

# Strange and Identified Particle Production

*Lee Barnby, University of Birmingham*  
*& Michele Floris, CERN*  
For the ALICE Collaboration



A Large Ion Collider Experiment

European Organisation for Nuclear Research



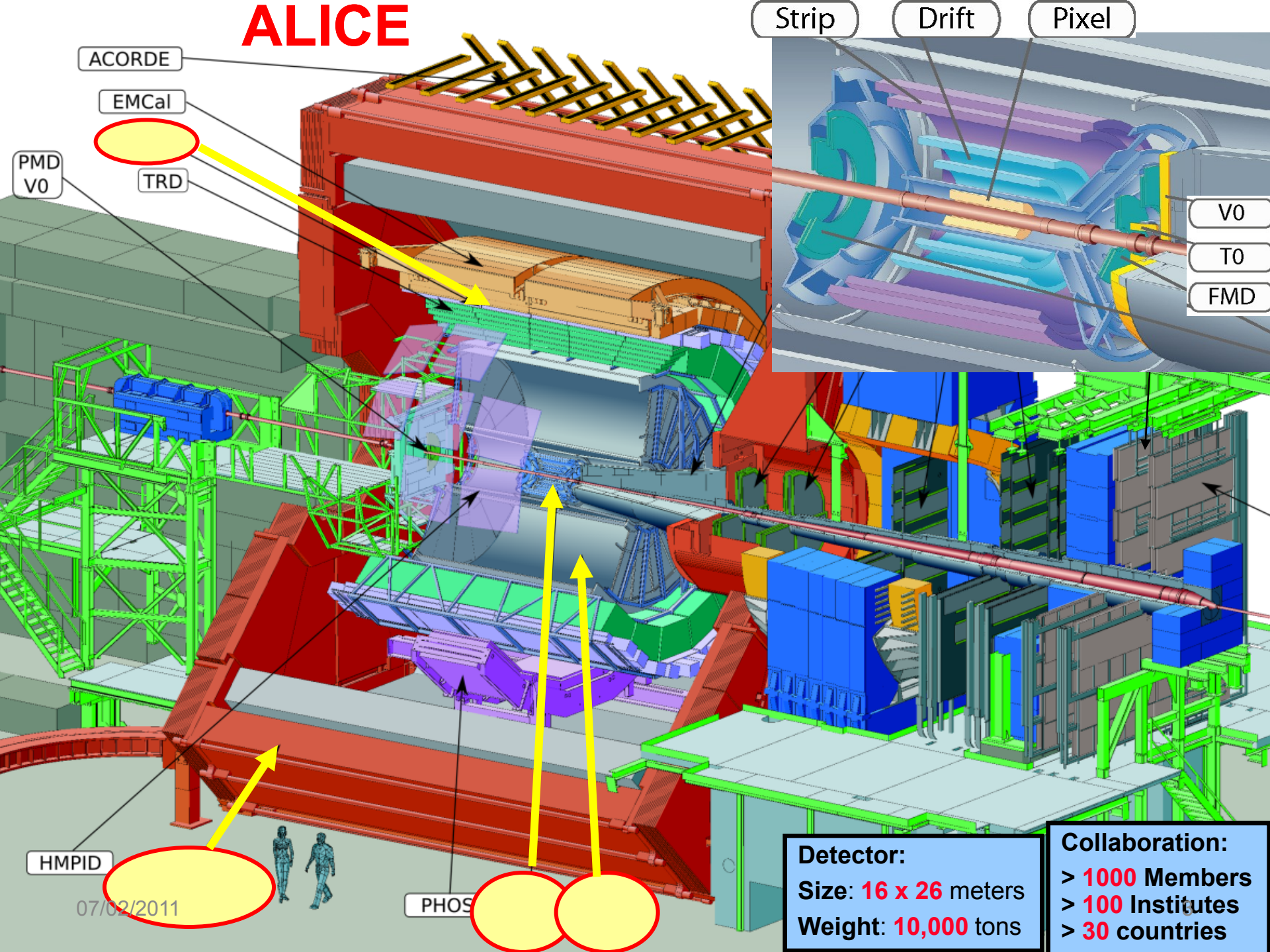
UNIVERSITY OF  
BIRMINGHAM

- Particle Identification in **ALICE**
  - Detectors and techniques
- Final results at  $\sqrt{s} = 900$  GeV
  - Submitted to EPJC
- Status of the analysis at 7 TeV
- Plans

[arXiv:1101.4110](https://arxiv.org/abs/1101.4110)  
[arXiv:1012.325](https://arxiv.org/abs/1012.325)



# ALICE



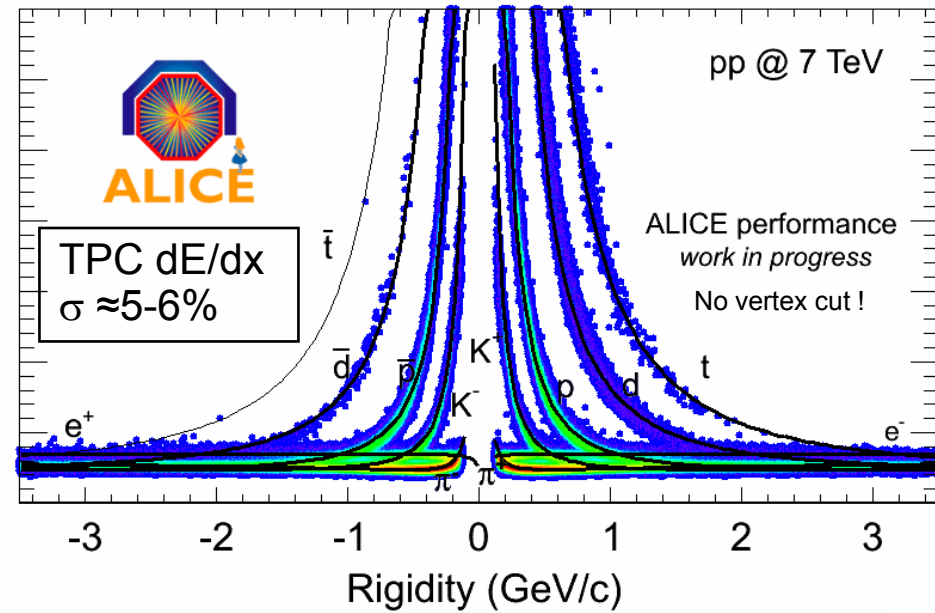
07/02/2011

**Detector:**  
**Size:** 16 x 26 meters  
**Weight:** 10,000 tons

**Collaboration:**  
> 1000 Members  
> 100 Institutes  
> 30 countries

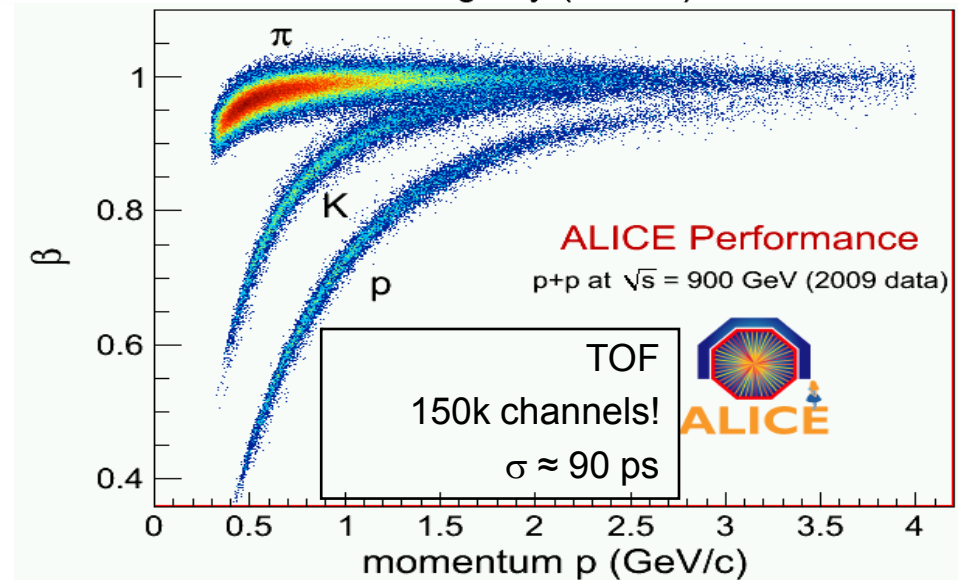
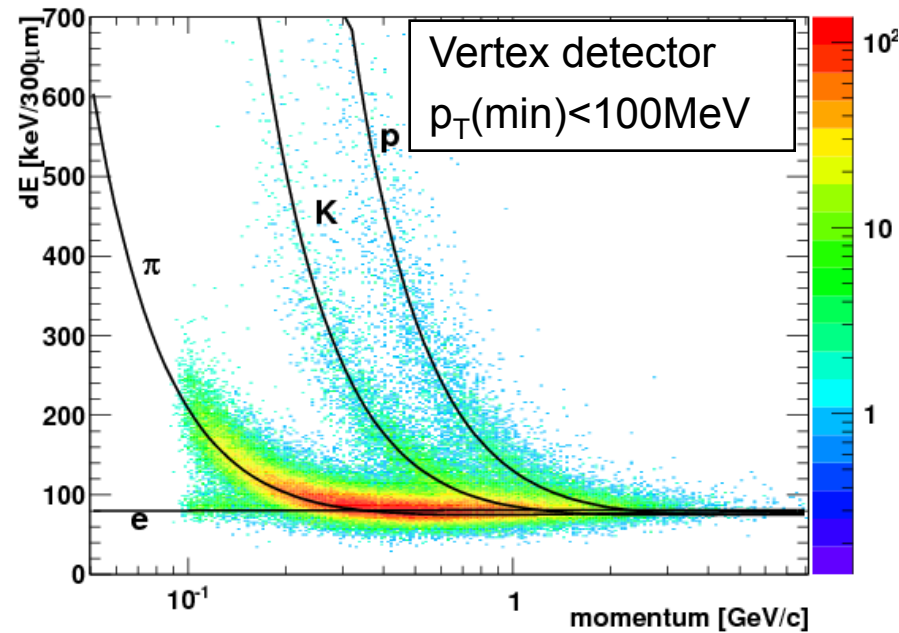
Different detectors/techniques to cover a wide momentum range  
 Today 0.1 – 2.5 GeV

TPC signal (a.u.)

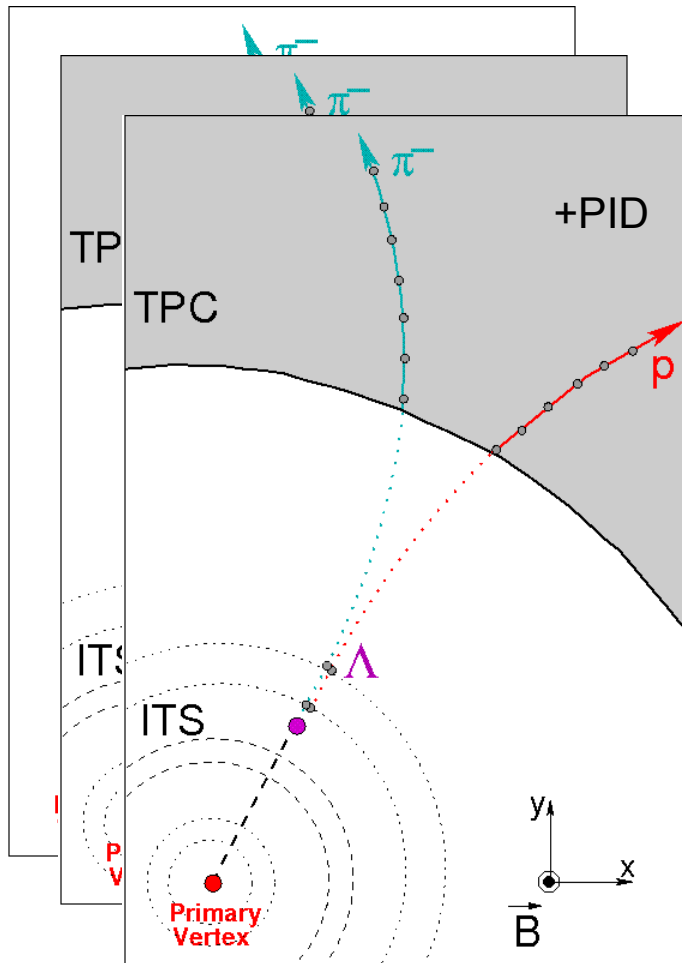


dEdX distribution (ITS signal, truncated mean)

Entries 148725



## Strange particles: topological identification



### Weak decay of strange particles

- displaced vertices ( $c\tau \sim \text{cm}$ )
- charged decay daughters
- $K_S^0$ ,  $\Lambda$ ,  $\Xi^-$  and  $\Omega^-$
- high branching ratio ( $>64\%$ )

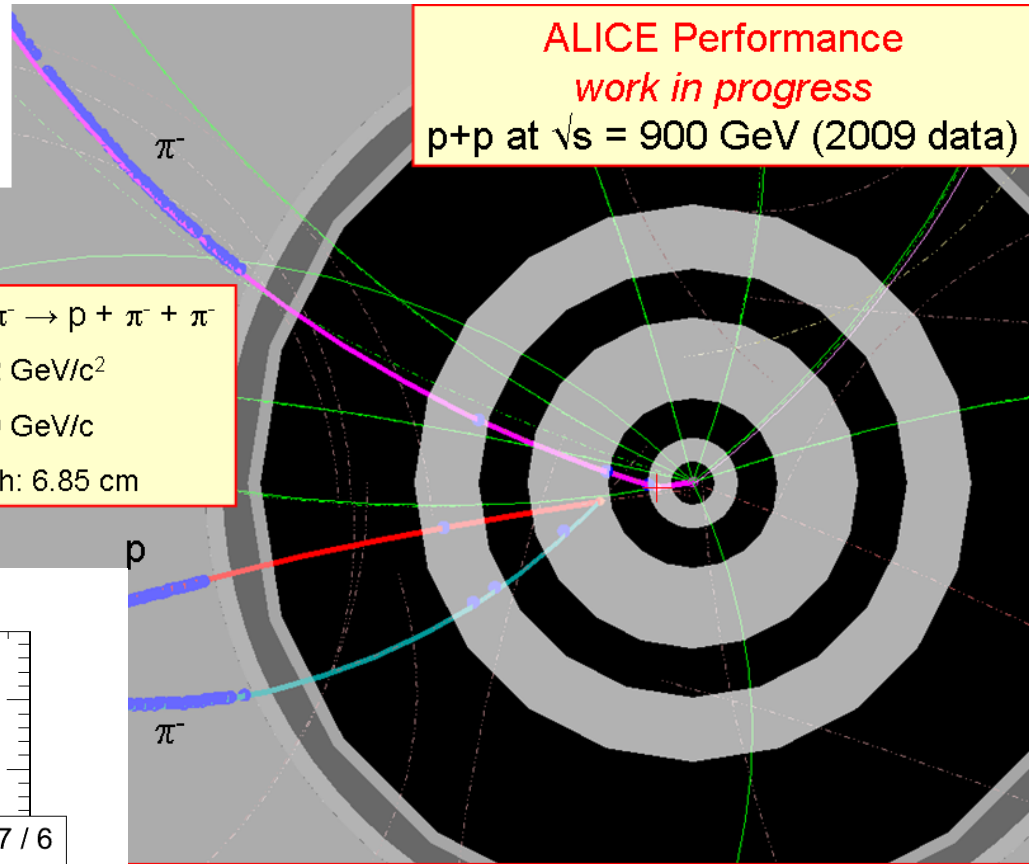
### Reconstruction from charged tracks

- tracking inward
- secondary track selection
- displaced vertex finder

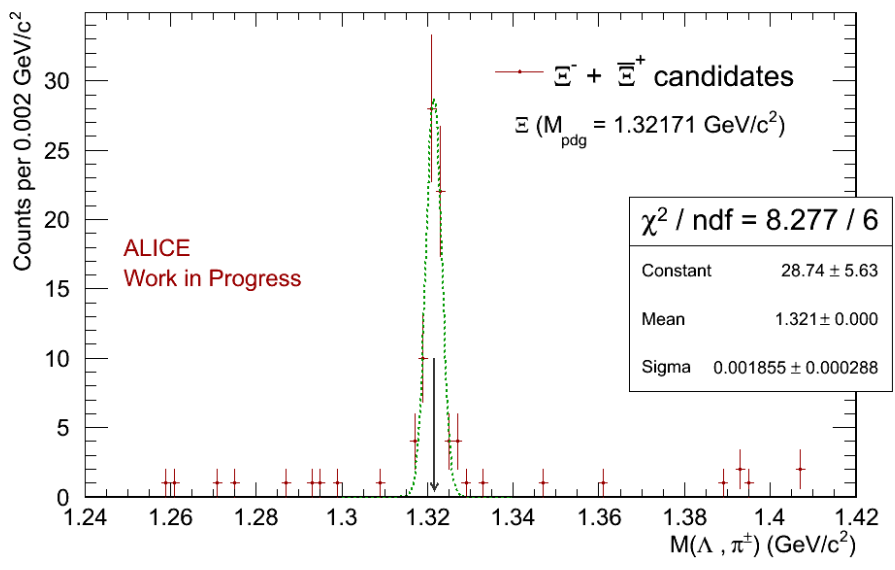
### Identification of secondary vertices

- quality selection (ITS clusters...)
- daughter PID ( $dE/dx$ , TOF, etc...)

$\Xi^- \rightarrow \Lambda^0 + \pi^- \rightarrow p + \pi^- + \pi^-$   
 Mass:  $1.322 \text{ GeV}/c^2$   
 $p_T$ :  $1.459 \text{ GeV}/c$   
 Decay length:  $6.85 \text{ cm}$



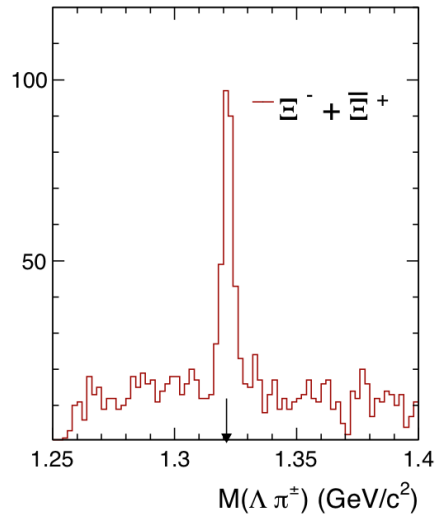
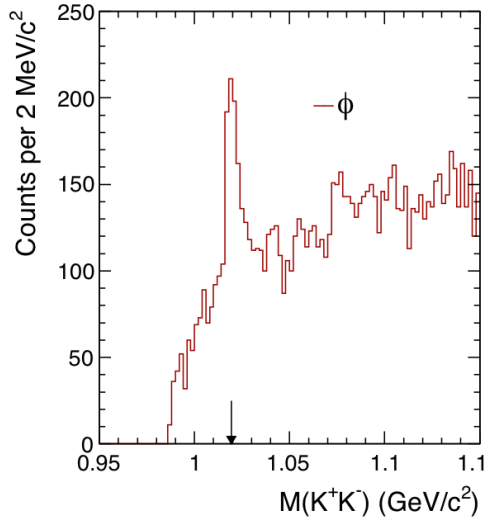
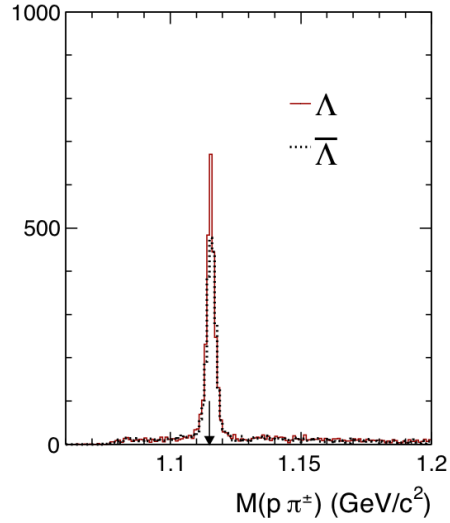
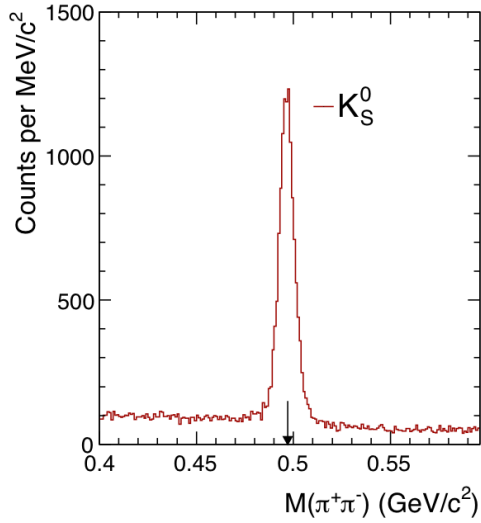
ALICE data, p-p at 900 GeV

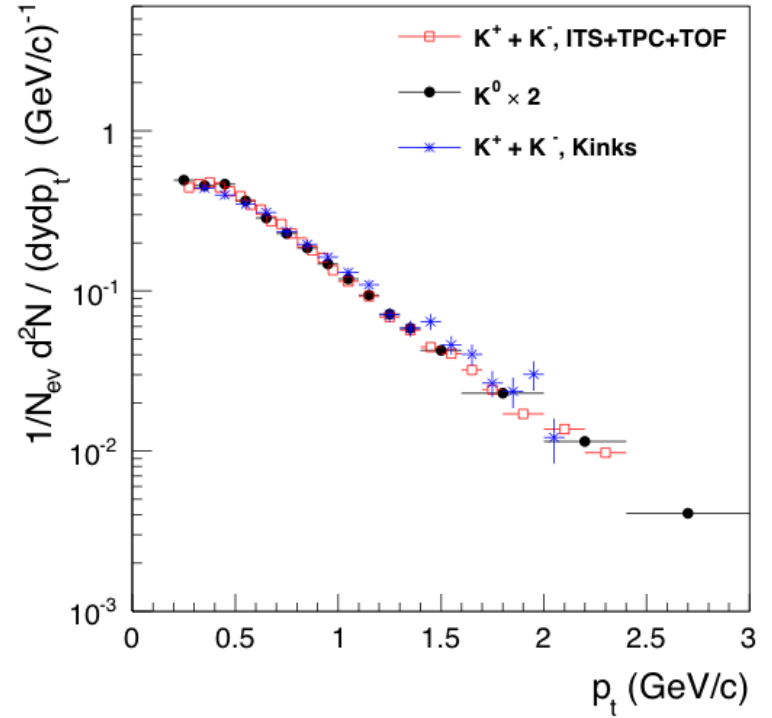
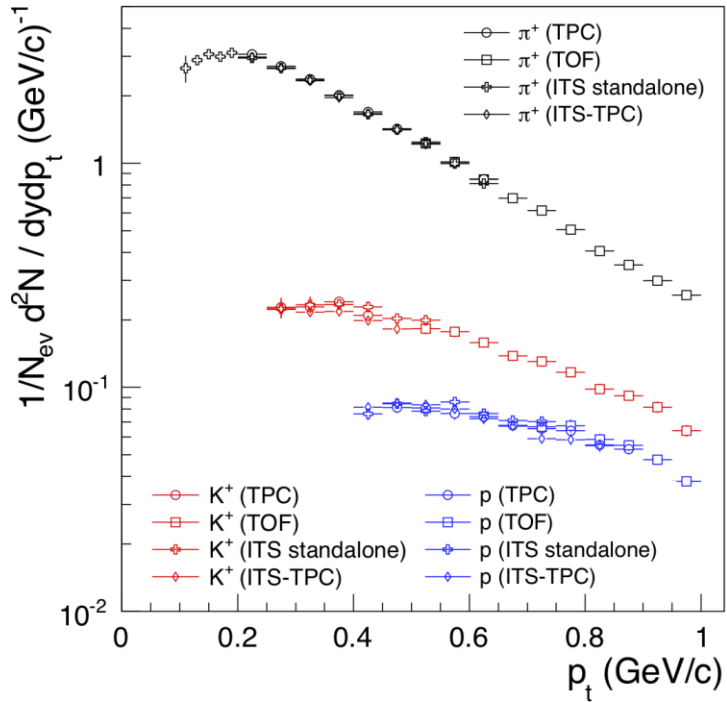


raw data chunk 09000104892020.130, event in chunk 1840



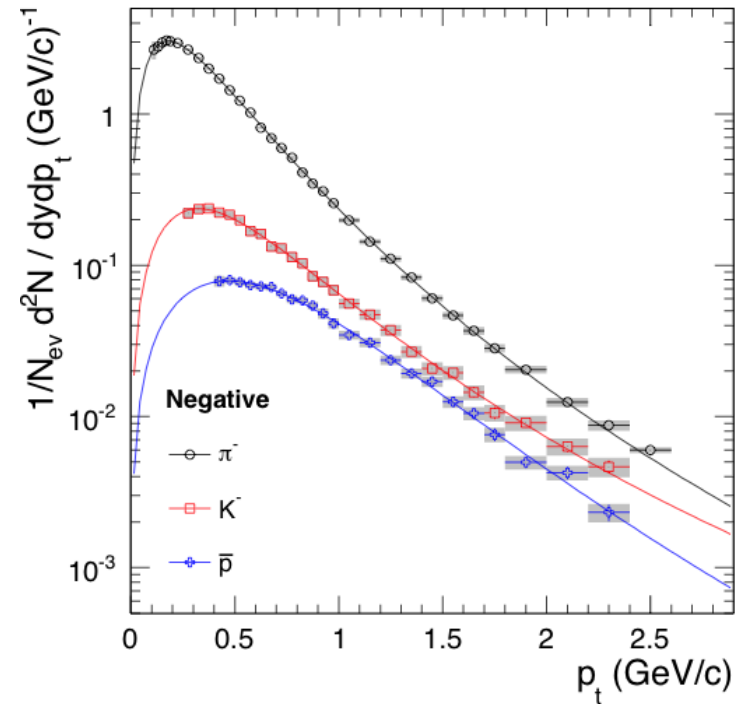
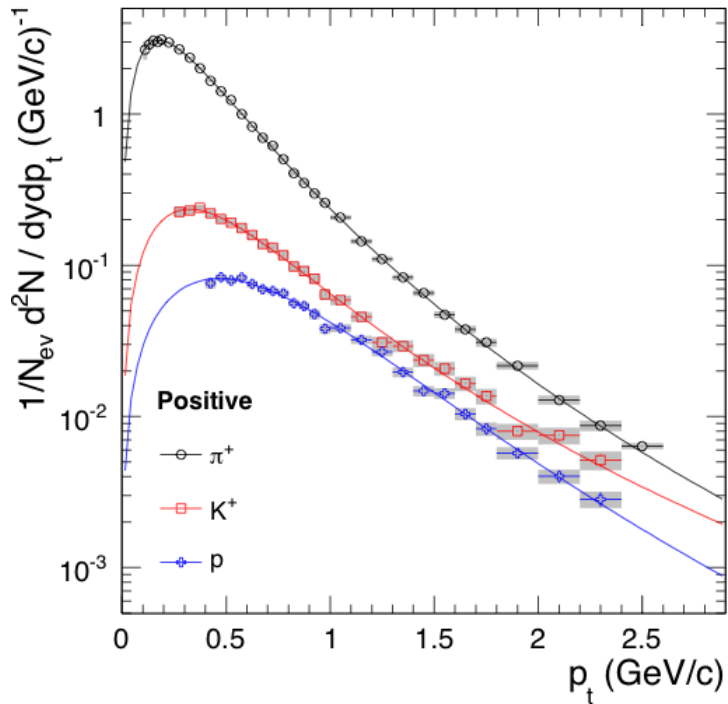
arXiv:1012.3257



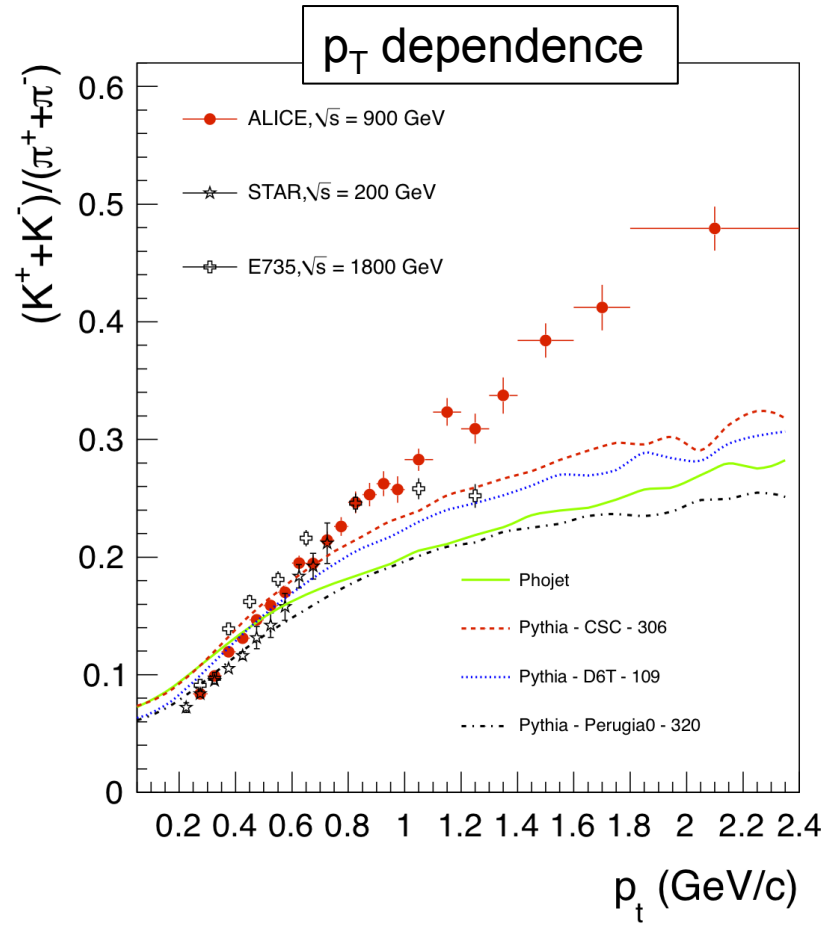
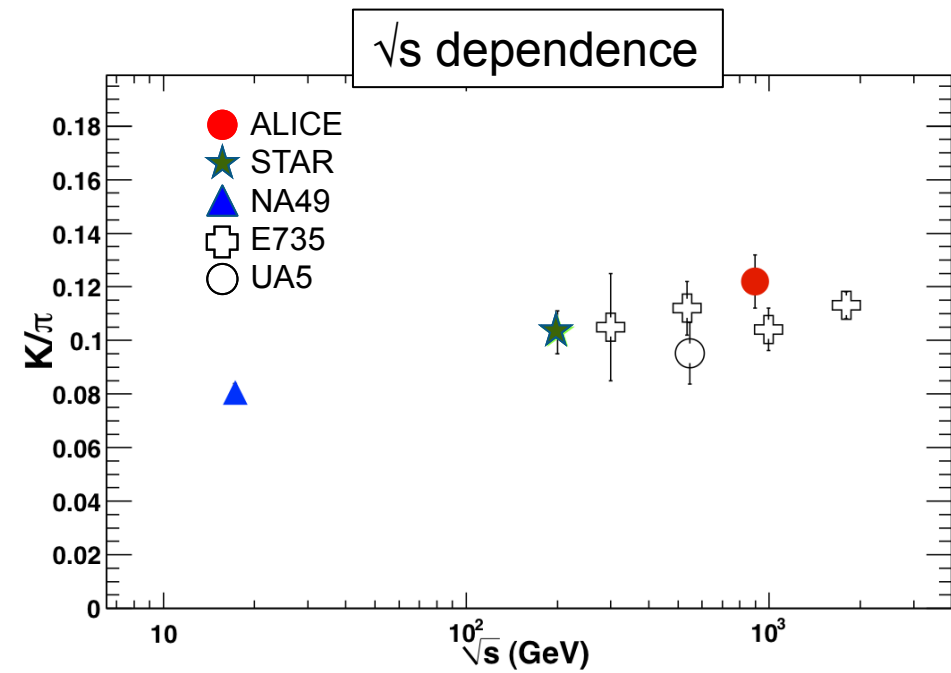


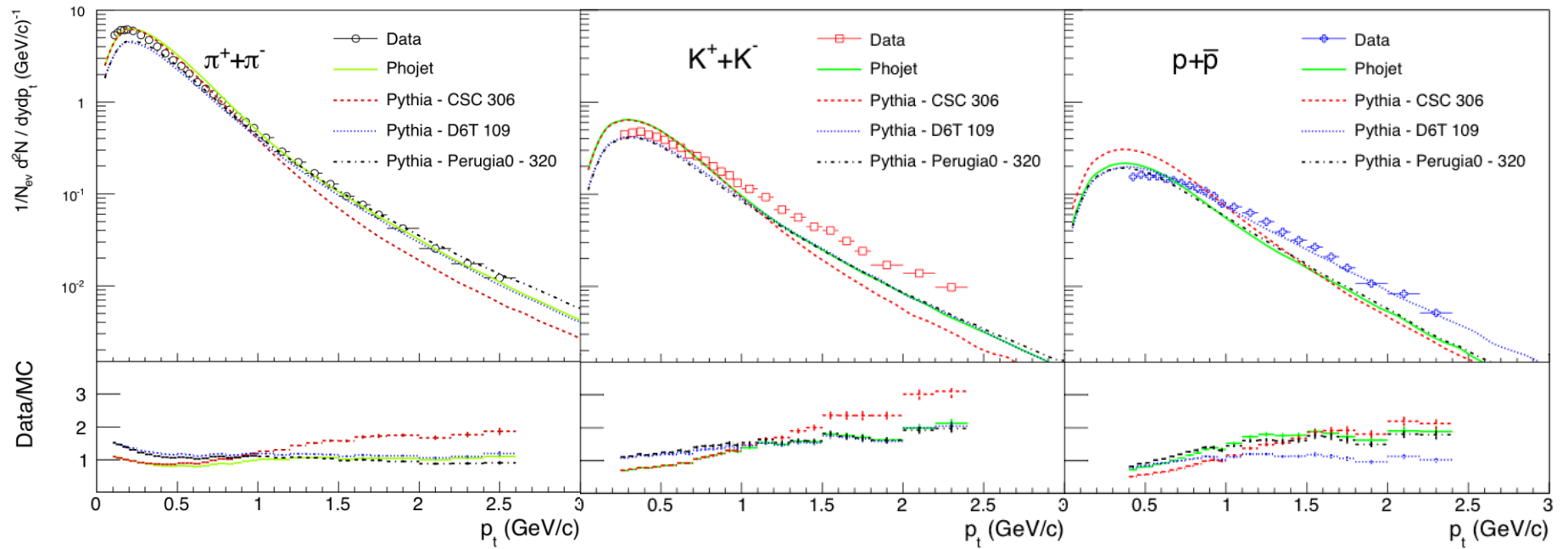
Multiple detectors or techniques can be cross-checked

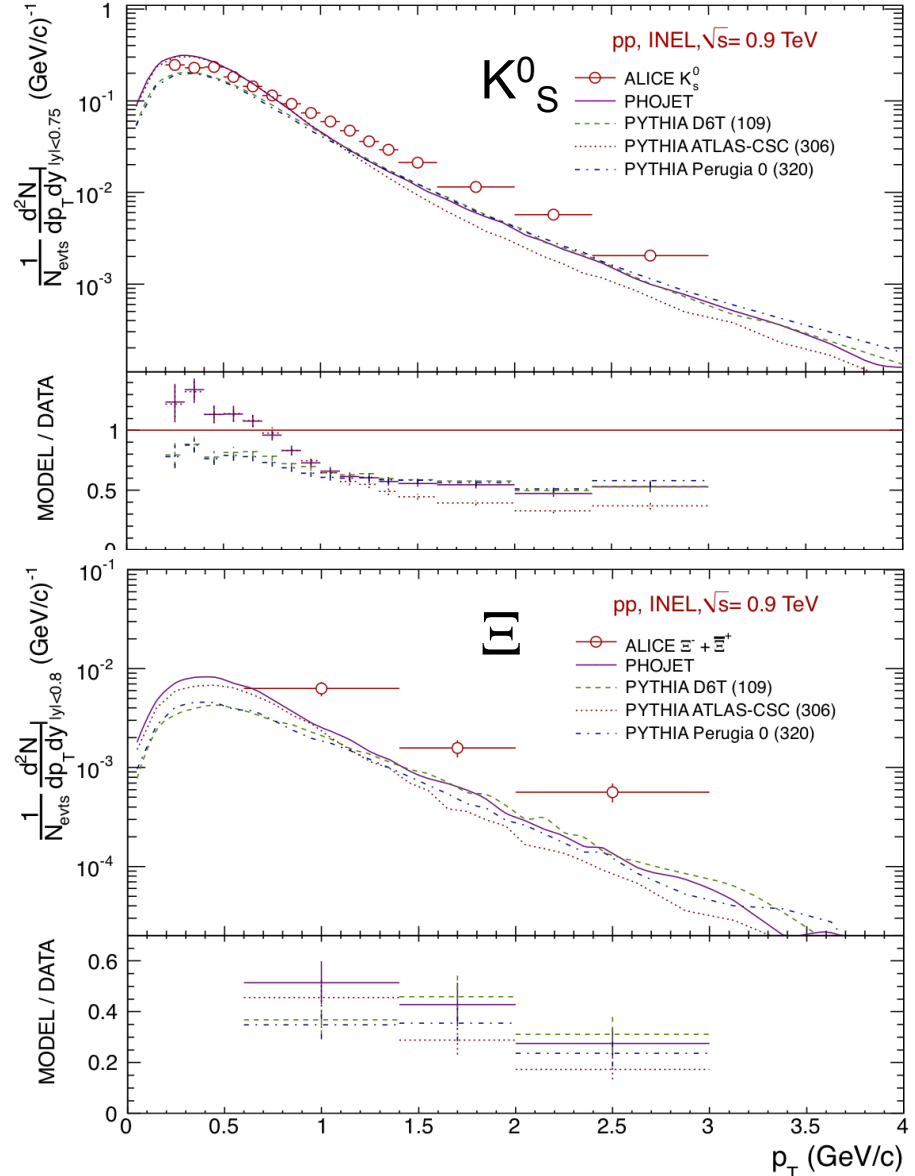
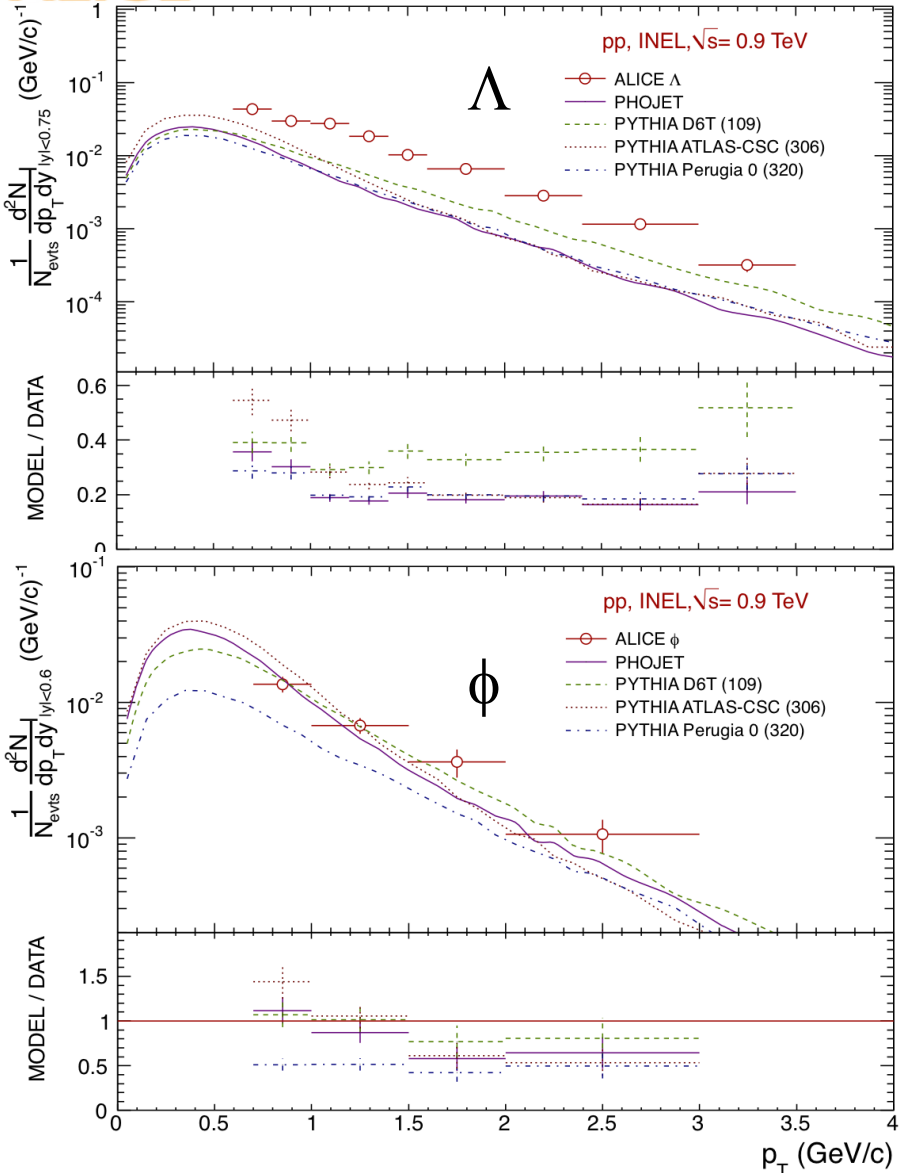


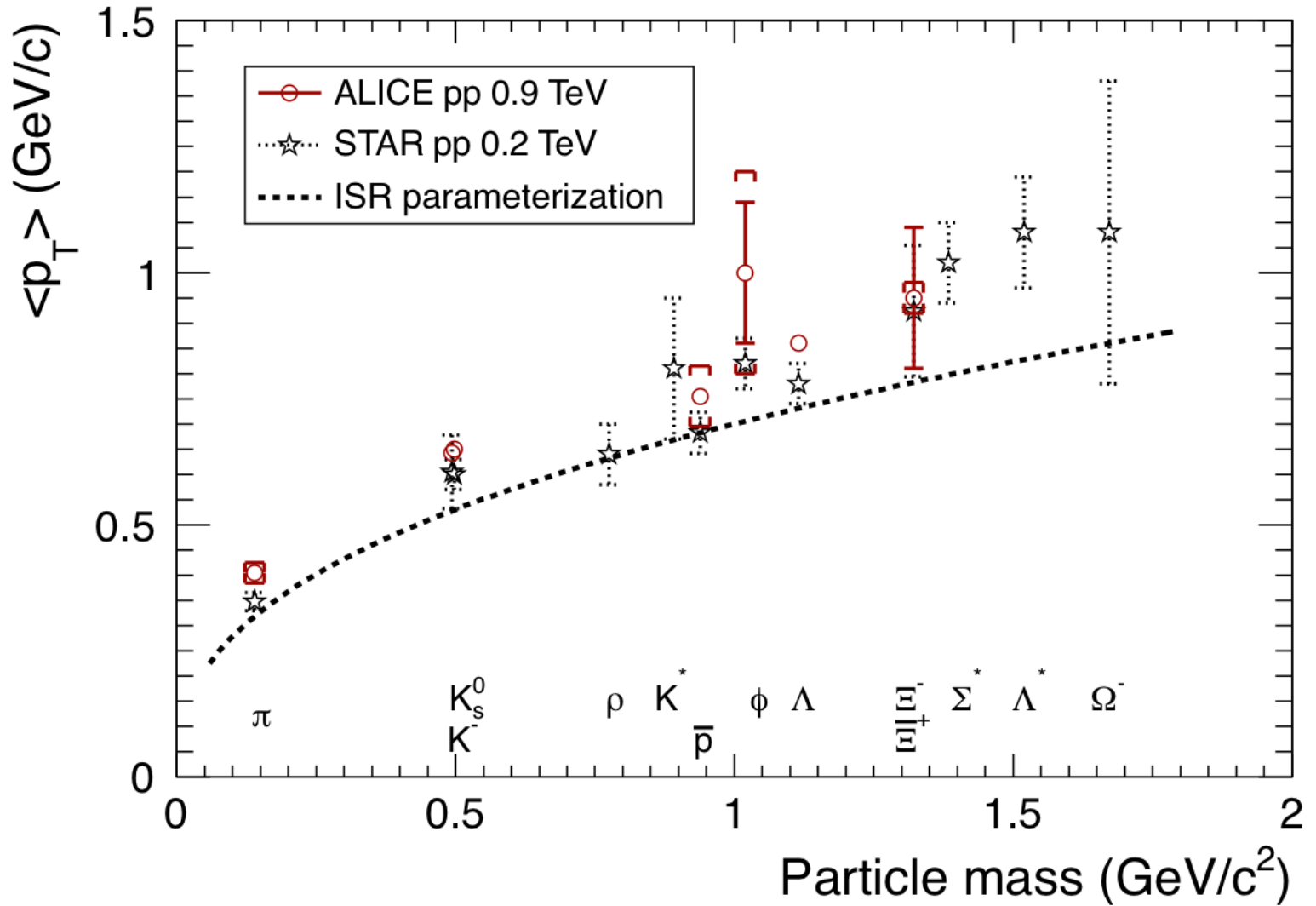


| Particle  | $dN/dy$                     | $\langle p_t \rangle$ (GeV/c) | Lowest $p_t$ (GeV/c) | Extrapolation | $\chi^2/ndf$ |
|-----------|-----------------------------|-------------------------------|----------------------|---------------|--------------|
| $\pi^+$   | $1.493 \pm 0.016 \pm 0.074$ | $0.404 \pm 0.002 \pm 0.02$    | 0.10                 | 10%           | 61.75/30     |
| $\pi^-$   | $1.485 \pm 0.016 \pm 0.074$ | $0.403 \pm 0.002 \pm 0.02$    | 0.10                 | 10%           | 44.01/30     |
| $K^+$     | $0.181 \pm 0.007 \pm 0.015$ | $0.663 \pm 0.007 \pm 0.05$    | 0.20                 | 12%           | 50.95/24     |
| $K^-$     | $0.180 \pm 0.007 \pm 0.015$ | $0.646 \pm 0.007 \pm 0.05$    | 0.20                 | 12%           | 44.88/24     |
| $p$       | $0.079 \pm 0.003 \pm 0.006$ | $0.780 \pm 0.007 \pm 0.06$    | 0.35                 | 20%           | 35.48/21     |
| $\bar{p}$ | $0.076 \pm 0.003 \pm 0.006$ | $0.772 \pm 0.007 \pm 0.06$    | 0.35                 | 20%           | 34.11/21     |

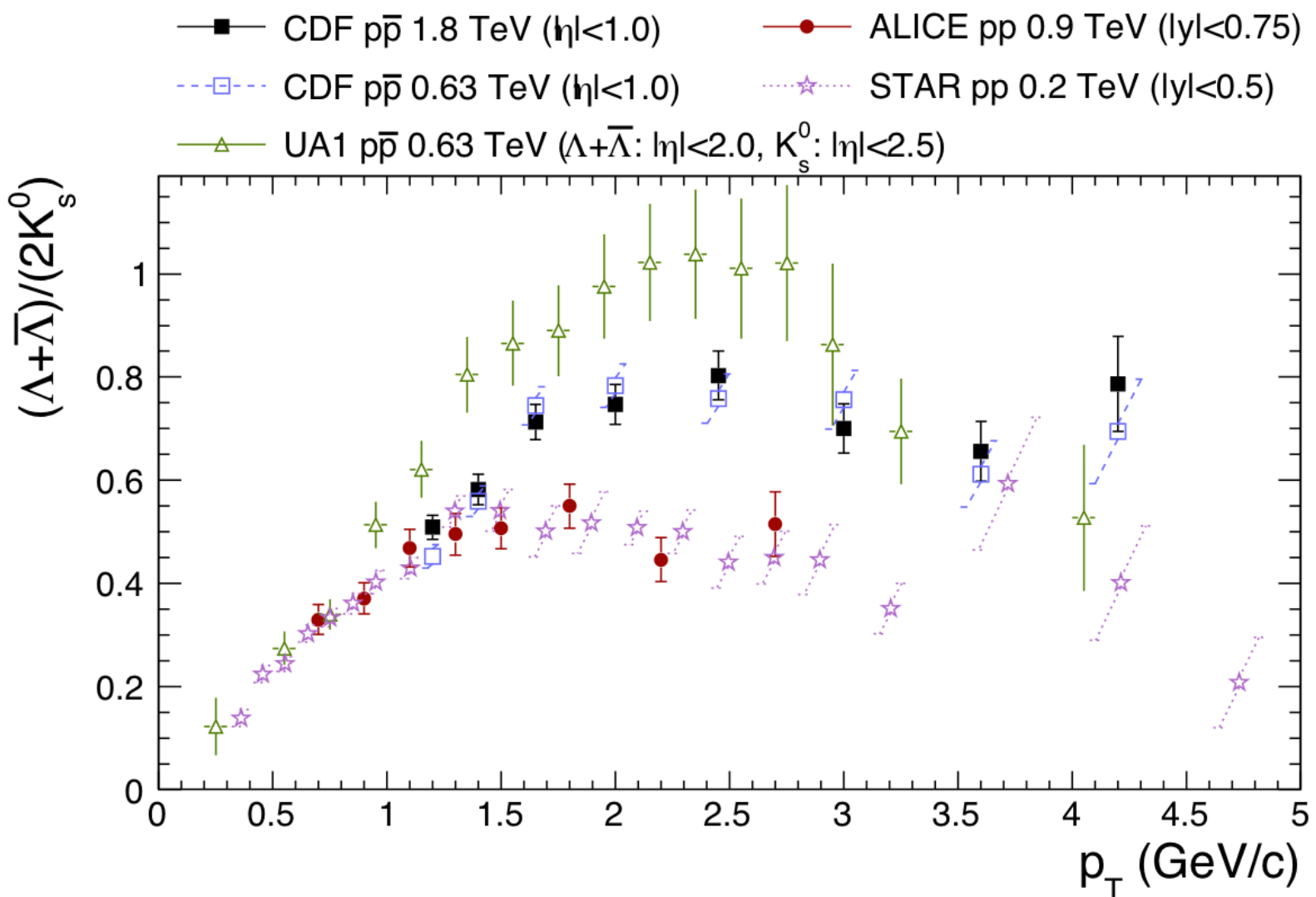






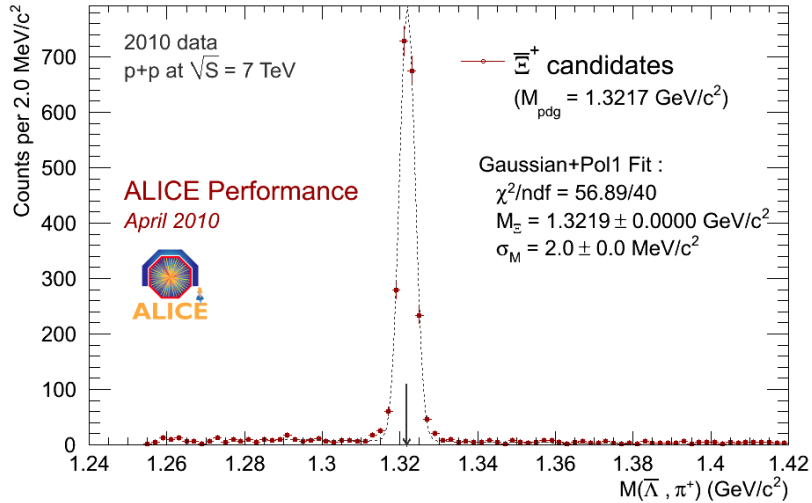




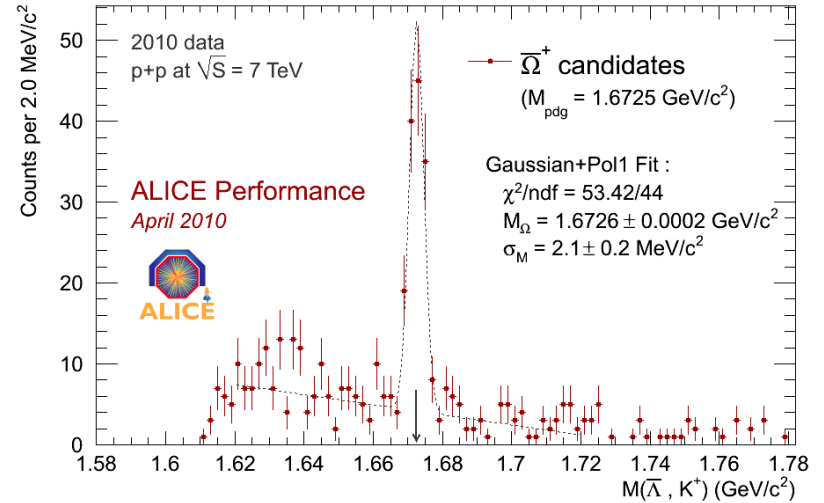


Part of difference to CDF is because they do not correct for feed-down from  $\Xi$

ALICE data, p-p at 7 TeV (sel. runs 114783 - 115401 / GRID pass1) - 5.71 Mevents

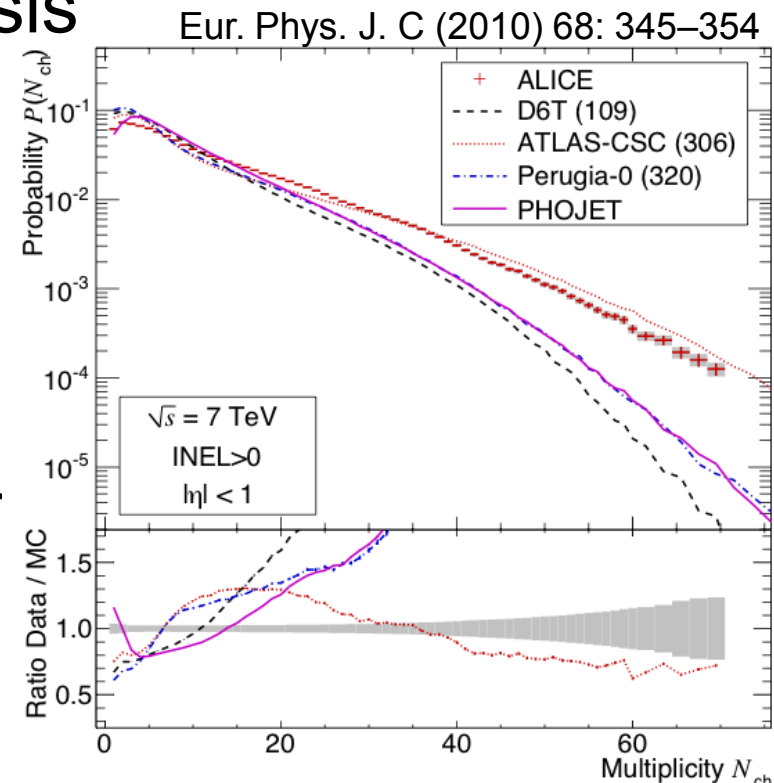


ALICE data, p-p at 7 TeV (sel. runs 114783 - 115401 / GRID pass1) - 5.71 Mevents



For particles which were limited ( $\Xi$ ,  $\phi$ ) or not possible ( $\Omega$ ) at 900 GeV we expect at 7 TeV many more  $p_T$  bins for  $\Xi$ ,  $\Phi$  and enough to extract  $\Omega$  yield  
 $\Lambda$  and  $K_S^0$  also have much bigger  $p_T$  reach

- pp @ 7 TeV
  - Finish standard analysis like 900 GeV
  - Include PYTHIA8 comparison
  - PID underlying event analysis
  - $m_T$  spectra
  - Multiplicity dependence
    - Divide using measured  $N_{ch}$
    - Report  $dN_{ch}/d\eta$  in each class
    - Approach used in HBT paper



- Possible future developments
  - Correlations of identified particles
  - Hadro-chemistry of jets
  - Normalization to different classes of events for comparisons
    - INEL>0 or INEL>1 classes
    - Need to find common definition - same or unidentified spectra or ?
  - Report in similar limited phasespace
    - Eg “candle”  $p_T > 0.5$ ,  $|\eta| < 0.8$

- ... especially to our PhD students working on strangeness and identified particles