Measurement of Baryonic Resonances in pp Collisions at the LHC with ALICE

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Motivation

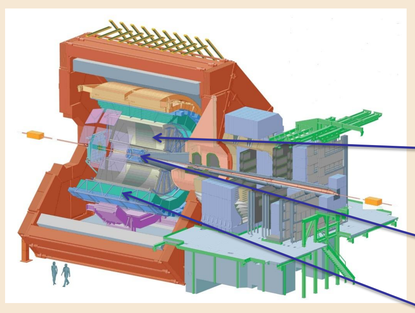
The measurement of resonances could help significantly in disentangling the different phases of the fireball evolution in heavy-ion collisions.

Due to the short lifetimes of about less than 20 fm/c for most of the resonances (12.6 fm/c for Λ(1520) and 1.7 fm/c for the Δ(1232)) they can be used as probes for the phase between the chemical and the kinetic freeze-out where rescattering and re-generation can change the observed particle yield [1,2].

To test this and compare to the up to now very successful description of the hadron abundances in the statistical model (for example [3]) we will study resonance to particle ratios, i.e. Λ(1520)/Λ and Δ(1232)/p in our case.

This poster shows results from the analysis of Λ(1520) and Δ(1232) for 7 TeV pp data, which will be used as a baseline for the heavy-ion analysis.

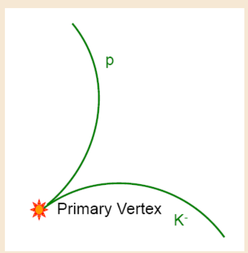
ALICE



ALICE as the designated heavy-ion physics experiment at the LHC offers excellent particle identification and tracking capabilities which are mainly exploit by using:
- Time Projection Chamber (TPC) as main tracking and PID device (using the specific energy loss).
- Inner Tracking System (ITS) to improve the track quality close to the vertex.
- TOF to identify particles by their time-of-flight.

Track selection

- $|\eta| < 0.9$
- Track quality cuts for ITS and TPC, such as a given number of reconstructed clusters in the TPC to guarantee good tracking and particle identification.



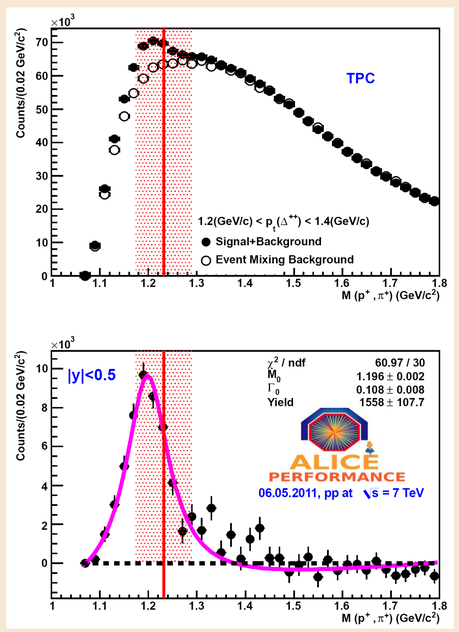
Example for Λ(1520) → pK⁻

Particle Identification (PID)

- The particles used for the analysis (p, K) measured by dE/dx have to be in a 3σ band around the Bethe-Bloch expectation for the given particle in the TPC.
- If TOF is used for PID the measured time of flight must stay within a 3σ band around the expected time of flight for a kaon with the same momentum at the primary vertex, which is estimated from the integrated track length given by the reconstruction.

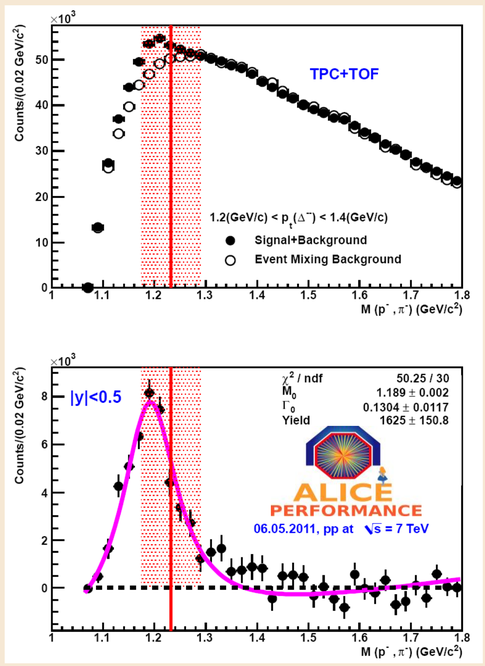
Δ⁺⁺(1232)/Δ⁻⁻(1232) measurement

The analysis of doubly charged Δ(1232) (Δ⁺⁺(1232) → pπ⁺ with a branching ratio of ~100% and its charged conjugate) is performed using two PID options: TPC and TPC+TOF



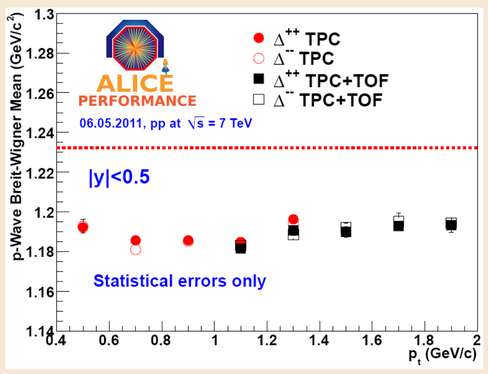
The signal is fitted with a relativistic p-wave Breit-Wigner convoluted with a phase space factor.

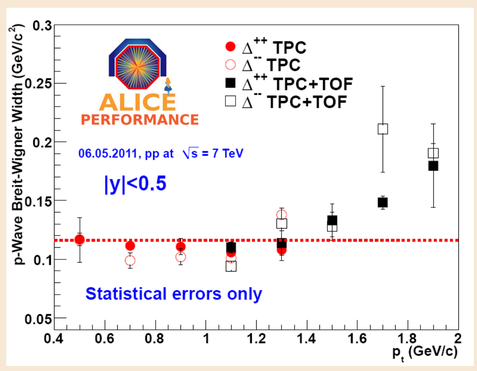
Event mixing background was used to to extract the signal in different p_t bins.



Δ⁺⁺(1232)/Δ⁻⁻(1232) results

The extracted Breit-Wigner width is close to the PDG value.

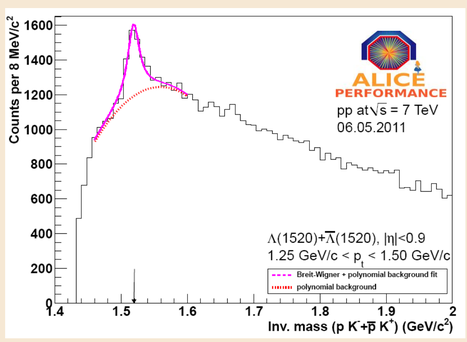


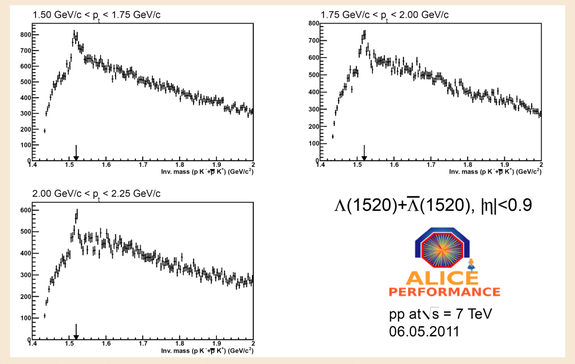


The Breit-Wigner mean is shifted significantly towards lower values in comparison to the PDG value.

Λ(1520) measurement

Λ(1520) was measured in the decay channel Λ(1520) → pK⁻ (BR: 22.5%) and to enhance the signal also the charged conjugate is added.

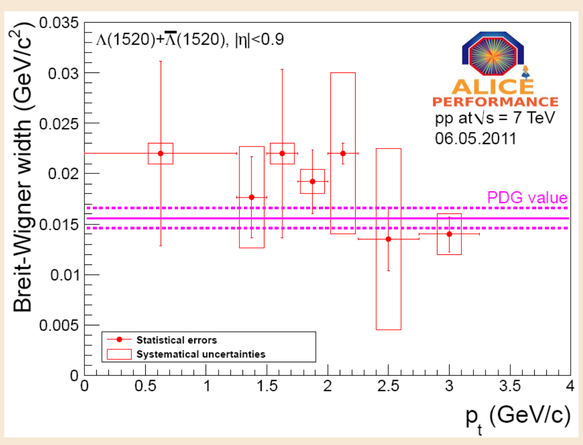


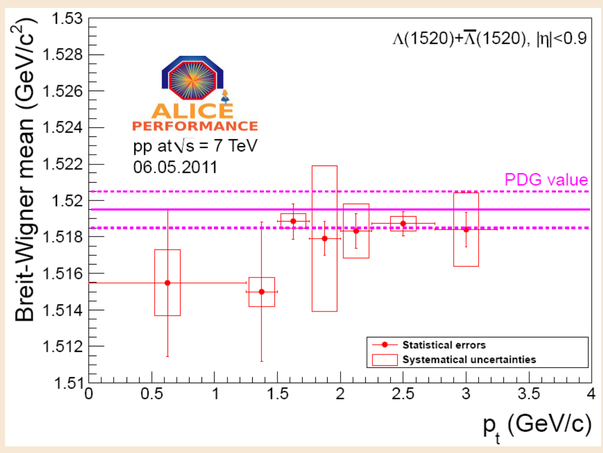


The signal is fitted with a Breit-Wigner plus an polynomial of 3th order to describe the background in the peak region.

Λ(1520) results

The extracted width and mass of the Λ(1520) are in good agreement with the PDG values.

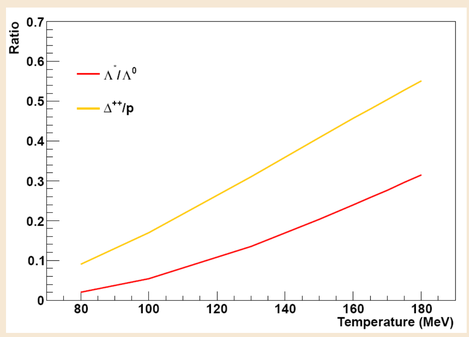




Discussion and Outlook

A mass shift towards lower values is observed for the Δ(1232). In heavy-ion collisions it can be explained as a kinematical shift inside a thermal medium which is coupled to the Nπ ↔ Δ(1232) interaction [4].

The next step is the extraction of yields and to compare the ratios of Λ(1520)/Λ and Δ(1232)/p with models such as THERMUS [5]. Calculations using THERMUS have been performed to show the dependence of the particle ratio over the temperature.



The presented analysis in pp is done as a baseline and will be continued for the PbPb data.

References

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[3] A. Andronic, P. Braun-Munzinger, J. Stachel, Phys. Lett. B 673, 142 (2009); Erratum-ibid. B 678, 516 (2009); arXiv:0812.1186
[4] W. Weinhold, B. Friman, W. Nörenberg, Phys. Lett. B 433, 236 (1998)
[5] S. Wheaton, J. Cleymans and M. Hauer, Comput. Phys. Commun. 180, 84 (2009)

ALICE EMMI H-QM Helmholtz Research School Quark Matter Studies HGS-HIRe for FAIR Helmholtz Graduate School for Hadron and Ion Research HELMHOLTZ ASSOCIATION Alliance on Cosmic Matter in the Laboratory YILDIZ TEKNİK ÜNİVERSİTESİ 1911 GSI