Status of Λ_c section in C.D.R.

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….FROM THE CDR: a brief introduction to the Lc

2.2.3 Charm baryons: $\Lambda_c \to pK\pi$ as a benchmark case

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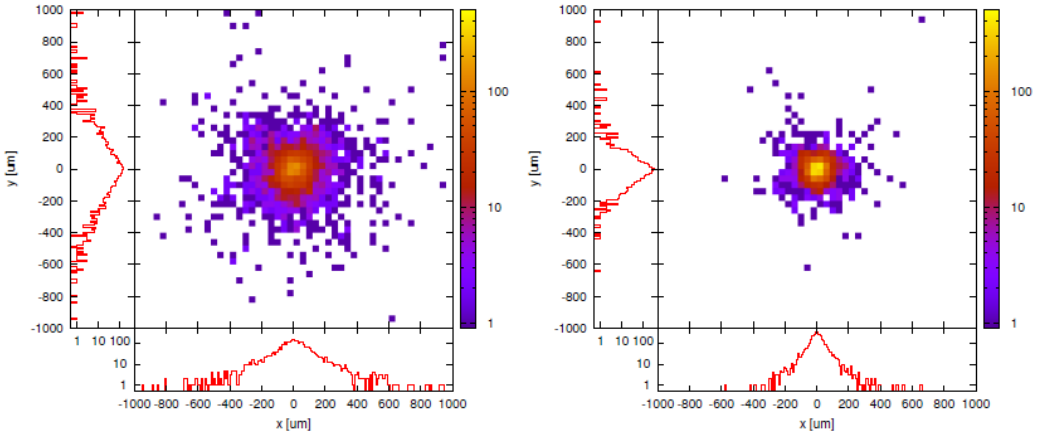
The physics motivation for the measurement if charm baryon production was discussed in Sec. ??. The most promising measurement is the decay of the Λ_c^+ into three charged prongs (p, K^-, and π^+) with a BR of 5.0% [?].

In order to identify the decay vertex, a very high resolution is of need, owing to the short mean proper decay length of the Λ_c, $c\tau \approx 60$ μm [?]. Therefore an improvement of the resolution would allow a much cleaner separation of its decay point (the secondary vertex) from the interaction point (primary vertex) with respect the current ITS, as it is seen in Fig. 2.20.



Magnus

Figure 2.20: Distribution of the residuals between the reconstructed and generated position of $\Lambda_c \to pK\pi$ decay vertices in the plane transverse to the beam line, for the present (left) and upgrade (right) ITS scenarios.

Invariant Mass's studies

- mention to cut's optimization
- signal in pp: ITS upgrade performances and scaling of the signal to calculate the significance

$$\text{Significance} = \text{signal}/\sqrt{(\text{signal} + \text{background})}$$

From the proposal:

This distribution has been scaled to the same statistics of the data sample ($N_{exp} = 1.9 \times 10^8$ events) because of the lower statistics of the Monte Carlo sample analyzed with the Hybrid Method ($N_{MC} = 1.3 \times 10^8$).For the background the scaling factor is

$$S_B = N_{data}/N_{MC}\,.$$

For the signal an additional small correction has been added to take into account the number of $c\bar{c}$ per event in the analyzed MC sample ($N^{c\bar{c}}_{MC}/event = 0.11$).

$$S_{signal} = (N_{data}/N_{MC}) \cdot (N^{c\bar{c}}/event)/(N^{c\bar{c}}_{MC}/event)\,.$$

- The final number of the significance is 12.5 in the p_t> 3GeV/c while the current value is 5 →

- comparison between current and upgrade ITS performances in the same pt bin (p_t>3GeV/c)

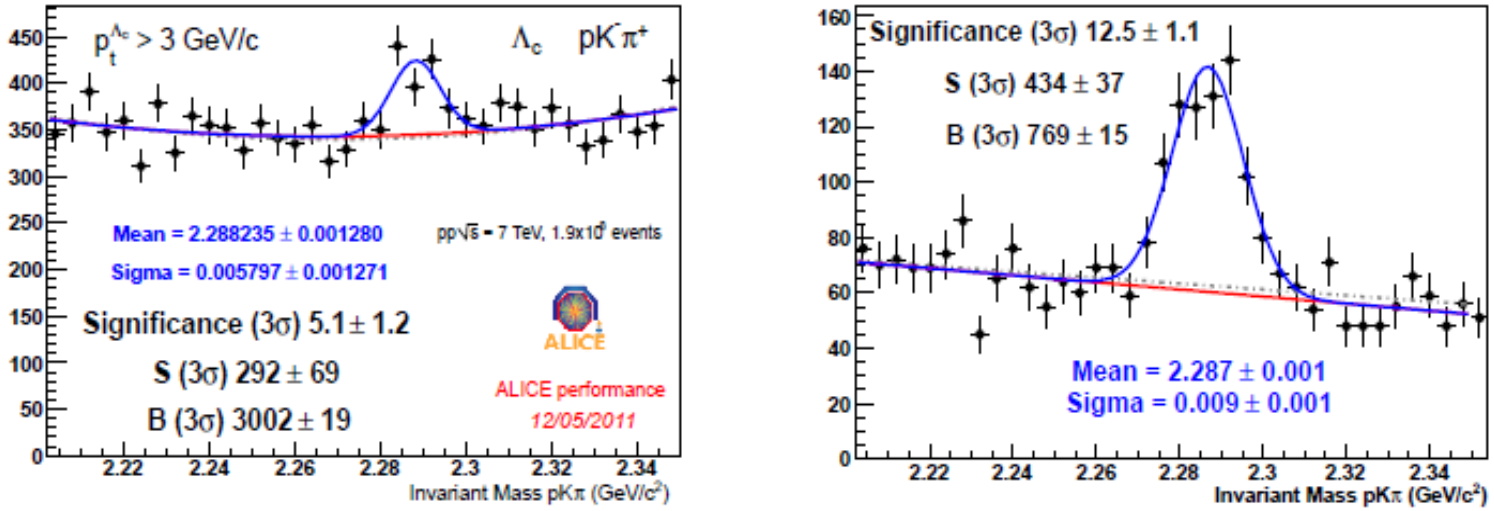
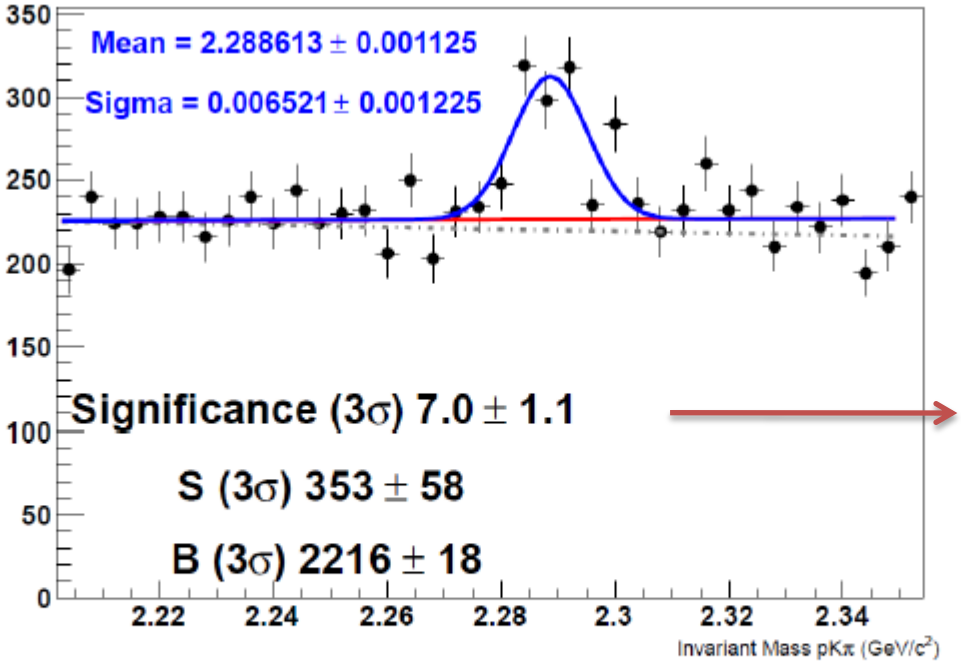


Fig. 1. – Left: Invariant mass spectrum $M[pK\pi]$ in p-p collisions at 7 TeV for $p_T > 3GeV/c^2$ in data. Right: The invariant mass spectrum obtained with the ITS Upgrade in $AllNew-0.3-4\mu\%$ configuration.

INVARIANT MASS DISTRIBUTION IN PbPb

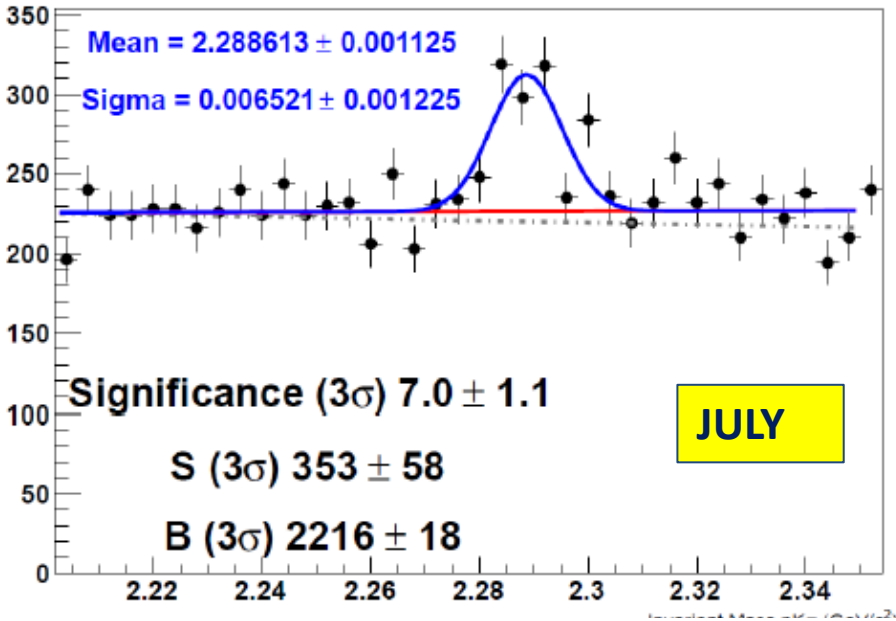
- *No signal in data* with the current ITS in any pt bin
- The signal is seen in the invariant mass distribution with the ITS Upgrade in an "enriched in charm" PbPb sample



This has to be scaled to the nominal LHC conditions

Fig. 2. – Invariant mass spectrum $M[pK\pi]$ with ITS Upgrade in Pb–Pb MC. Λ_c candidates with $p_t > 4GeV/c$ are considered

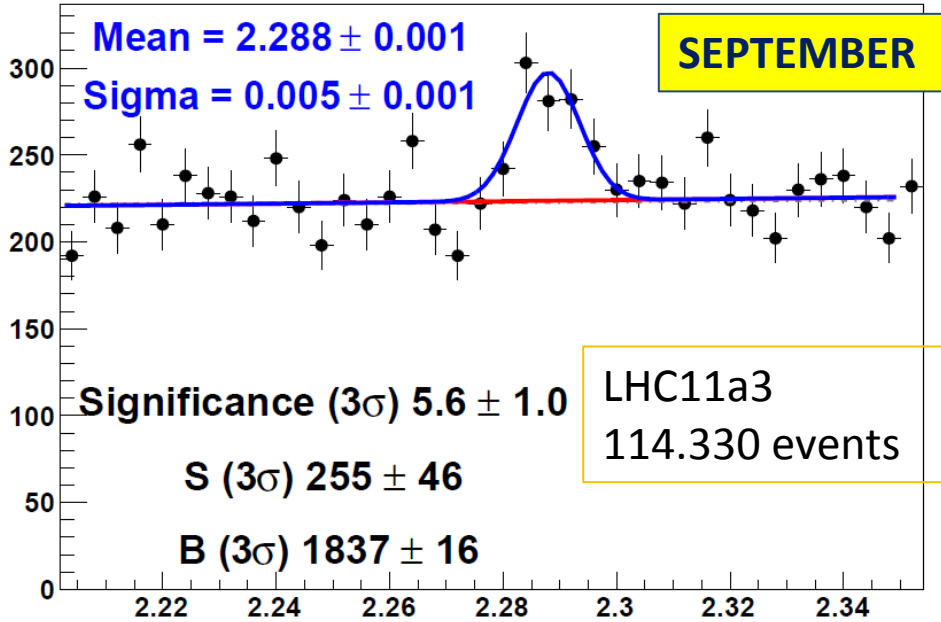
INVARIANT MASS DISTRIBUTION IN PbPb: issues in analysis cuts



LHC11a3
127.000 events

In July: changes in Lc cut's class

- pt cuts were changed in the official analysis with the current ITS
- I tried to use these new cuts →
  - lower values of the significance (from 7 -> 4.3)
- I have restored the old pt cuts: and now the new result is comparable with the old one



LHC11a3
114.330 events

SCALING the Signal and the background

- **Signal**: S'=A*S S= 255 (from the previous plot: entries under the peak)
  A= ($Nevent_{Data}/N_{MC\_analyzed}$)* ($N_{ccbar\_expected}/N_{ccbarMC}$)*B.R.(Lc->πKp)*fy
  where:
  - $Nevent_{Data}$= PbPb data in one month of data taking in a year :
    - ~ 10^7 events in 0-5% centrality (ref. PPR)
    - ~ 10^8 Minimum Bias (i.e. 0-100%)
  - $N_{ccbar\_expected}$: (per event) from PPR -> 115 ccbar in 0-5% centrality at 5.5 TeV
    → $N_{ccbar\_expected}$ in 0-100%= 25.3 (0.22 scaling factor due to the centrality)
  - $N_{ccbarMC}$: counted in the analyzed sample per event in 0-100% = 13
  - B.R.= 5%
  - fy = fraction of ccbar in which at least one is in |y|<1.5 with the decay forced (the sample is enriched in 20% of ccbar with this condition) → **fy = 0.7**

- **Background:** B' = $E^{currITS}$*B^{UP}
  - $E^{currITS}$=bkgDATA/bkgMC
    - ✓bkgDATA= background/event from **Current ITS** in data
    - ✓bkgMC =background/event from **Current ITS** in a minimum bias MC sample
  - B^{UP}= ($B_{MinBias}^{Upgrade}/N_{MC\_analyzed}$)*$N_{eventData}$
    - ✓ $B_{MinBias}^{Upgrade}$ = background/event from **ITS UPGADE** in a minimum bias MC sample

→ **Significance = 9.7 in pt>4GeV/c (0-100%centrality)**

INVARIANT MASS DISTRIBUTION IN PbPb: final result

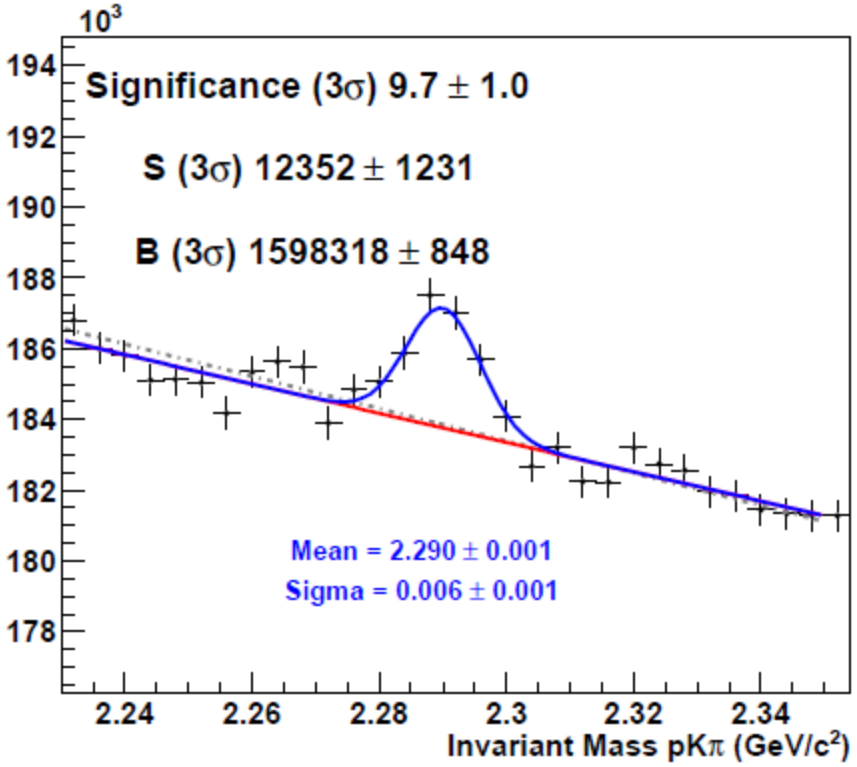


Fig. 2. – Invariant mass spectrum $M[pK\pi]$ with ITS Upgrade in Pb–Pb MC. Λ_c candidates with $p_t > 4GeV/c$ are considered in the centrality range (0-100%)

What next:

- present cuts are optimized for the ITSUpgrade in all the pt bins:

  no signal is found at low pt (pt<4 GeV/c)

  - trying to optimize cuts at lower pt (i.e. for instance for 2<pt<3)