Studies on charm–strange baryon \( \Xi_c^+ \) in 8.16 TeV pPb collisions with LHCb.

Roman Litvinov

on behalf of the LHCb collaboration.
The LHCb detector at CERN

- Precise detector in the forward region $2 < \eta < 5$;
- Able to explore $pp/PbPb$ collisions and fixed target mode!
- Excellent performances:
  - Interaction point resolution $< 80$ $\mu$m;
  - Momentum resolution 0.5–1.0\% (5–200 GeV/c);
  - High precision $e, \mu, \pi, K, p, \gamma$ identification.

Rapidity Coverage
- $y^*$: rapidity in nucleon–nucleon cms;
- $y_{\text{cms}} = \pm 0.465$;
- Forward: $1.5 < y^* < 4.0$;
- Backward: $-5.0 < y^* < -2.5$;
Motivation

$\Xi_c^+(2467 \text{ MeV/c}^2) = usc$

$\Lambda_c^+(2286 \text{ MeV/c}^2) = udc$

both decay into $p K^- \pi^+$

\[
\frac{\sigma(\Xi_c^+)}{\sigma(\Lambda_c^+)} = \frac{N_{\Xi_c^+}}{N_{\Lambda_c^+}} \times \frac{\varepsilon_{\Xi_c^+}}{\varepsilon_{\Lambda_c^+}} \times \frac{\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)}{\mathcal{B}(\Xi_c^+ \to pK^-\pi^+)}
\]

- Ratio of $\Xi_c^+ / \Lambda_c^+$ in pPb:
  - charm hadronization is not well understood;
  - charmed baryon formation might depend on collision system;
  - enhancement can be indication of other effects (ref.);

- $R_{FB}$
  - probes cold nuclear matter effects.
\[ \Xi_c^+ (2467 \text{ MeV/c}^2) = usc \]
\[ \Lambda_c^+ (2286 \text{ MeV/c}^2) = udc \]
both decay into \( p K^- \pi^+ \)

\[ \frac{\sigma(\Xi_c^+)}{\sigma(\Lambda_c^+)} = \frac{N_{\Xi_c^+}}{N_{\Lambda_c^+}} \times \varepsilon_{\Xi_c^+} \times \frac{\mathcal{B}(\Lambda_c^+ \to pK^-\pi^+)}{\mathcal{B}(\Xi_c^+ \to pK^-\pi^+)} \]

\[ \mathcal{B}(\Xi_c^+ \to pK^-\pi^+) = (0.45 \pm 0.21 \pm 0.07)\% \text{ (Belle)} \]
\[ \mathcal{B}(\Xi_c^+ \to pK^-\pi^+) = (1.135 \pm 0.002 \pm 0.387)\% \text{ (LHCb)} \]

Data:
- \( pPb \) and \( Pbp \) \( \sqrt{S_{\text{NN}}} = 8.16 \text{ TeV} \)
Conclusion

- There are no other measurements of this quantity in pPb at the moment (only in pp in a different kinematic range).

- Theory predictions with the EPPS16 nuclear PDFs computed in three different factorisation scales $\mu_F$.

- The predictions have large difference in the region of low $p_T$ where LHCb is most sensitive.

- Having a measurement in this region could be crucial in disentangling the different model and give clear indication of the mechanism of charm hadronisation in pPb collisions.
The LHCb detector at CERN

- Precise detector in the forward region $2 < y < 5$;
- Able to explore $p\bar{p}$/PbPb/PbPb collisions and fixed target model;
- Excellent performances:
  - Interaction point resolution < 80 $\mu$m;
  - Momentum resolution 0.5-1.0\% (5-200 GeV/c);
  - High precision on $p$, $p$, $K$, $\pi$, $\eta$, $\gamma$ identification.

Rapidity Coverage
- $y^*: \text{rapidity in nucleon-nucleon c.m.s.}$
- $y_{\text{max}} = 0.465$;
- Forward: $1.5 < y^* < 4.0$;
- Backward: $-5.0 < y^* < -2.5$;

Motivation

- $\Sigma^+_c(2467)$ MeV/c2 = usc
- $\Lambda^+_c(2286)$ MeV/c2 = udc
- both decay into $\rightarrow pK^-\pi^+$

- $\sigma(\Sigma^+_c) = \frac{N_{\Sigma^+_c}}{N_{\Lambda_c^+}} \times \frac{\sigma(\Lambda_c^+)}{\sigma(\Sigma^+_c)}$
- $\langle \Sigma^+_c \rightarrow pK^-\pi^+ \rangle = 0.45 \pm 0.21 \pm 0.07$ (Belle II)
- $\sigma(\Sigma^+_c) = 0.45 \pm 0.07$ (Belle II)
- $\langle \Lambda_c^+ \rightarrow pK^-\pi^+ \rangle = 1.135 \pm 0.002 \pm 0.387$ (LHCb)
- $\langle \Lambda_c^+ \rightarrow pK^-\pi^+ \rangle = 1.135 \pm 0.002 \pm 0.387$ (LHCb)

- Ratio of $\Sigma^+_c/\Lambda_c^+$ in PbPb:
  - charm hadronization is not well understood;
  - charmed baryon formation might depend on collision system;
  - enhancement can be indication of other effects (ref.);
- $R_{PB}$:
  - probes cold nuclear matter effects.

Strategy

Conclusion

- There are no other measurements of this quantity in PbPb at the moment.
- Only in $pp$ in a different kinematic range.
- Theory predictions with the EPS09 nuclear PDFs computed in three different factorisation scales $M_T$.
- The predictions have large difference in the region of low $p_T$ where LHCb is most sensitive.
- Having a measurement in this region could be crucial in disentangling the different models and give clear indication of the mechanism of charm hadronisation in PbPb collisions.

Data:
- $p\bar{p}$ and PbPb $\sqrt{s_{NN}} = 8.16$ TeV

arXiv:2012.11346
arXiv:1712.07024