Average transverse momenta of baryon production at p-p collider experiments and their crucial implications for HE hadroproduction physics

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Introduction

The standard phenomenological QGSM analysis of baryon production at proton-proton colliders led to new implications for the high energy hadroproduction physics.

The primary data on transverse momentum distributions of hyperons from ISR, STAR, ALICE, CMS and ATLAS on the energy scale 53, 200, 900 and 7000 GeV can be fitted in the framework of QGSM approach.

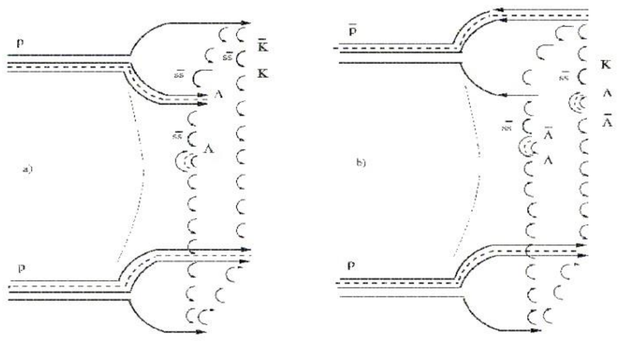
Average transverse momenta dependence on energy shows what happens with hadroproduction . The <Pt> growing with energy can prompt to more hadron states that supply the spectra with higher transverse momenta.

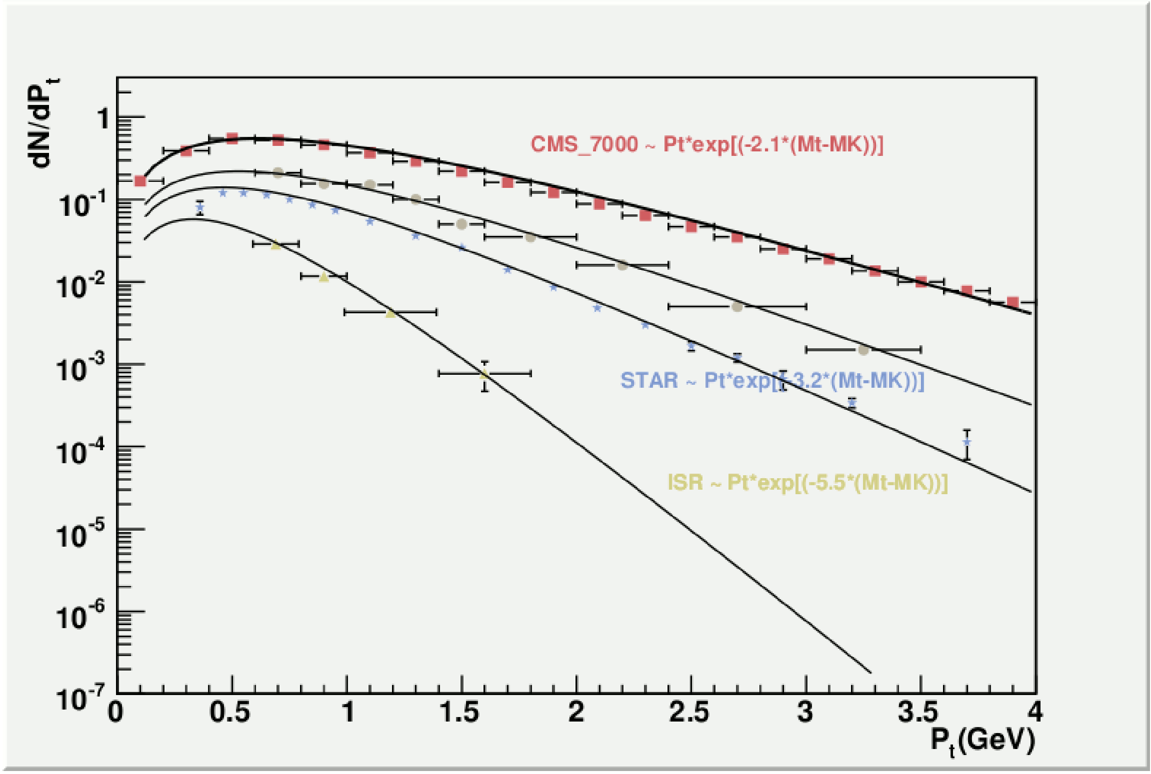
Recent data on heavy baryons and mesons are gathered and described. It is interesting to study the growing of average transverse momenta with the mass of hadrons in order to conclude on the baryon/meson symmetry at heavy quark masses.

The complicate form of baryon spectra at nonzero rapidity's can help with the identification of impact of extragalactic sources on the spectra of cosmic rays.

The baryon/antibaryon asymmetry is also included into analysis that opens a perspective of separating the different quark (diquark) contributions.

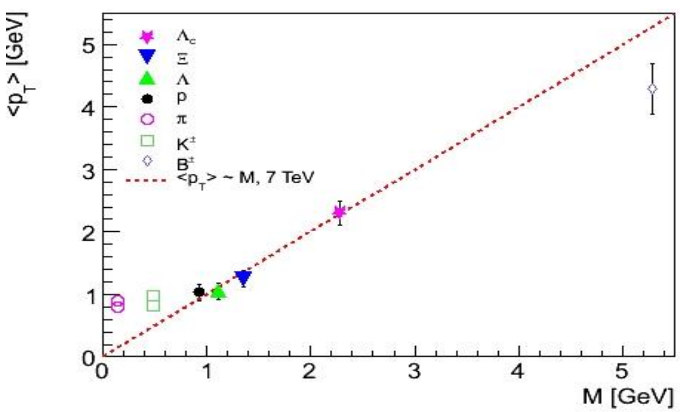
The baryon data from ISR, STAR, ALICE, CMS and ATLAS : QGSM fit

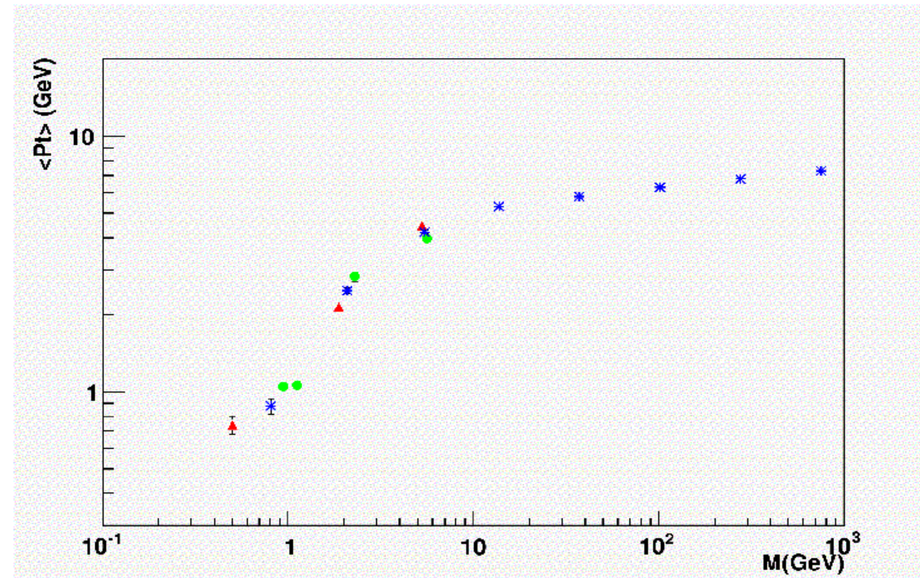


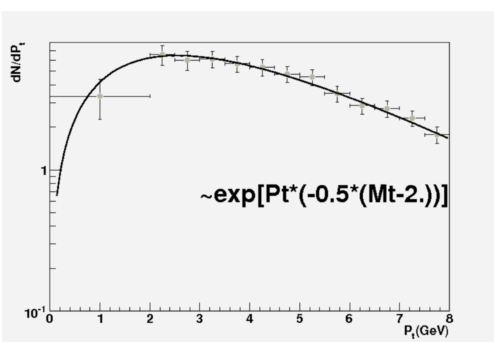


dN/dpt ~ pt*exp[-B(Mt-mK)]

Average <p_t> vs. mass: heavy baryon/meson symmetry





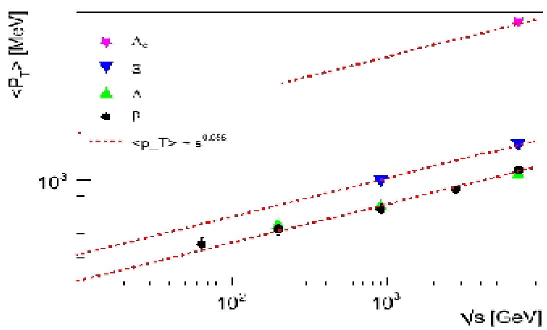


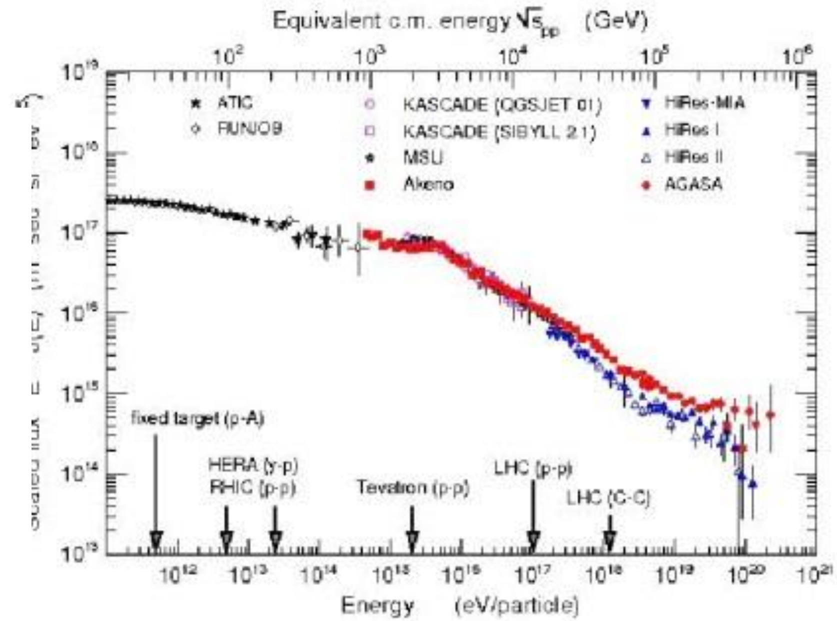
Average p_t dependence on hadron mass at 7 TeV (top left)

Mass dependence of <p_t> and a sequence of heavy hadrons: 0.73 ;1.99; 5.41; 14.7; 40.; 109. GeV (top right)

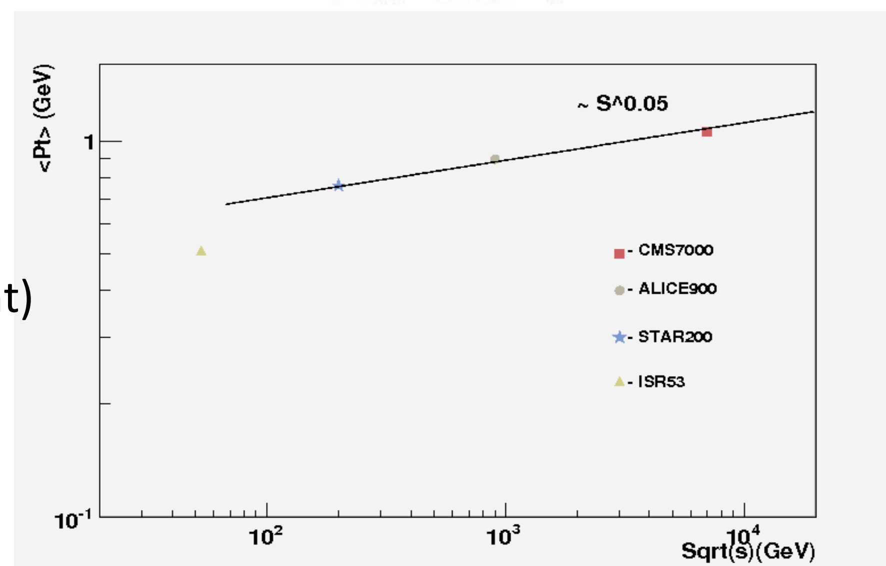
LHCb result on B-meson spectra and QGSM fit (bottom left)

Average <p_t> vs. energy: no important changes in hadroproduction

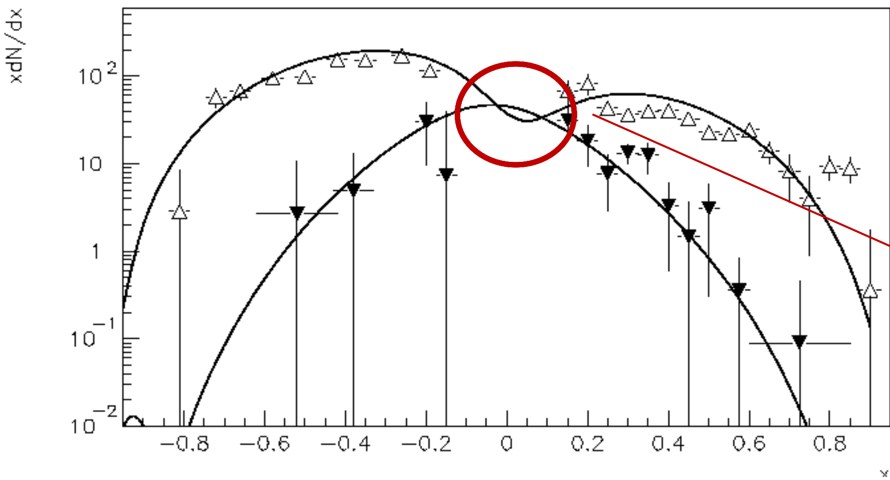


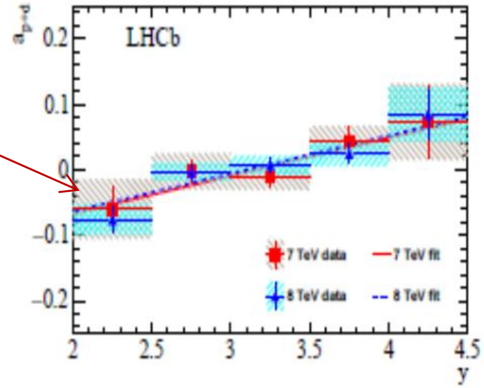


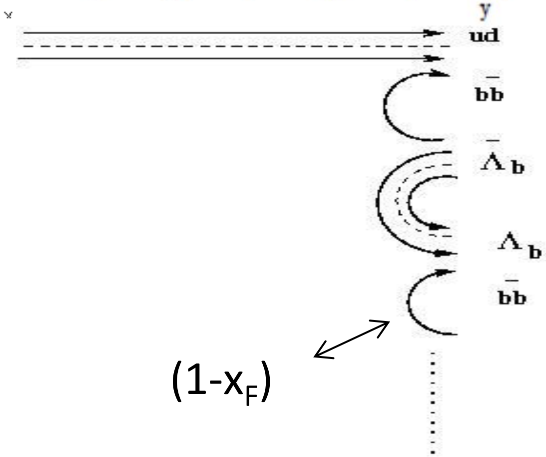
Energy dependence of <p_t> :
all sorts of hadrons (top left);
average transverse momenta of hyperon (top right)



Baryon spectra at -1< x_F<1 : contributions from diquark-antidiquark pairs and diquark fragmentation







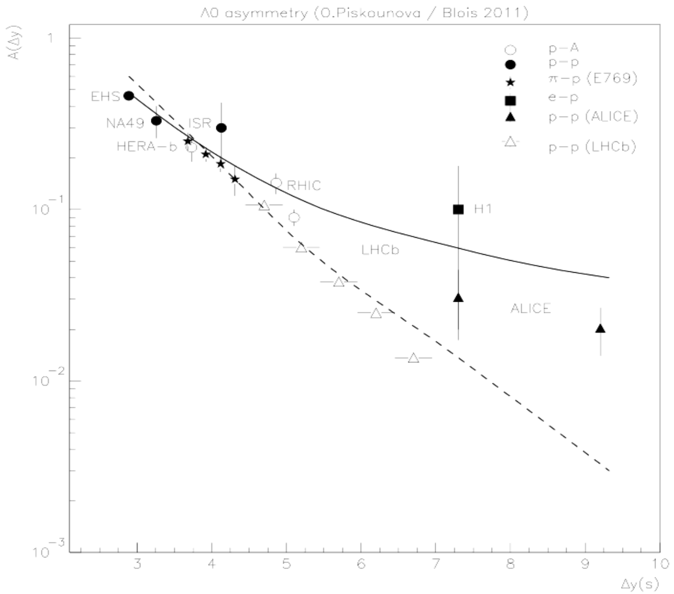
Λ_c production spectra in the full rapidity range for $\Sigma-p$ collision (top left picture);

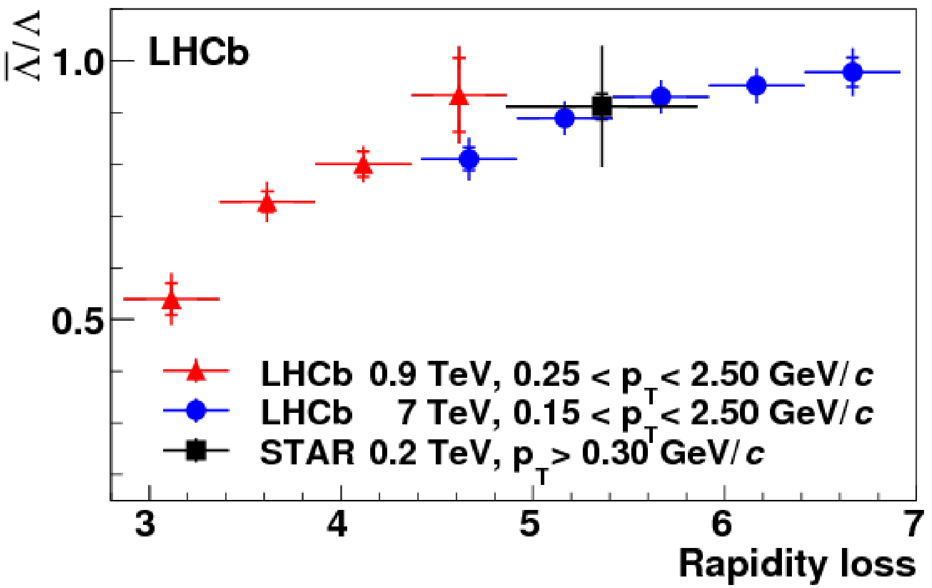
LHCb result for Λ_b /antiΛ_b asymmetry (top right);

QGSM diagram of leading diquark and diquark-antidiquark pair contributions into Λ_b spectrum (right).

Baryon/antibaryon asymmetry at central rapidity and String Junction

Nonzero asymmetry is still at LHC 7 TeV .
This asymmetry can be brought only by SJ !





Baryon spectra in laboratory system and antiparticle/particle asymmetry due to leading diquark fragmentation

n and antiproton spectra in the collider
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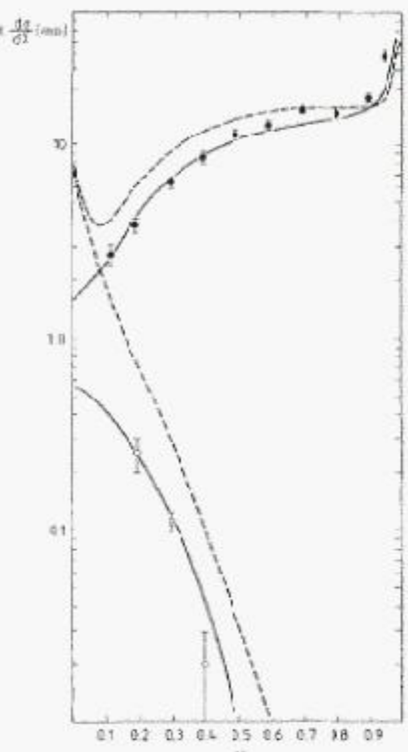
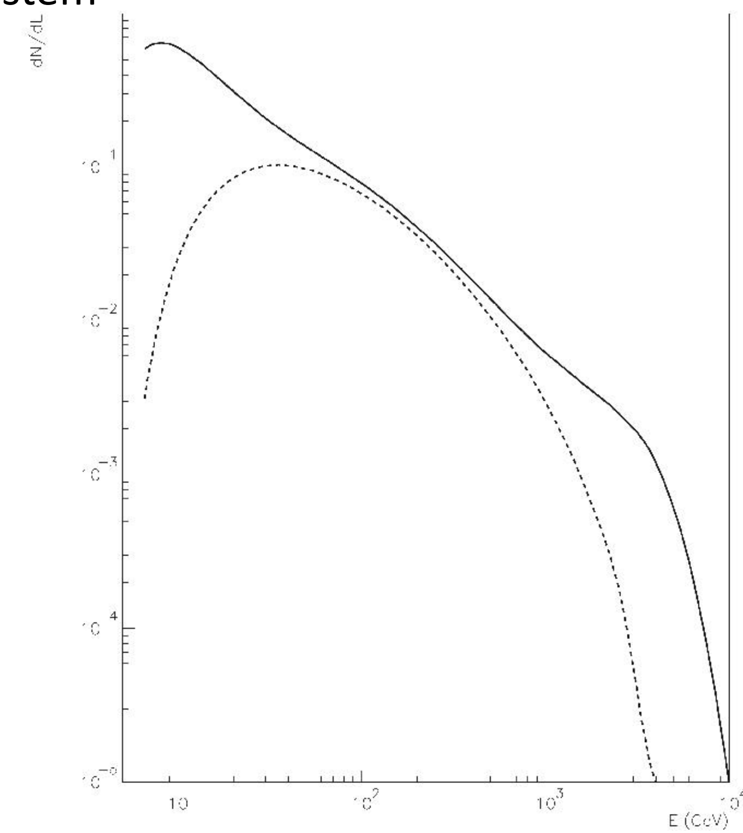


Baryon spectra in the laboratory system



Conclusions I

This study has shown how the routine analysis of collider data results in many crucial implications for the entire field of hadroproduction physics.

The detail consideration of results in transverse momentum distributions of hyperons has revealed the change in the slopes of spectra in the region of low Pt.

The spectra of baryons are becoming harder and harder with the energy growth from ISR(53 GeV) and RHIC (200 GeV) up to LHC (0,9 and 7 TeV).

The energy dependence of hyperon average p_t was calculated. These average values are slowly growing with energy with the power low ~ s^0.05. Thus it makes us conclude that processes , taking place in baryon production at the up-to-date energies of LHC, are not something unpredictable.

The average transverse momentum analysis through the different mass of hadrons reveals some regularity in the mass gaps between heavy quark baryon-meson generations. This observation gives us the possibility to suggest more hadrons with the masses ~ 13.7, 37.3, 101.5, 276, 750... GeV that are produced by geometrical progression with the mass multiplier of order $\Delta\{\ln M\} = 1$ and may possess new quantum numbers. The existence of such hadronic states supports the change in the slopes of transverse momentum distributions and the growing of average transverse momenta with energy.

Conclusions II

The baryon/antibaryon asymmetries that have been already measured in LHC experiments are the most promising subject for the further study.

The leading character of baryon spectra causes the asymmetry in production of baryons vs. antibaryons in the laboratory system of measurements. Growing charge ratios of secondary particle spectra in CR have resulted from the baryon production in the CR interactions with positive matter targets.

The studies of baryon-to-meson ratios in nucleus-nucleus reaction have to use the baryon spectrum calculations in order to explain the registered "baryon anomaly" in nucleus-nucleus interactions. The leading form of baryon spectra can provide the extra baryons, migrated from the diquark fragmentation area of spectra into the intermediate p_t region due to jet suppression processes in nuclear environment.

The negative baryon/antibaryon asymmetry at nonzero rapidity is the result of interplay of central baryon production and leading production in the diquark fragmentation.