

# Multiplicity dependence of $\Xi_c^+$ baryon production in pp collisions at $\sqrt{s} = 13$ TeV with ALICE

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on behalf of the ALICE collaboration



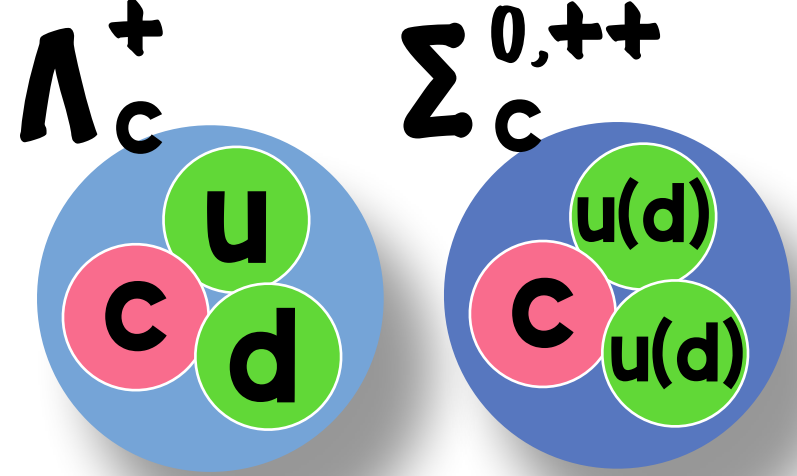
ALICE



## Motivation

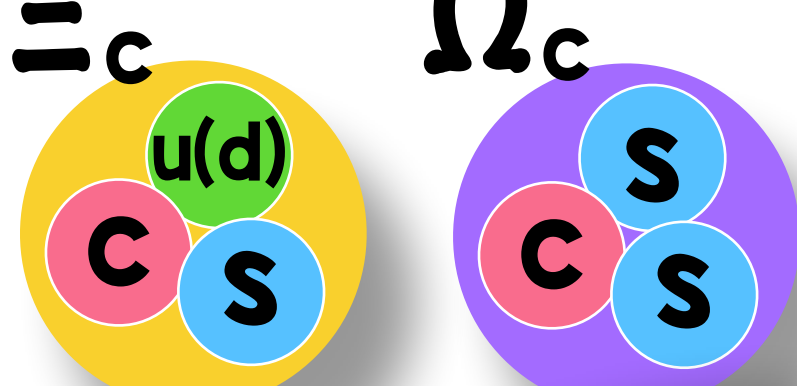
- Significant enhancement of charm-baryon production yields was observed in pp collisions, compared to  $e^+e^-$  and  $e^+p$  collisions

### Charm baryons without strangeness



- Production ratios to  $D^0$  mesons can be described by models implementing modified hadronization of charm quarks [ALICE, Phys. Rev. Lett. 128 (2022) 012001]

### Charm baryons with strangeness



- Models including coalescence for the hadronization of charm quarks are closer to data
- An accurate model description is still challenging!

$\Lambda_c^+$  production ratios to  $D^0$  mesons show significant multiplicity dependence! What about the  $\Xi_c^+$ ?

Measure the  $\Xi_c^+$  production as a function of multiplicity

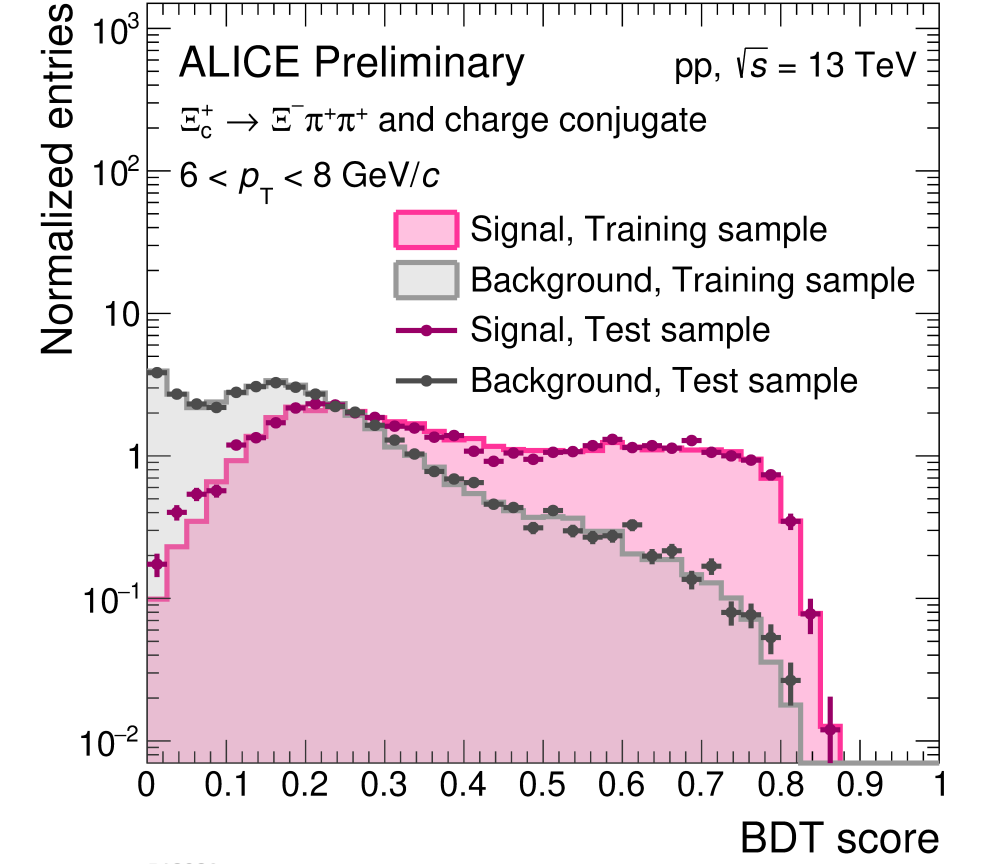
## $\Xi_c^+$ baryon

- Mass : 2.468 GeV/c<sup>2</sup>
- Lifetime : 132  $\mu$ m
- Quark constituent : u, s, c
  - Isospin partner :  $\Xi_c^0$  (d, s, c)
- Decay channel
  - $\Xi_c^+ \rightarrow \Xi^- \pi^+ \pi^+$
  - Branching ratio =  $2.9 \pm 1.3$  %

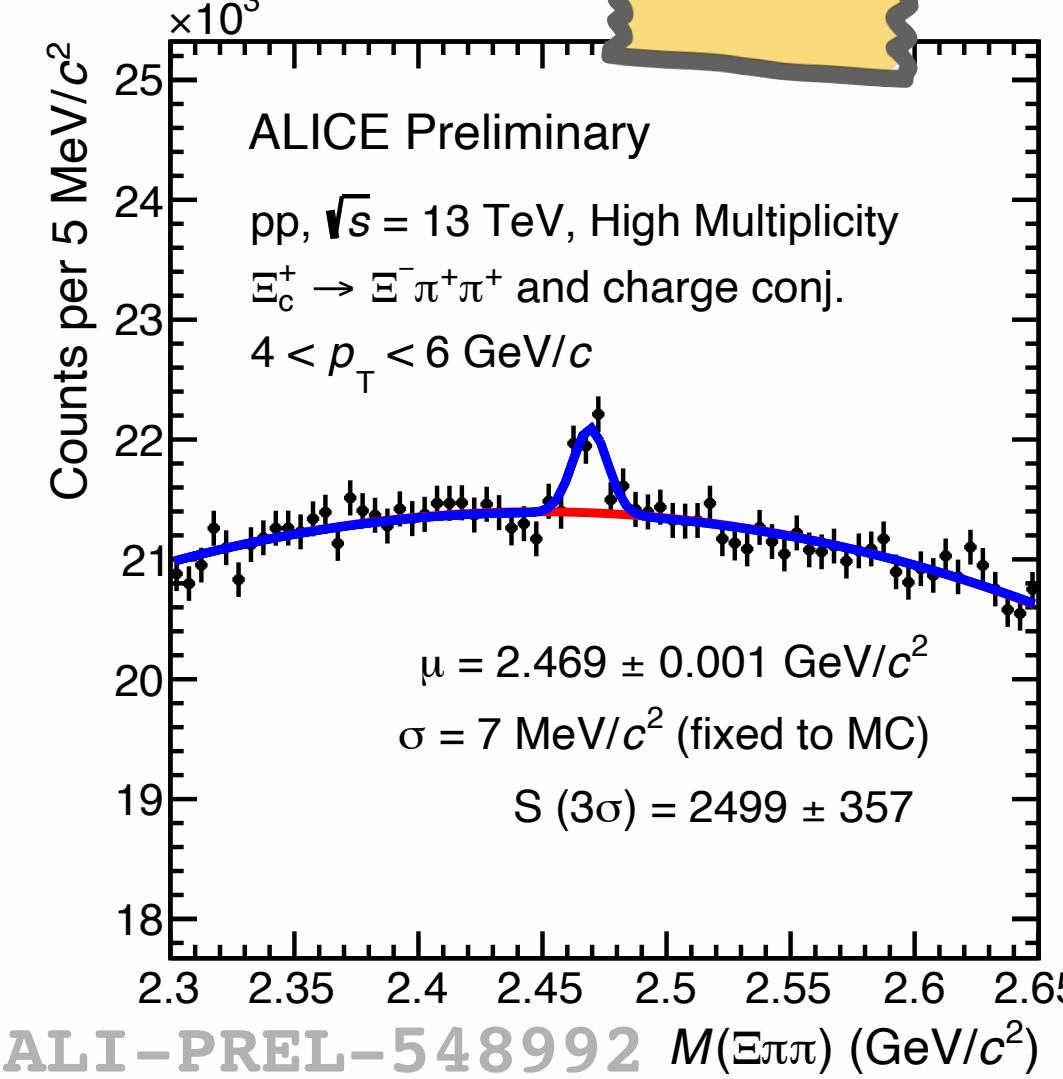
## Signal extraction

- Built binary classification model by exploiting Boosted decision Trees (BDT) algorithm to reduce the combinatorial background

- Training output  $\rightarrow$  BDT score as the probability of each  $\Xi_c^+$  candidates to be signal
- The BDT selection was applied to  $\Xi_c^+$  candidates



- Fitting function for invariant mass distribution
  - Signal : Gaussian function
  - Background : linear function and 2nd order polynomial function (only for highest multiplicity class)



First  $\Xi_c^+$  signal extraction from lowest to highest multiplicity class

## ALICE detector

ITS  
 $|\eta| < 0.9$   
Vertexing & tracking

TPC  
 $|\eta| < 0.9$   
Particle identification & tracking

TOF  
 $|\eta| < 0.9$   
Particle identification

## Analysis strategy

Reconstruction of  $\Xi_c^+$  as a function of charged particle multiplicity in pp collision at 13 TeV

### $\Xi_c^+$ reconstruction

- Signal extraction via invariant mass fit method
- Extract signal in given  $p_T$  and multiplicity class
- Adopt the machine learning algorithm

### Multiplicity estimator

- Summation of signal amplitude in the V0 detector, percentile distribution ( $p_{V0M}$ )
- $p_{V0M}$  converted to the number of charged particles in the range  $|\eta| < 1$

### Data samples

- pp  $\sqrt{s} = 13$  TeV, recorded by ALICE detector in 2016, 2017 and 2018 (Run 2)
  - Minimum-bias data,  $\sim 1.8$  B events
  - High multiplicity triggered data,  $\sim 0.5$  B events

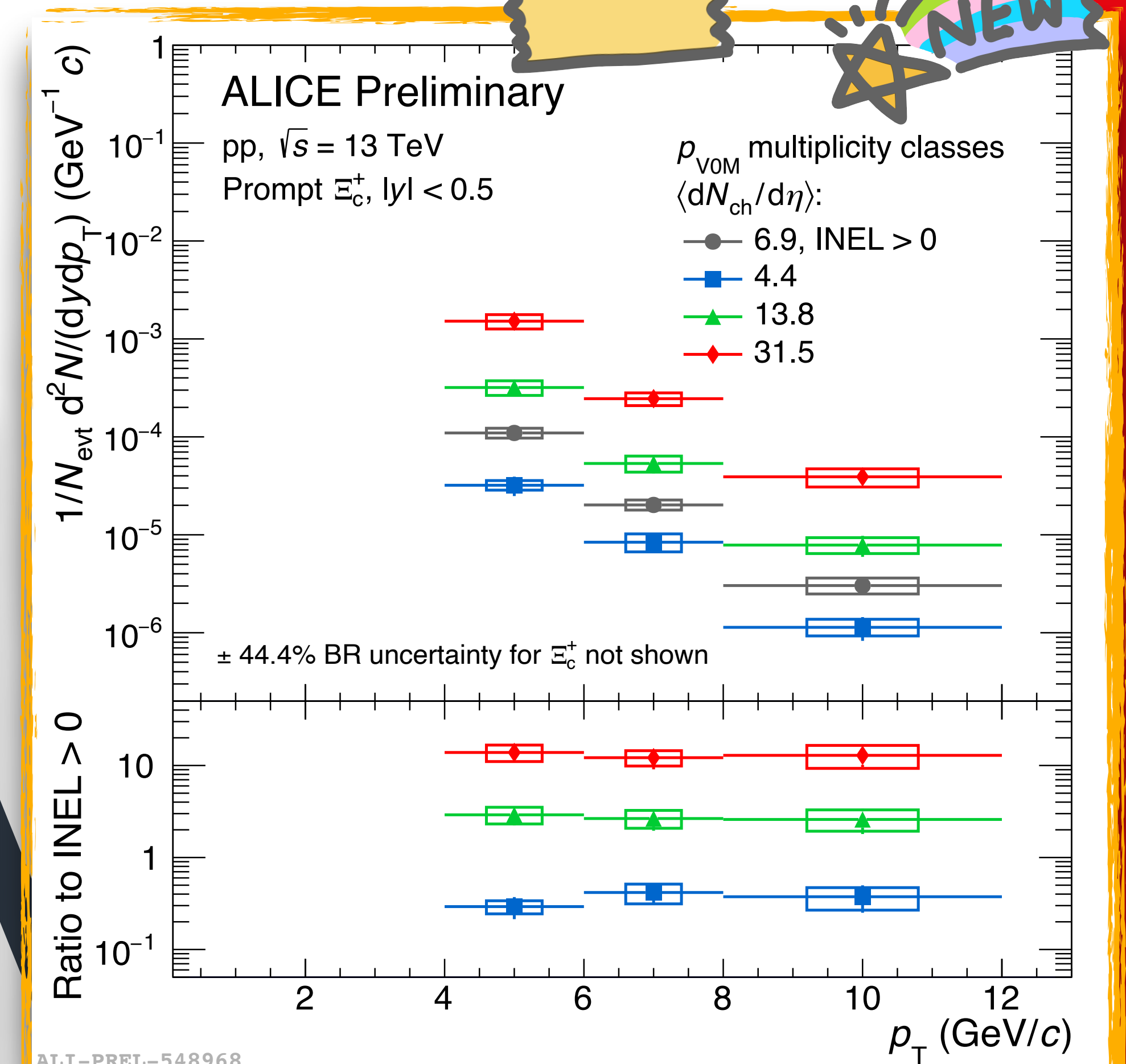
### Observables

- Production yield of  $\Xi_c^+$  in different multiplicity classes
- Production yield ratios between  $\Xi_c^+$  baryon and  $D^0$  meson

## Results 1

### Corrected yield per event spectra

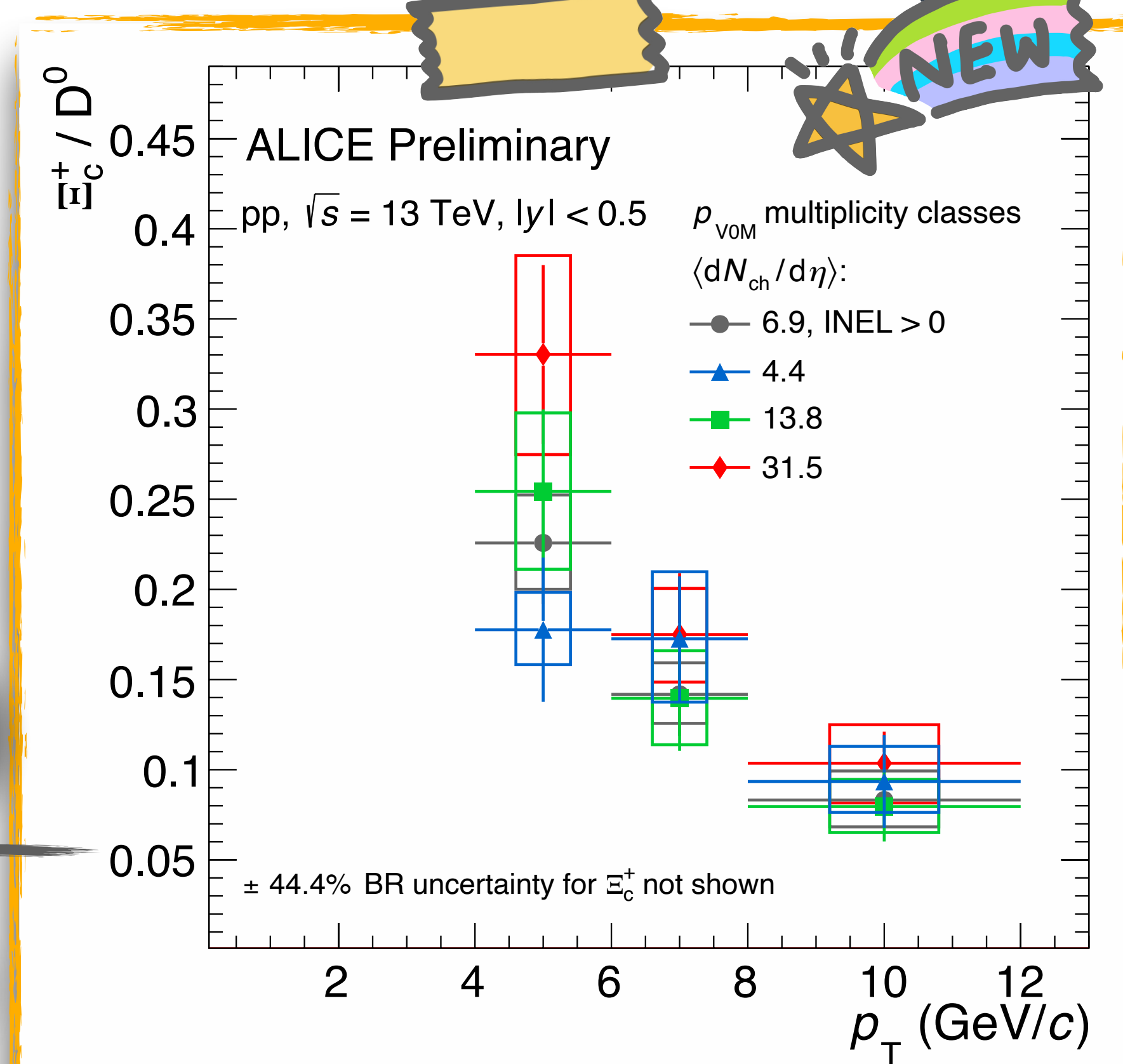
- Clear hierarchy in the corrected yields increasing from low to high multiplicity



## Results 2

### Baryon-to-meson ratio

- The  $\Xi_c^+$  production yield with respect to the  $D^0$  meson
- No clear multiplicity dependence on  $\Xi_c^+/D^0$  in measured  $p_T$  range within the large uncertainty



## Conclusion

- The first measurement of the corrected yield of  $\Xi_c^+$  baryons as a function of charged particle multiplicity class, and baryon-to-meson production yield ratios between  $\Xi_c^+$  baryons and  $D^0$  mesons were shown
- No clear multiplicity dependence on  $\Xi_c^+/D^0$  within the uncertainty

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