First results on spectra of identified hadrons in central Xe+La collisions from NA61/SHINE at CERN SPS

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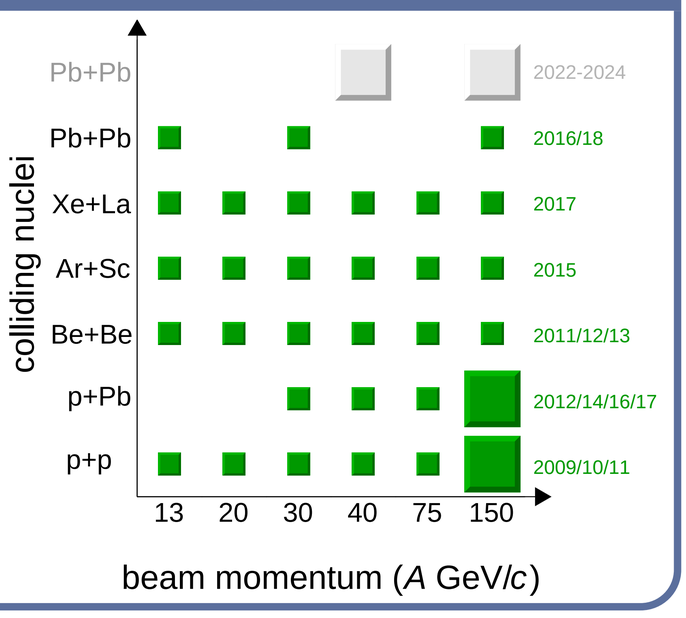
1. Introduction

This poster presents results on spectra and mean multiplicities of π^-, K^+ and K^- produced in the 20% most central ^{129}Xe+^{139}La collisions at the beam momentum 150A GeV/c ($\sqrt{s_{NN}} = 16.8$ GeV). These studies are the part of the strong interactions program of NA61/SHINE at the CERN SPS investigating the properties of the onset of deconfinement and searching for the possible existence of a 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 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; CERN-EP-2023-179] do not show any indications of the horn structure, however enhancement of the K^+/π^+ ratio was observed for Ar+Sc. Therefore, Xe+La, as a system with size between Ar+Sc and Pb+Pb, is crucial for the NA61/SHINE strong interaction program.

2. System size and energy scan

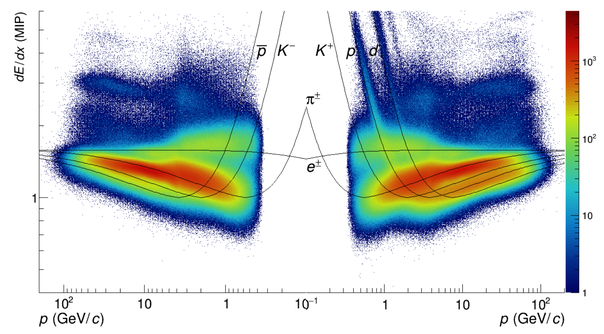
The NA61/SHINE heavy ion program includes 2D scan in beam momentum ($13A - 150(158)A$ GeV/c, corresponding $\sqrt{s_{NN}} = 5.12 - 16.8(17.3)$ GeV) and system size (p+p, ^{7}Be+^{9}Be, ^{40}Ar+^{45}Sc, ^{129}Xe+^{139}La, ^{208}Pb+^{208}Pb) to study the onset of deconfinement and search of the critical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

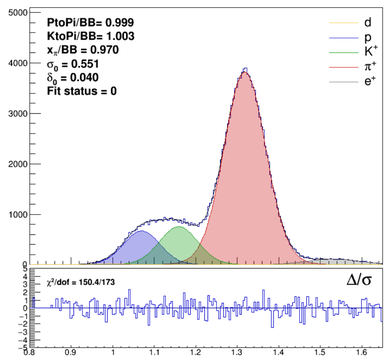


3. Methods of particle identification

Two ways of particle identification were used for the analysis:

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

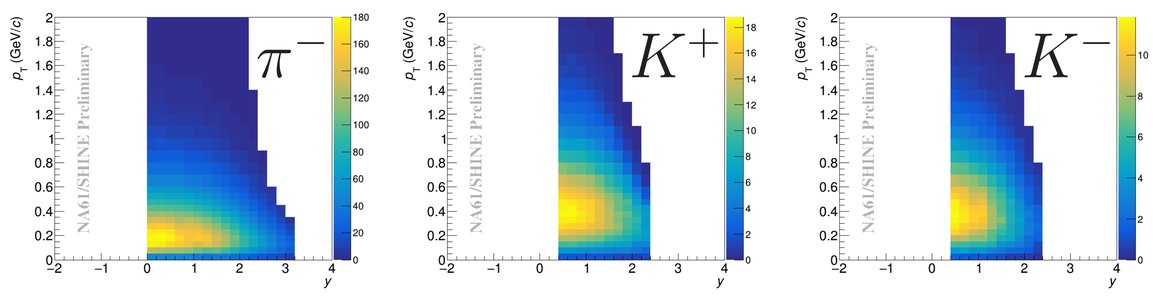




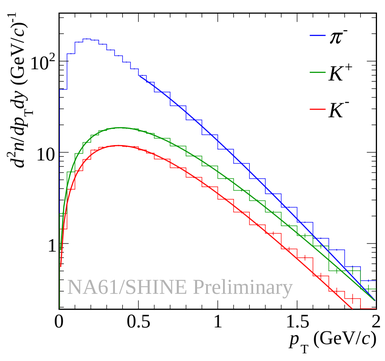
- h^- method for π^-. Majority of negatively charged particles created in the collision are pions, therefore $d^2n/dydp_T$ spectrum of π^- may be calculated from h^- reconstructed spectrum using MC correction. Advantage of method – no cut on momentum like for dE/dx, therefore this method gives maximal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

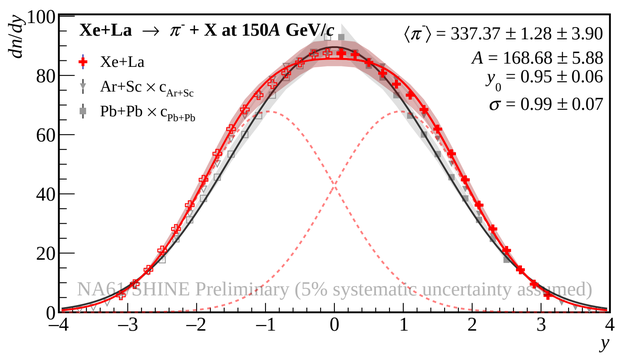
4. Results

Corrected $d^2n/dydp_T$ spectra of π^-, K^+ and K^-:



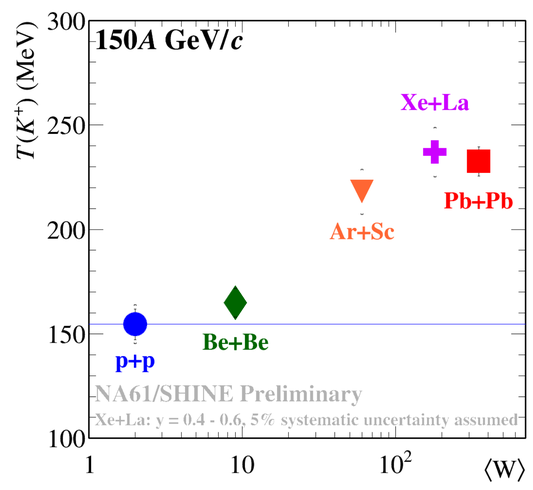
$K^\pm$ and π^- p_T spectra at $y = 0.4 - 0.6$ and dn/dy spectrum of π^-:

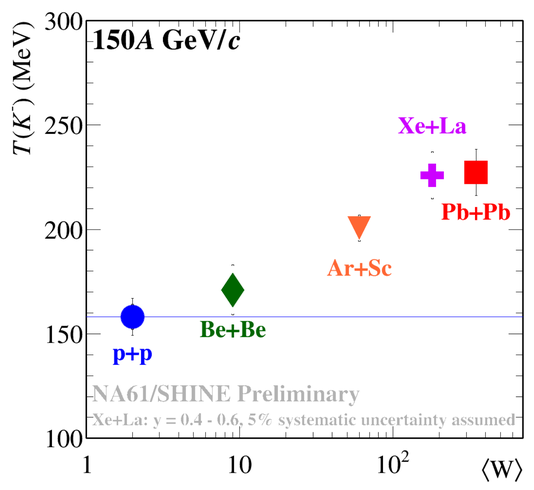




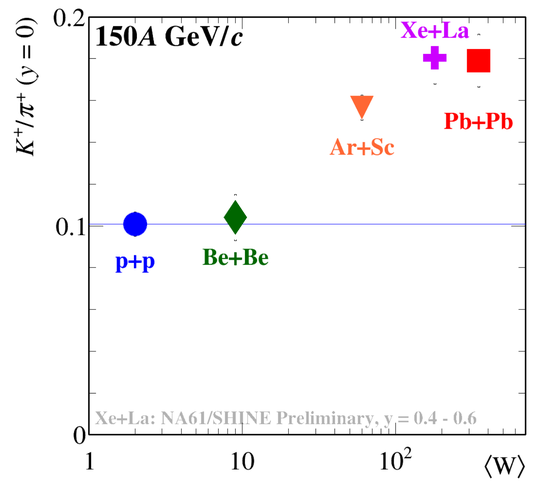
5. System size dependence

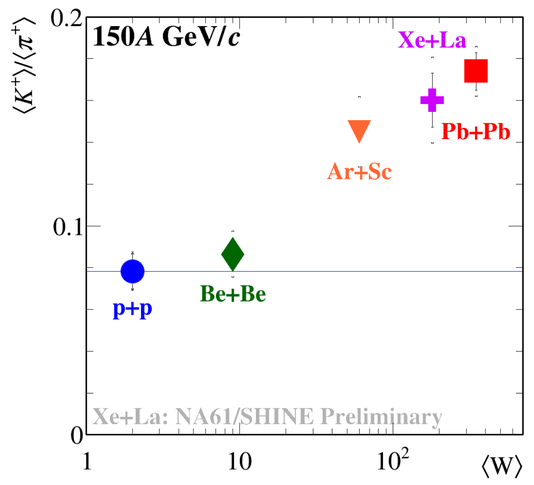
The inverse slope parameter (T) of the p_T spectra of $K^\pm$ at midrapidity:



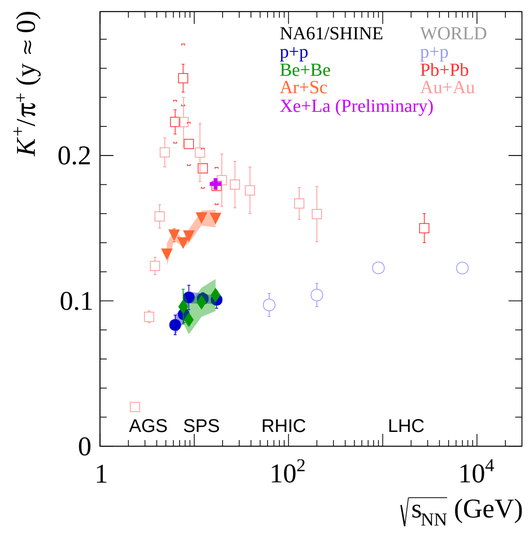


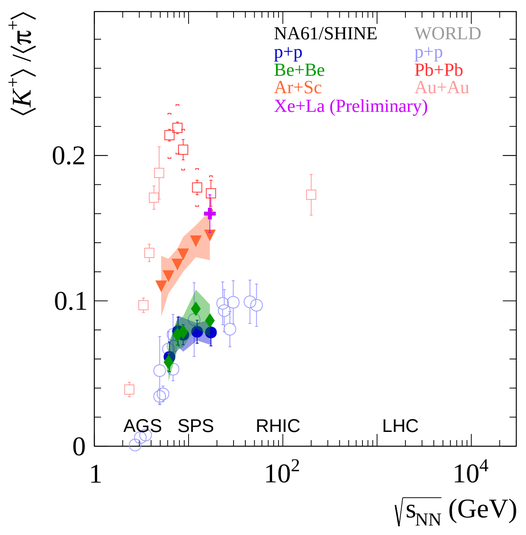
System size dependence of the K^+/π^+ ratio at $y = 0$ and $\langle K^+\rangle/\langle\pi^+\rangle$:





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





$\langle K^-\rangle = 28.1 \pm 3.2 \pm 3.8$, $\langle K^+\rangle = 52.0 \pm 4.2 \pm 6.7$,
$\langle\pi^-\rangle = 337.4 \pm 1.3 \pm 3.9$, $\langle\pi^+\rangle = 324.9 \pm 1.2 \pm 3.8$,
$\langle\pi^+\rangle$ was estimated from $\langle\pi^-\rangle$ using correction factor calculated from MC.

6. Conclusions

- First results on spectra and total yields of π^-, K^+ and K^- at 150A GeV/c are presented.
- Values of the K^+/π^+ ratio at $y = 0$ and $\langle K^+\rangle/\langle\pi^+\rangle$ for Xe+La are between corresponding values for Ar+Sc and Pb+Pb.
- The inverse slope parameter of the p_T spectra of $K^\pm$ at midrapidity for Xe+La is close to Pb+Pb.

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