Baryon number transport at LHC energies with the ALICE experiment

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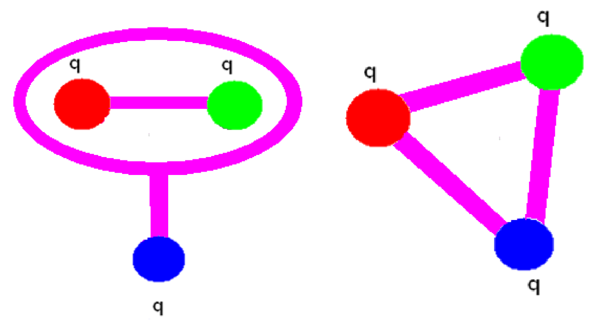
Motivation

Constituent quark model

D. B. Lichtenberg and L. J. Tassie, Phys. Rev. 155, 1601 (1967)

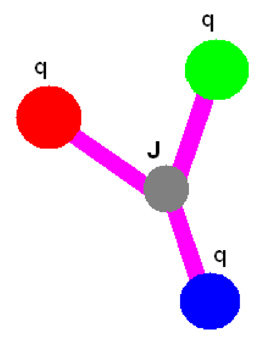
- ~1967
- Baryons are described as quark-diquark pairs
- Valence quarks carry baryon number
- BN of valence quark = 1/3
- Baryon produced in collision is formed around the diquark



String junction model

M. Imachi, S.Otsuki, and F. Toyoda, Prog. Theor. Phys. 52, 341 (1974)

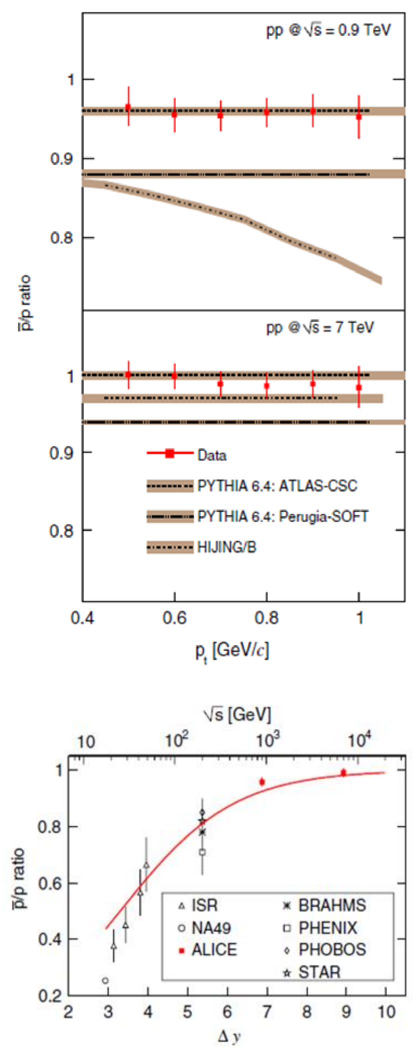
- ~1974
- Valence quarks are connected via nonperturbative configuration of gluonic field called string junction (J)
- Baryon number is carried by string junction
- BN of valence quark = 0
- BN of string junction = 1
- Outcoming baryon is formed around string junction with presence of several sea quarks



Antiproton/proton results from ALICE

ALICE: Phys. Rev. Lett. 105, 072002 (2010)

- Flat p_t dependence of the ratio.
- Scenario with α_{SJ}=1 disfavored by ALICE results.
- Energy dependence: mid rapidity ratio goes to unity for high energies.



Baryon ratio

- $R = N_{\bar{B}}/N_B$
- Most of the baryons are from pair production
- Any excess of baryons in central rapidity comes from the BN transport
- Meaningful only in BN asymmetric collisions(i.e. not for Tevatron).

Baryon number transport

G.C.Rossi, G.Veneziano, Nucl. Phys. B123, (1977) 507

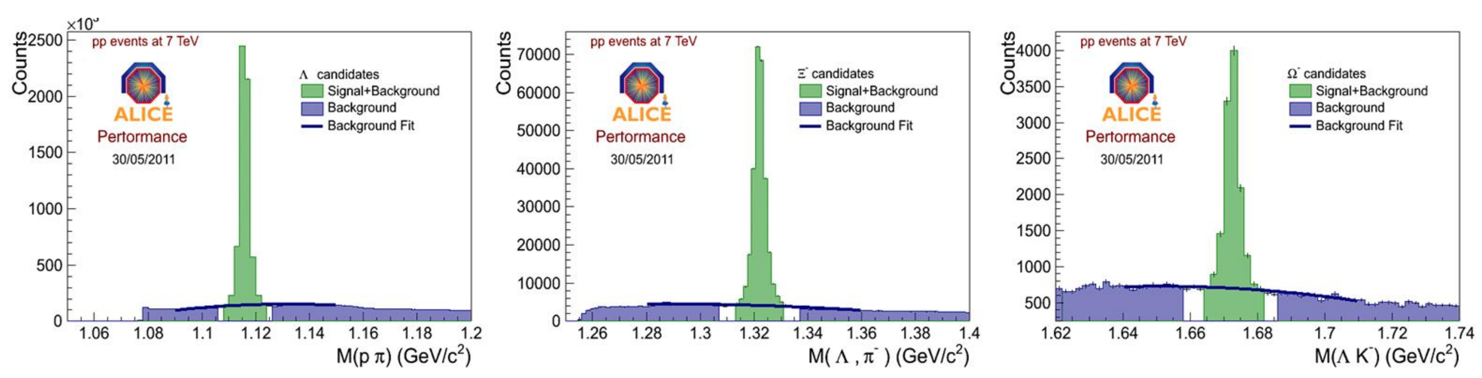
B. Z. Kopeliovich and B. Povh, Phys. Lett. B 446, 321 (1999).

- In inelastic high energy collisions, the products typically emerge at angles close to beam direction
- Deceleration of conserved BN of the beam = BN transport.
- Probability of BN transfer thorough rapidity interval is $\approx e^{(\alpha-1).\Delta y}$, $(\Delta y = y_{beam} - y_{baryon})$
- α depends on the configuration in which BN is transported
  - Diquark (CQM)
  - SJ accompanied by diquark
  - SJ accompanied by quark
  - SJ itself

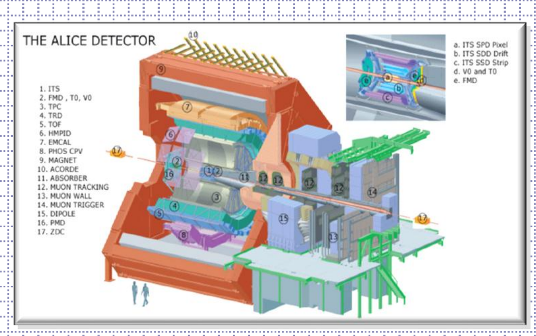
	α ≈
Diquark	-1/2
SJ accompanied by diquark	-1/2
SJ accompanied by quark (Rossi & Veneziano)	1/2
SJ itself	1/2
SJ itself (Kopeliovich & Povh)	1

Reconstruction and identification of strange baryons

- Strange baryons in ALICE are reconstructed using their weak decay topology in charged particles only.
- Mass for each candidate (Λ, Ξ and Ω) is calculated using measured momentum of daughter tracks and known mass of daughters according to mass hypothesis.
- Each invariant mass distribution is fitted by combination of Gauss function and polynomial function of second order.
- This fit is used for the determination of the peak position and width. Parameters of the fit were used to determine signal area (4 σ around mean value) and background area on each side of peak (6 σ from mean value).
- Background area was fitted by 2nd order polynomial function. Integral of the function was subtracted from histogram content under peak.
- This procedure is performed in several bins in rapidity and transverse momentum.



Analysis

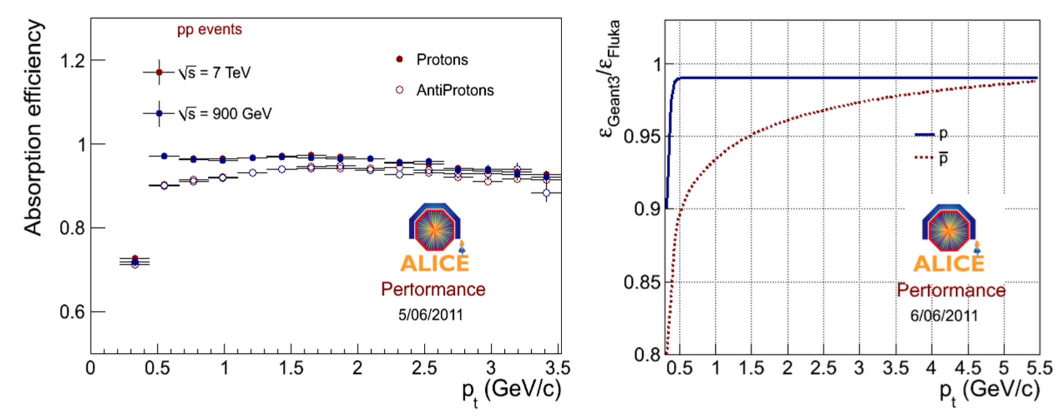


Corrections

- The TPC of the ALICE experiment is symmetric around mid-rapidity and has full azimuthal coverage.
- As a consequence, many detector effects such as the acceptance, the reconstruction and the particle identification ones are the same for particles and anti-particles and thus cancel out in the ratio.
- Effects which we need to correct for are absorption (Λ, Ξ, Ω) and secondary particles produced in material (Λ)
- To first order feed down effects cancel out in the ratio

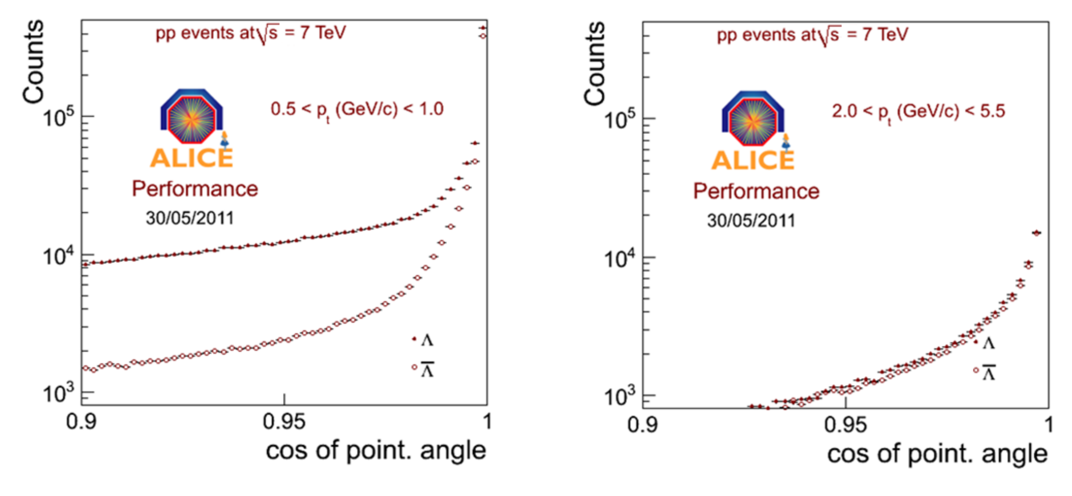
Absorption correction

- By absorption we mean the interaction of particle with material resulting in the disappearence of the first
- Correction factors were extracted from MC
  - Rely on proper description of material budget
  - Rely on proper description of cross section in the transport code
  - Geant-3 cross section overestimates the data.
  - Fluka cross section which is in good agreement with data taken into account



Correction for background Λ

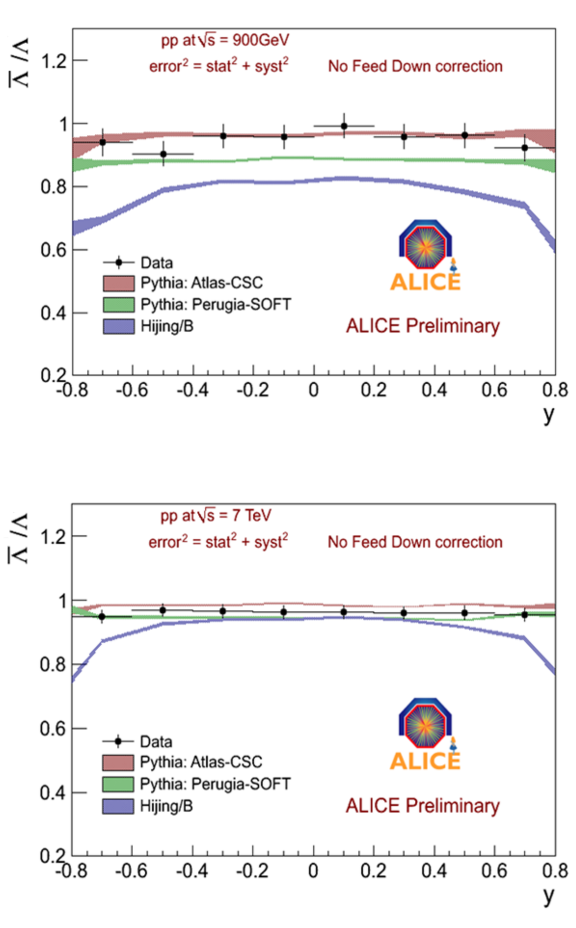
- Correcting for secondary Λ created from material by kaons
- Difference between Λ and anti-Λ is visible in the cosine of pointing angle distribution



Results

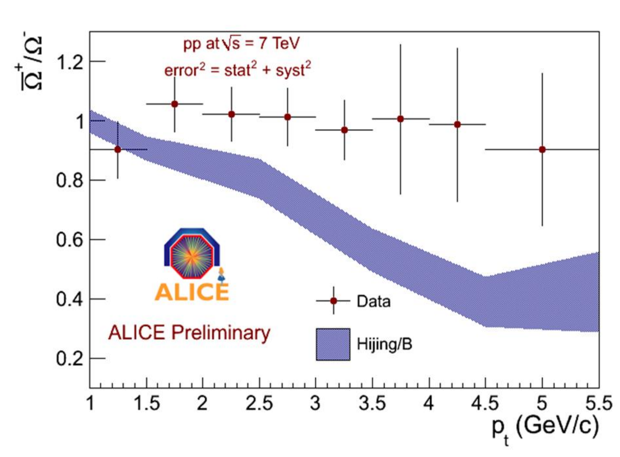
Rapidity dependence

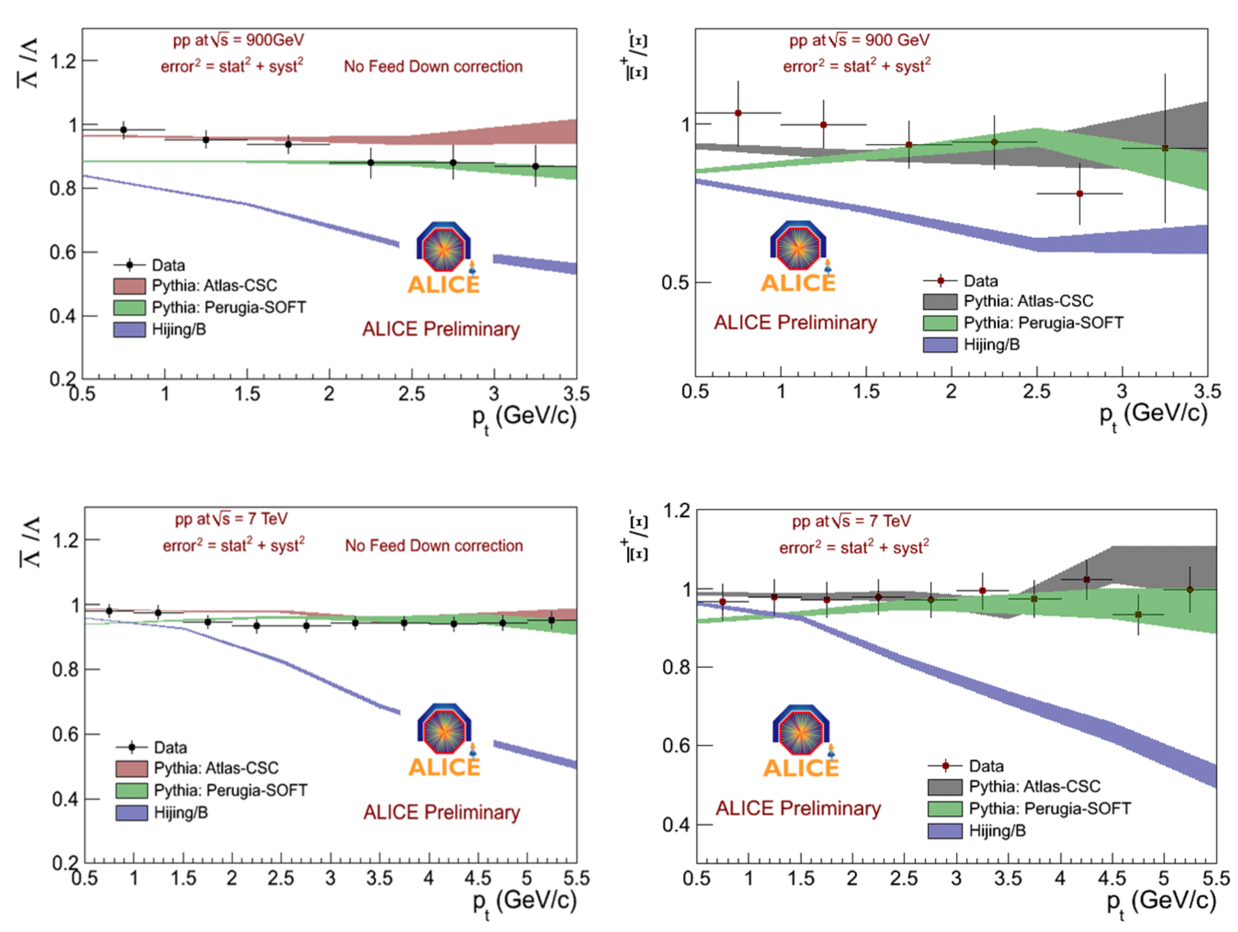
- Preliminary results show no sign of rapidity dependence
- Experimental points are compared with different model predictions that include variation of BN transport mechanisms:
  - HIJING-B clearly underestimates the ratio and does not describe also the shape
  - The different PYTHIA tunes describe the data well.



Transverse momentum dependence

- Preliminary results show no sign of transverse momentum dependence
- Experimental points are compared with different model predictions that include variation of BN transport mechanisms.
  - HIJING-B predicts a decrease of the ratio with increasing p_t not seen in p+p collisions.
  - The different PYTHIA tunes describe the data well.





Mid-rapidity ratios