

News on identified hadron production in central nucleus-nucleus collisions from NA61/SHINE at CERN SPS



Oleksandra Panova for the NA61/SHINE Collaboration

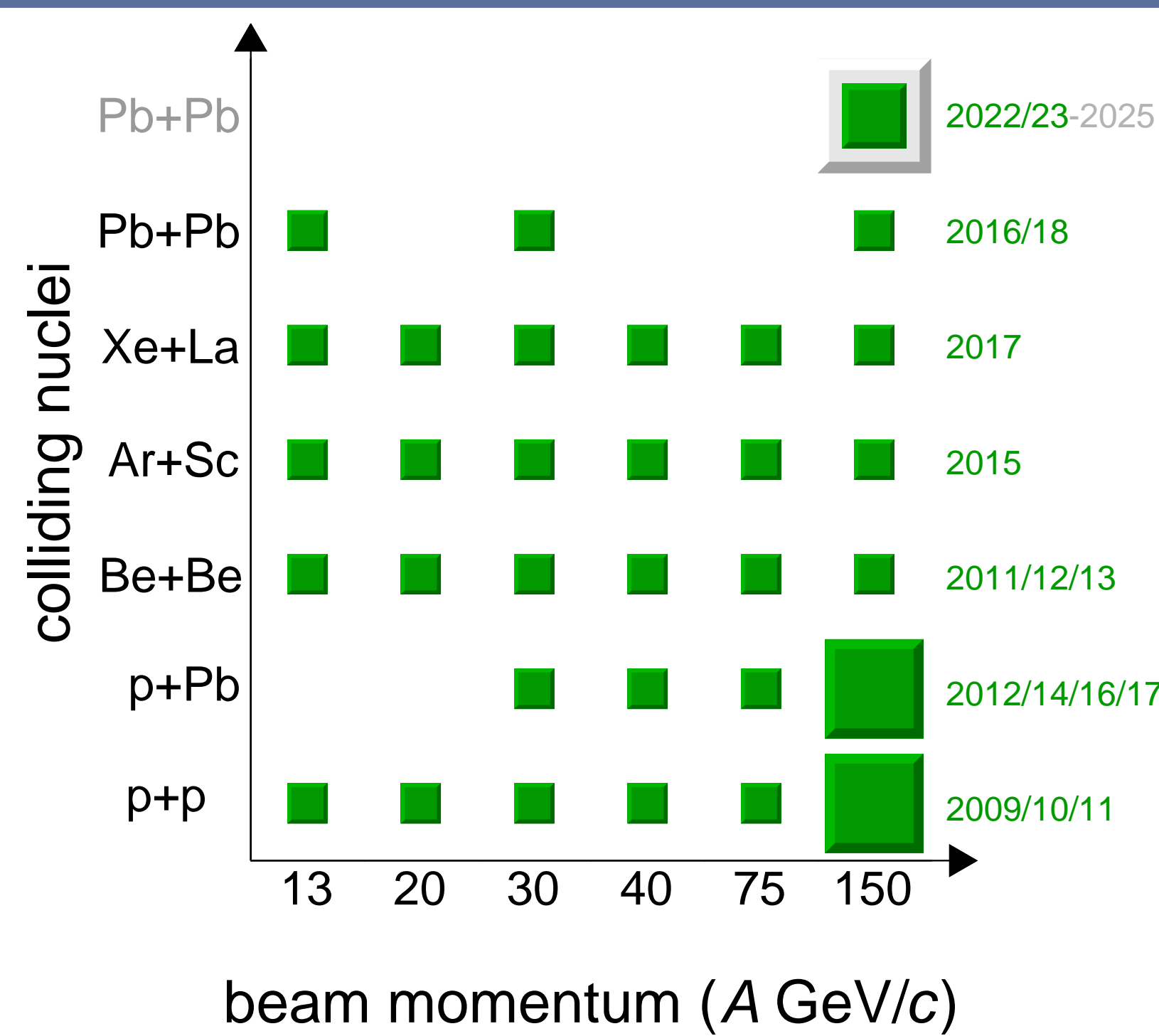
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1. Introduction

This poster presents results on spectra and mean multiplicities of π^- , K^+ , and K^- produced in the central $^{129}\text{Xe}+^{139}\text{La}$ collisions at beam momenta $30A - 150A$ GeV/c ($\sqrt{s_{NN}} = 7.62 - 16.83$ GeV). These studies are the part of the strong interaction program of NA61/SHINE at the CERN SPS investigating the properties of the onset of deconfinement and searching for the possible existence of the critical point. The program is mainly motivated by the observed rapid changes in hadron production properties in central Pb+Pb collisions at about $30A$ GeV/c by the NA49 experiment [PRC 77 024903, 2008]. These findings were interpreted as due to the onset of deconfinement. Current results of NA61/SHINE for lighter systems [EPJ C 74 2794, 2014; EPJ C 77 671, 2017; EPJ C 80 961, 2020; EPJ C 81 73, 2021; EPJ C 81 397, 2021; EPJ C 84 416, 2024] do not show indications of the horn structure. However, enhancement of the K^+/π^+ ratio was observed for Ar+Sc compared to $p+p$ and Be+Be. Therefore, Xe+La, as a system with a size between Ar+Sc and Pb+Pb, is crucial for the NA61/SHINE strong interaction program.

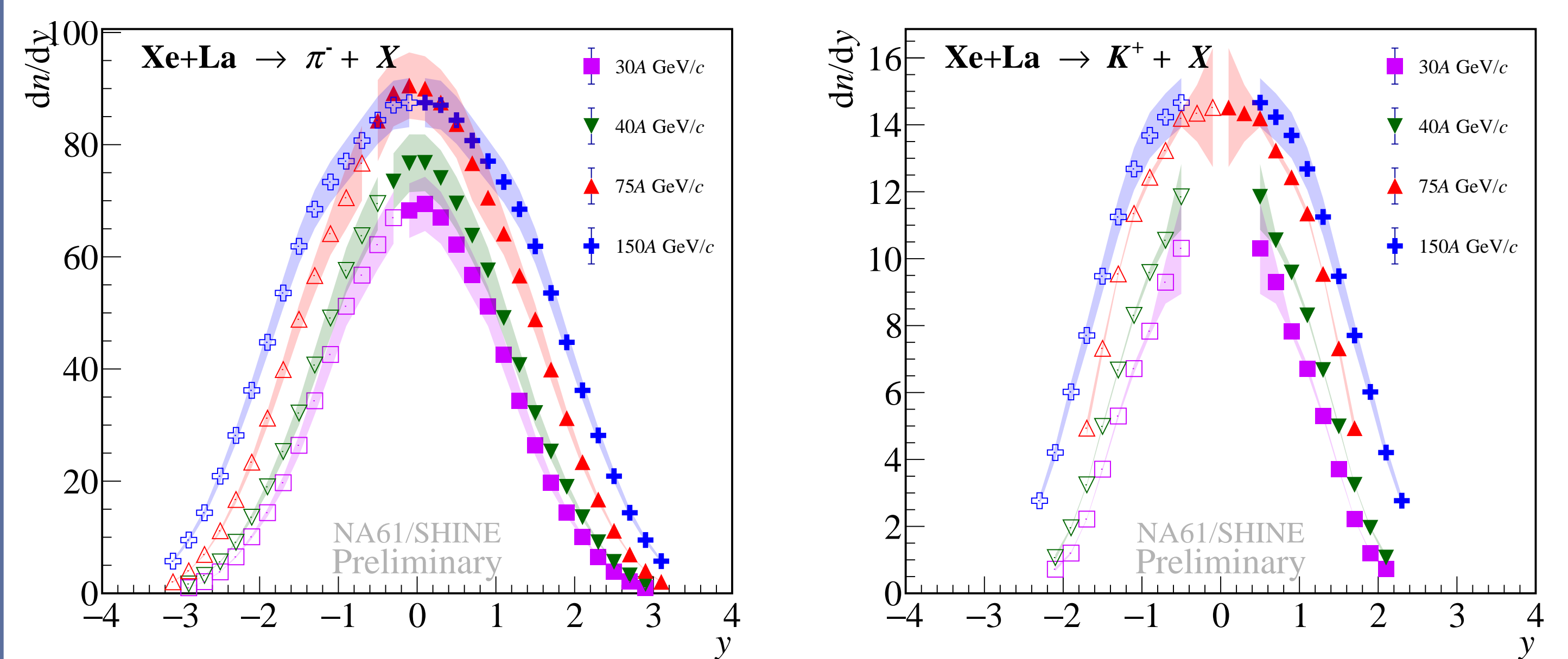
2. System size and energy scan

The NA61/SHINE strong interaction program includes 2D scan in beam momentum ($13A - 150(158)A$ GeV/c, corresponding $\sqrt{s_{NN}} = 5.12 - 16.8(17.3)$ GeV) and system size ($p+p$, $^7\text{Be}+^9\text{Be}$, $^{40}\text{Ar}+^{45}\text{Sc}$, $^{129}\text{Xe}+^{139}\text{La}$, $^{208}\text{Pb}+^{208}\text{Pb}$) to study the properties of the onset of deconfinement and search for the critical point of strongly interacting matter.



5. Rapidity spectra and multiplicities

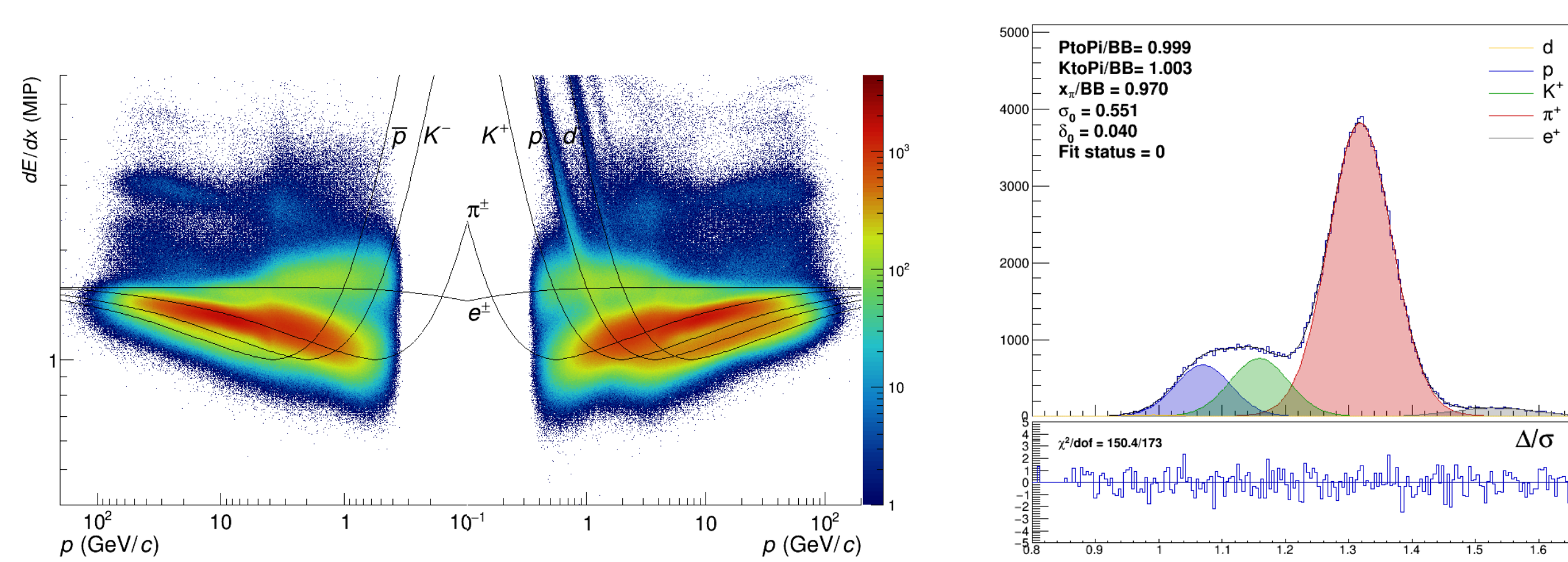
dn/dy spectra of π^- and K^+ :



3. Methods of particle identification

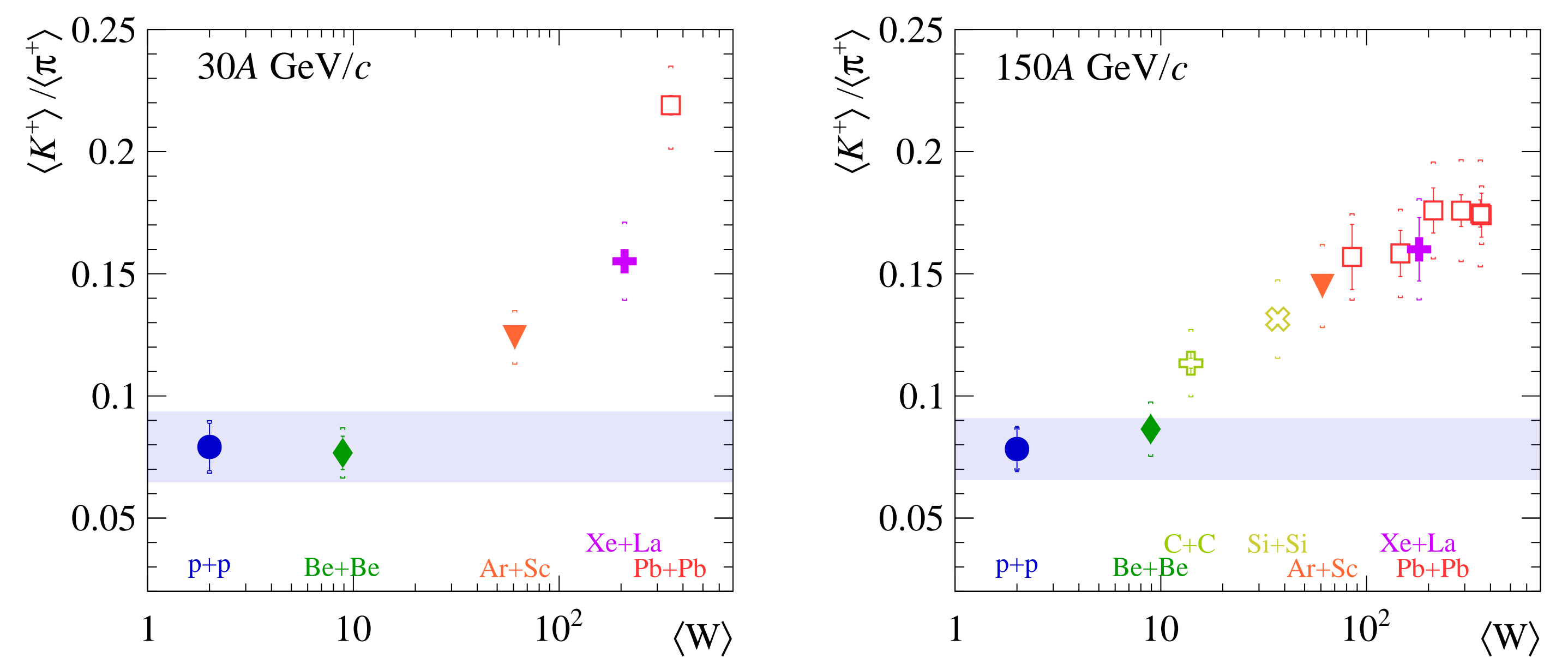
Two ways of particle identification were used for the presented analysis:

- dE/dx particle identification for K^\pm is based on the dependence of the ionization energy loss of particle on its momentum. This method does not work for momenta smaller than 5 GeV/c. Distribution of charged particles in the $dE/dx - p$ plane and fit example:



- h^- method for π^- . The majority of negatively charged particles created in the collision are pions; therefore, $d^2n/dydp_T$ spectrum of π^- may be calculated from h^- reconstructed spectrum using MC correction. Advantage of method – no cut on momentum like for dE/dx ; hence, this method gives maximal possible acceptance.

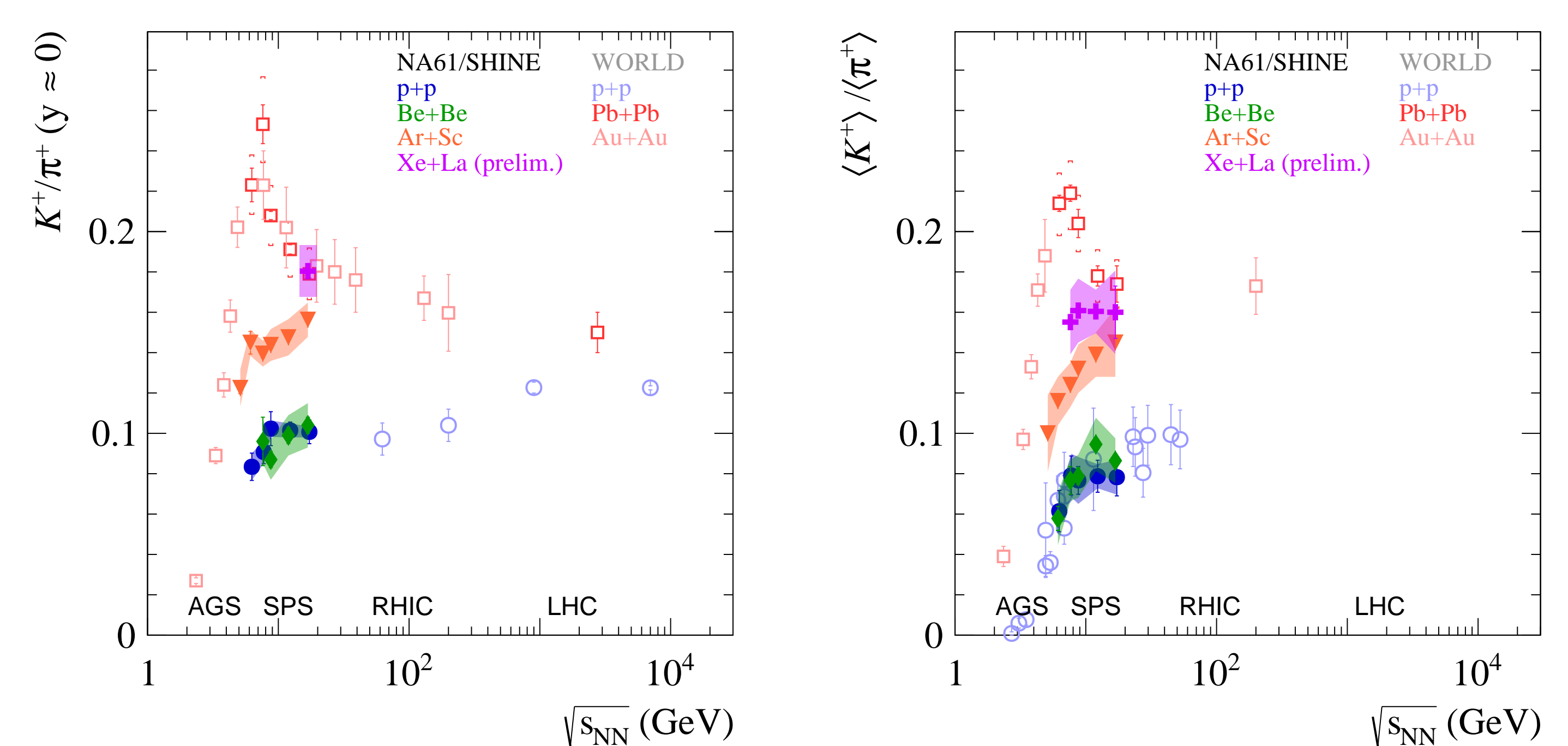
System size dependence of the $\langle K^+ \rangle / \langle \pi^+ \rangle$ at $30A$ and $150A$ GeV/c:



$\langle \pi^+ \rangle$ was estimated from $\langle \pi^- \rangle$ using isospin correction factor calculated from MC.

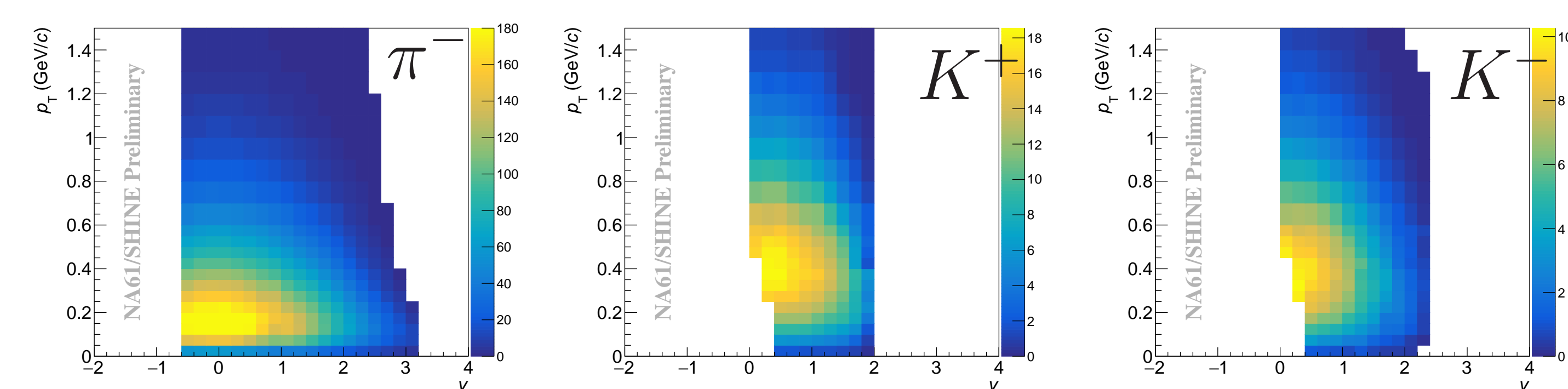
$\langle W \rangle$ – mean number of wounded nucleons.

Energy dependence of the K^+/π^+ ratio at $y \approx 0$ and $\langle K^+ \rangle / \langle \pi^+ \rangle$:

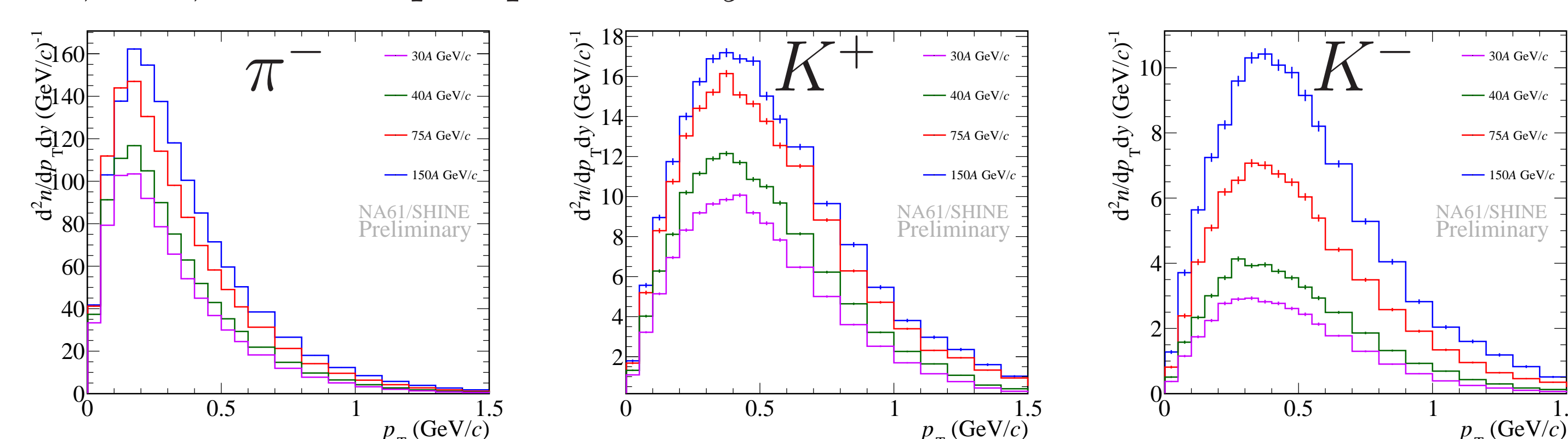


4. Results

$d^2n/dydp_T$ spectra of π^- , K^+ , and K^- at $75A$ GeV/c:



π^- , K^+ , and K^- p_T spectra at $y = 1.0 - 1.2$:



The 10% most central collisions were selected at $30A - 75A$ GeV/c and 20% at $150A$ GeV/c.

6. Conclusions

- Preliminary results on spectra and yields of π^- , K^+ , and K^- produced in central Xe+La collisions at $30A - 150A$ GeV/c are presented.
- Values of the K^+/π^+ at $y \approx 0$ and $\langle K^+ \rangle / \langle \pi^+ \rangle$ ratios for Xe+La are between corresponding values for Ar+Sc and Pb+Pb.

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