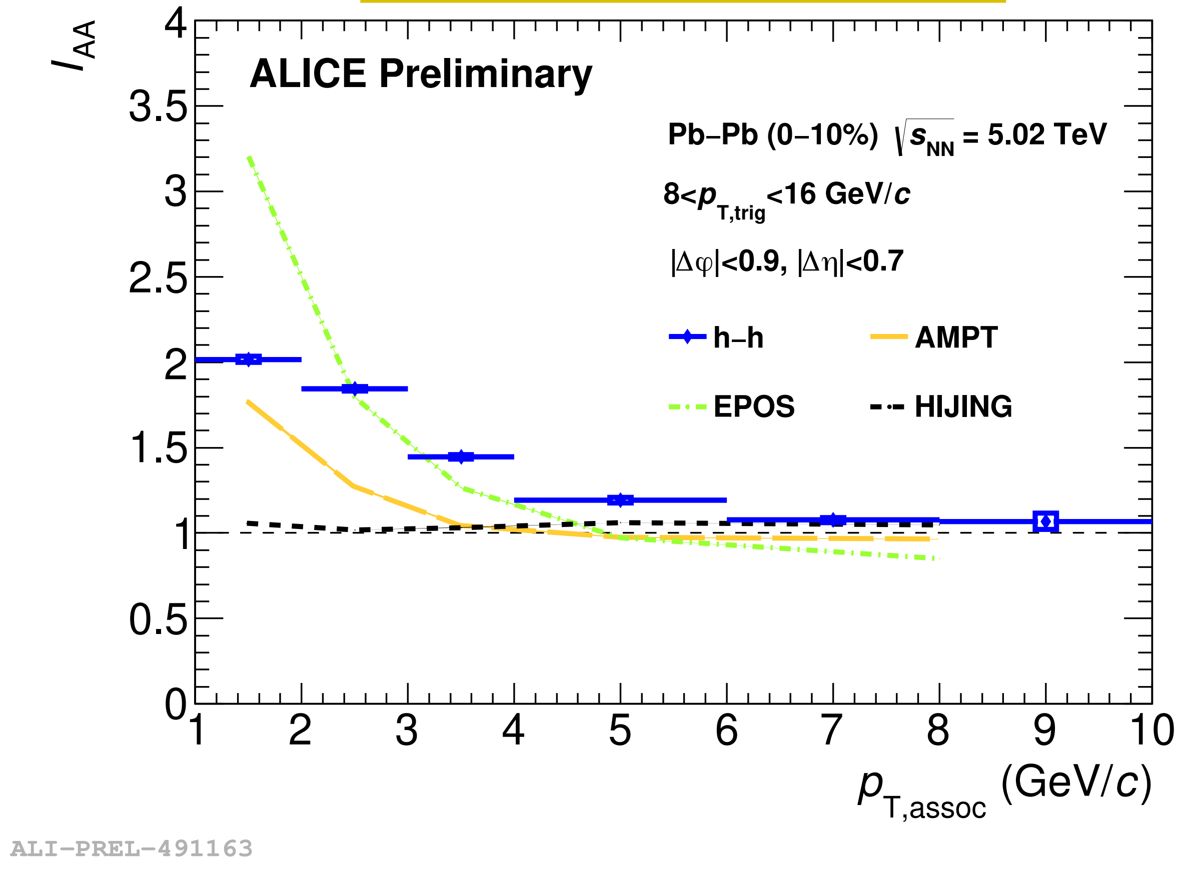
$$I_{AA} = \frac{Y^{Pb-Pb}_{\Delta\varphi}}{Y^{pp}_{\Delta\varphi}}$$

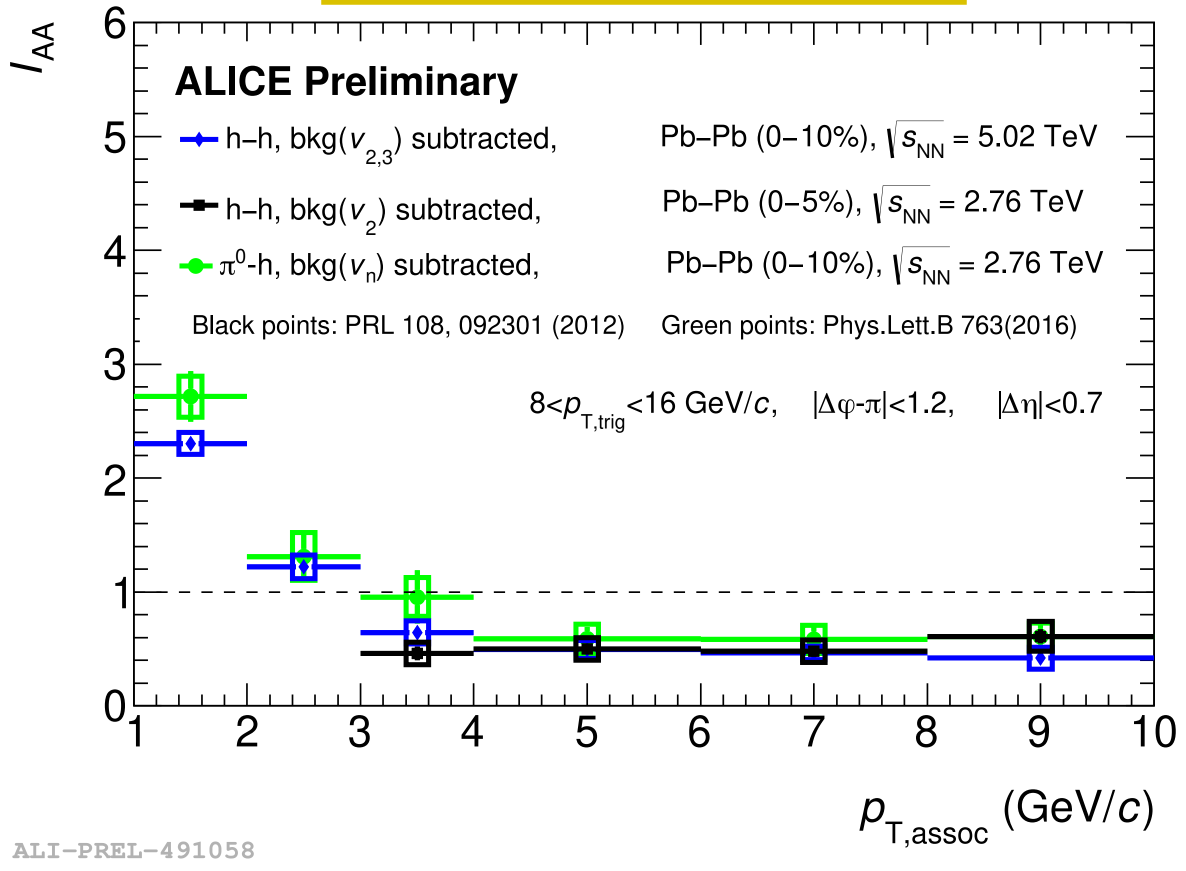




near-side

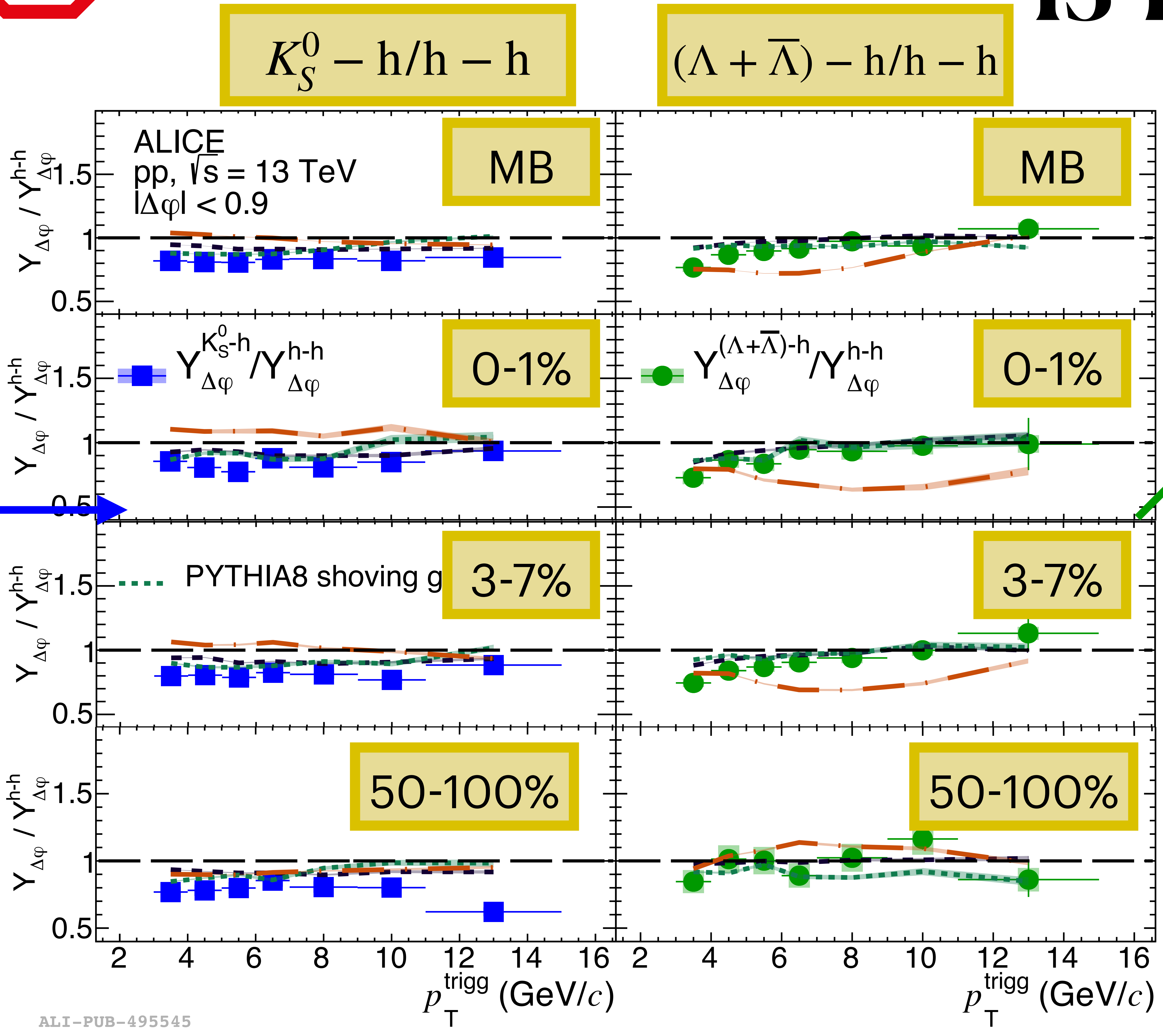
away-side





- Strong enhancement at the near-side for all trigger particles
- Suppression at the away-side for high p_T^{assoc}
- No significant dependence on the trigger particle
- New measurement consistent with previous ones at 2.76 TeV
- HIJING shows no effect as expected

Jet-like particle yield ratios to h-h yields in pp at 13 TeV

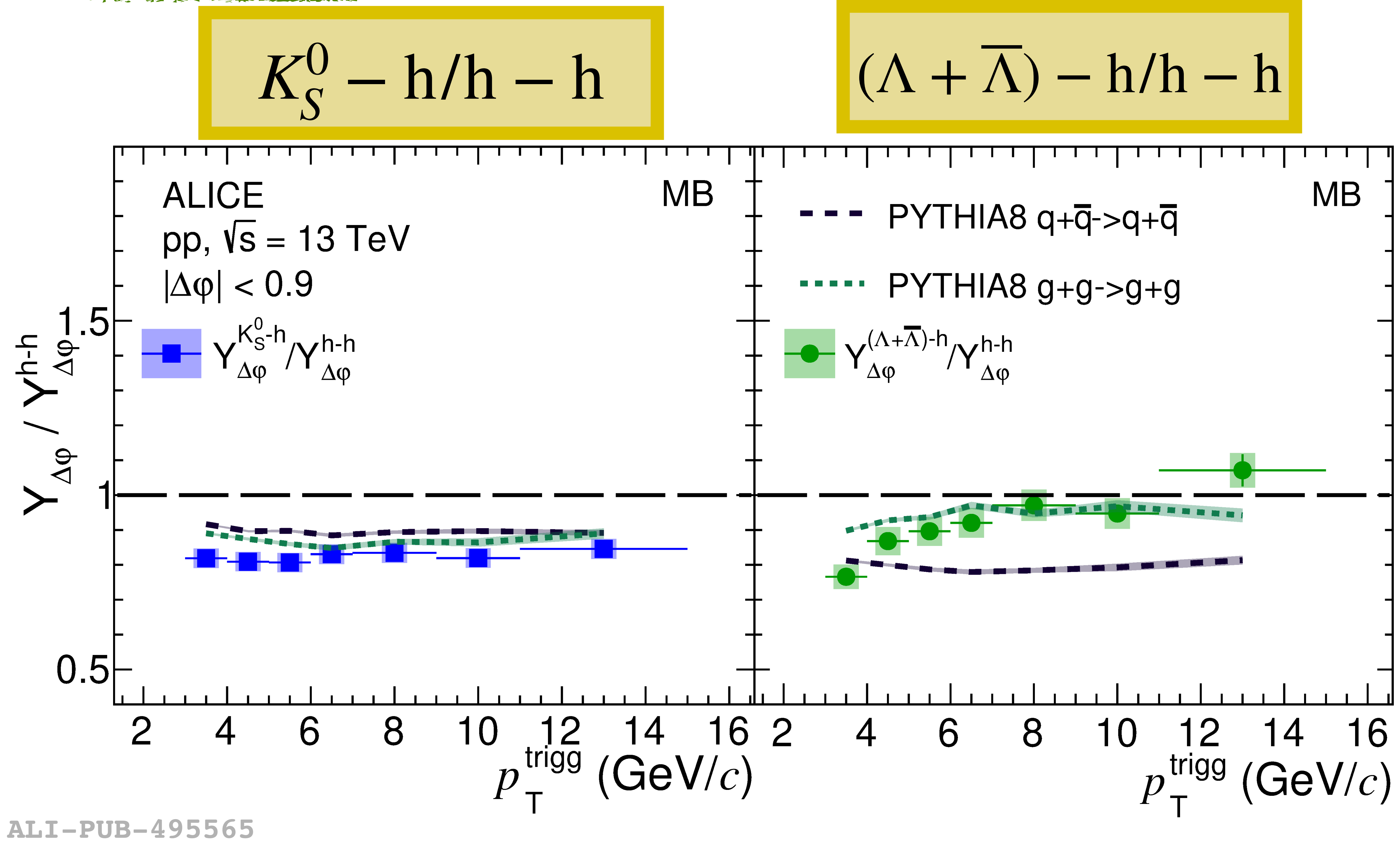


New

- Different trends of the ratio for different trigger particles:
  - K_S^0 - rather flat with p_T^{trigg} and below unity
  - Λ increasing with p_T^{trigg}
- No dependence on the event multiplicity

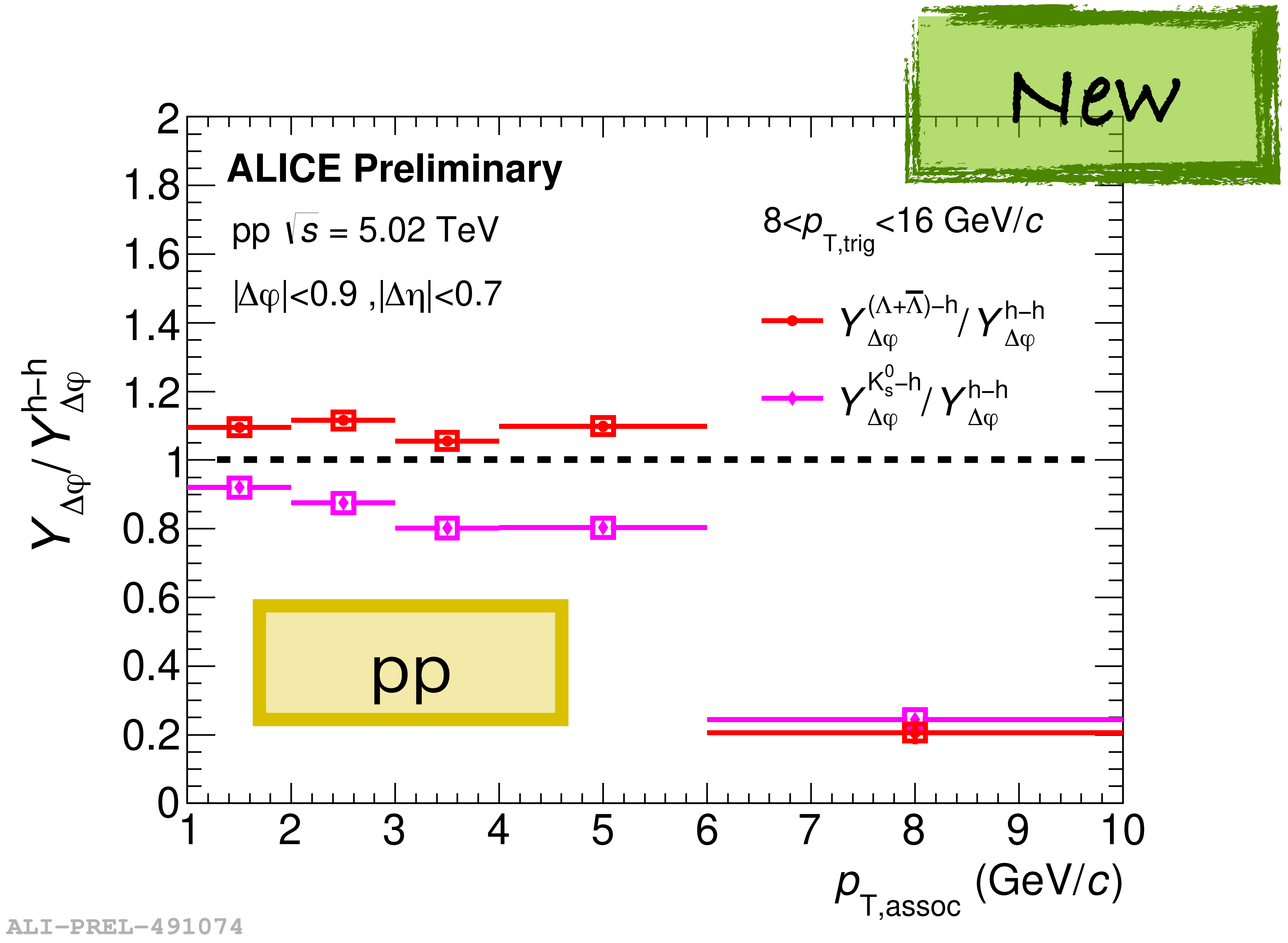
Jet-like particle yield ratios to h-h yields in pp at 13 TeV

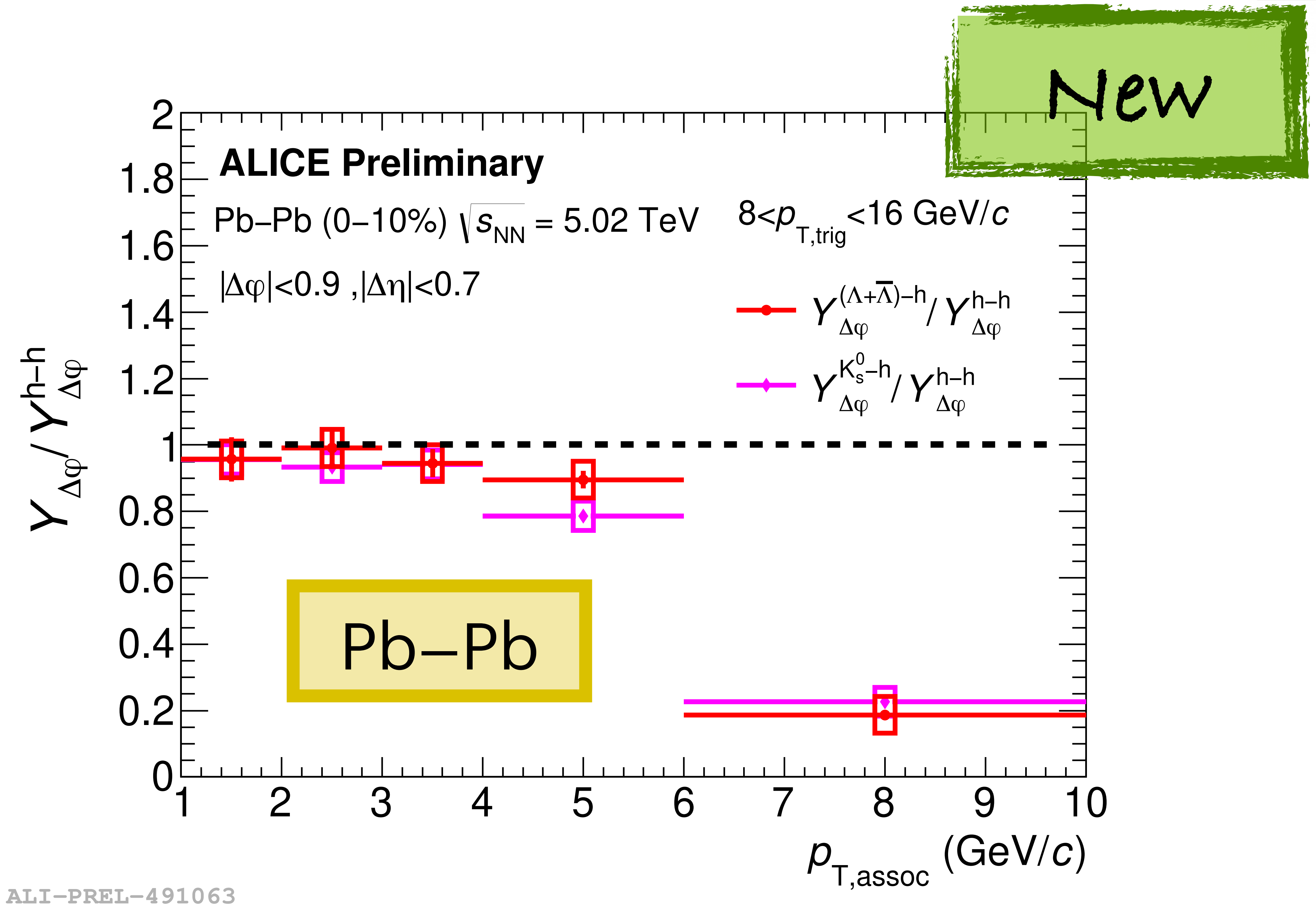
New



- Different trends of the ratio for different trigger particles:
  - K_S^0 - rather flat with p_T^{trigg} and below unity
  - Λ increasing with p_T^{trigg}
- No dependence on the event multiplicity
- Triggering with high-p_T Λ causes a bias towards gluon jets

Jet-like yield ratios to h-h yields at 5.02 TeV





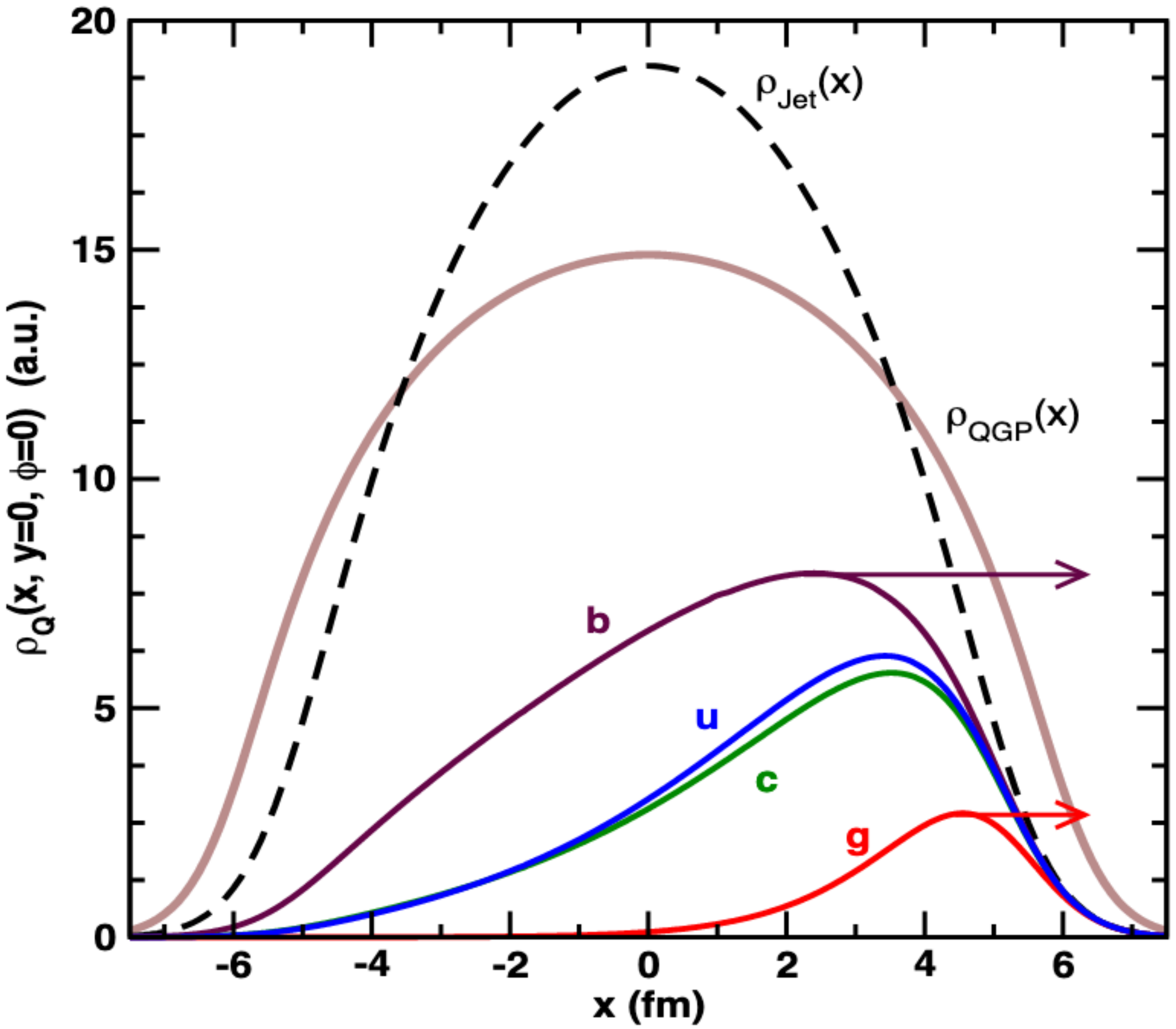
- Similar trend present also in pp at 5.02 TeV
- In the Pb–Pb collisions, the difference is almost not visible

Summary

- A difference between jet-like particle yields triggered with K^0_S and Λ with respect to charged hadron was observed in pp collisions at 13 TeV and 5.02 TeV
  - Similarly as in $e^+ + e^-$ collisions
  - Explanation for pp (through PYTHIA8): triggering with Λ causes a bias towards gluon jets
- No multiplicity dependence on yields in pp collisions at 13 TeV
- I_{AA} shows no significant dependence on the trigger particle
  - Produced in similar depth of QGP

Back-up

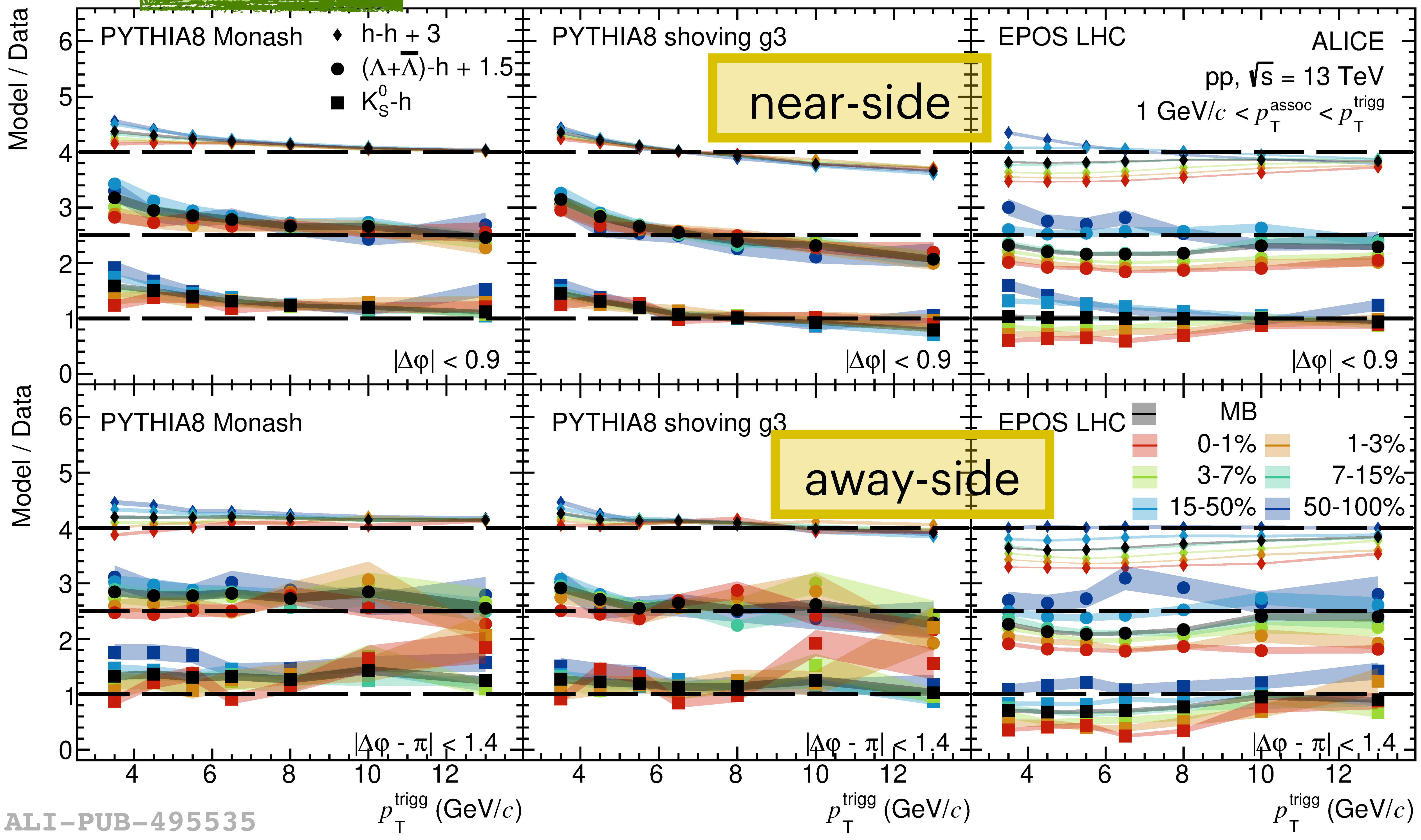
Origin of 15 GeV jets in QGP



[1] S. Wicks, W. Horowitz, M. Djordjevic, M. Gyulassy, "Elastic, inelastic, and path length fluctuations in jet tomography", Nuclear Physics A (2007), arXiv:nucl-th/0512076

Model comparison in pp at 13 TeV

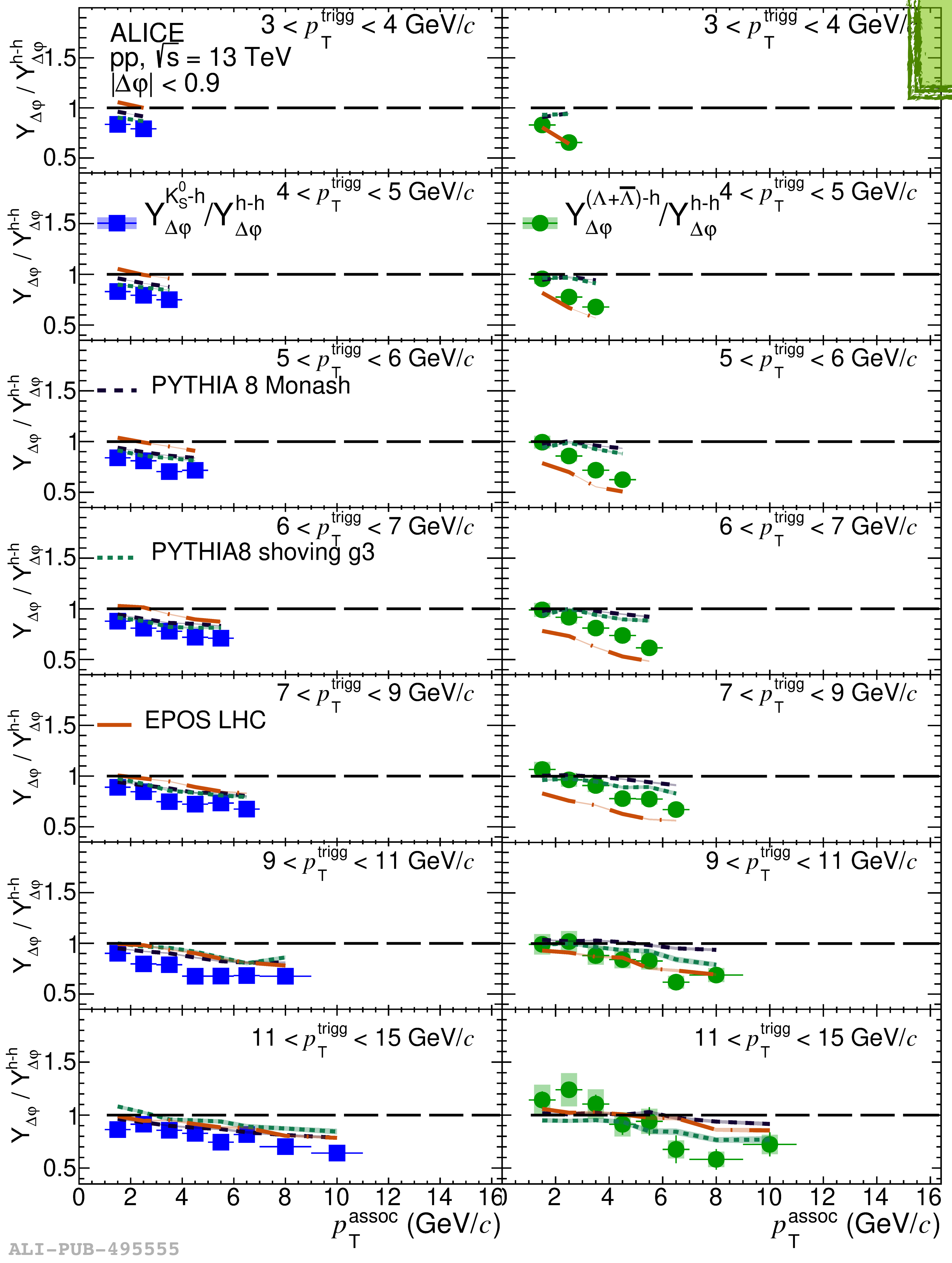
New



- PYTHIA8 - the deviation from data depends weakly on multiplicity
  - Monash tune better for hard processes
  - Shoving better for intermediate p_T
- EPOS LHC - strong dependence on multiplicity

Jet-like yield ratios to h-h yields in pp at 13 TeV

New



- The difference is mostly pronounced for the softer part (low p_T^{assoc}) of the harder processes (high p_T^{trigg})