Ω_c^0 production in pp collisions at $\sqrt{s} = 13$ TeV with ALICE

Tiantian Cheng for the ALICE Collaboration

Central China Normal University (Wuhan, China)

GSI Helmholtzzentrum für Schwerionenforschung (Darmstadt, Germany)

Email: tiantian.cheng@cern.ch

Heavy-flavour production

- The production of heavy-flavor (HF) hadrons can be described by the factorization theorem: $m_c \simeq 1.3\ \mathrm{GeV}/c^2, m_b \simeq 4.2\ \mathrm{GeV}/c^2 \gg \Lambda_{QCD}$

$$\frac{\mathrm{d}\sigma^D}{\mathrm{d}p_T^D}(\mu_F, \mu_R) = PDF(x_1)PDF(x_2) \otimes \frac{d\hat{\sigma}^c}{dp_T^c} \otimes D_{c\rightarrow D}(z = p_D/p_c)$$

- The mass of heavy quarks sets a perturbative scale, which can be tested in perturbative QCD (pQCD) calculations
- Yield ratios of hadrons are sensitive to heavy quark hadronisation
- Set a reference for p–Pb and Pb–Pb collisions

Exploited decay channels

(c. c.: charge conjugate)

$$\Omega_c^0(ssc) \rightarrow e^+\Omega^-\nu_e \rightarrow e^+(K^-\Lambda)\nu_e \rightarrow e(K p\pi)\nu_e + c.c.$$

$$\Omega_c^0(ssc) \rightarrow \pi^+\Omega^- \rightarrow \pi^+(K^-\Lambda) \rightarrow \pi(K p\pi) + c.c.$$

- Provide a value of $\mathrm{BR}(\Omega_c^0 \rightarrow e^+\Omega^-\nu_e)/\mathrm{BR}(\Omega_c^0 \rightarrow \pi^+\Omega^-)$

Decay channel: hadronic

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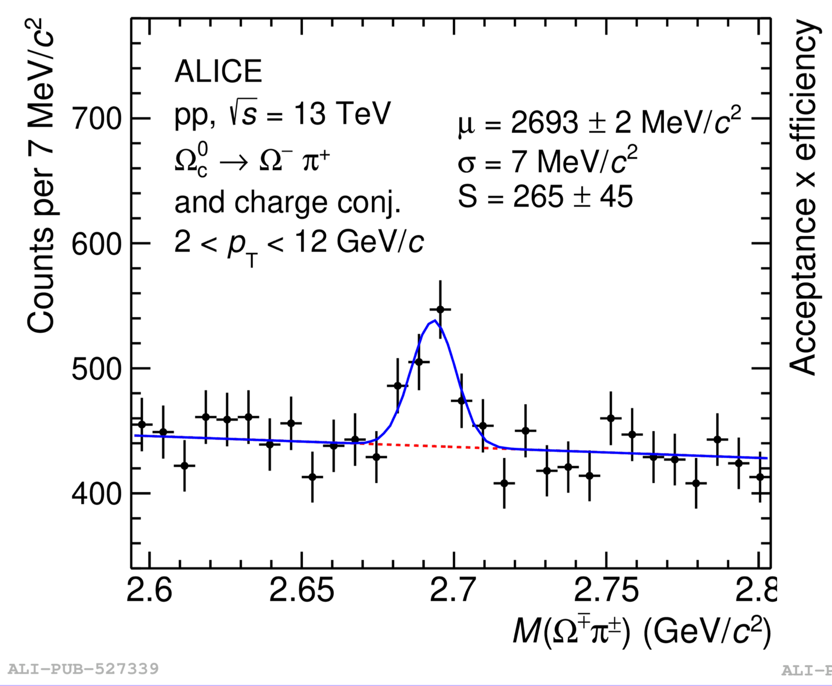
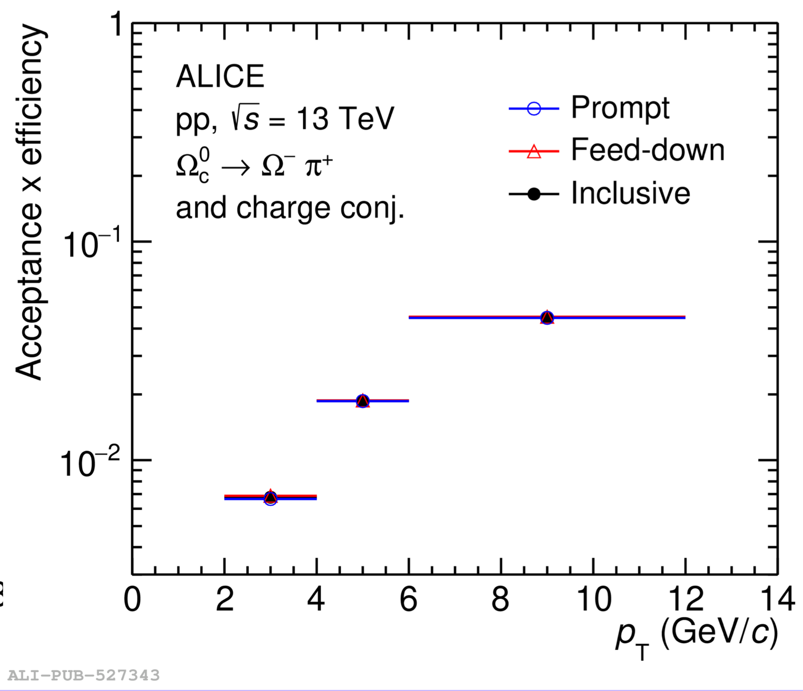
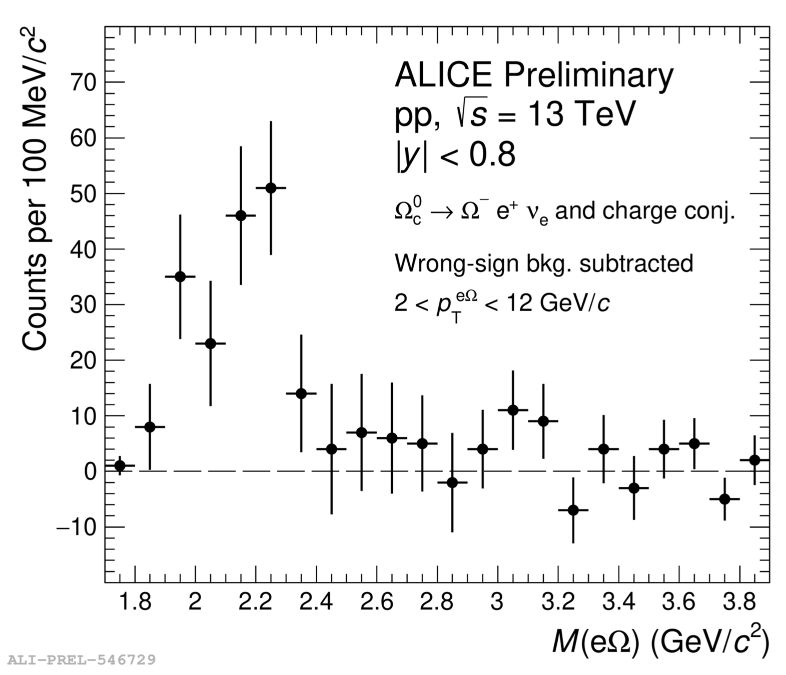
- The Kalman filter is used to reconstruct the Ω_c^0
- A machine learning algorithm based on the Boosted Decision Tree (BDT) is adopted to reduce combinatorial background
- Signal extraction from fit to invariant-mass distribution
- Raw yield corrected for acceptance and efficiency of inclusive Ω_c^0



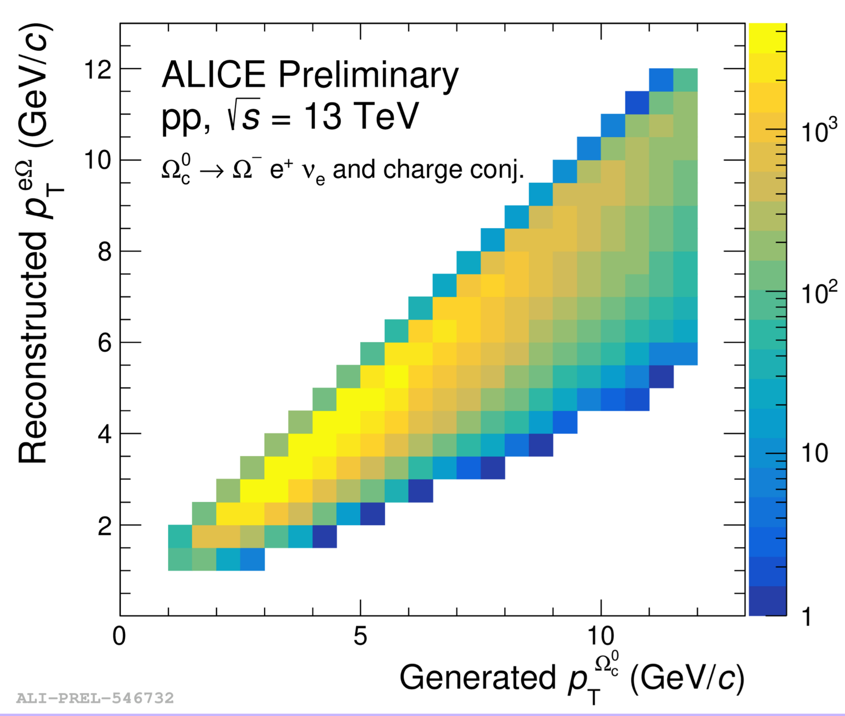


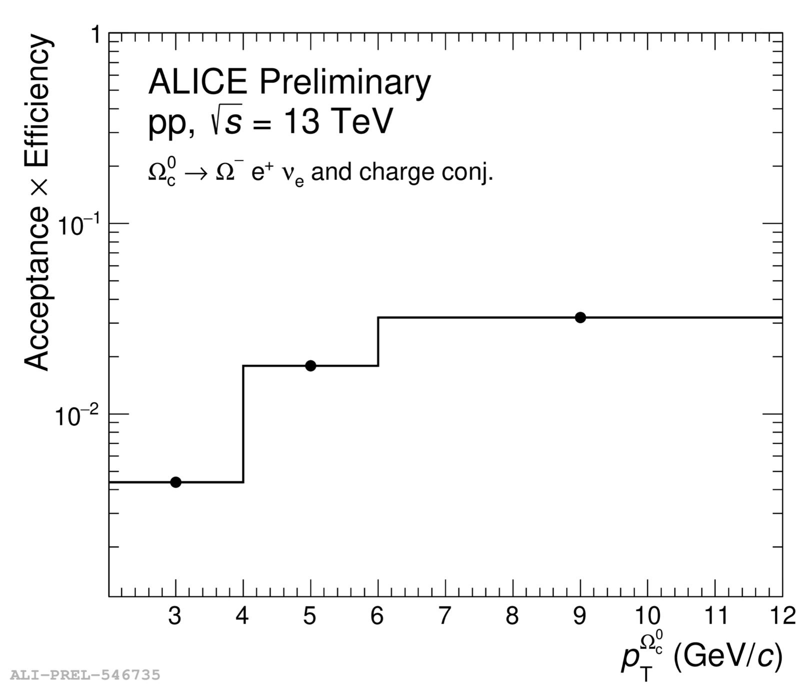
Decay channel: semileptonic

- The Ω_c^0 candidates are built from $e^+\Omega^-$ pairs
  - Electrons are identified using the measurements of $\mathrm{d}E/\mathrm{d}x$ and the time-of-flight measurement of the TOF detector
  - The Kalman filter is used to reconstruct the Ω^-
- The raw yield is extracted by subtracting the wrong sign ($e^\pm\Omega^\pm$) from the right sign ($e^\pm\Omega^\mp$) invariant-mass distribution



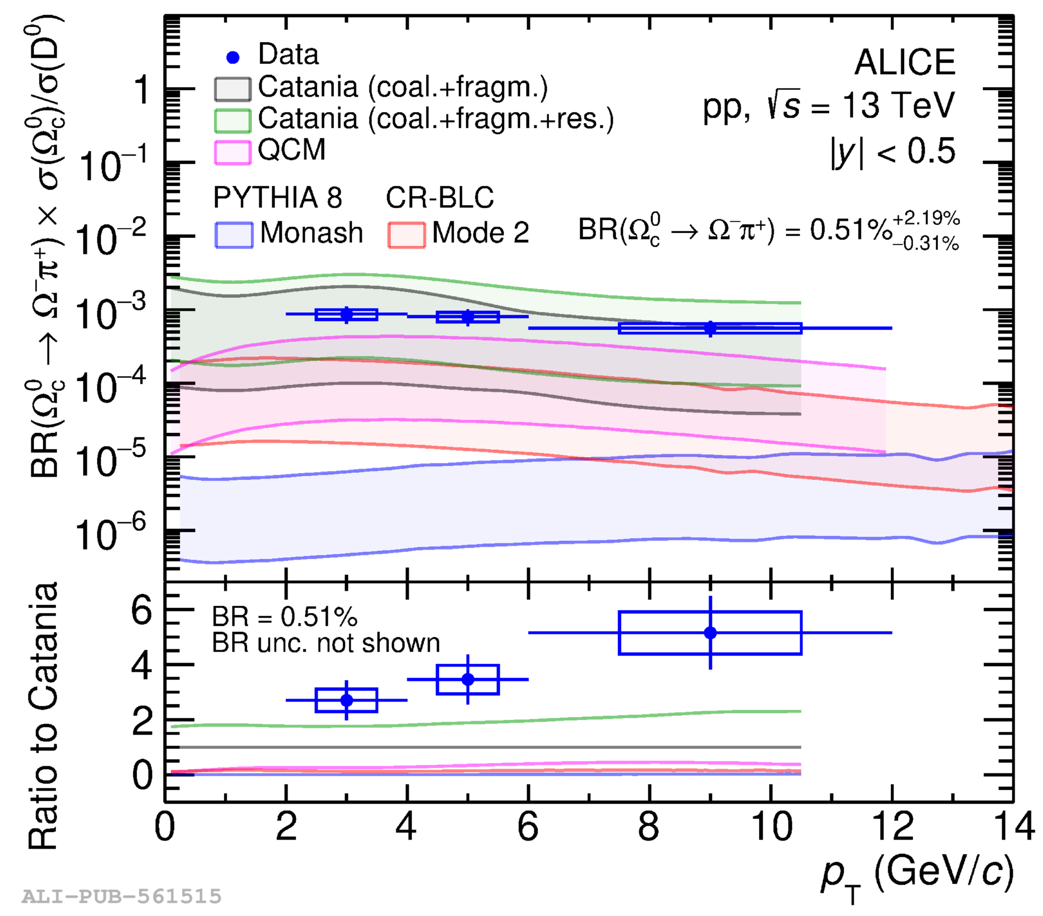
- The Bayesian unfolding technique is used to correct for the missing neutrino momentum
  - Correlation between the p_T of the Ω_c^0 baryon and the reconstructed $e^+\Omega^-$
- The unfolded yield is corrected for acceptance and efficiency





Results

- First measurement of Ω_c^0 production in $2 < p_T < 12$ GeV/c at the LHC
- The baryon-to-meson ratio is compared with different models
  - Largely underestimated by PYTHIA 8 Monash which is based on string fragmentation tuned from measurements in e⁺e⁻ collisions
  - Underestimated by PYTHIA 8 tunes with colour reconnection beyond leading colour approximation in which junction topologies increase the baryon production
  - Slightly underestimated by the quark-recombination model (QCM), in which charm quarks form hadrons by recombining with light quarks with the same velocity
  - Described by the Catania model including unmeasured resonances predicted by the Relativistic Quark Model, in which charm quarks can hadronise via 'vacuum' like fragmentation as well as recombination with light quarks
- The value of $\mathrm{BR}(\Omega_c^0 \rightarrow \Omega^-\pi^+)$ from theoretical calculation used limits the possibility of drawing stronger conclusions
  - $\mathrm{BR}(\Omega_c^0 \rightarrow \Omega^-\pi^+) = (0.51 \pm 0.07)\%$
- Extremely important to measure BR to discriminate models



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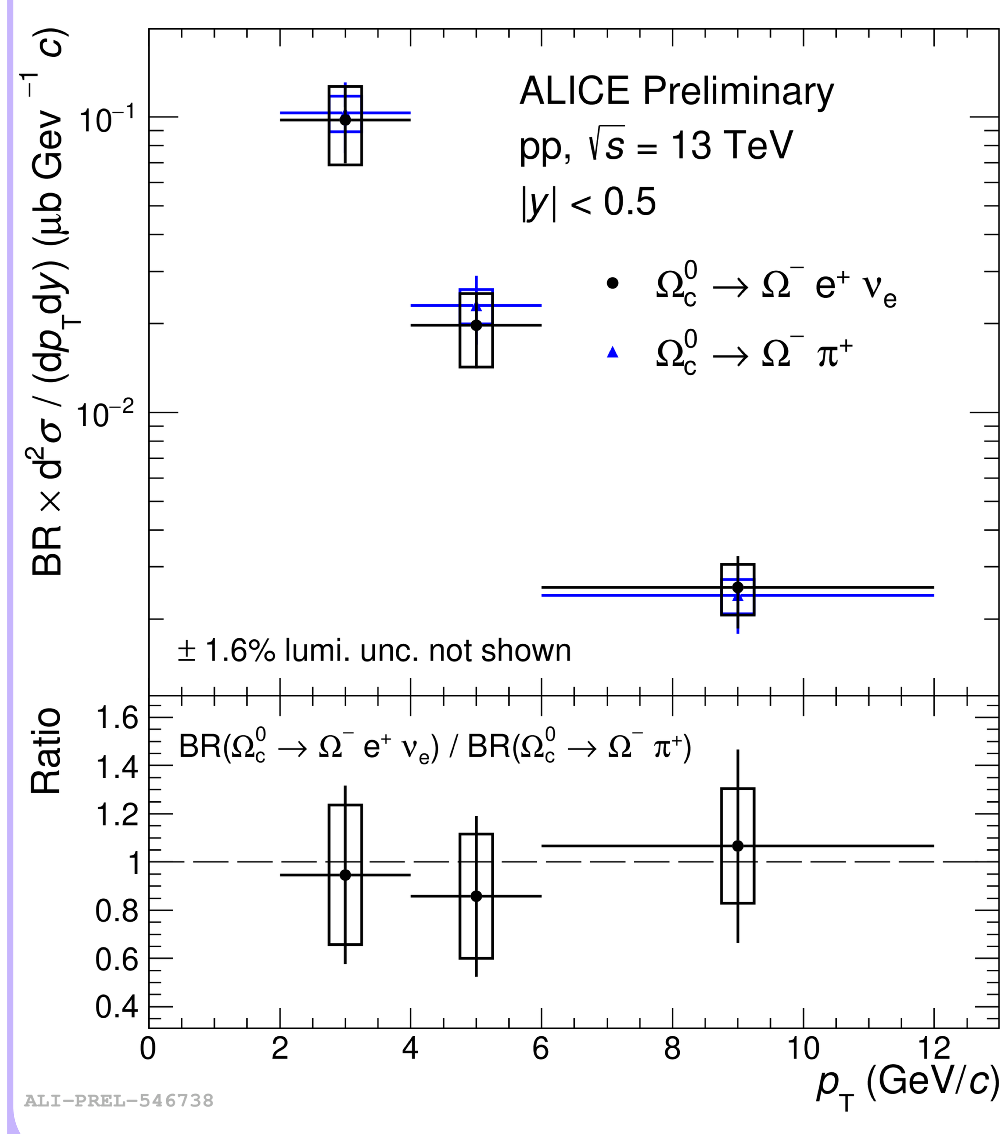
- The ratio of $\mathrm{BR}(\Omega_c^0 \rightarrow e^+\Omega^-\nu_e)/\mathrm{BR}(\Omega_c^0 \rightarrow \pi^+\Omega^-)$ is calculated at ALICE
- Preliminary result $\mathrm{BR}(\Omega_c^0 \rightarrow e^+\Omega^-\nu_e)/\mathrm{BR}(\Omega_c^0 \rightarrow \pi^+\Omega^-)$
  - **0.96 ± 0.21 (stat.) ± 0.28 (syst.)**
  - ALICE is compatible within 2.7σ with the more precise Belle measurement
  - ALICE is also consistent with theory calculations
- Future Run 3 data samples will allow to reduce systematic and statistical uncertainties



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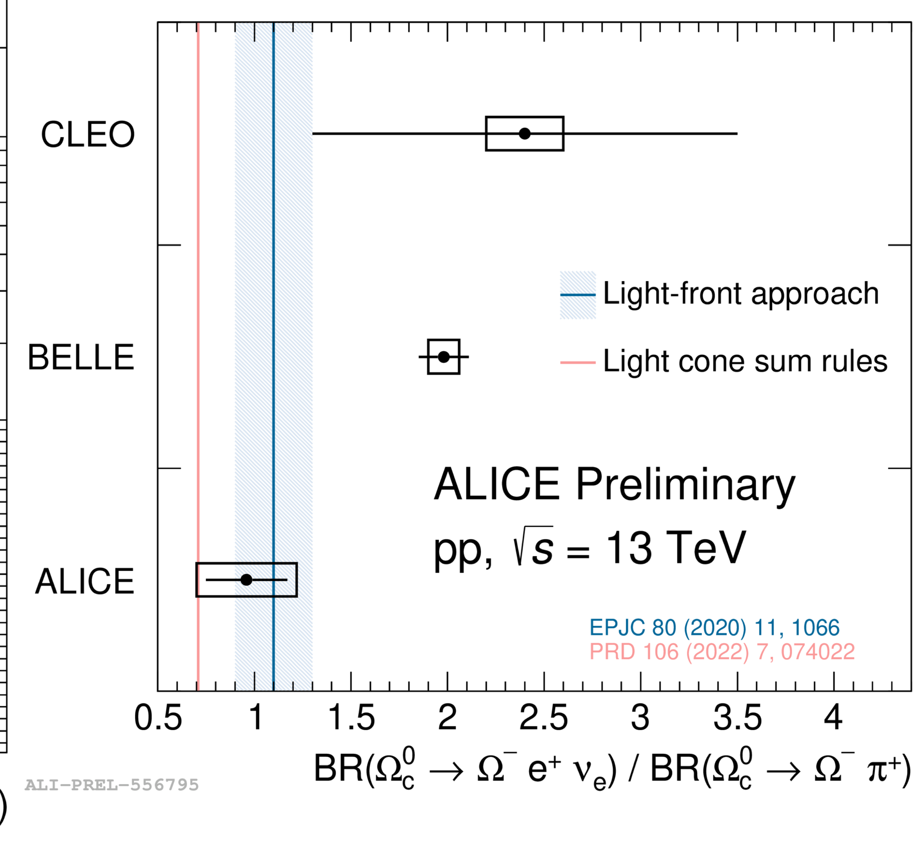
BELLE PRD 105 (2022) 9, L091101



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