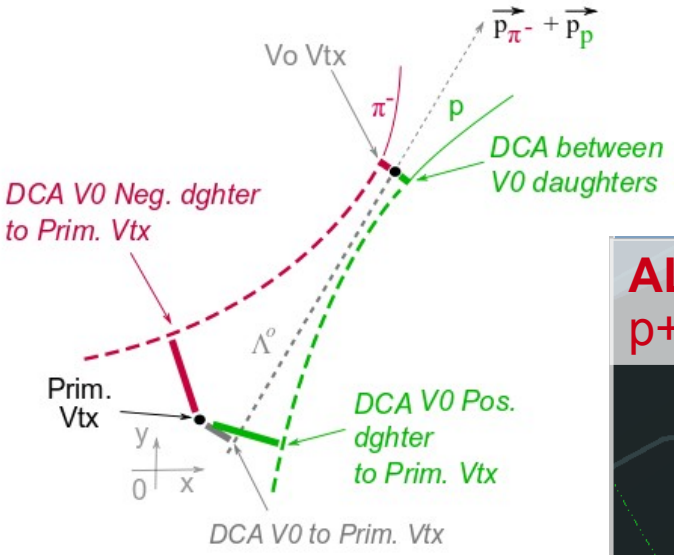
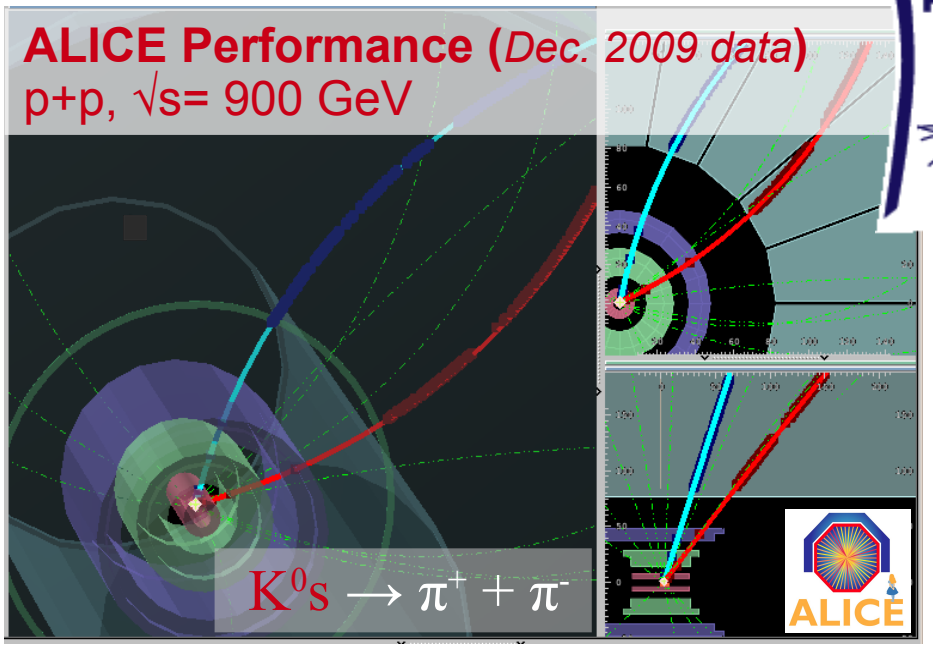
Antonin MAIRE – PhD student in Strasbourg

Strangeness production in ALICE

(via topological reconstruction :
$\varphi(1020)$ / K^0s, Λ^0 / $\Xi^{\pm}$, $\Omega^{\pm}$*)*





PHYSICS AT LHC 2010

for the ALICE collaboration

IPHC Institut Pluridisciplinaire Hubert CURIEN STRASBOURG

Outline

I. Introduction : strangeness, p-p and ALICE

Part A - 900-GeV data analysis

II. $\varphi(1020)$ → *resonance*

III. $K^0s + \Lambda^0, \overline{\Lambda}^0$ → *V0 topology*

IV. $\Xi^- + \overline{\Xi}^+$ → *Cascade topology*

V. Summary

Part B - 7-TeV data analysis

VI. K^0s, Λ^0, $\overline{\Lambda}^0$, $\Sigma^*(1385)$, Ξ^-, $\overline{\Xi}^+$, Ω^-, $\overline{\Omega}^+$ performance plots

VII. Conclusions and Prospects

I.1 – Introduction : p-p, strangeness

- Physical incentives :

Strangeness in p-p = benchmark for heavy-ion physics …
But, interest in itself = strangeness production mechanisms :

pQCD (*high pt*)

Vs

soft interactions (*low pt*)

→ understand the *soft part* of the event + its interplay with the *hard part*,
→ constrain the phenomenology (Multi-Parton Interaction ? Thermal-like ?)
of QCD-inspired models (Pythia, EPOS, Phojet …)

- Measurement status : (p+p) or (p+$\bar{p}$) measurements at high energies :

√s	Experiment(s)	Collisions	Particles	Ref./Link
200 GeV	(UA5) + STAR	(p+$\bar{p}$) + p+p	K^0s, Λ^0, $\Xi^{\pm}$, $\Omega^{\pm}$	STAR paper
630 GeV	UA1 + CDF	p+$\bar{p}$	K^0s, Λ^0	UA1 paper
900 GeV	UA5	p+$\bar{p}$	K^0s, Λ^0, Ξ^-	UA5 paper
1,8 TeV	CDF	p+$\bar{p}$	K^0s, Λ^0	CDF paper

→ **LHC : 900 GeV + 7 TeV ?**

I.2 – Introduction : strangeness, ALICE

- Experimental point of view :

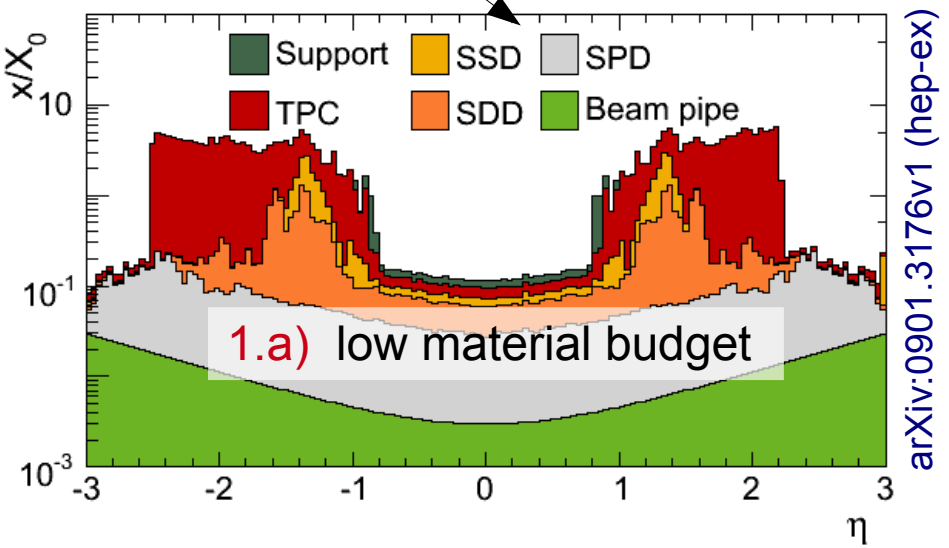
  A. Strangeness via *PID-only* = $K^{\pm}$ / See **A.Dainese** – 1st physics results (link)

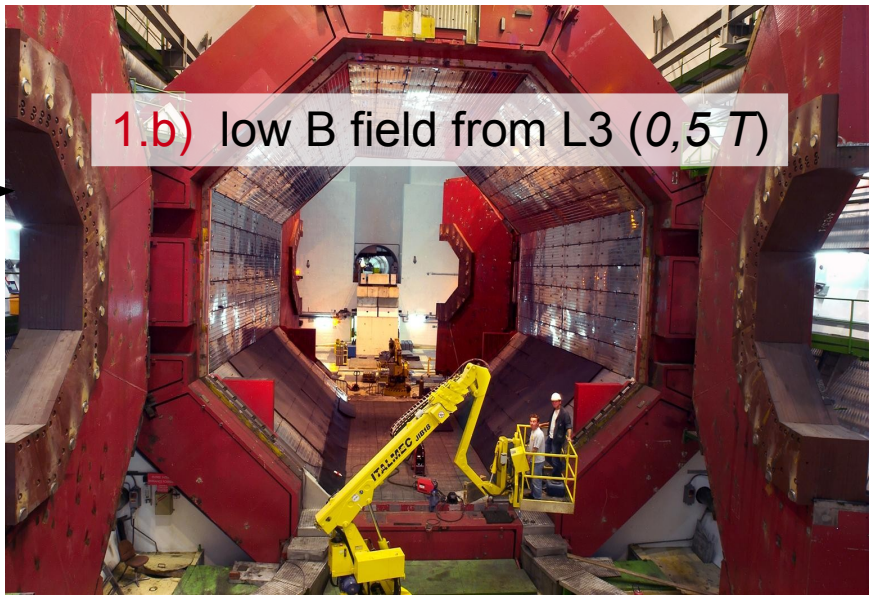
  B. Strangeness via *topology* =
  neutral strange + multi-strange … (NB : identif° from low pt (*~0.2 MeV/c*) to high pt (~10 GeV/c)

- ALICE point of view :

Good identification capabilities at mid-rapidity

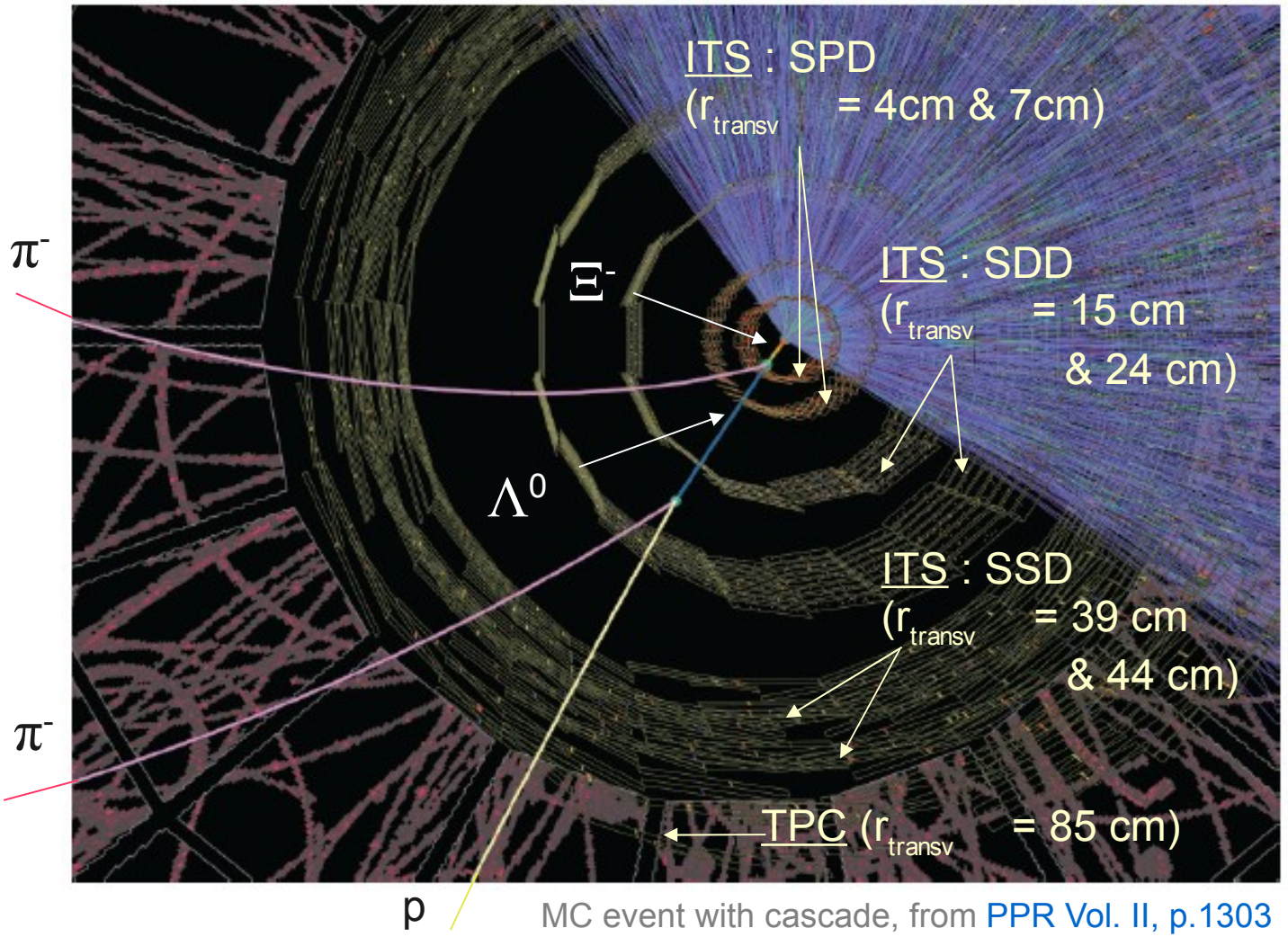
1. < low pt cut-off





2. < very good PID capabilities
(ITS, TPC, TRD, TOF, HMPID)

I.3 – Introduction : ALICE sub-detectors



MC event with cascade, from PPR Vol. II, p.1303

- Sub-detectors needed :

  1. Inner Tracking System
  2. Time Projection Chamber

→ for tracking + PID

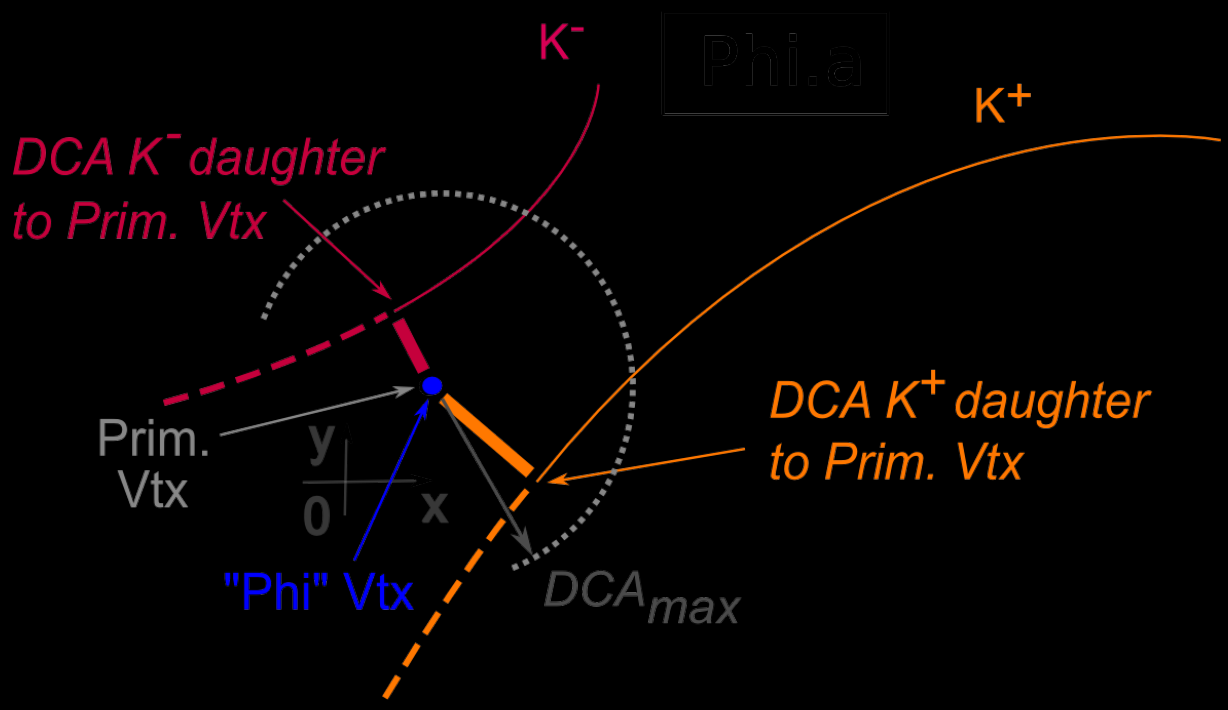
(+ 3. Time Of Flight
→ for PID)

- Data :

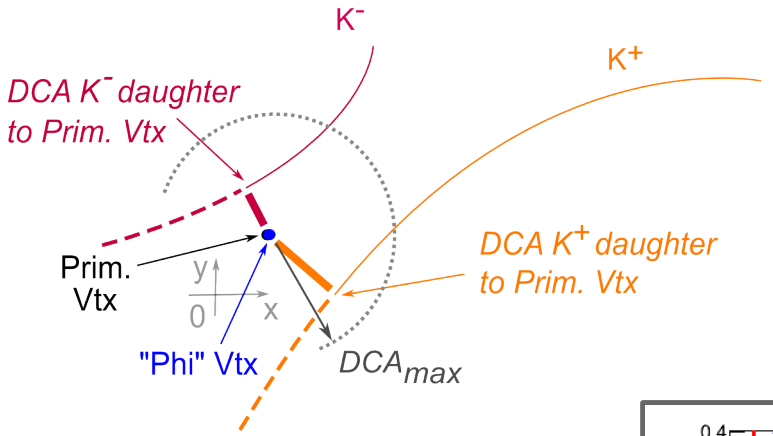
→ December 2009
p+p, 900 GeV
~ 250 k evts

→ March 2010 <
p+p, 7 TeV
> 100 Mevts ...

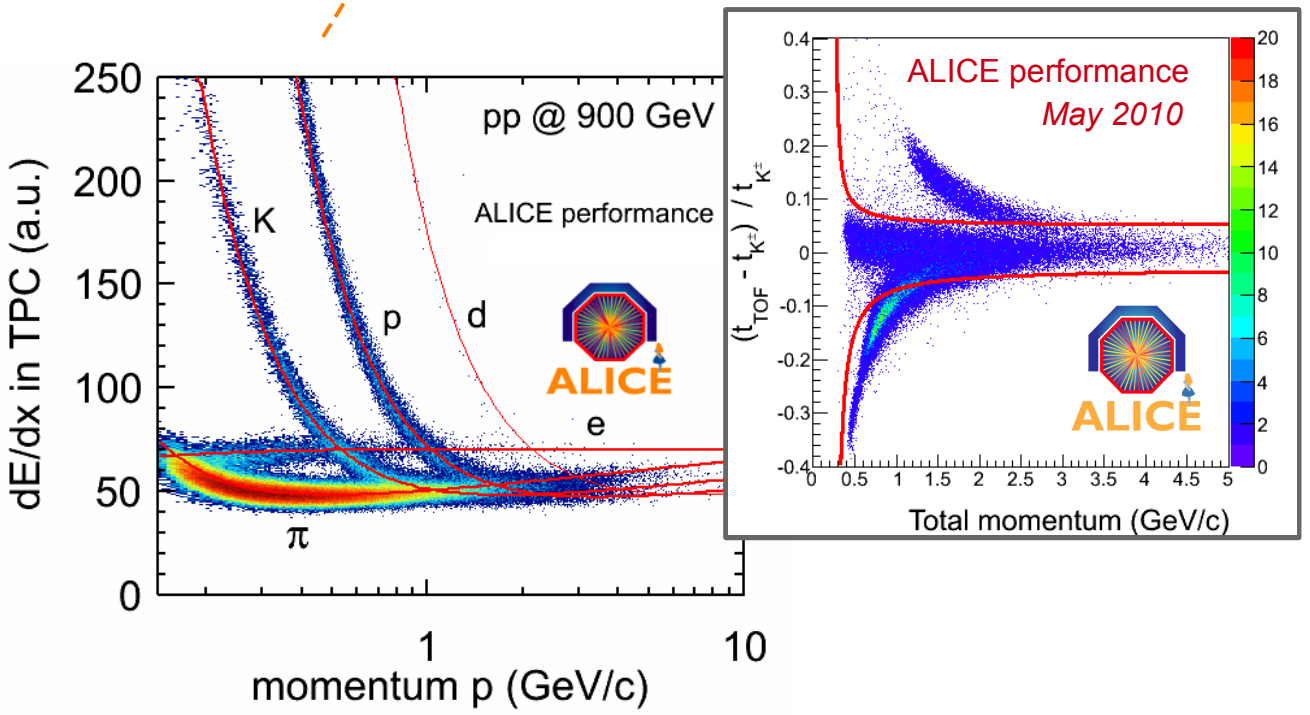
II. – 900 GeV : φ(1020)

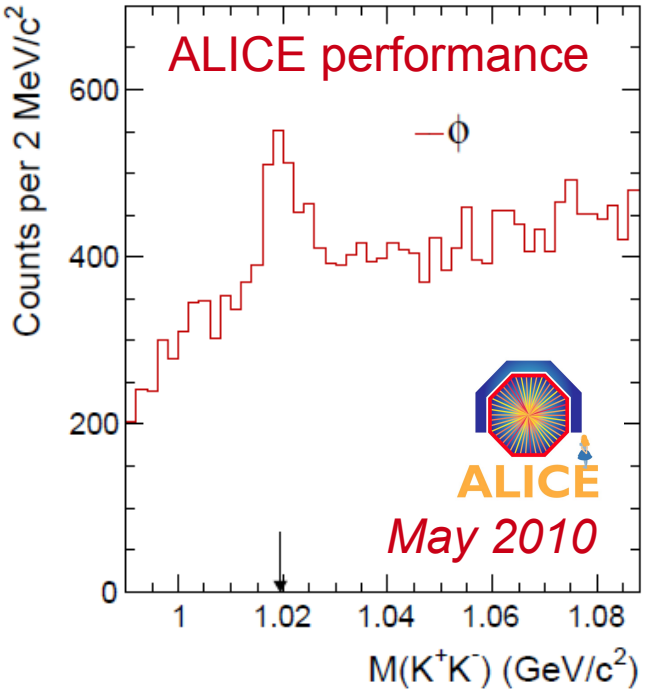


II.1 – φ(1020) : reconstruction



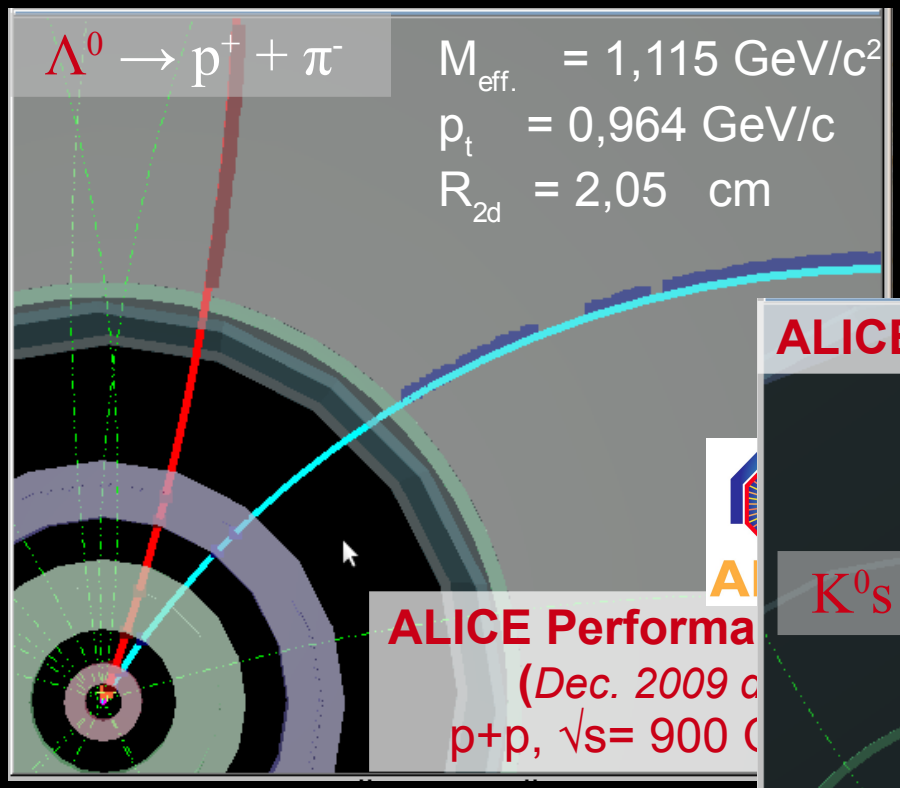
- Decay channel : $\varphi(1020)\ (s\bar{s}) \rightarrow K^+ + K^-$
- Reconstruction based *primary* tracks, with opposite charges, + Kaons identified via *TPC+TOF PID*



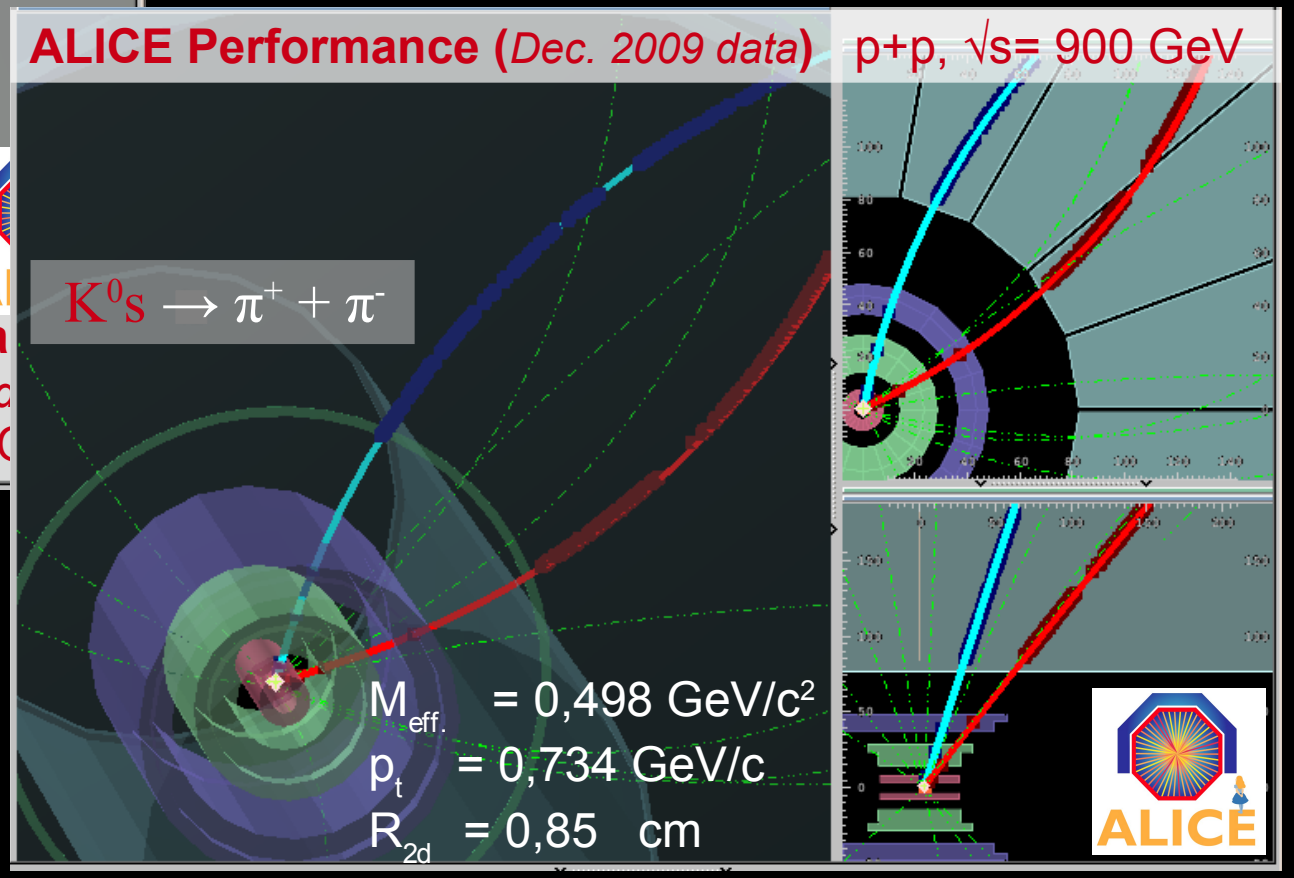


III. – 900 GeV : V0

K^0s,
Λ^0 and $\overline{\Lambda}^0$

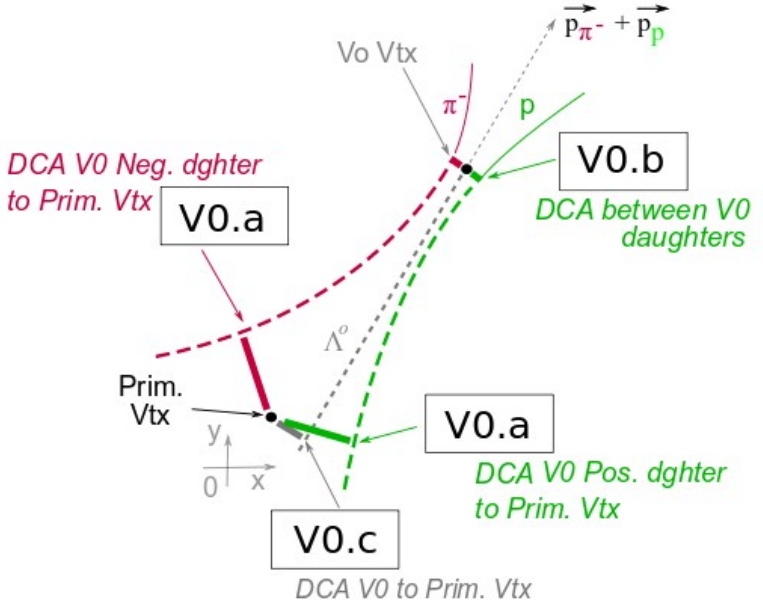


Pass4 - Run 09000104892 / Chunk 020.130 / Event 184

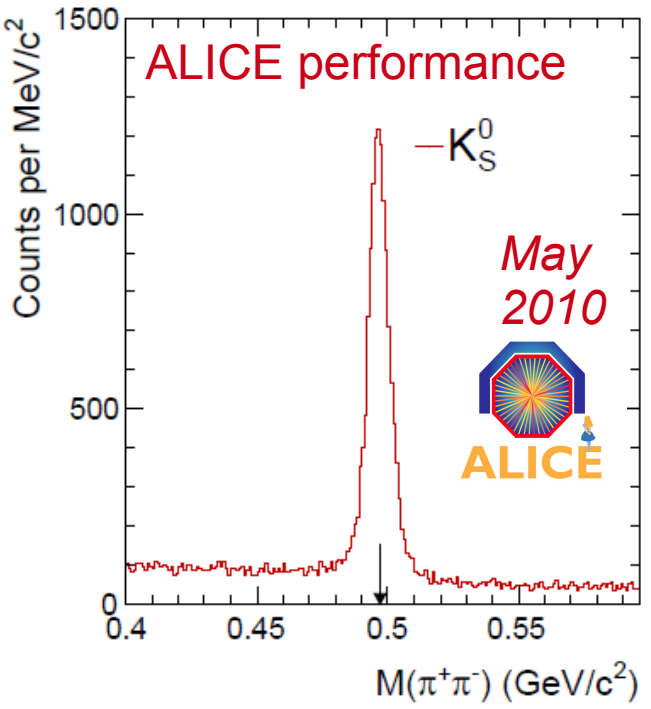


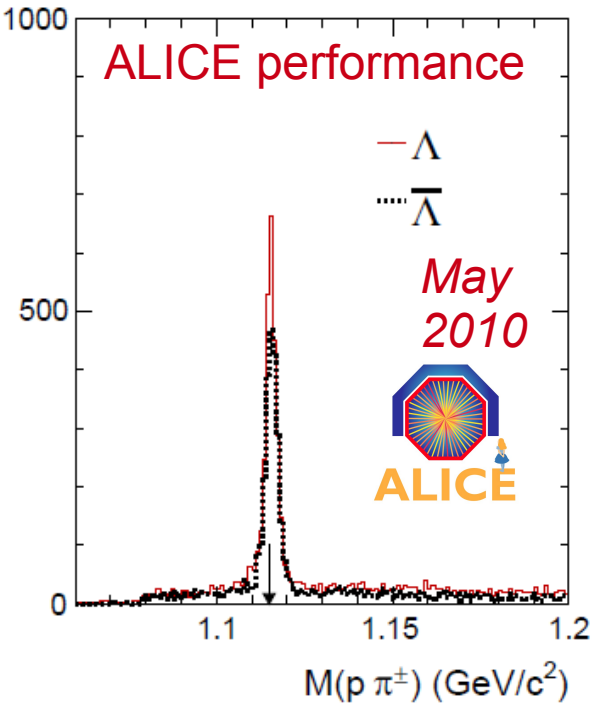
Pass4 - Run 09000104892 / Chunk 020.130 / Event 288

III.1 – K^0s, Λ^0, $\overline{\Lambda}^0$: reconstruction



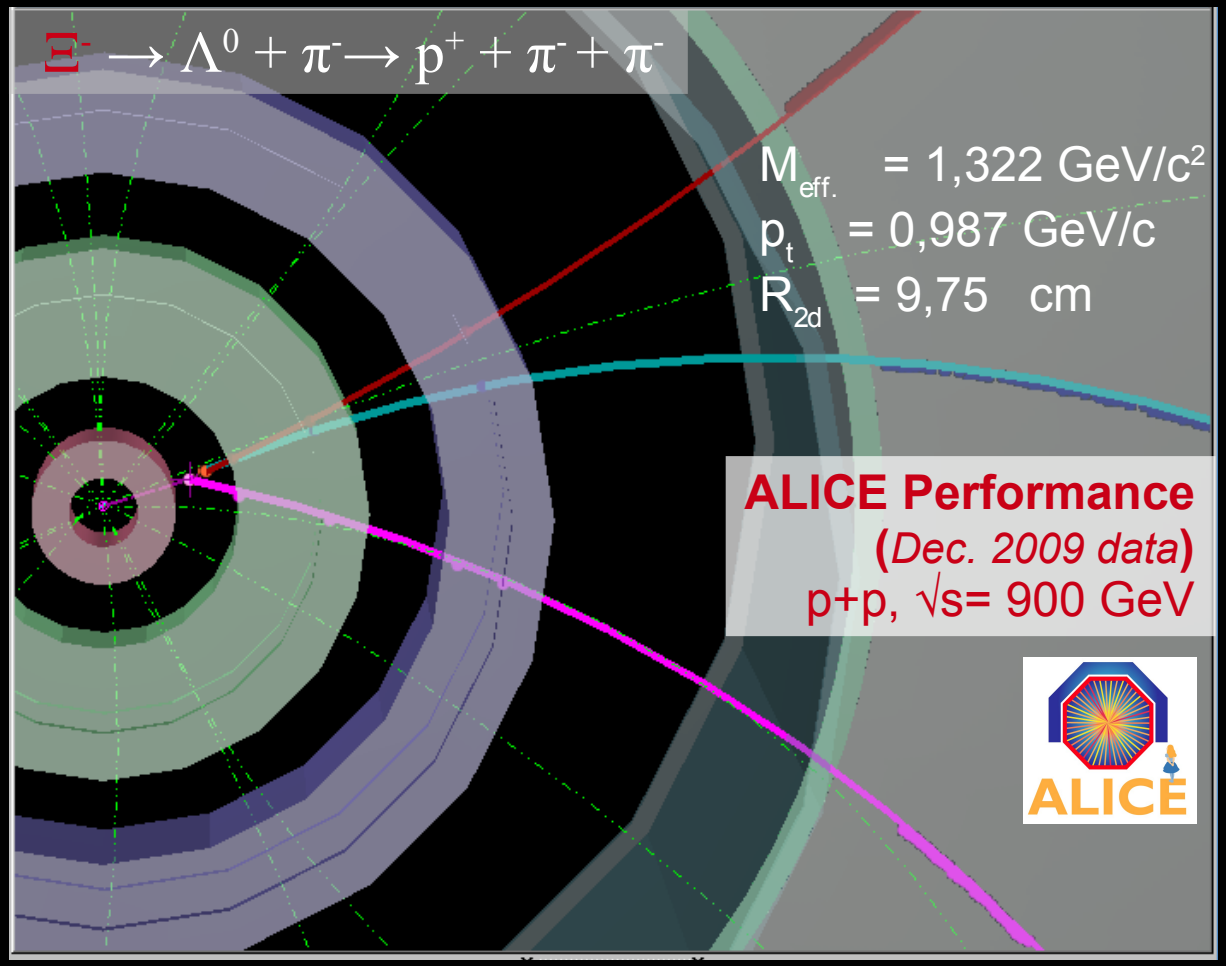
- Decay channel : $K^0s\ (d\bar{s}) \rightarrow \pi^+ + \pi^-$ $(c\tau = 2{,}68\ cm)$
  $\Lambda^0(uds) \rightarrow p^+ + \pi^-$ $(c\tau = 7{,}89\ cm)$





- Reconstruction based on *2dary* tracks, with opposite charges, within a fiducial volume,
  + "*V0 topology*"
  + protons identified via *TPC PID*

IV. – 900 GeV : Cascades, $\Xi^{\pm}$

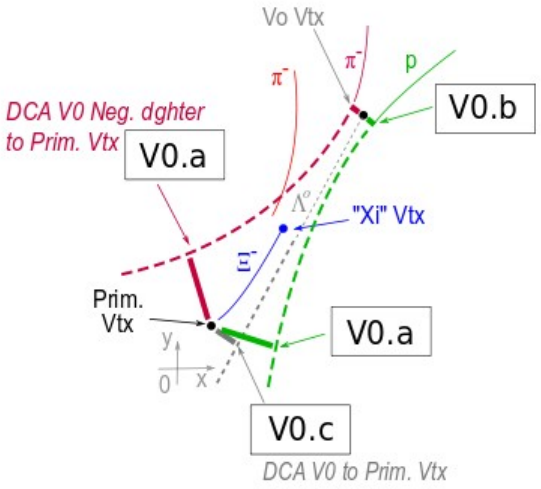


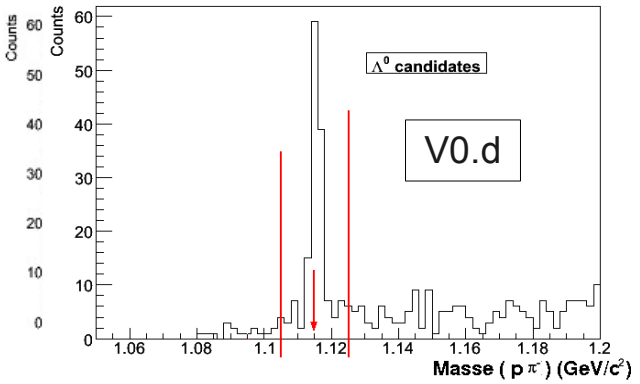
Pass4 - Run 09000104892 / Chunk 020.30 / Event 108

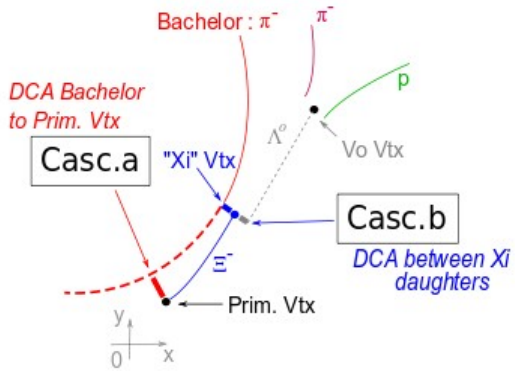
IV.1 – $\Xi^{\pm}$: reconstruction

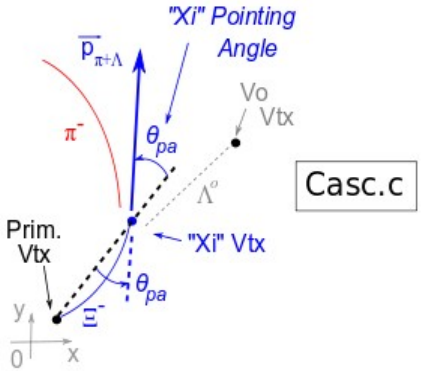
- Decay channel :

$$\Xi^- (dss) \rightarrow \Lambda^0(uds) + \pi^- \rightarrow p + \pi^- + \pi^- \quad (c\tau = 4{,}91 \text{ cm})$$
$$\overline{\Xi}^+ (\overline{dss}) \rightarrow \overline{\Lambda}^0(\overline{uds}) + \pi^+ \rightarrow \overline{p} + \pi^+ + \pi^+ \quad (c\tau = 4{,}91 \text{ cm})$$

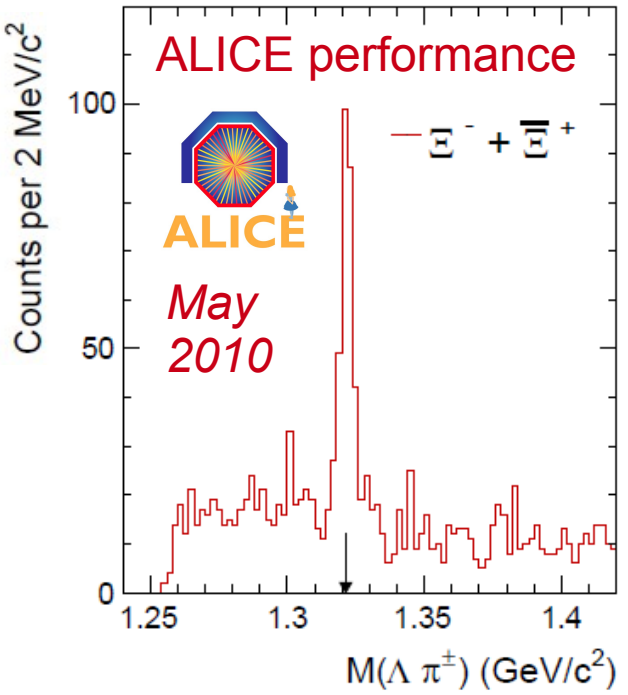






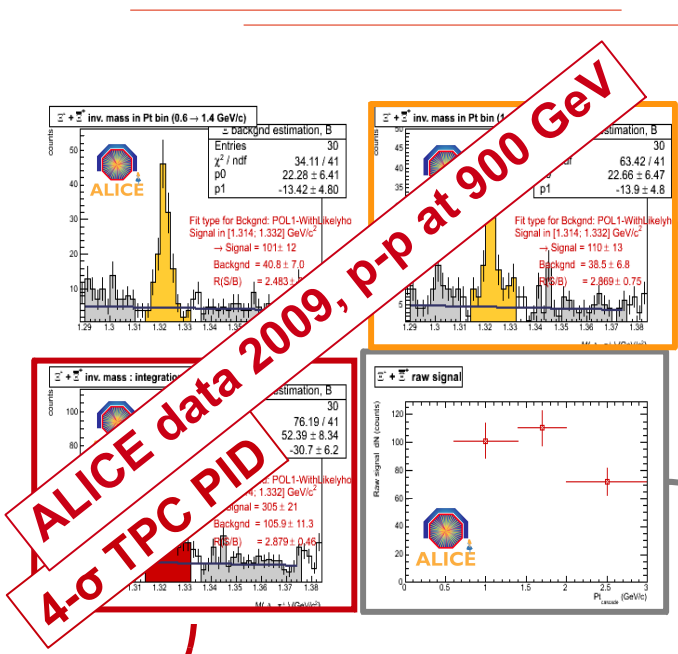


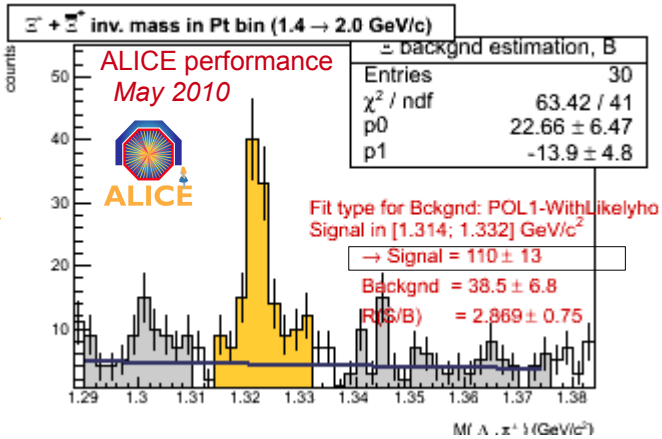
- Reconstruction based on three *2dary* tracks, within a fiducial volume,
  + "Cascade *topology*"
  + *TPC PID* on each daughter



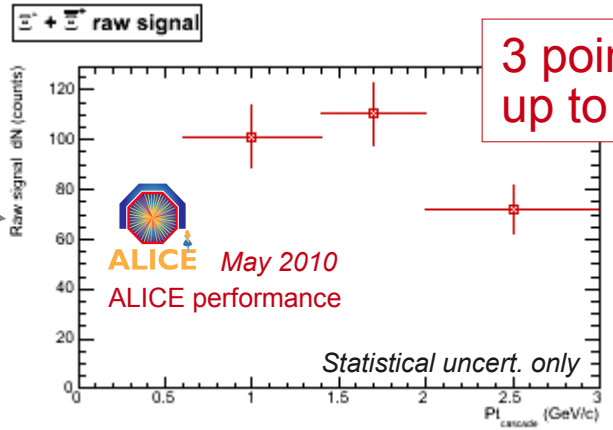
V. – 900 GeV : Summary plots

V.1 – Summary : signal extraction principle



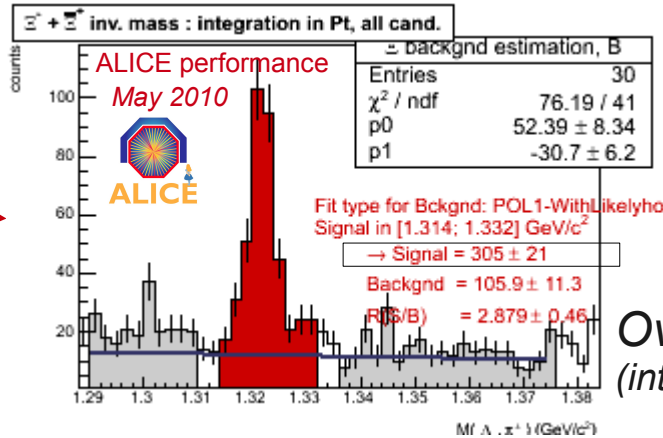


Example of Pt bin



3 points,
up to 3,0 *GeV/c*

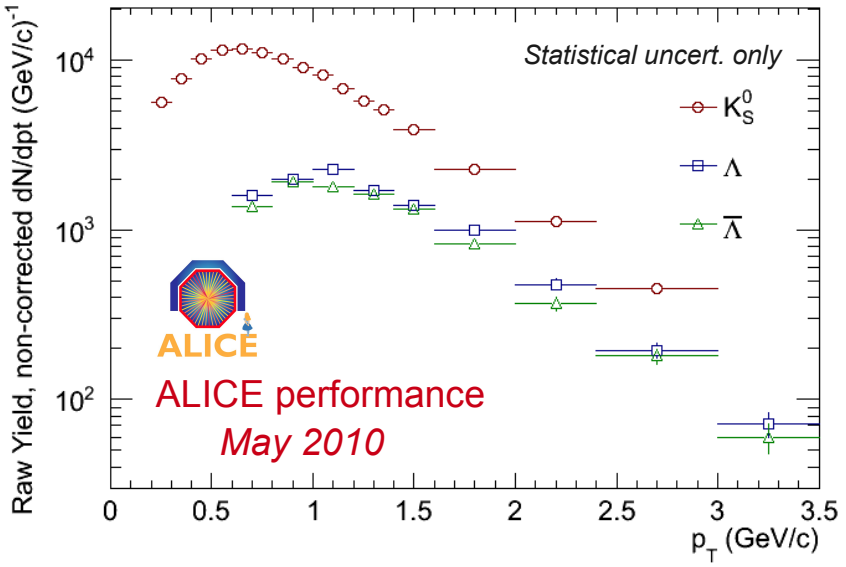
Raw signal

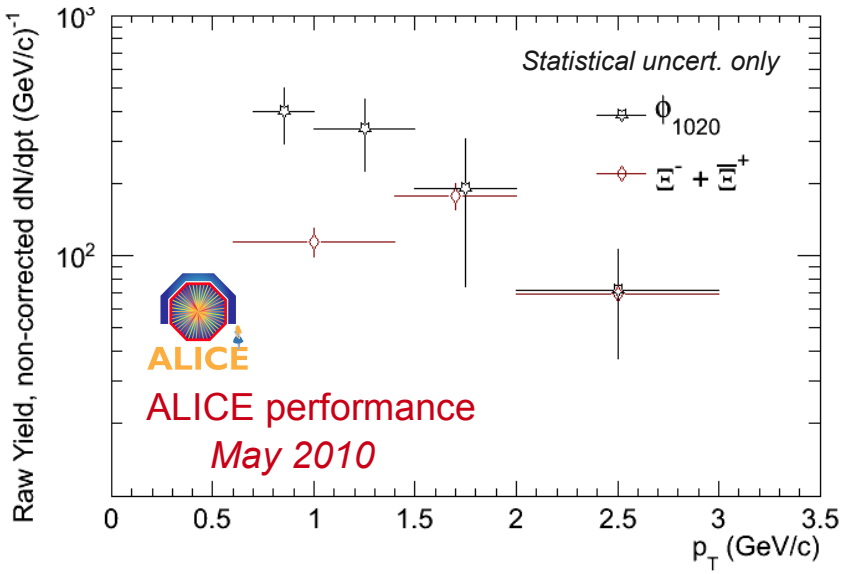


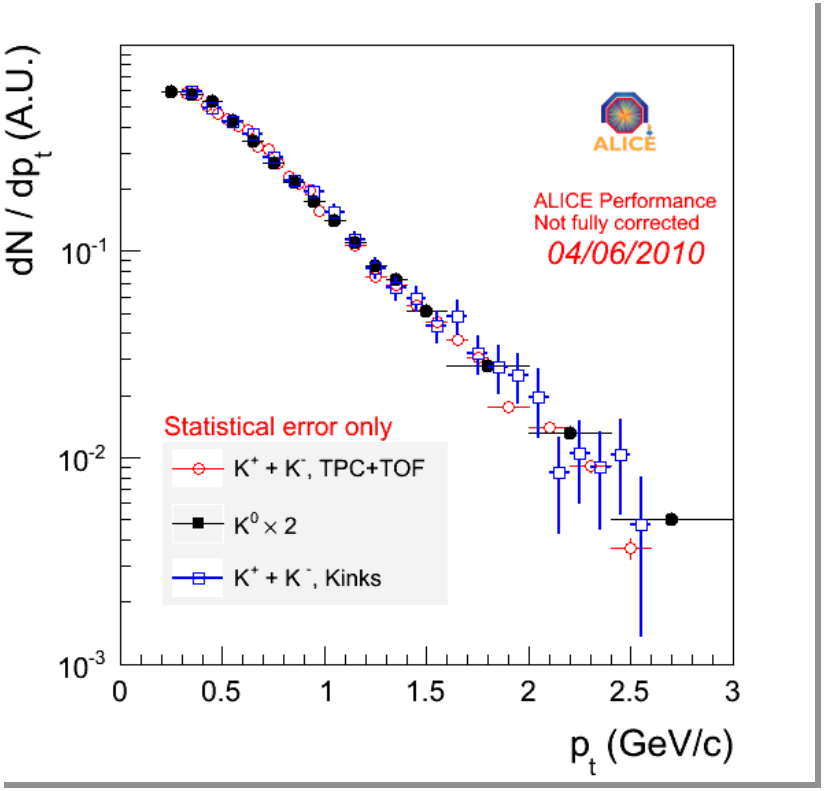
Overall signal
(integrated in Pt)

Spectrum :
$1/N(evts) \cdot 1/2\pi \cdot d^2N/dp_t dy$
* Efficiency corrections

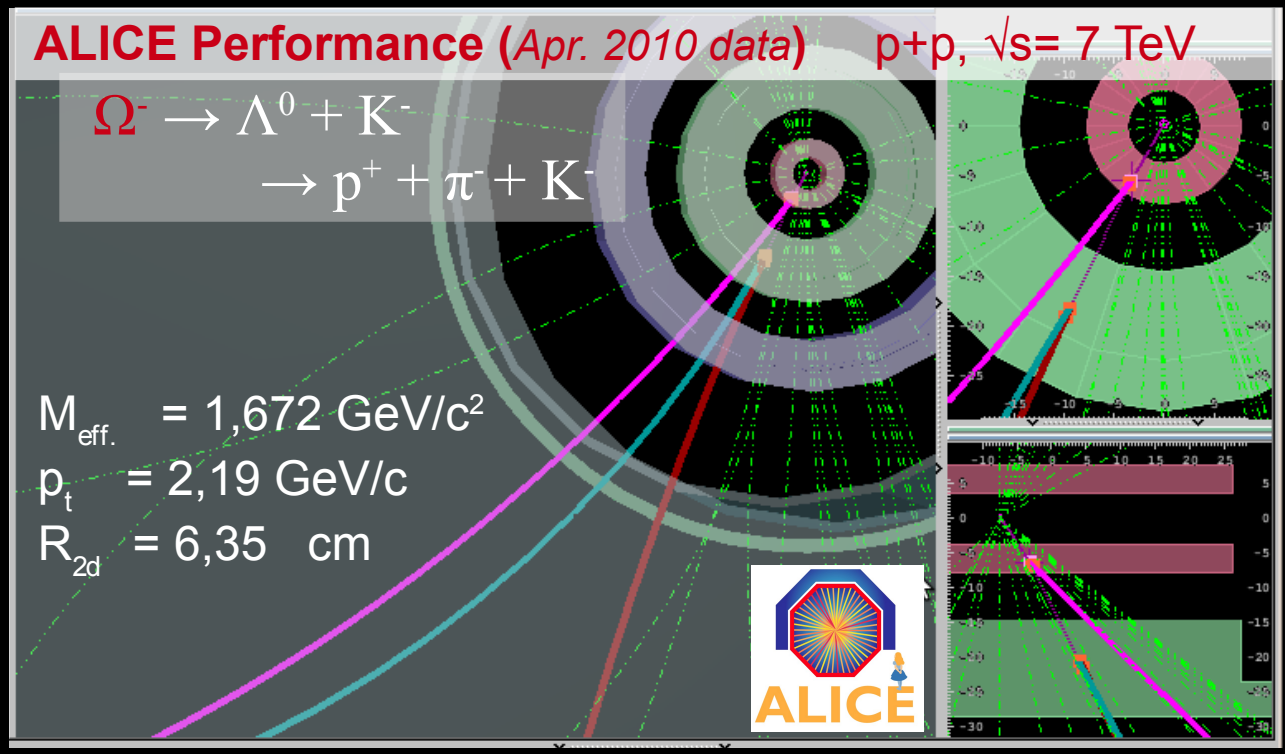
V.2 – Summary : raw counts + comparison





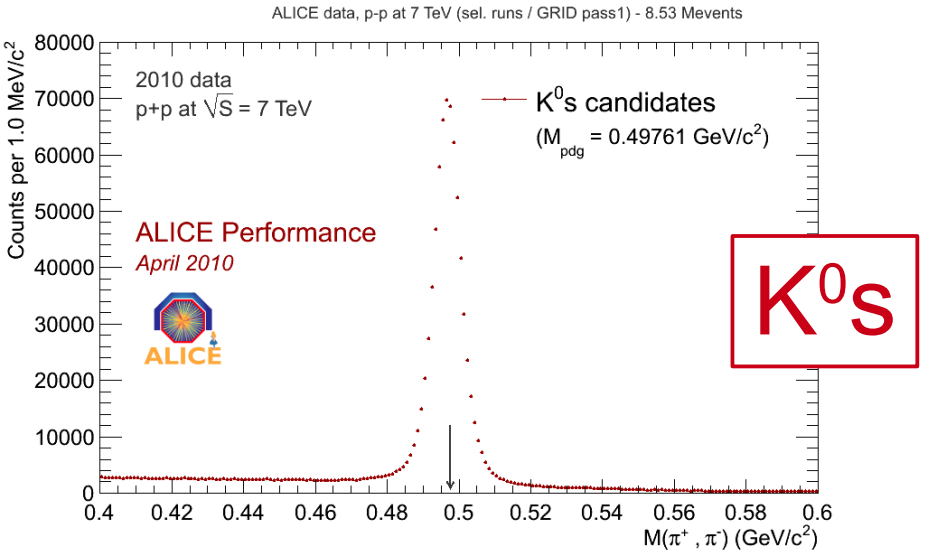


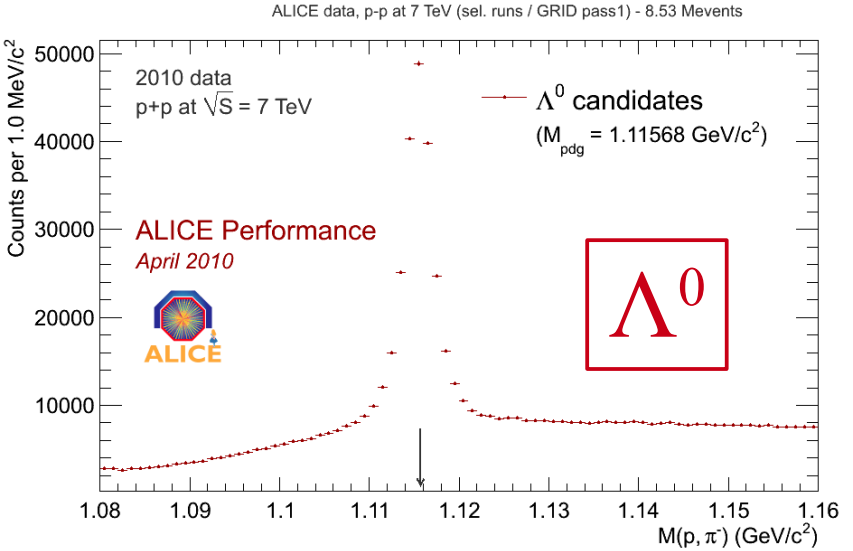
VI. – 7 TeV : K^0_S, Λ^0, $\overline{\Lambda}^0$, Σ^*, $\Xi^{\pm}$, $\Omega^{\pm}$

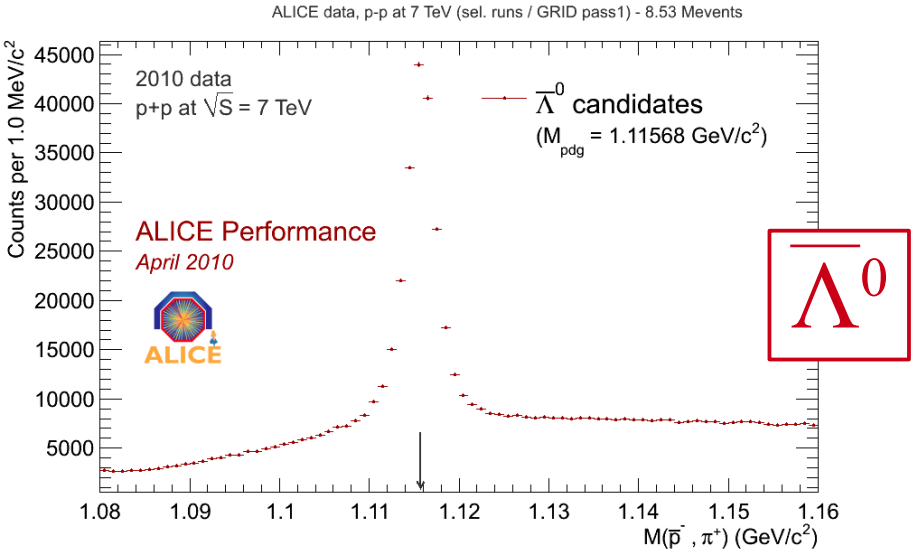


Pass1 - Run 10000115322 / Chunk 029.150 / Event 2428

VI.1 – V0 : K^0s, Λ^0, $\overline{\Lambda}^0$







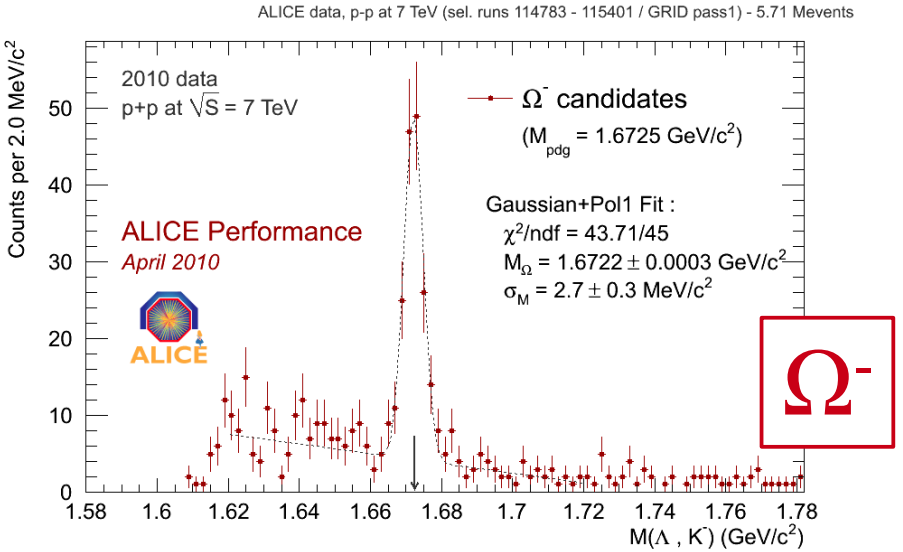
VI.2 – Cascades : $\Sigma^*(1385)$, $\Xi^{\pm}$, $\Omega^{\pm}$

- Decay channel :

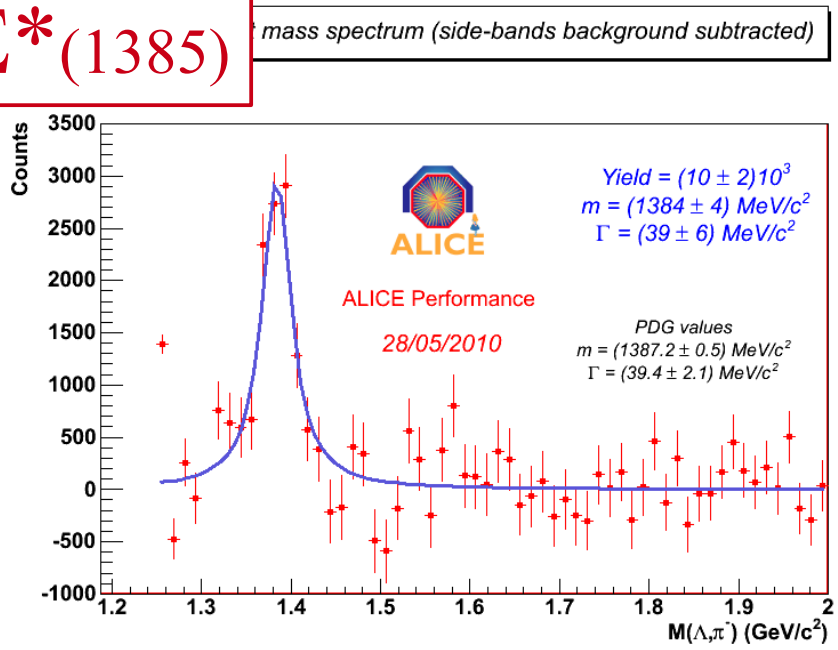
Ω^- (sss) $\rightarrow$ Λ^0(uds) + K^- $\rightarrow$ p + π^- + K^- ($c\tau$ = 2,46 cm)

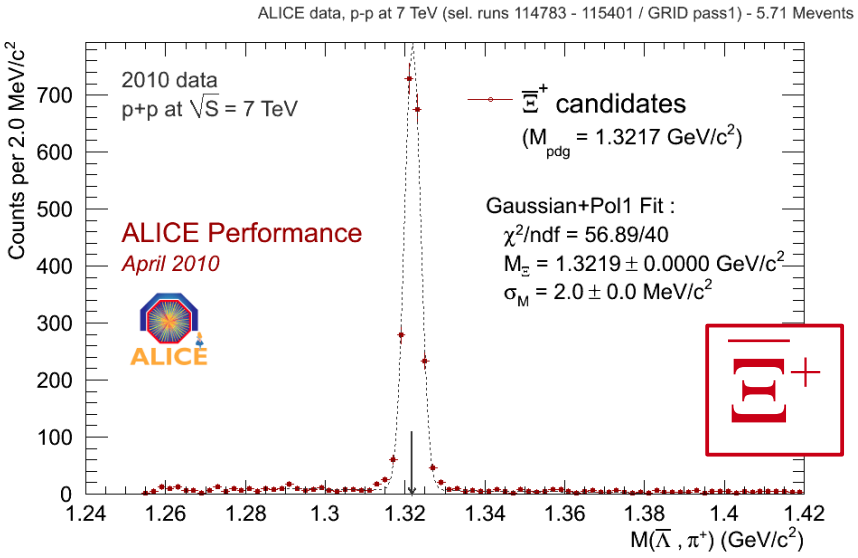
$\overline{\Omega}^+$ ($\overline{sss}$) $\rightarrow$ $\overline{\Lambda}^0$($\overline{uds}$) + K^+ $\rightarrow$ $\overline{p}$ + π^+ + K^+ ($c\tau$ = 2,46 cm)

e.g. Σ^{*-}(dds) $\rightarrow$ Λ^0(uds) + π^- $\rightarrow$ p + π^- + π^-



$\Sigma^*(1385)$





Conclusions and Prospects

Conclusions :

Goal : baseline for comparisons with MC models + benchmark for heavy-ion collisions at LHC

ALICE detector : good capabilities to **identify strangeness** via topological reconstruction

→ Measurements at 900 GeV + performances at 7 TeV, shown.

Prospects :

Extend the analyses to 7-TeV p+p data, where :

= more statistics available,

enabling more **differential analyses** (spectra = f(pt, y, Multiplicity, ...)