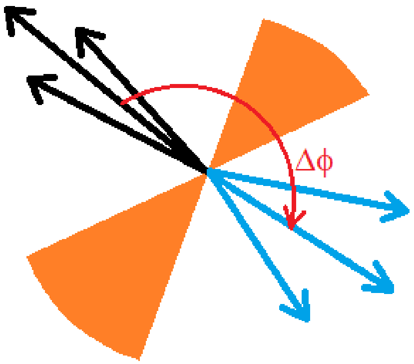
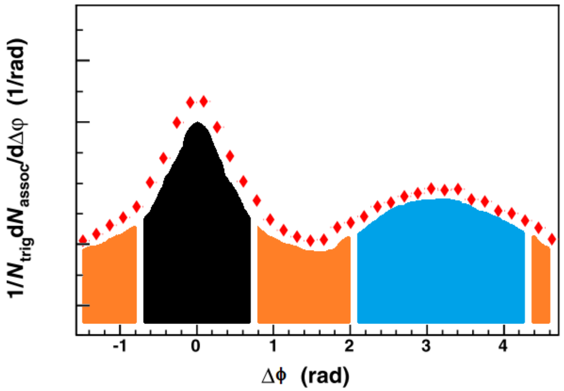
Deuterons in Jets via 2-Particle Correlations





2018 Annual US LHC Users Association Meeting
Fermilab, Batavia Illinois, USA

Brennan Schaefer for the ALICE Collaboration

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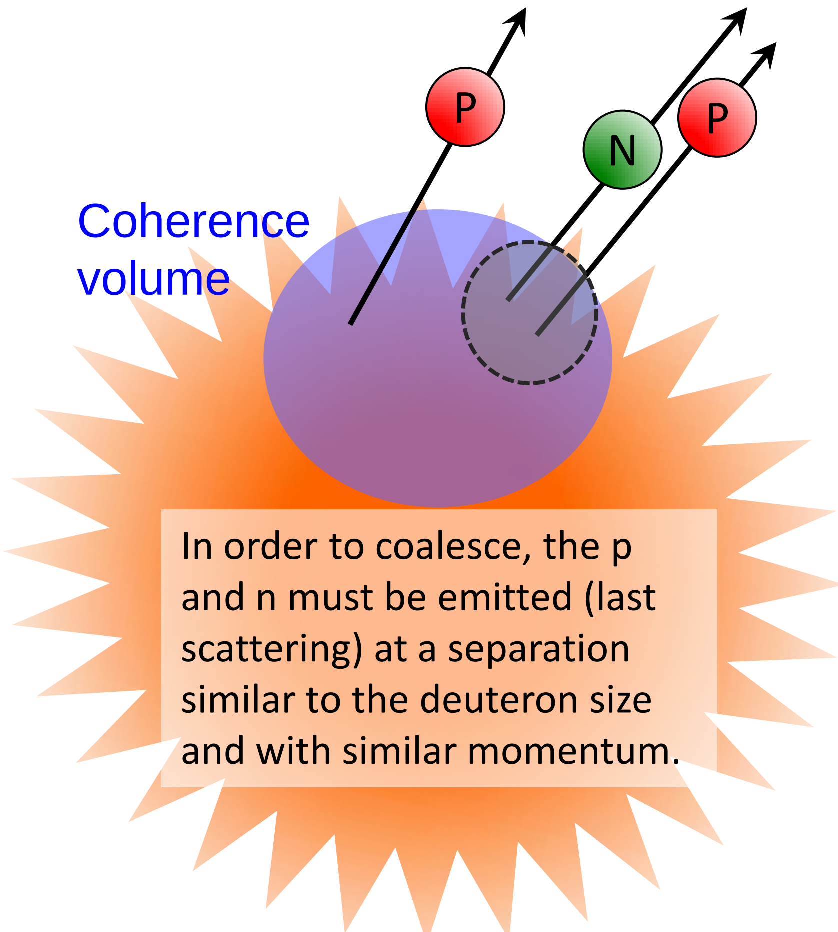
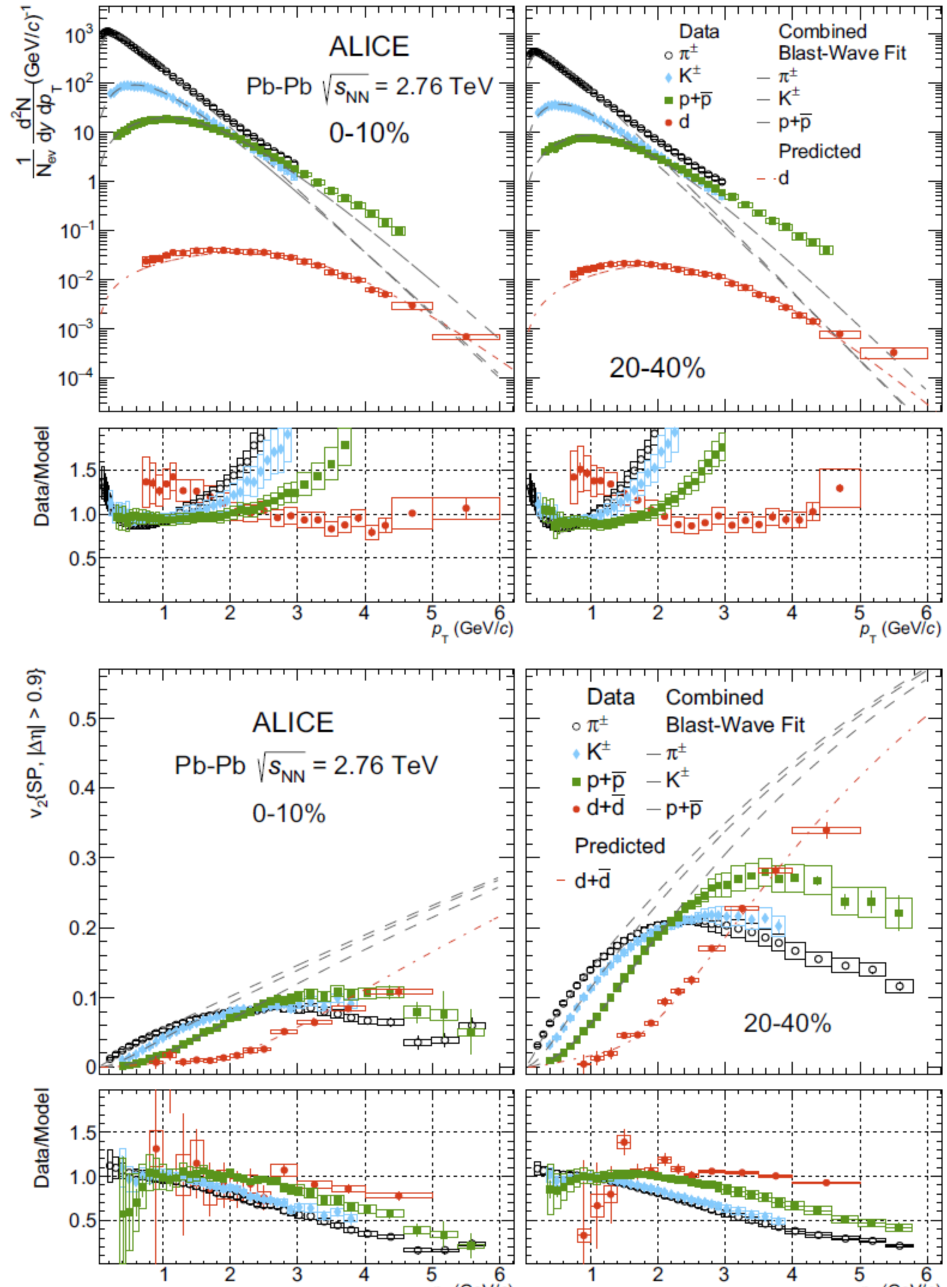
Bulk matter properties of deuteron production are addressed by numerous measurements





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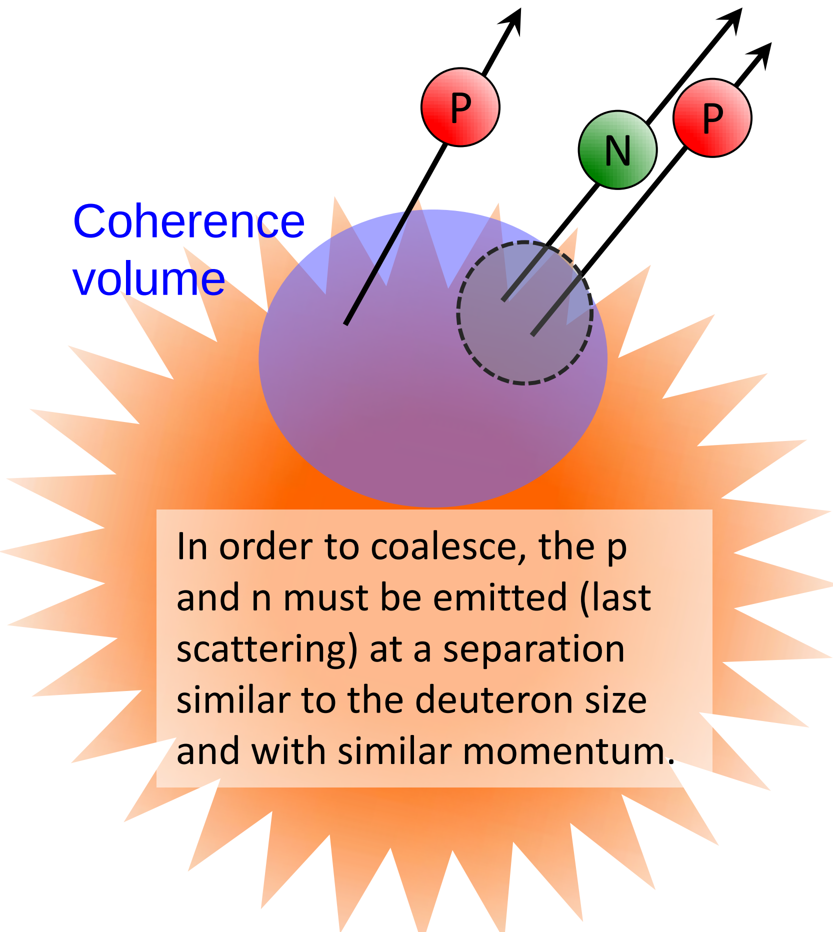
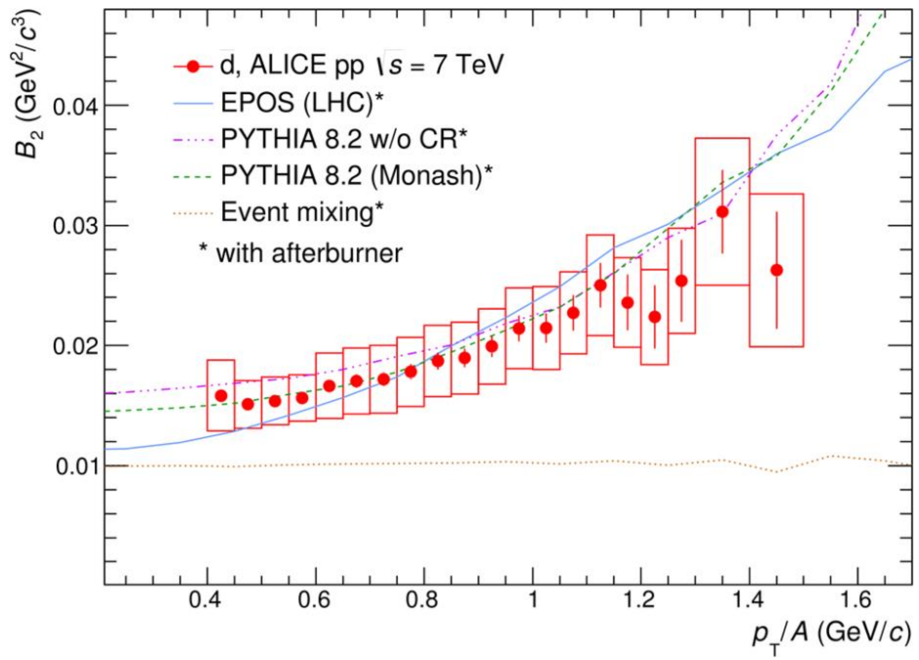
Bulk matter properties of deuteron production are addressed by numerous measurements



In order to coalesce, the p and n must be emitted (last scattering) at a separation similar to the deuteron size and with similar momentum.

$$E_d \frac{d^3 N_d}{d p_d^3} = B_2 \left(E_p \frac{d^3 N_p}{d p_p^3} \right)^2$$

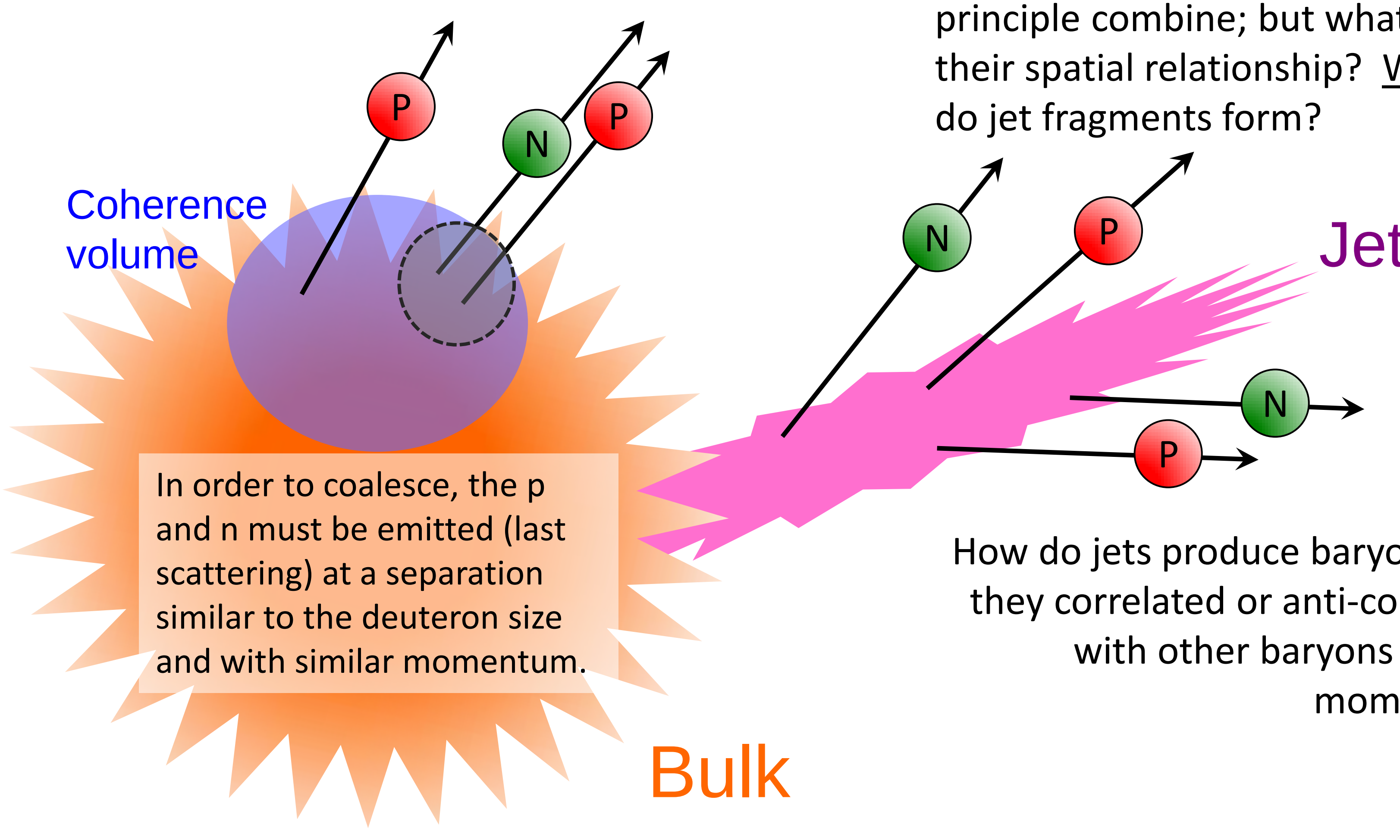


PHYSICAL REVIEW C **97**, 024615 (2018)

coalescence threshold: p_0=100 MeV/c

Are deuterons made in jets?

Nucleons from jet and bulk can in principle combine; but what is their spatial relationship? Where do jet fragments form?

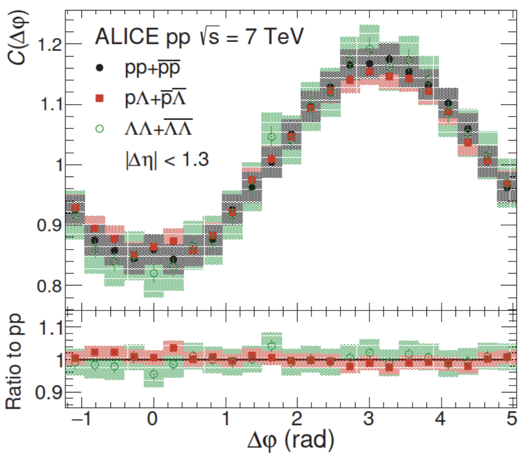


In order to coalesce, the p and n must be emitted (last scattering) at a separation similar to the deuteron size and with similar momentum.

How do jets produce baryons? Are they correlated or anti-correlated with other baryons at close momentum?

Di-hadron correlations

recent measurements indicate baryon pairs are suppressed within jet fragmentation



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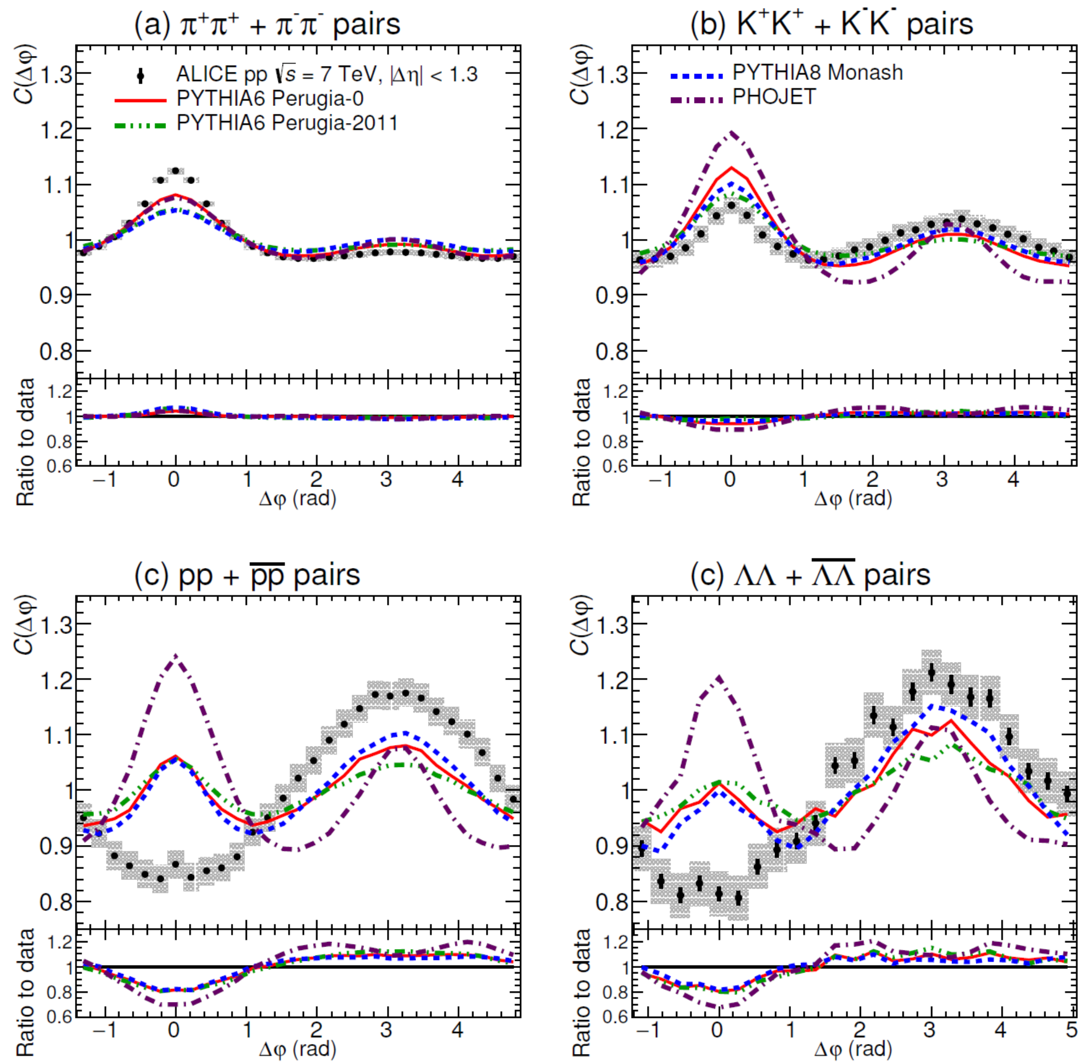

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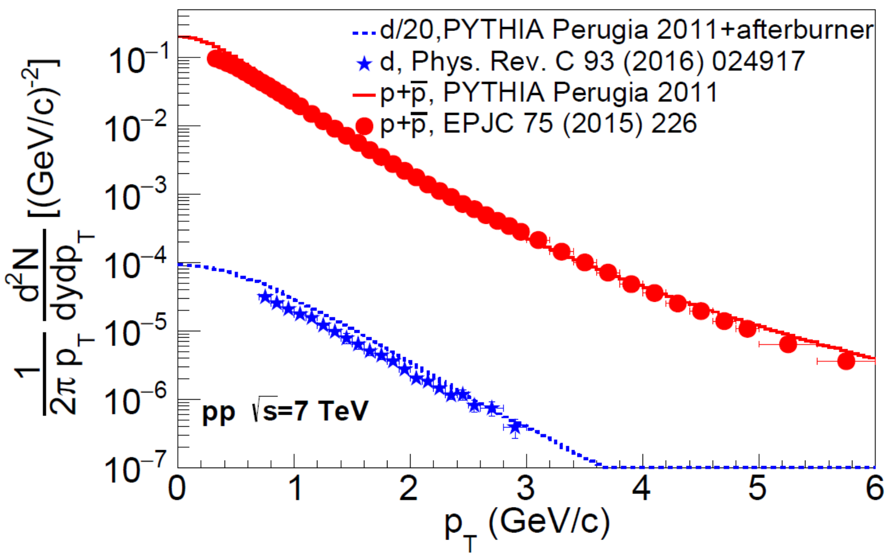
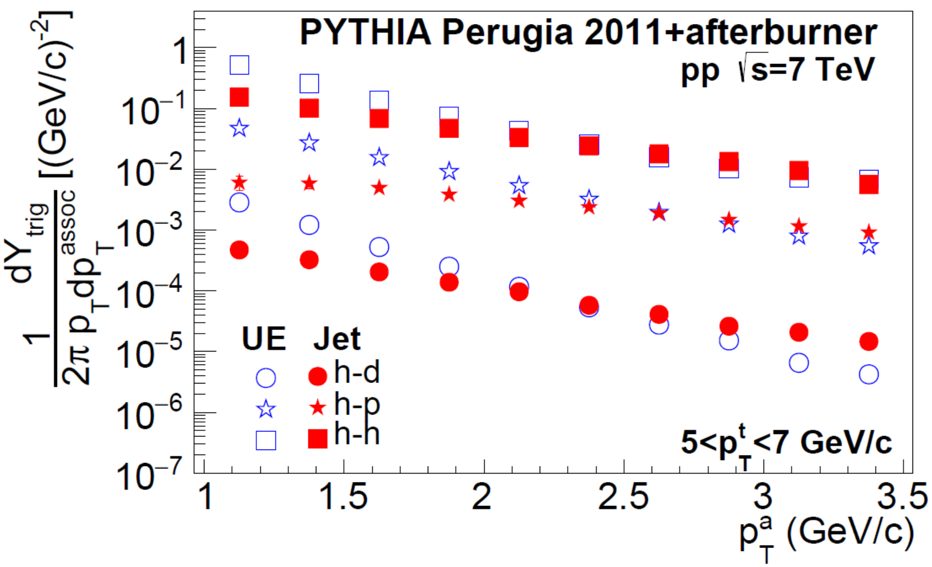
Model predictions

Natasha Sharma, et al, Phys. Rev. **C98**, 014914 (2018)



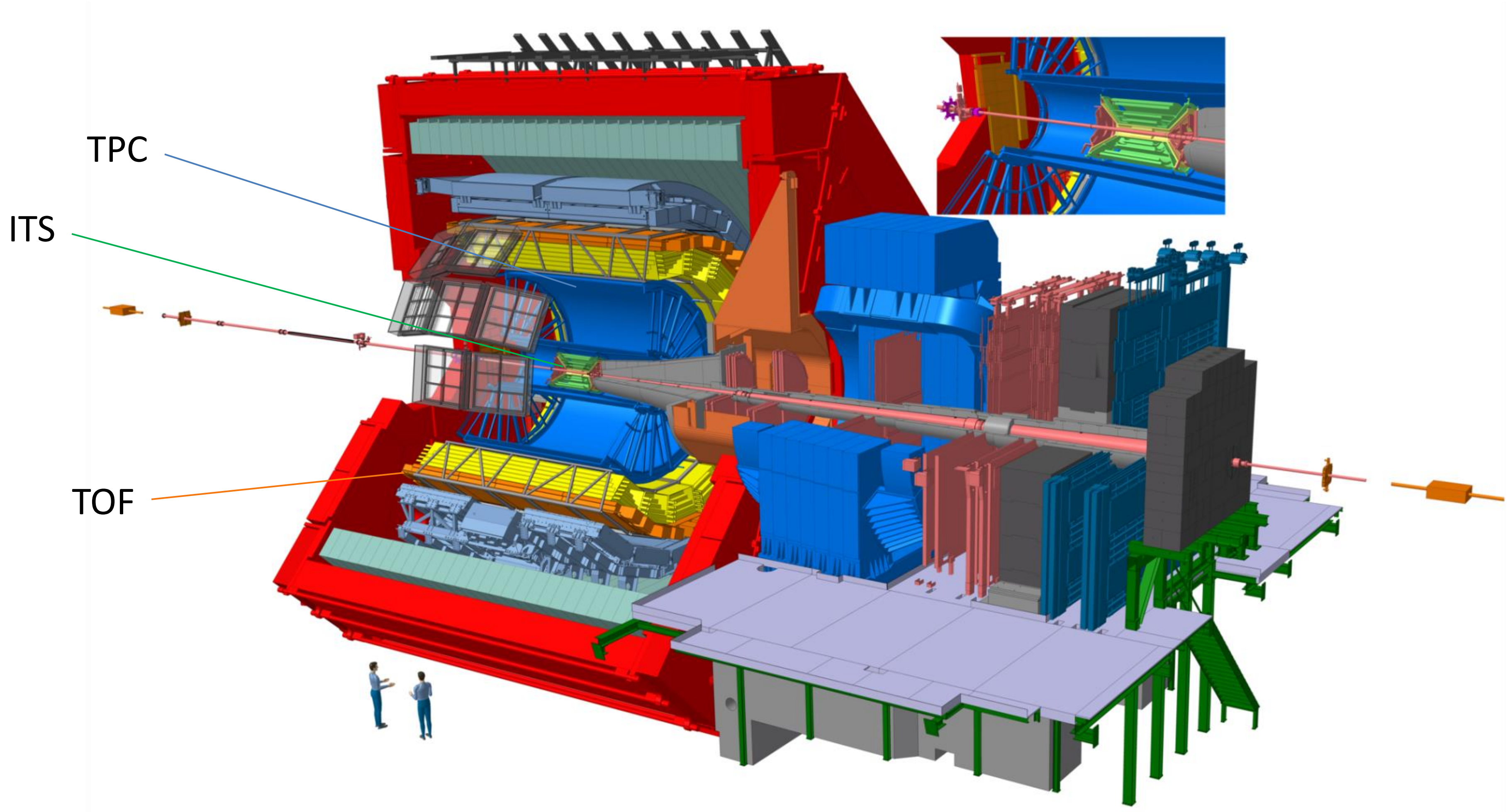
deuteron and proton spectra



conditional spectra

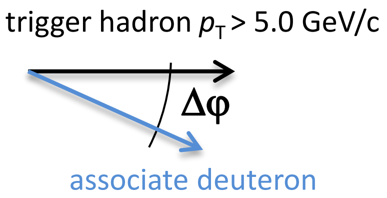
The ALICE Detector

- 0.5T Magnetic field
- 6 Silicon Layers
- 90m^3 TPC
- 3.9m TOF radius



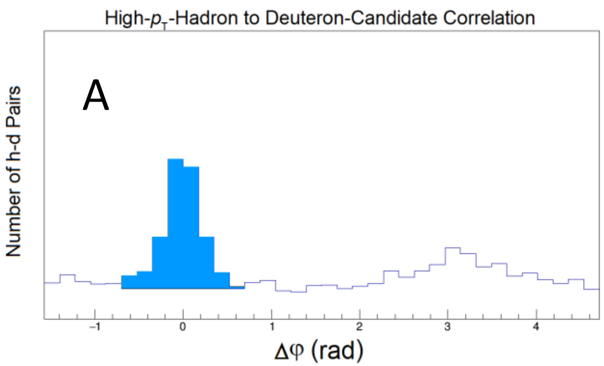
Analysis method

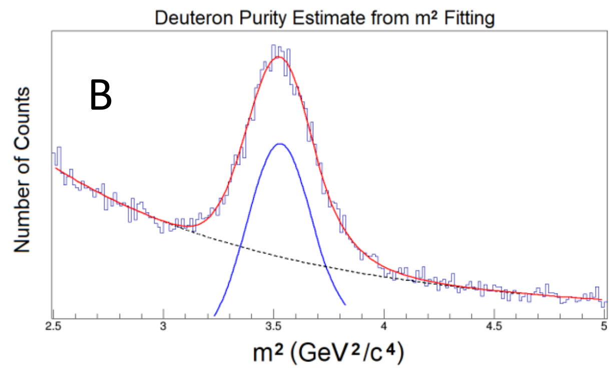
1.1B minimum bias pp 13 TeV events

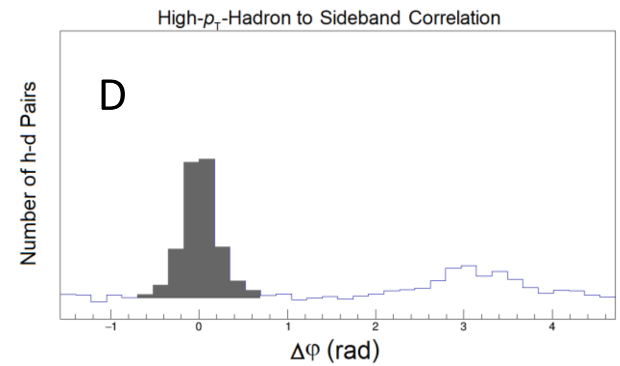


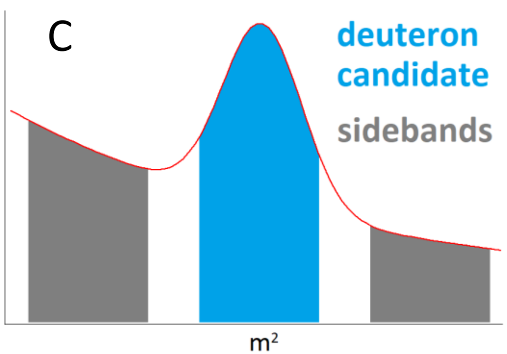
$$Y^{deuteron} = \left(Y^{deuteron}_{candidate} - \frac{back}{signal + back}\frac{area_{deuteron}}{area_{sideband}} Y^{sideband}\right)\frac{1}{efficiency \cdot accept.}$$

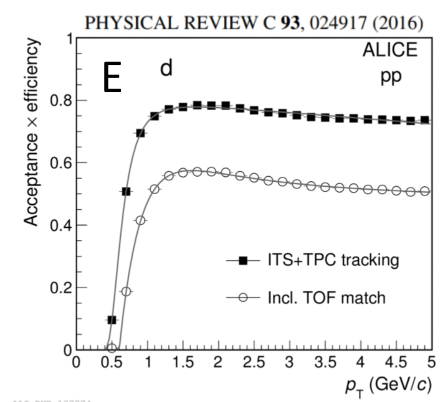
A B C D E











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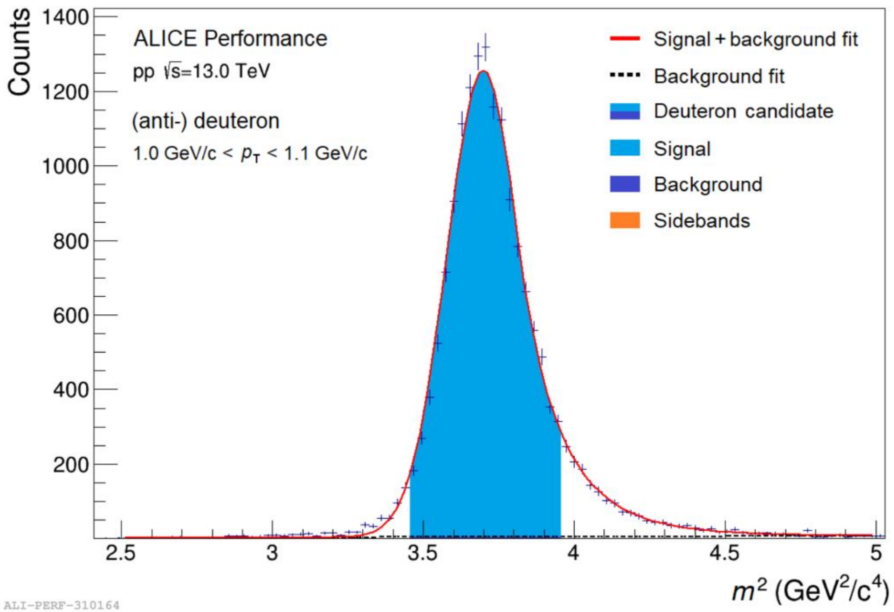
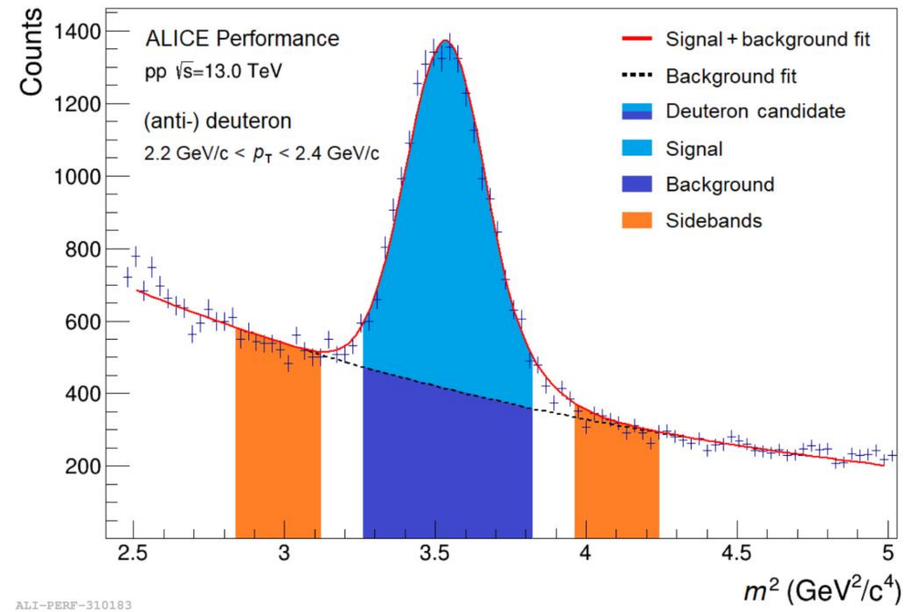
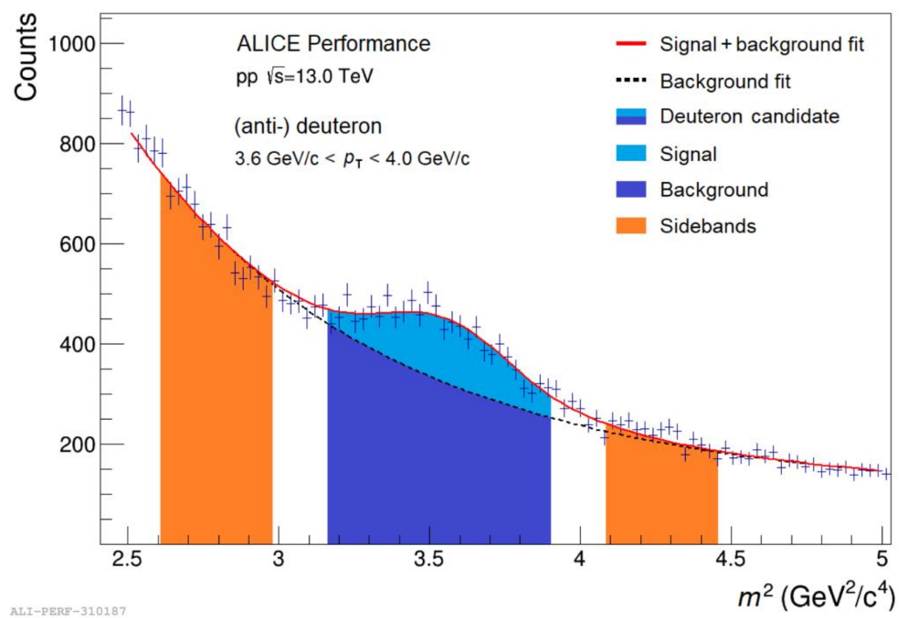




$$m^2 = p^2(\frac{t^2}{L^2} - 1)$$



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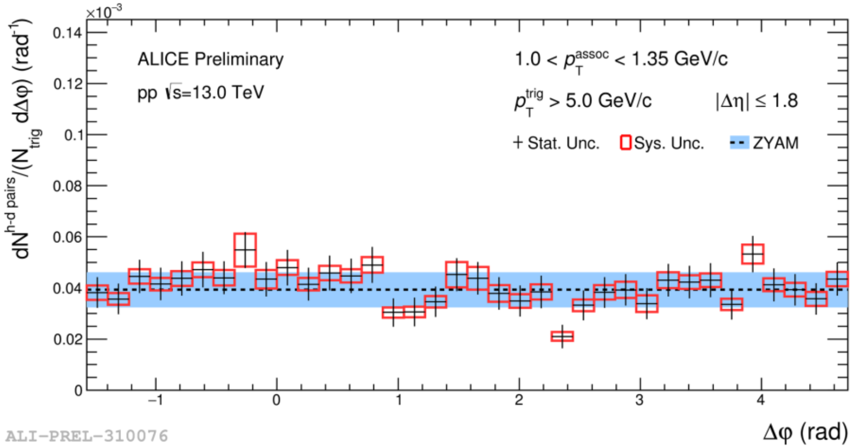
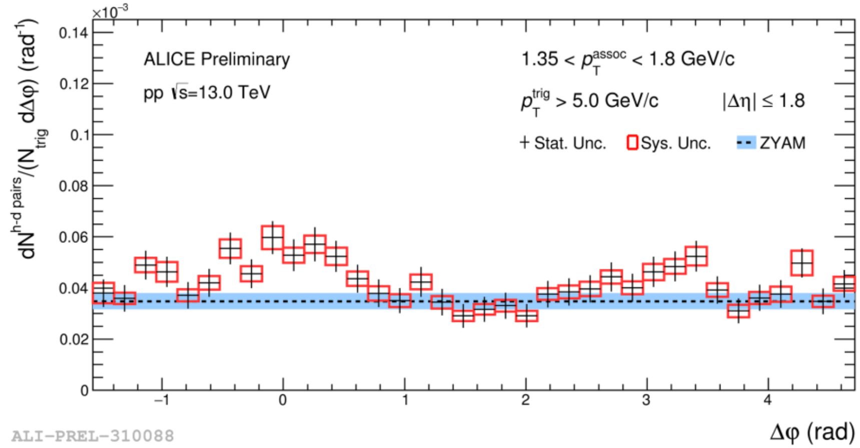
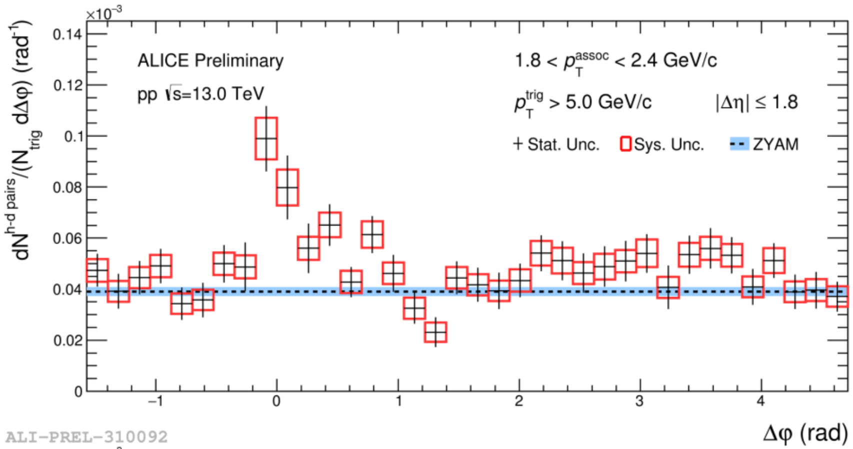
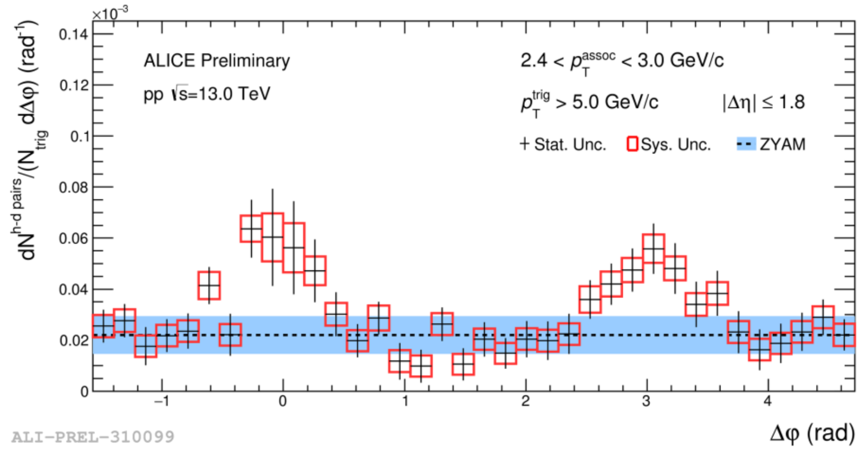
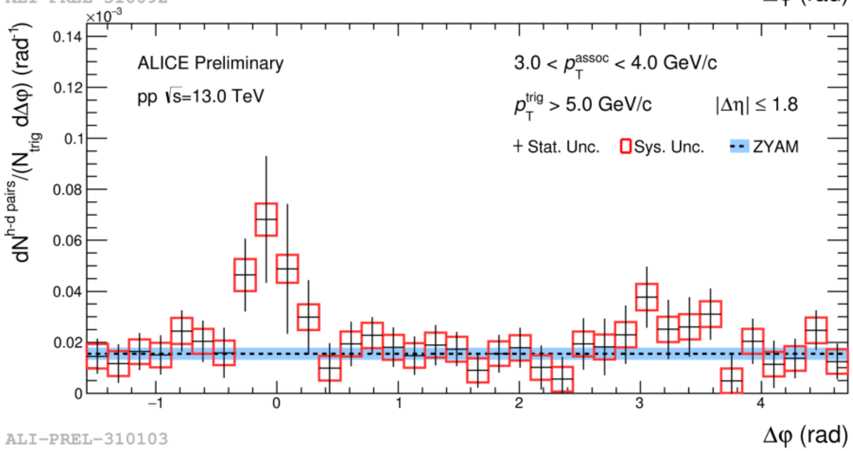
h-d Correlations Results new!





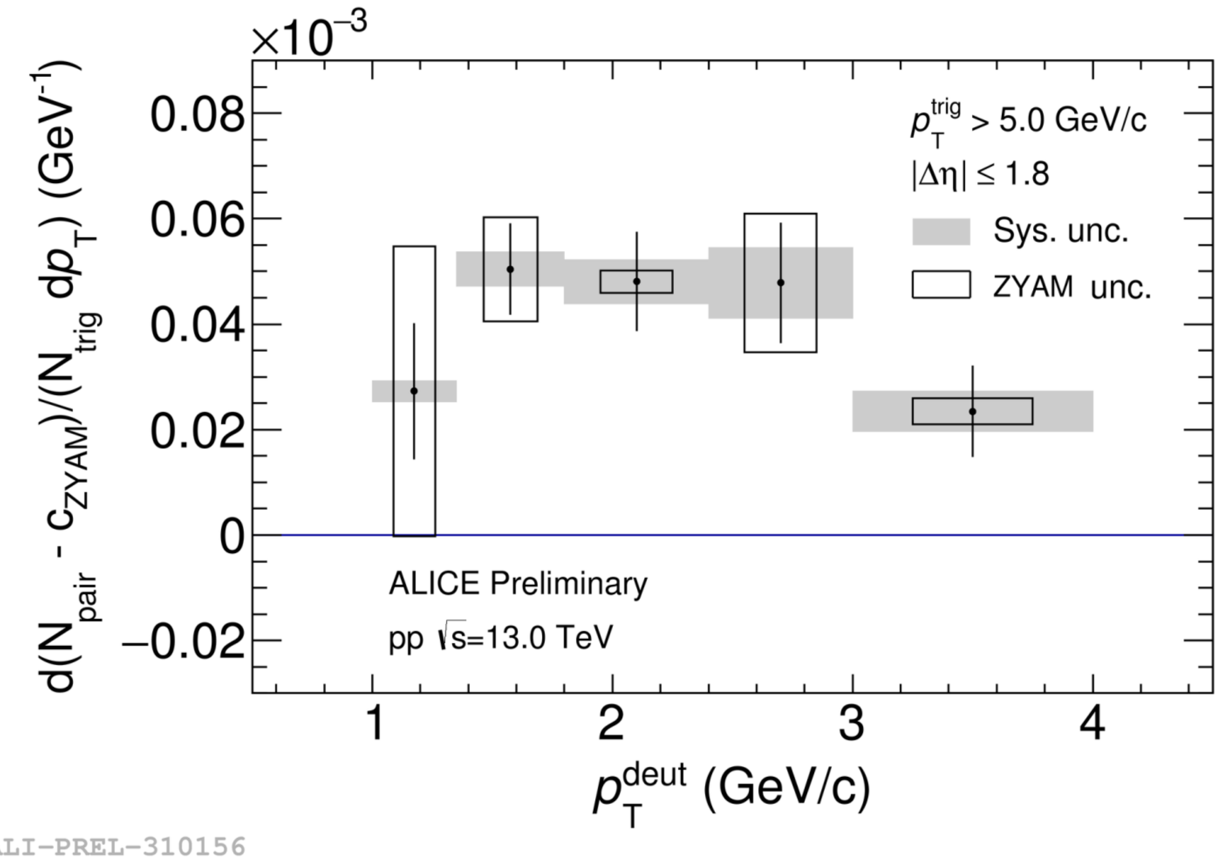






- Zero Yield At Minimum found with local averaging (data pts.) and local fitting (sys)
- Systematic uncertainty from tracking cut changes, purity method, sideband selection
- 1/60,000 min-bias events has a high p_T trigger and deuteron candidate.
- A discernable near side peak exists near Δφ = 0, away side peak near Δφ = π.

Per-trigger correlated yields



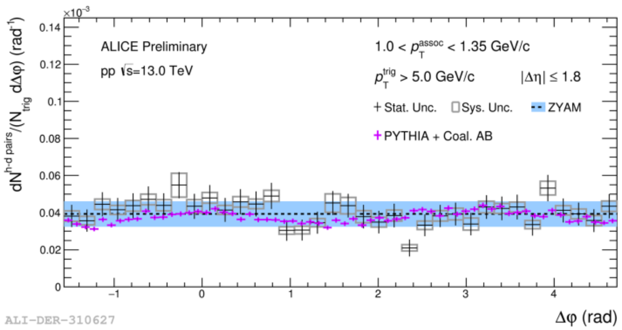
Separation of 2-4 standard dev. from zero for data points between 1.5 and 4 GeV/c.

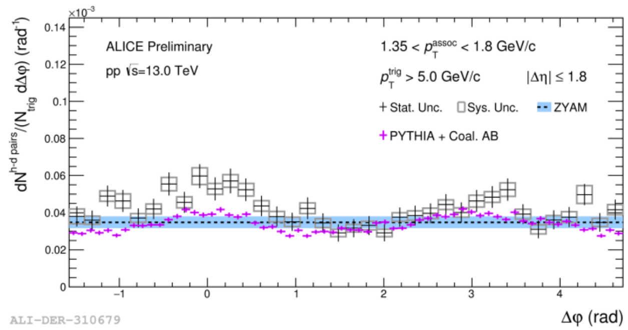
Model comparison

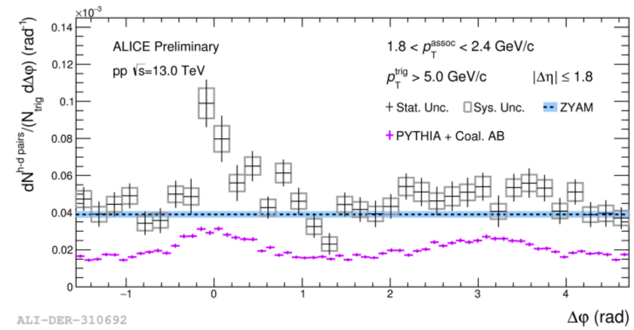
PYTHIA + COALESCENCE AFTERBURNER

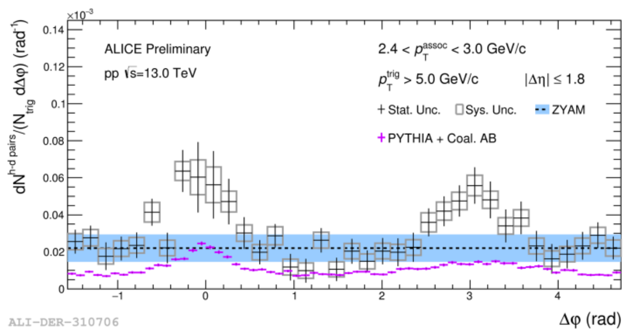
(p_0 = 100 MeV/c) afterburner described in ALICE-PUBLIC-2017-010

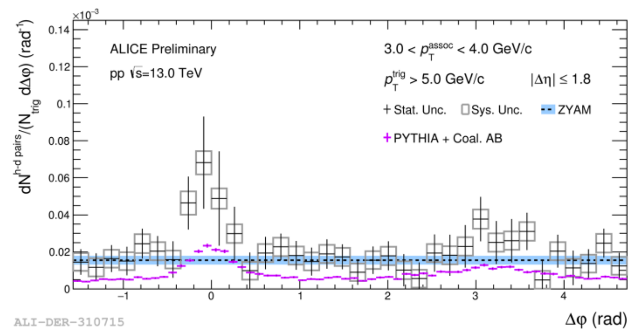
h-d correlations











- Results are qualitatively described by PYTHIA model calculations where protons and neutrons from jet fragmentations coalesce.

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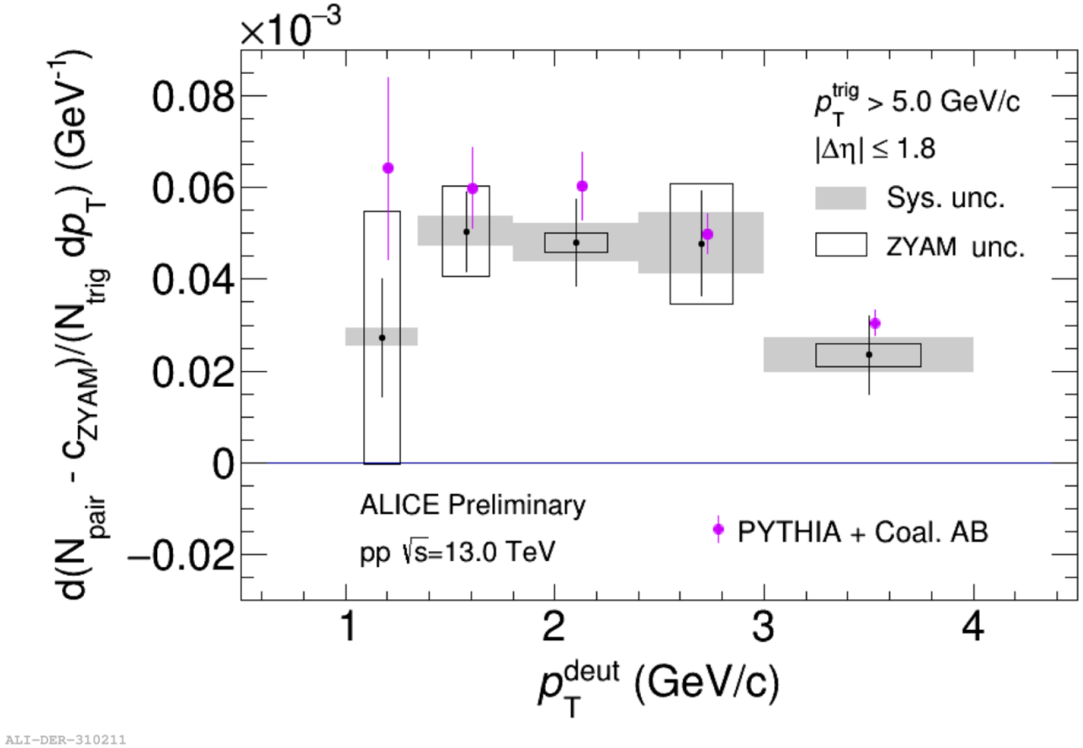

- Results are consistent with PYTHIA model calculations where protons and neutrons from jet fragmentation coalesce.

Conclusions:

- In events containing both high-p_T hadrons and deuterons, the deuterons are emitted [slightly] preferentially in the direction of the high-p_T hadron.
- Results are consistent with PYTHIA model calculations where protons and neutrons from jet fragmentations coalesce.

Future investigation:

- Characterize in-jet deuteron production with B_2-in-jet measurement.