12th MPI at LHC

ALICE strange particles and fragmentation measurements

Marek Bombara on behalf of the ALICE Collaboration

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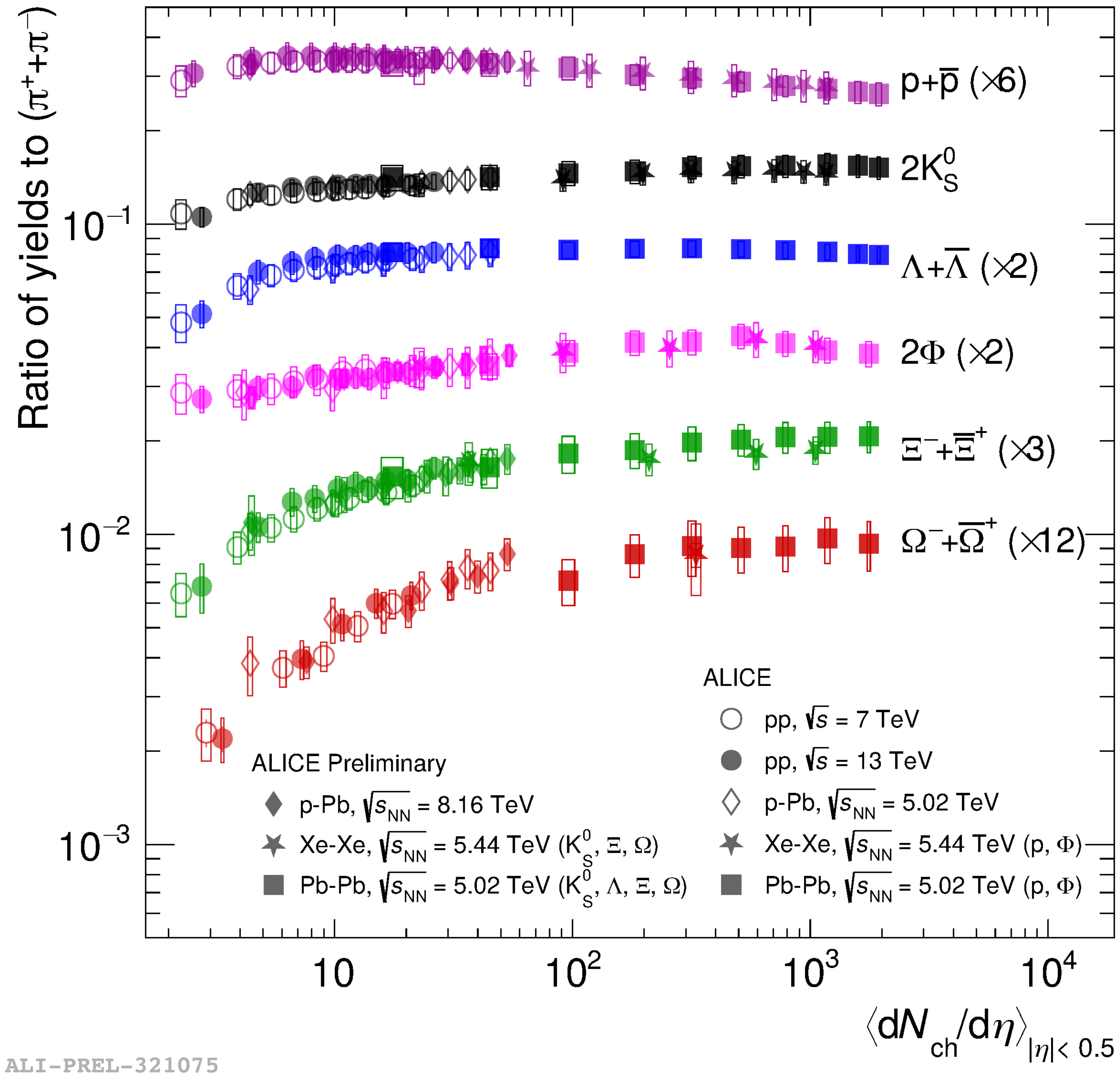
12th International workshop on Multiple Partonic Interactions at the LHC
LIP, Lisbon, Portugal
11-15 October 2021

Strangeness enhancement in small systems



- enhancement of strange particle w.r.t. non-strange yield clearly visible for high multiplicity proton-proton (pp) collisions
- very nice overlap with p–Pb and Pb–Pb results, the ratio as a function of $\langle dN_{ch}/d\eta \rangle$ is independent of collision type and energy

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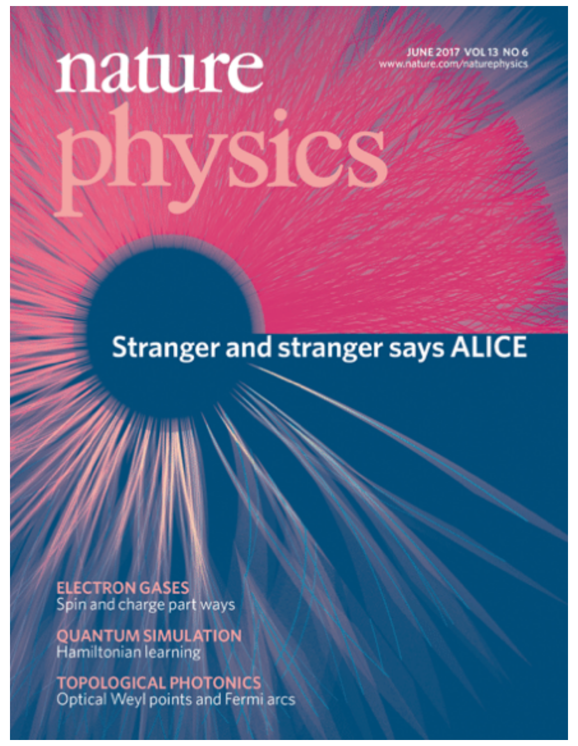
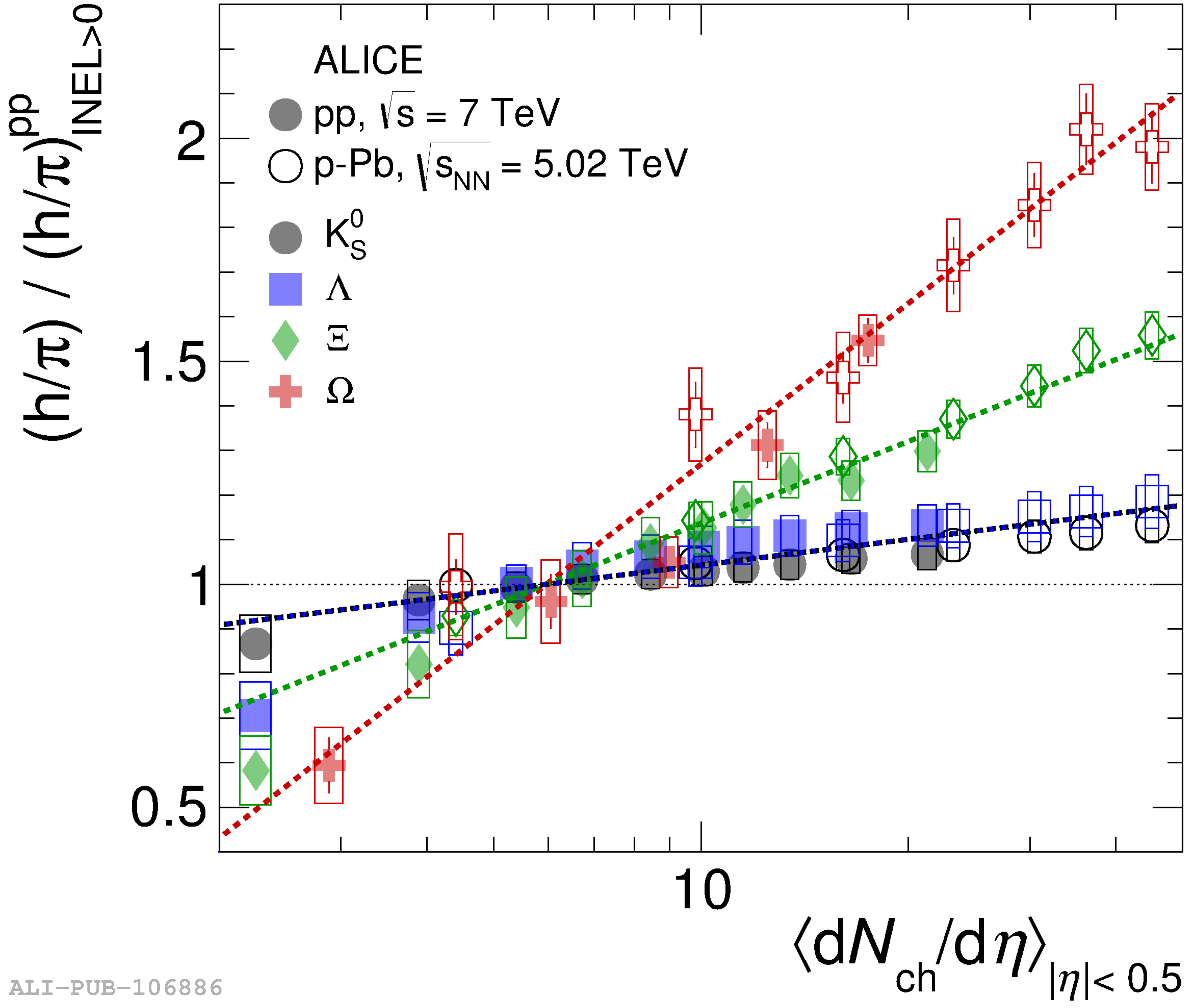


ALICE Collaboration, Nature Phys 13, 535–539 (2017)
ALICE Collaboration, Eur.Phys.J.C 80, 167 (2020)



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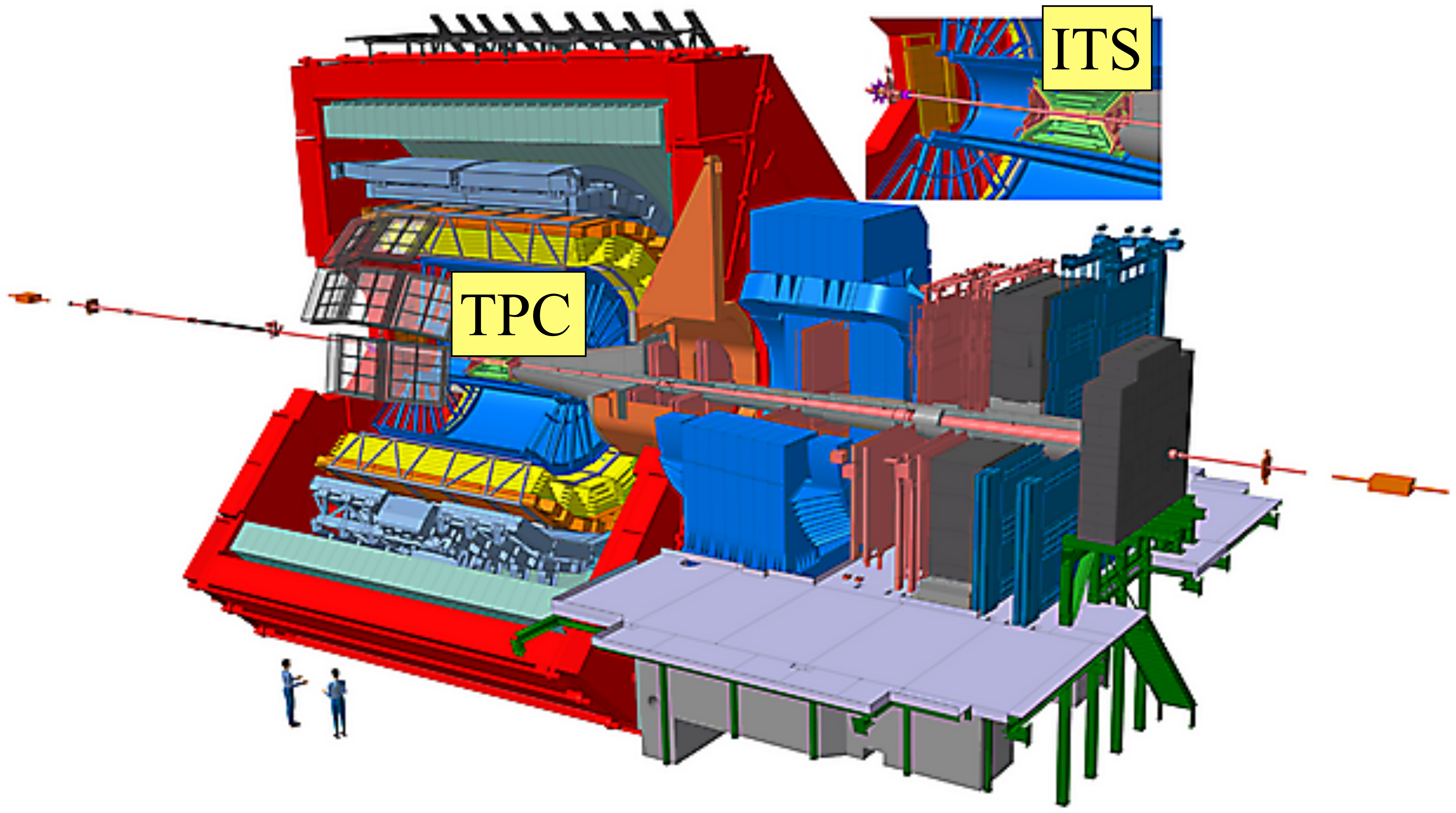
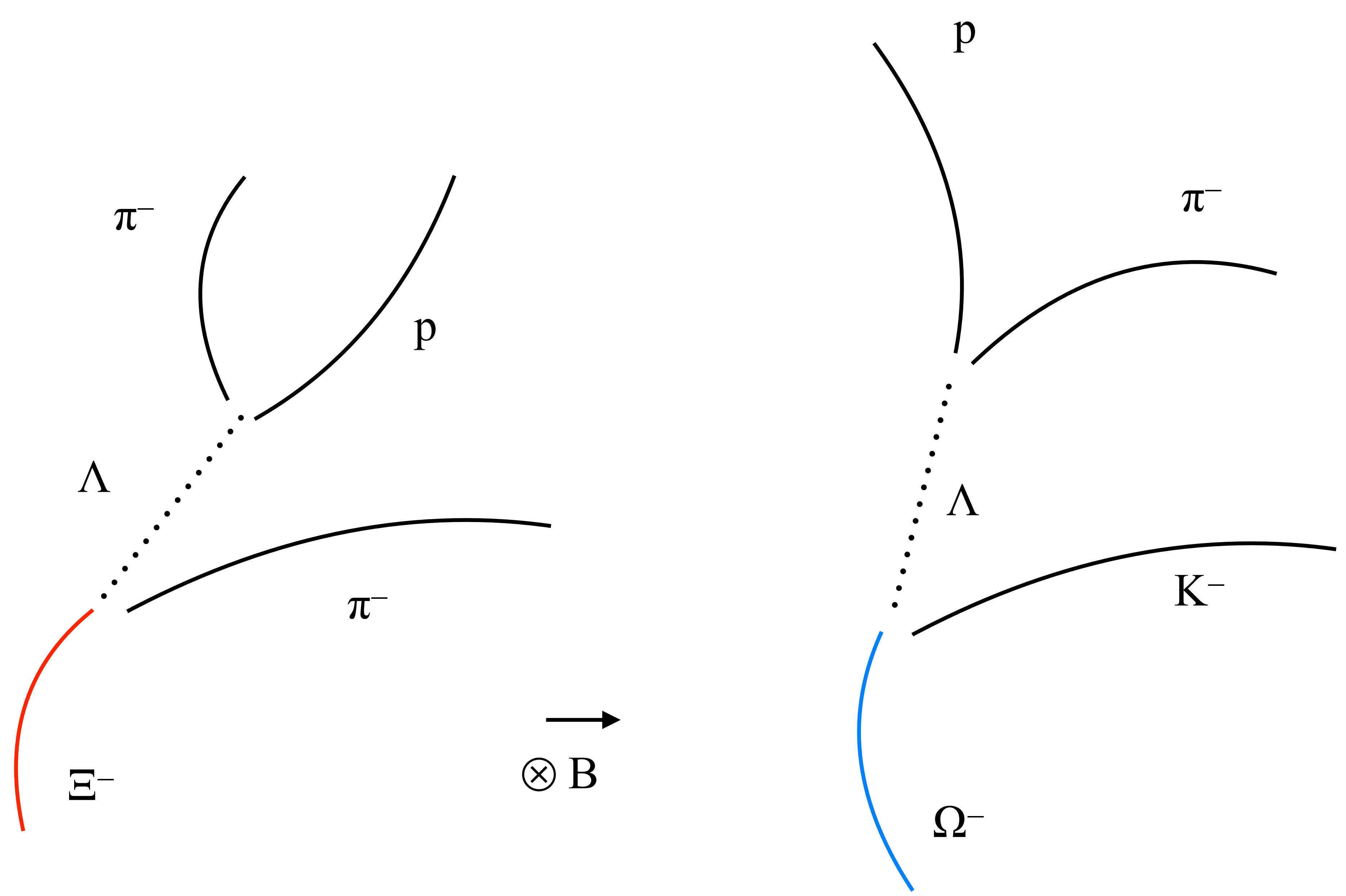
- very nice overlap with p−Pb and Pb−Pb results, the ratio as a function of $\langle dN_{ch}/d\eta \rangle$ is independent of collision type and energy
- hierarchy of the enhancement determined by the hadron strangeness!

What are the roles of jet/UE in strangeness production in high-multiplicity pp or p−Pb collisions?

ALICE experiment at the Large Hadron Collider





- ITS (Inner Tracking System): primary vertex reconstruction, tracking, particle identification
- TPC (Time Projection Chamber): main tracking detector, particle identification
- Data: pp at $\sqrt{s} = 13$ TeV

ITS+TPC: excellent identification of strange hadrons via decay products up to high transverse momentum (jet domain)

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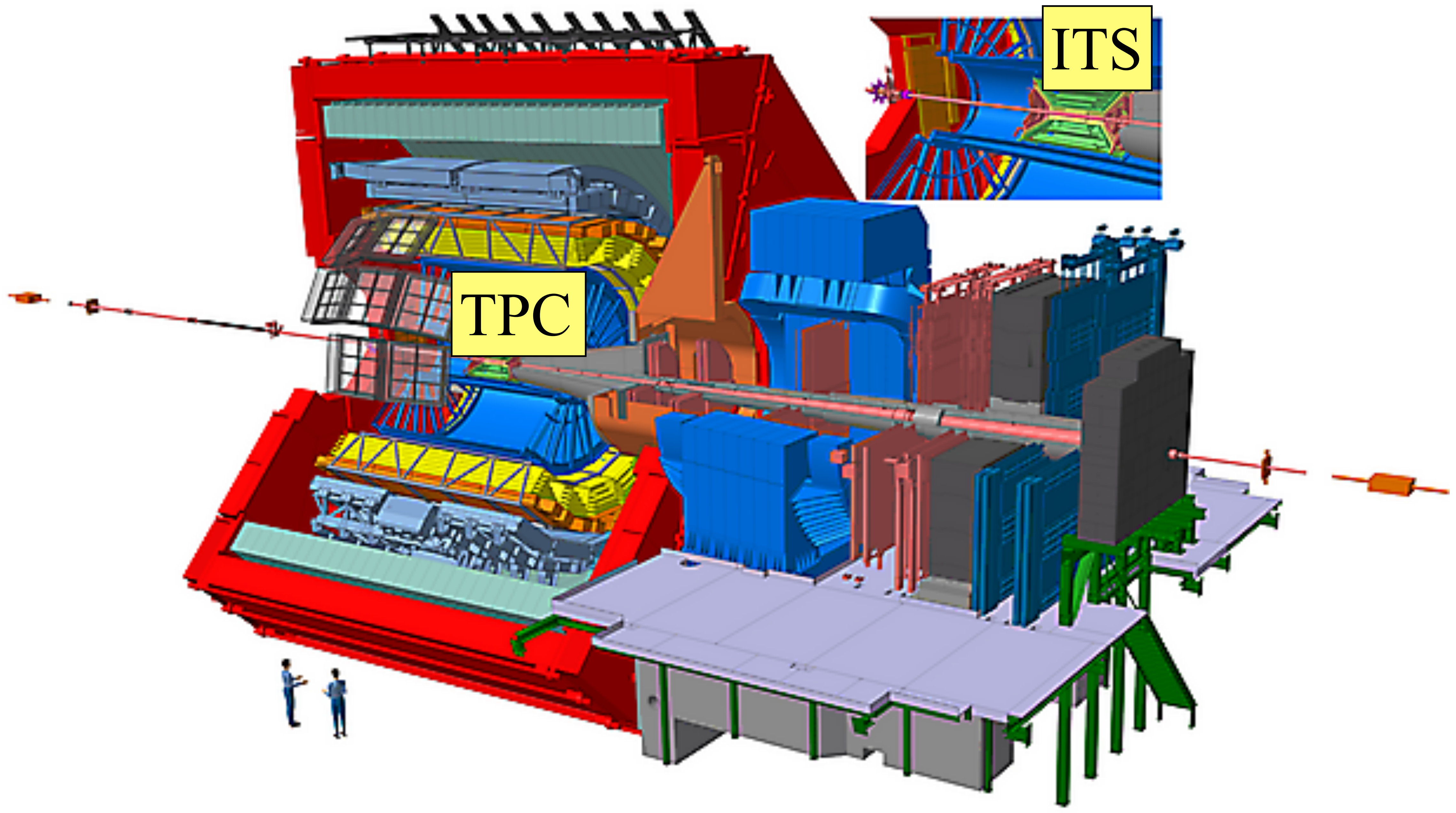

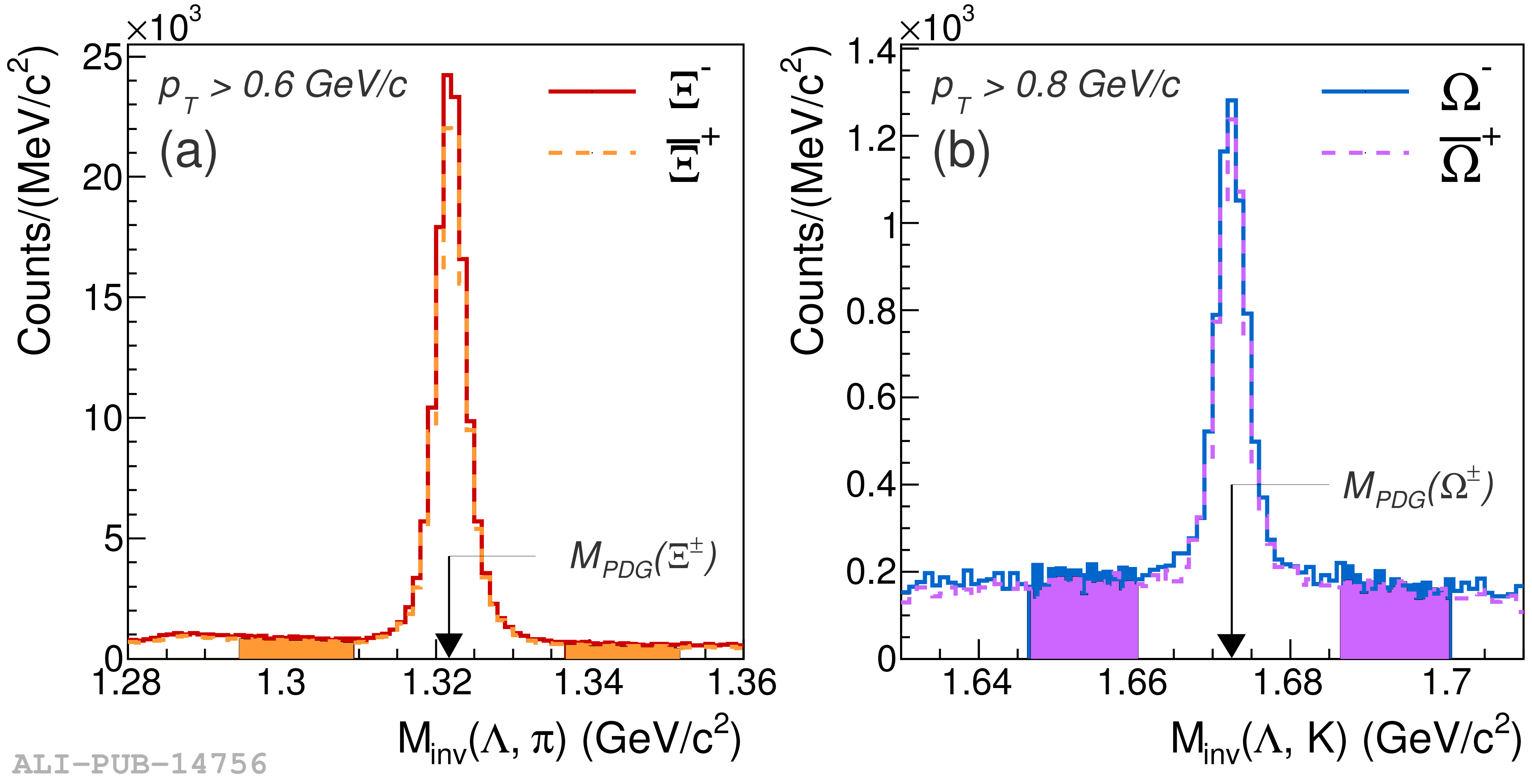

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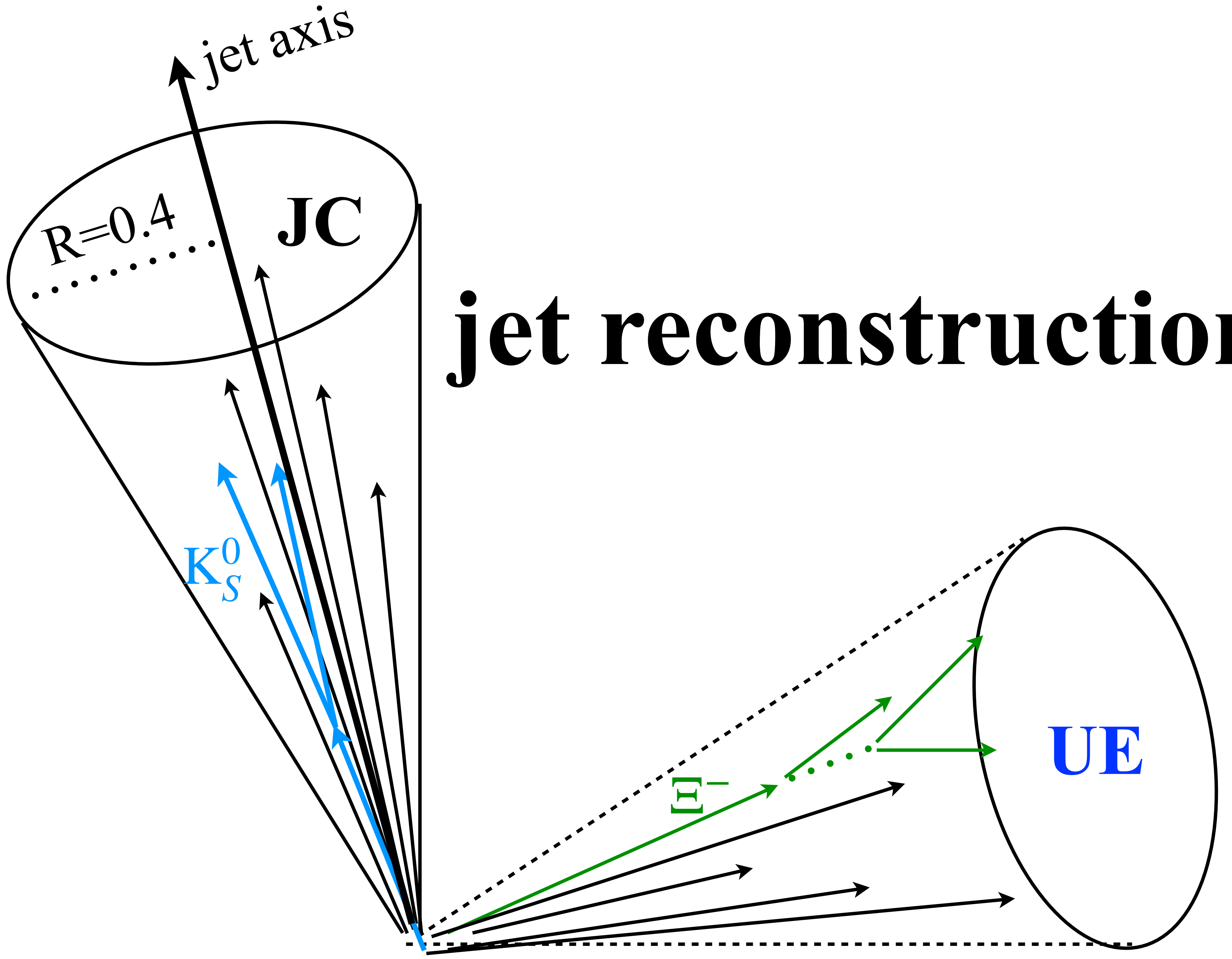
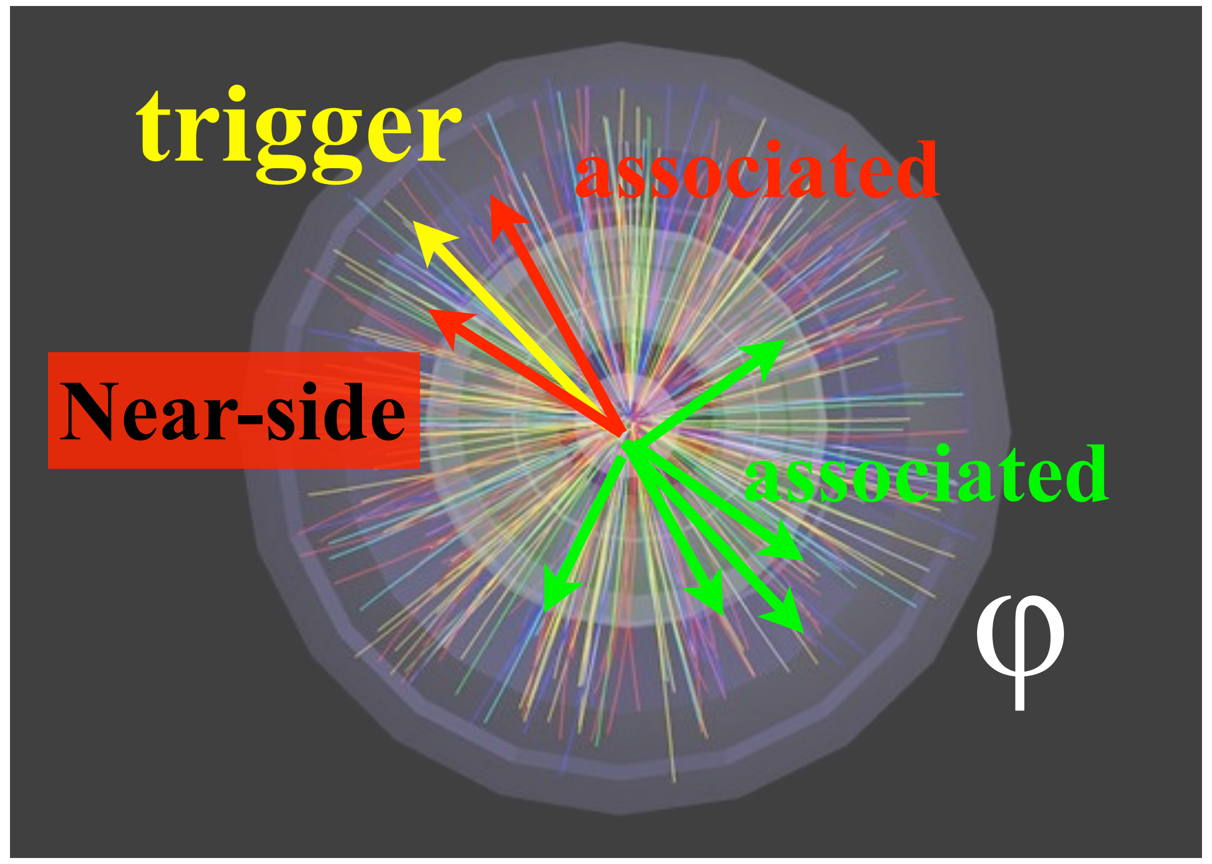
Methods for studying particles from fragmentation

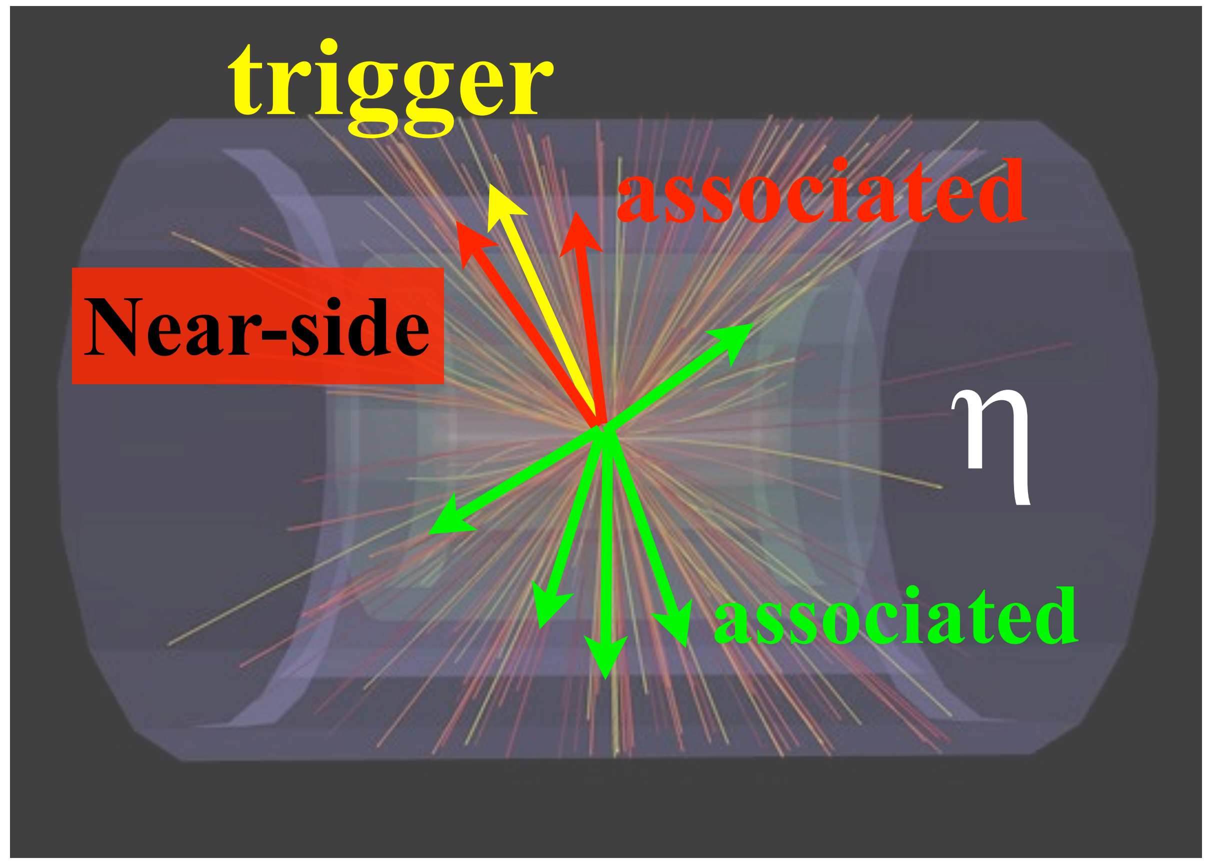


jet reconstruction

high-p_T angular correlations



$\Delta\varphi = \varphi_{trigger} - \varphi_{associated}$



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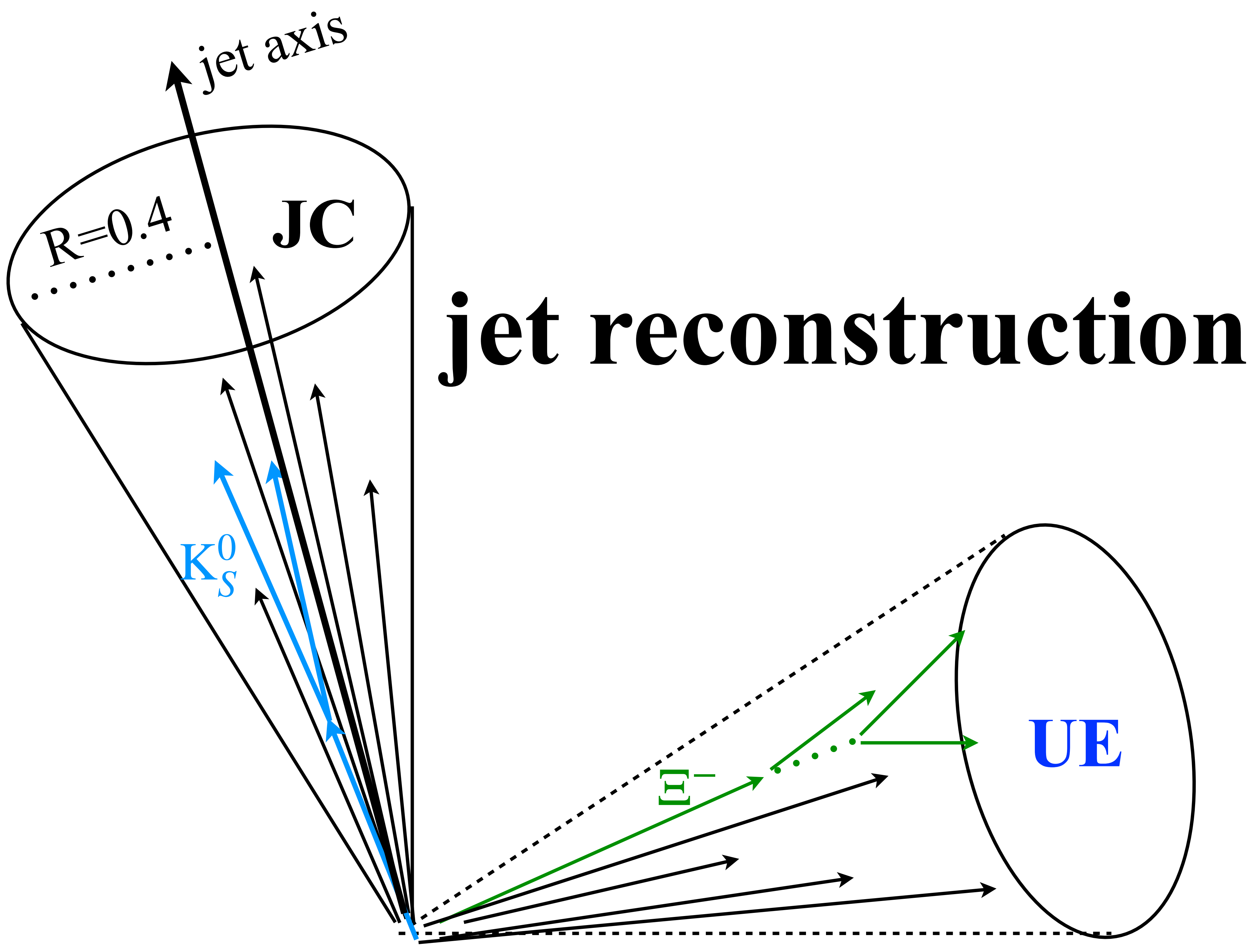
Methods for studying particles from fragmentation



- jet reconstruction: anti-k_T, R=0.4, $p_{T,jet} > 10$ GeV/c
- $R(\text{strange hadron, jet}) = \sqrt{\Delta\varphi^2 + \Delta\eta^2} < 0.4$
- strange hadrons in jet cone - **JC** particles
- strange hadrons in perpendicular cone (particles from underlying event) - **UE** particles
- strange hadrons from jet fragmentation (**JE** particles):
  JE = JC - UE

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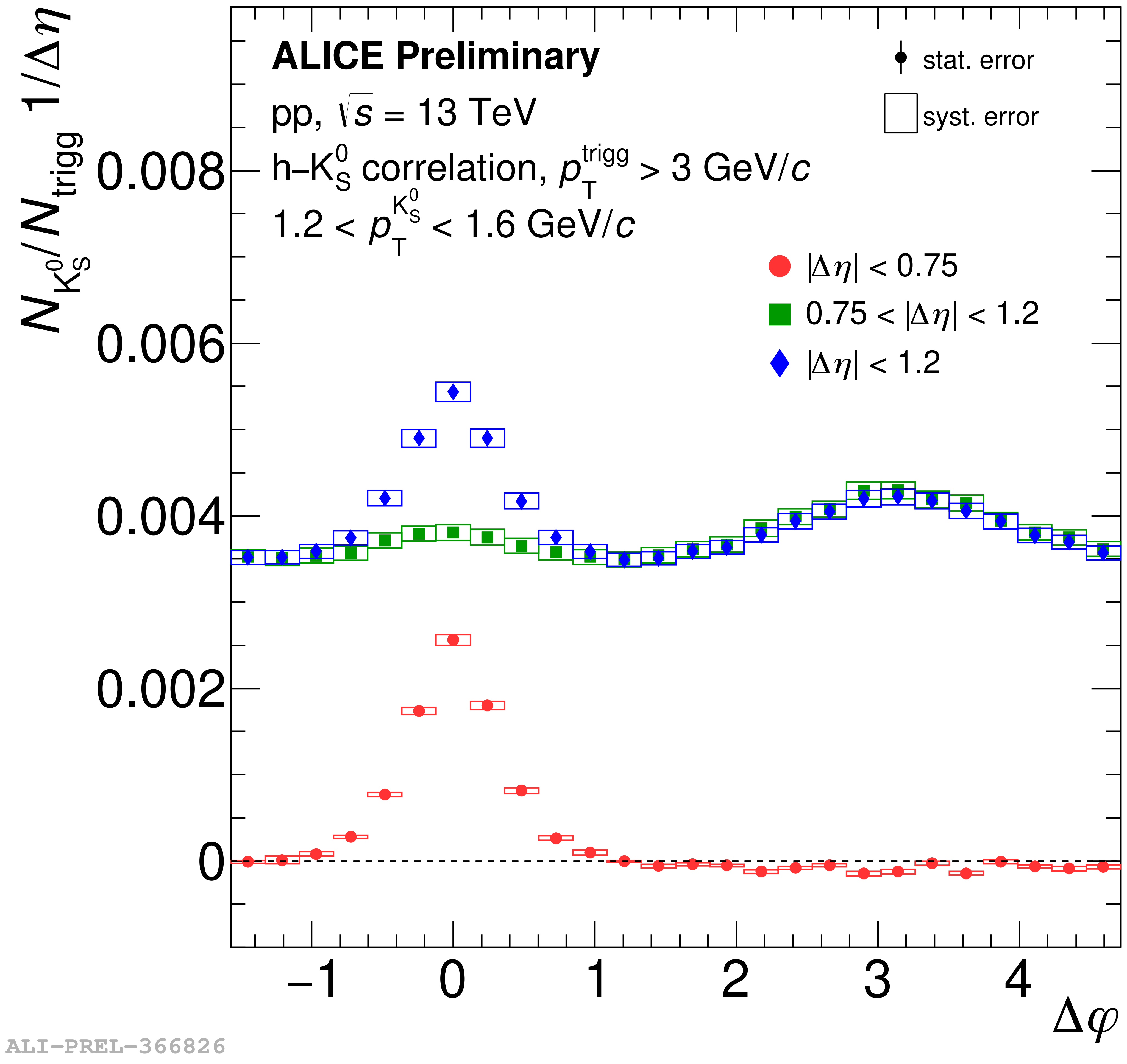

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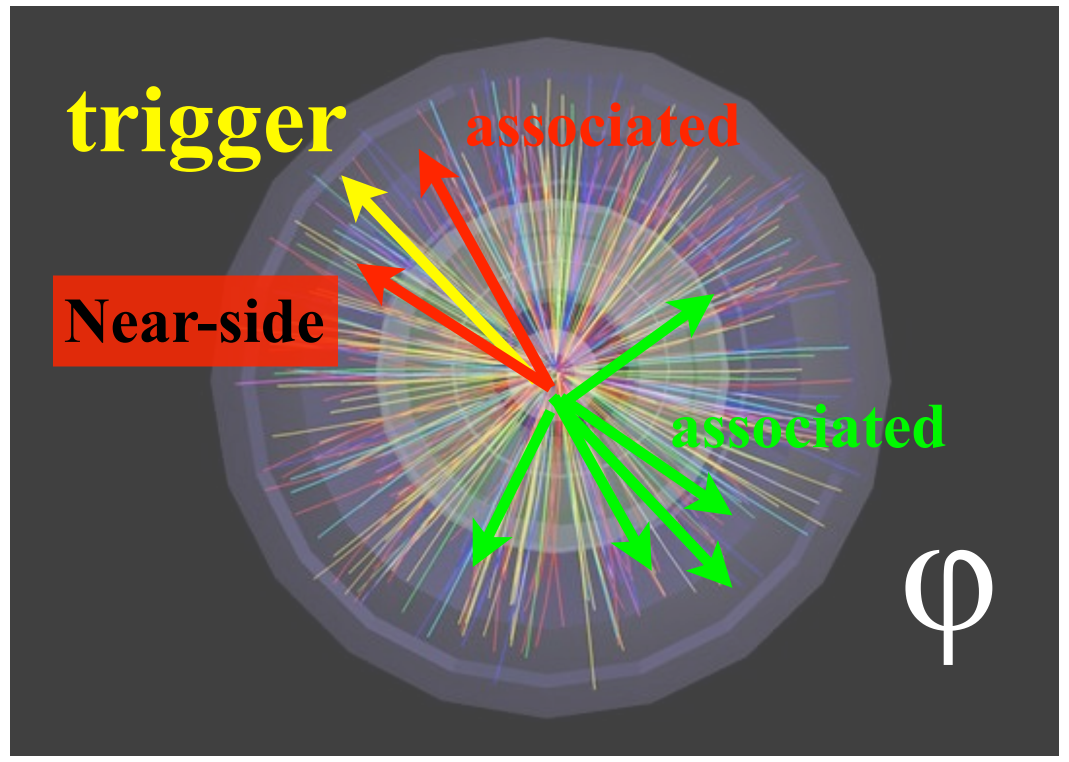

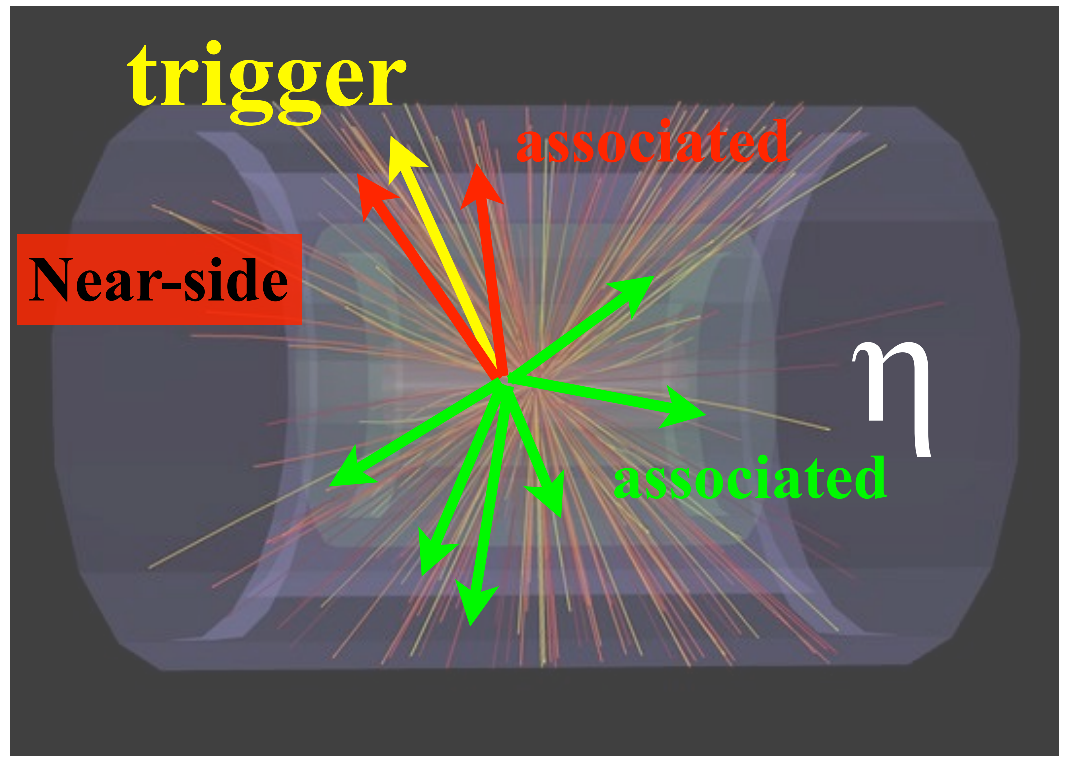

$\Delta\varphi = \varphi_{trigger} - \varphi_{associated}$ $\Delta\eta = \eta_{trigger} - \eta_{associated}$

- trigger particle (jet axis proxy) - charged hadron with highest p_T in event & $p_T > 3$ GeV/c
- associated particles: identified strange hadrons

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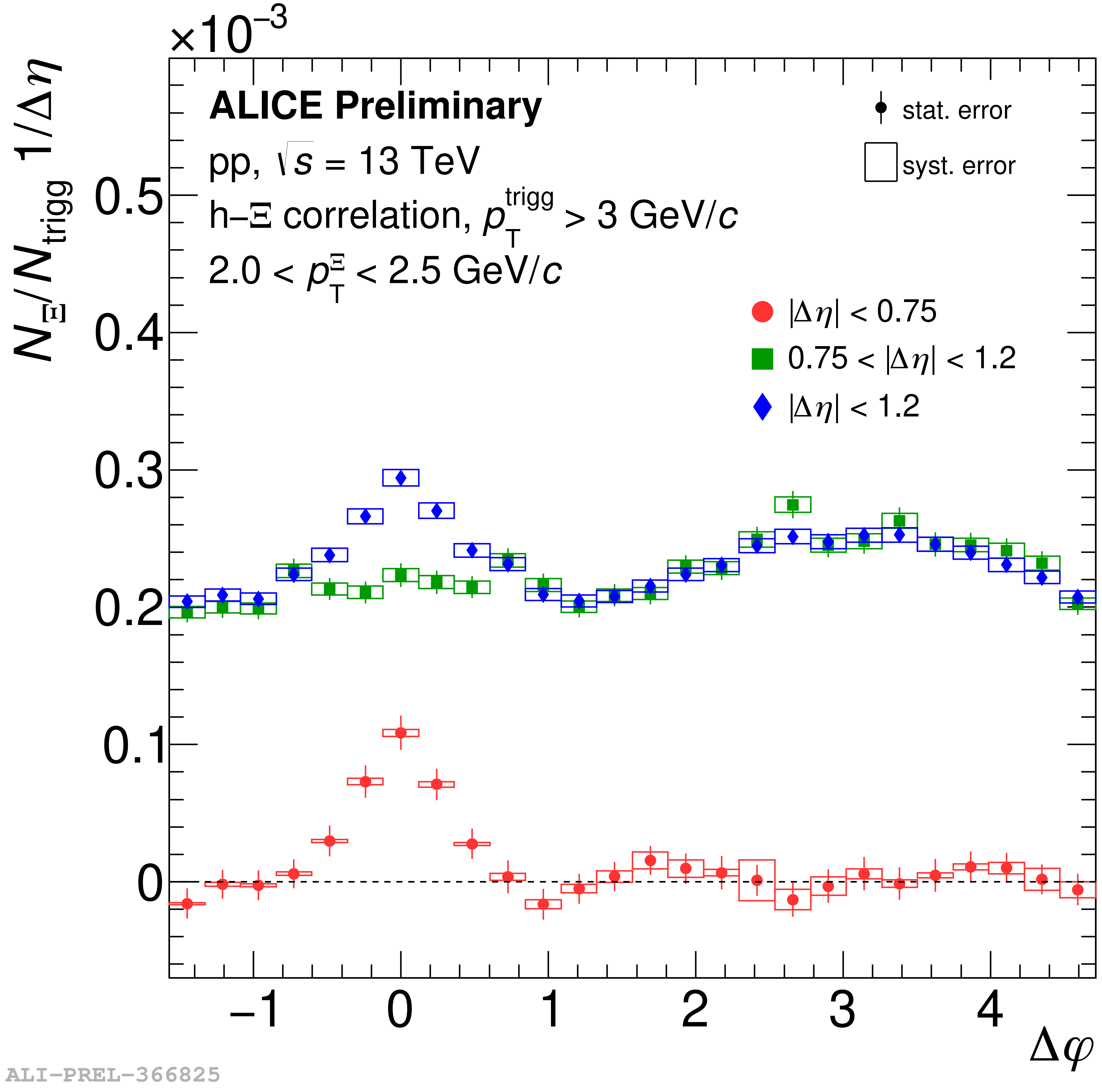

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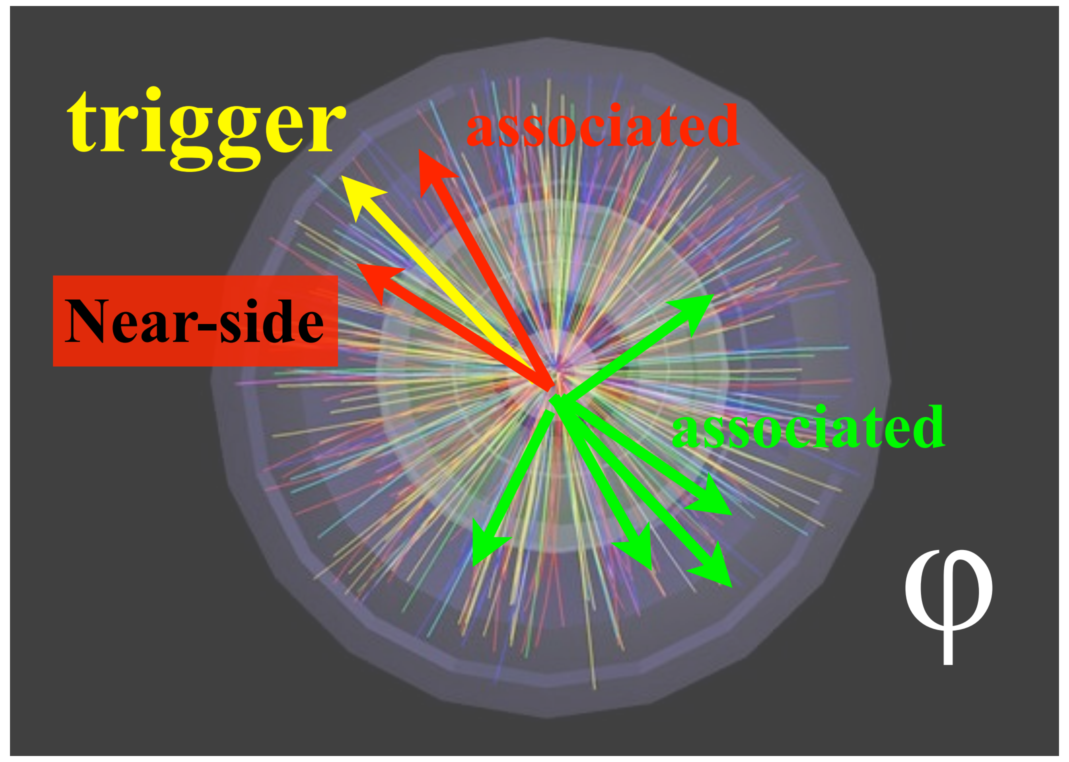

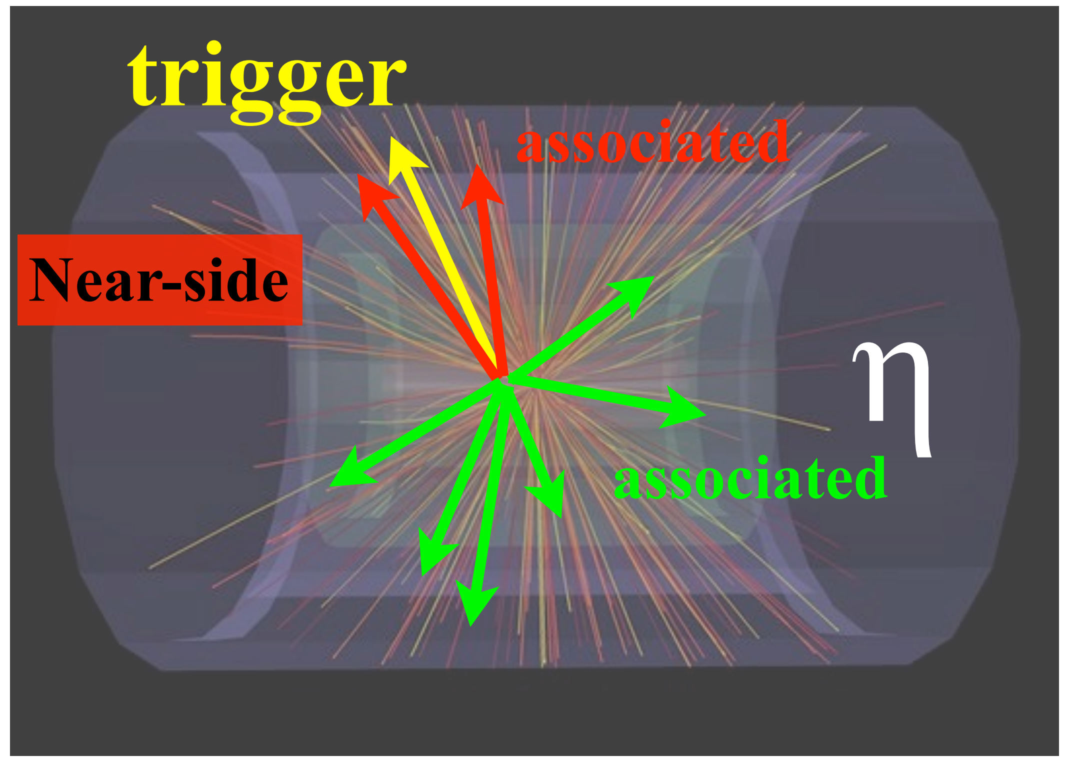

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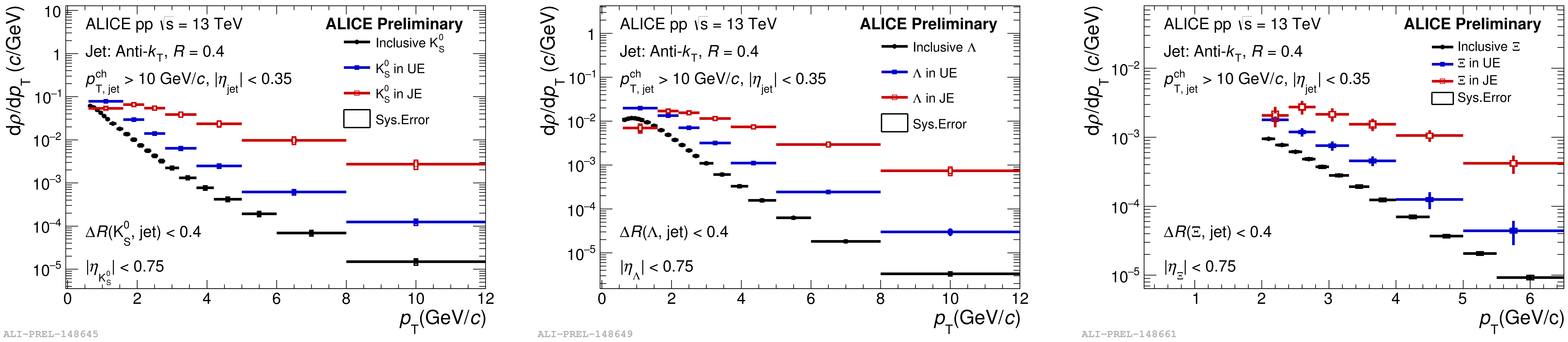
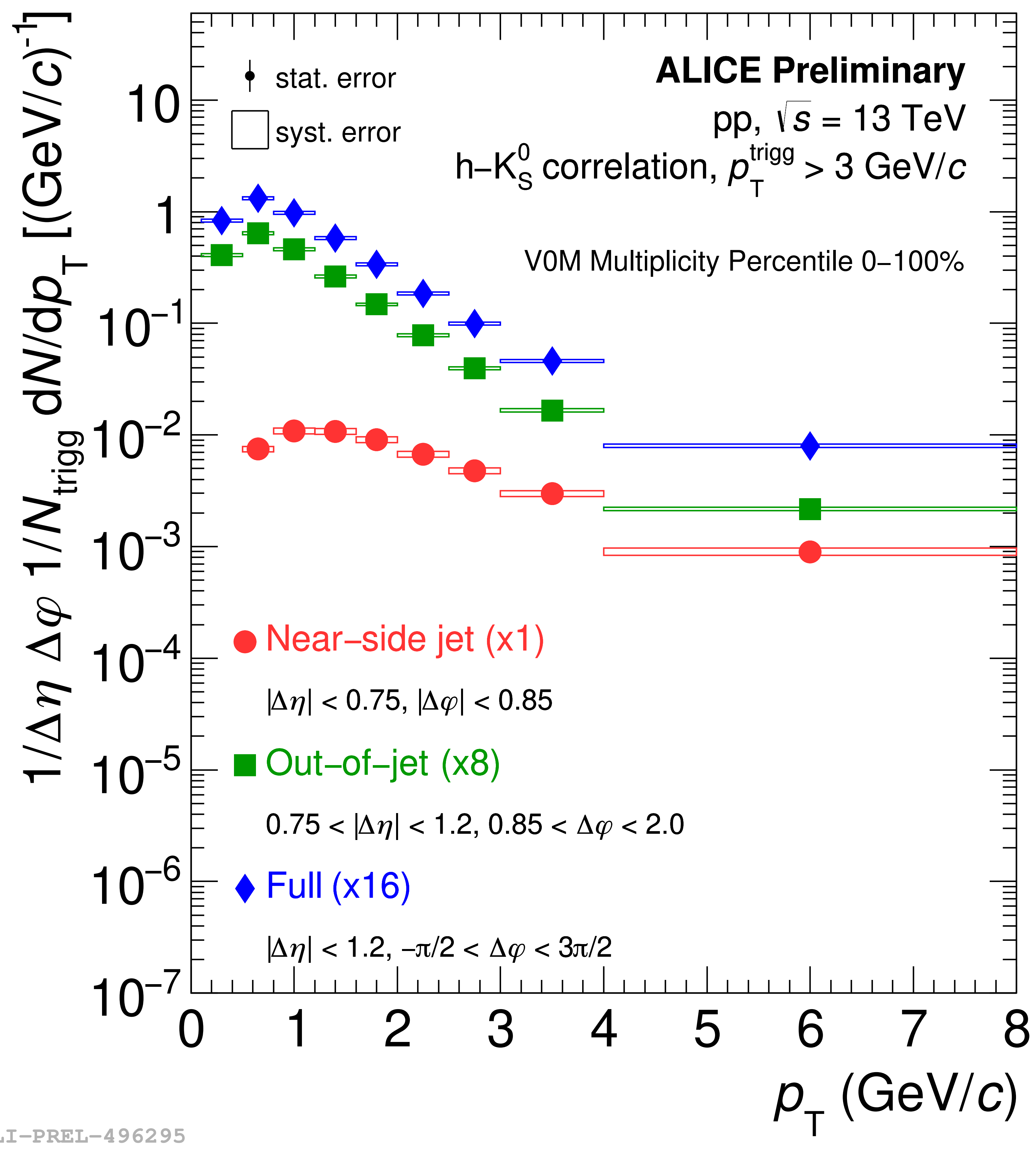
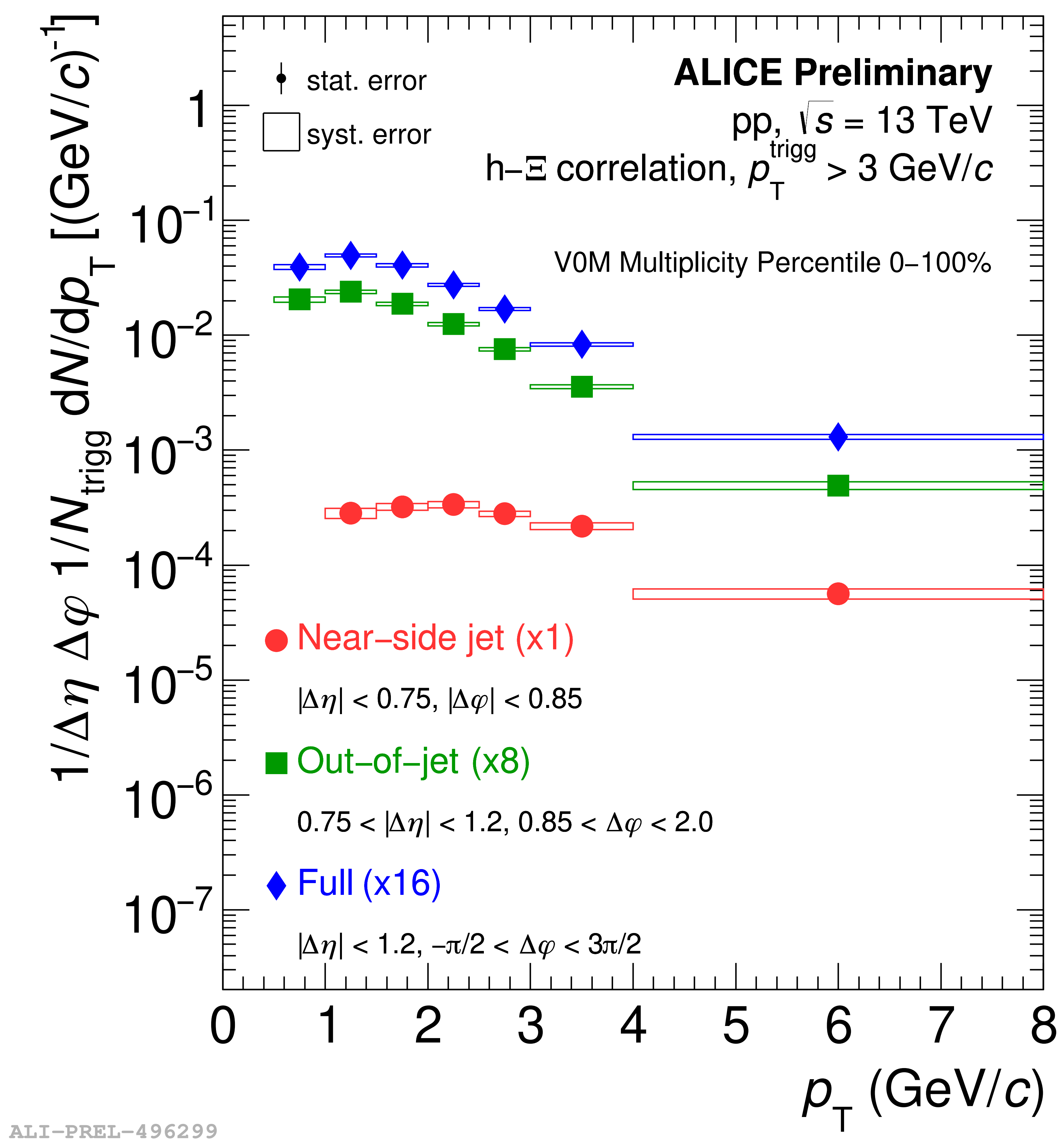
Strange hadron p_T spectra in jets



- spectra hardest for strange hadrons in jets (JE)
- UE spectra (background) dominate in low p_T (K^0 and Λ)
- UE spectra harder than inclusive - events are affected by jet bias

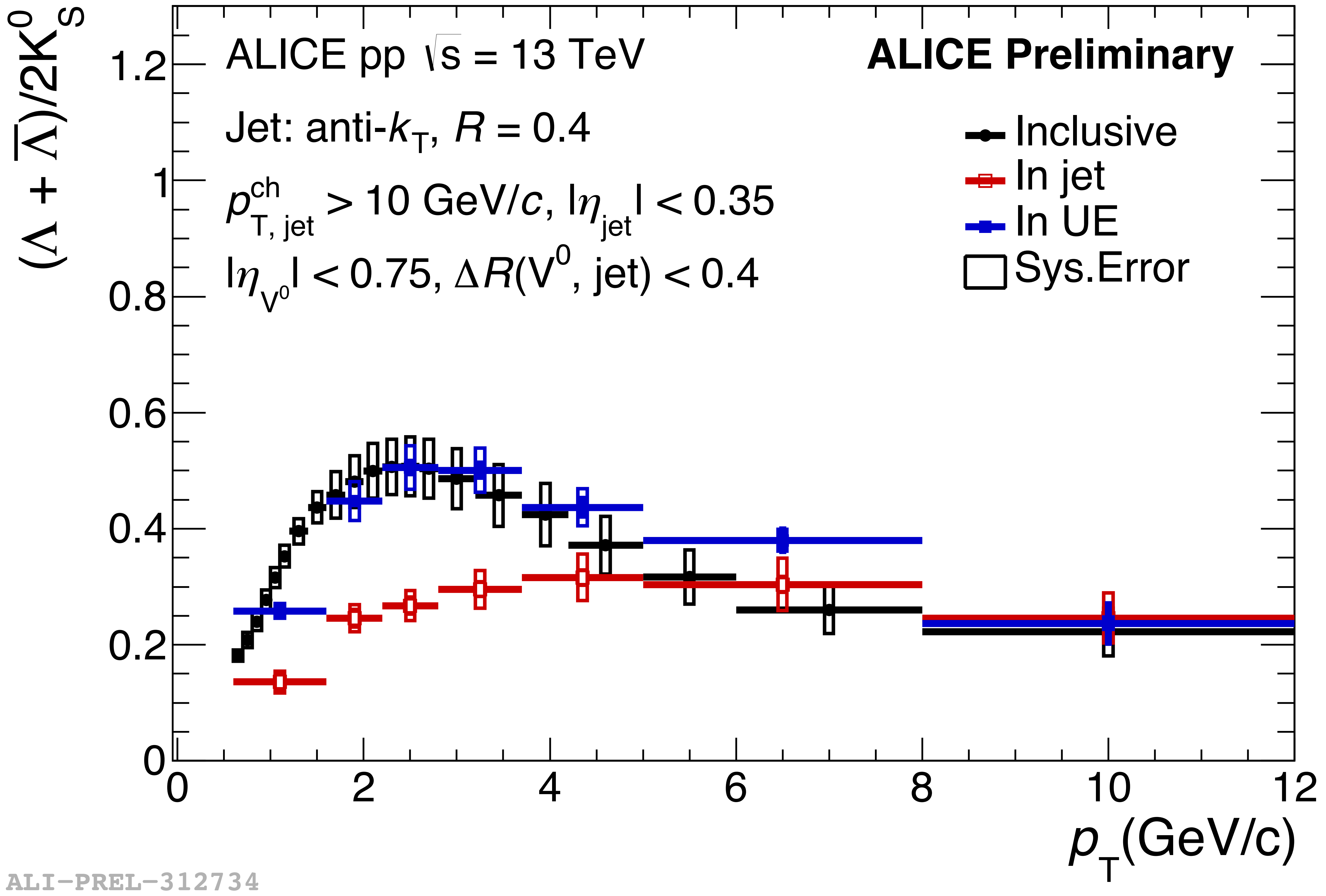
Strange hadrons p_T spectra in high-p_T angular correlations

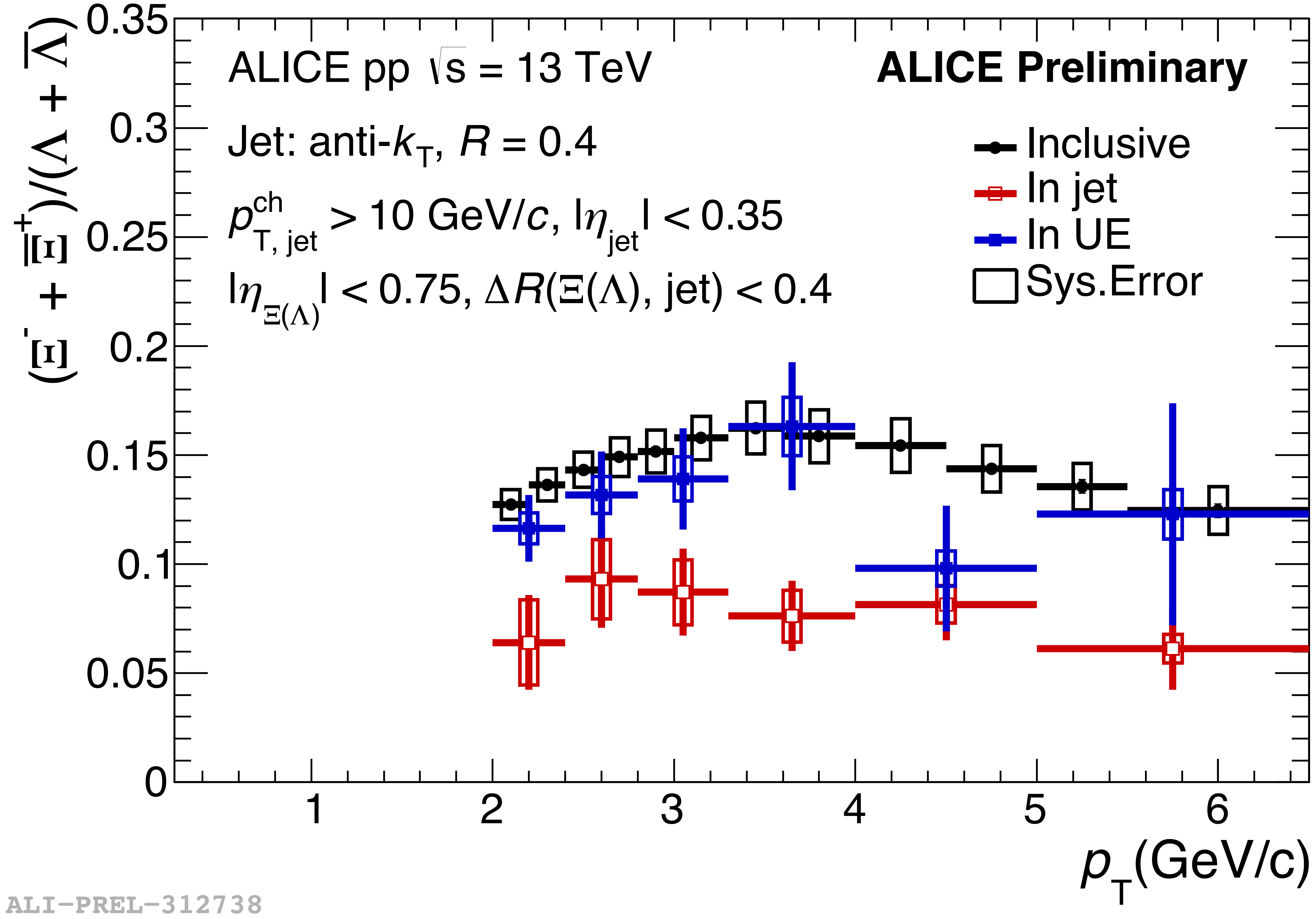




- near-side jet spectra of strange hadrons harder than out-of-jet spectra or full spectra

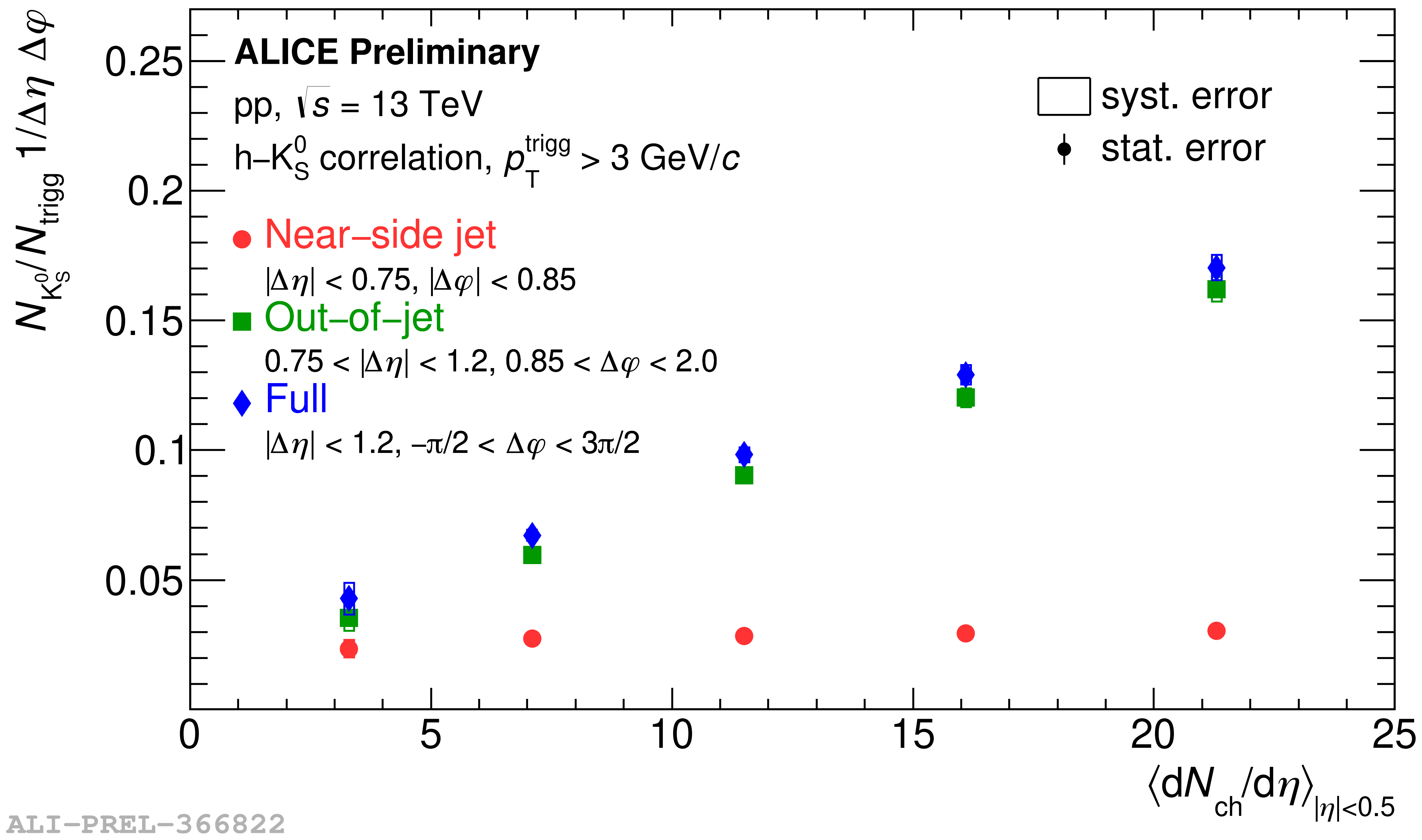
Spectra ratios in jets and in UE

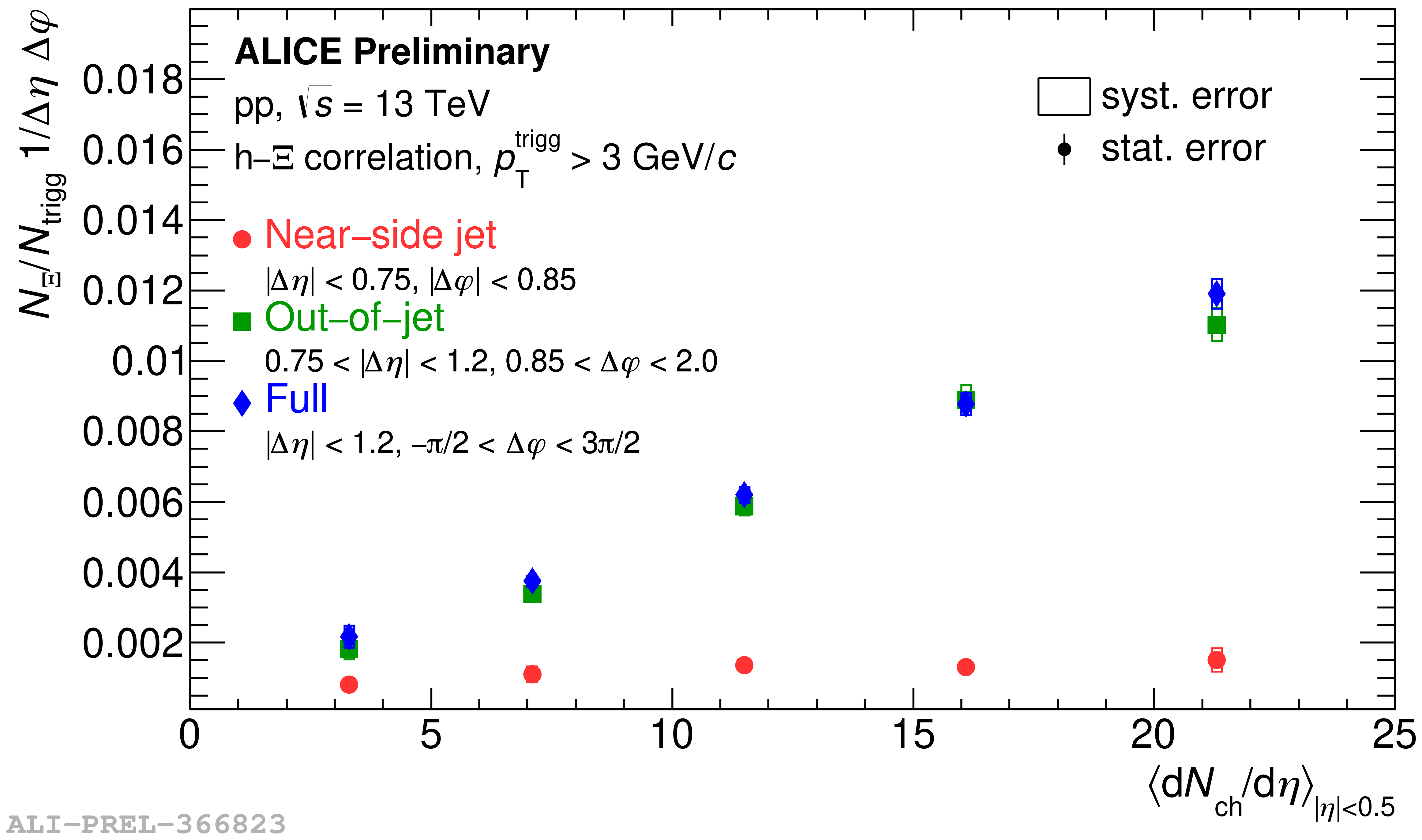




- spectra ratios for UE and inclusive particles show enhancement and a maximum at mid-p_T and they are consistent with each other ⇒ the enhancement is driven by soft processes (UE)
- ratio Ξ/Λ in jets seems only slightly dependent on p_T and systematically lower for most of the p_T interval than UE and inclusive ratios

Strange hadron yields from correlations vs. multiplicity

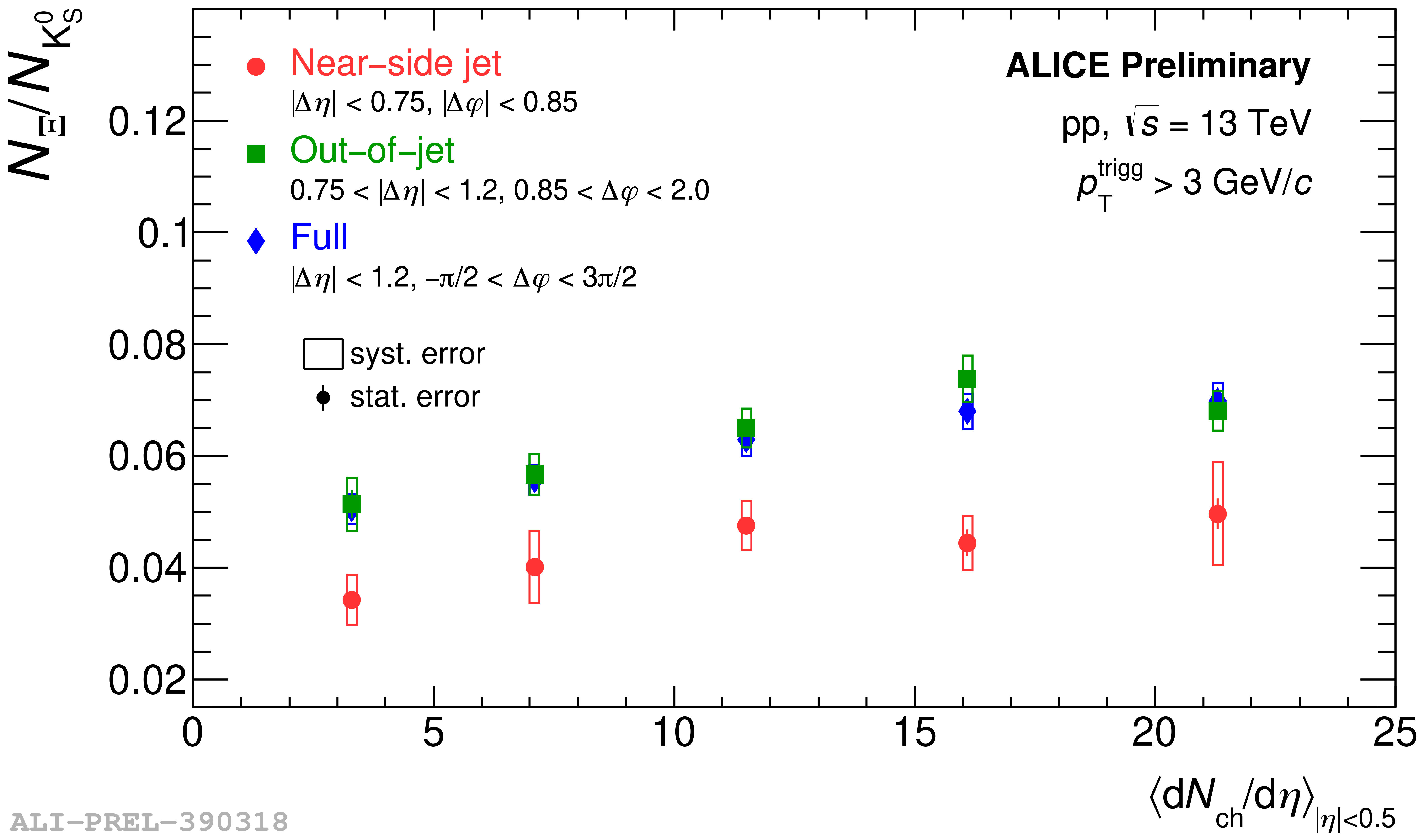




- Strange hadron yields from out-of-jet and full samples increase with multiplicity and they are consistent with each other ⇒ the increase is driven by soft processes
- Near-side jet yields do not depend on multiplicity

Strange hadron yields ratio vs. multiplicity

- Out-of-jet and full yield ratios show an enhancement as a function of multiplicity (resembling the enhancement of the inclusive strangeness production w.r.t. to pions)
- Near-side jet contributes less to the enhancement, in order to be potentially more conclusive the sample will be extended using events with higher multiplicities (HM triggers)



Summary

- the ALICE experiment can use jets and di-hadron correlation method to study soft and hard production of strange hadrons in pp collisions
- the p_{T} **spectra** of strange hadrons are harder in jets (near-side) than in UE (out-of-jet) or inclusive (full) sample
- the enhancement in the p_{T} **spectra ratios** is caused by soft processes, particles from jets have minimal contributions
- strange hadron **yields** show an increase of out-of-jet and full samples with multiplicity - the increase is caused by soft processes, no multiplicity dependence found for near-side jet **yield**
- Ξ/K^0 **yield ratio** shows an enhancement as a function of multiplicity in out-of-jet and full samples (both mutually consistent), inconclusive whether or not the near-side jet sample contributes to enhancement