Production of pions, kaons and protons in Xe–Xe collisions at $\sqrt{s_{\mathrm{NN}}} = 5.44$ TeV

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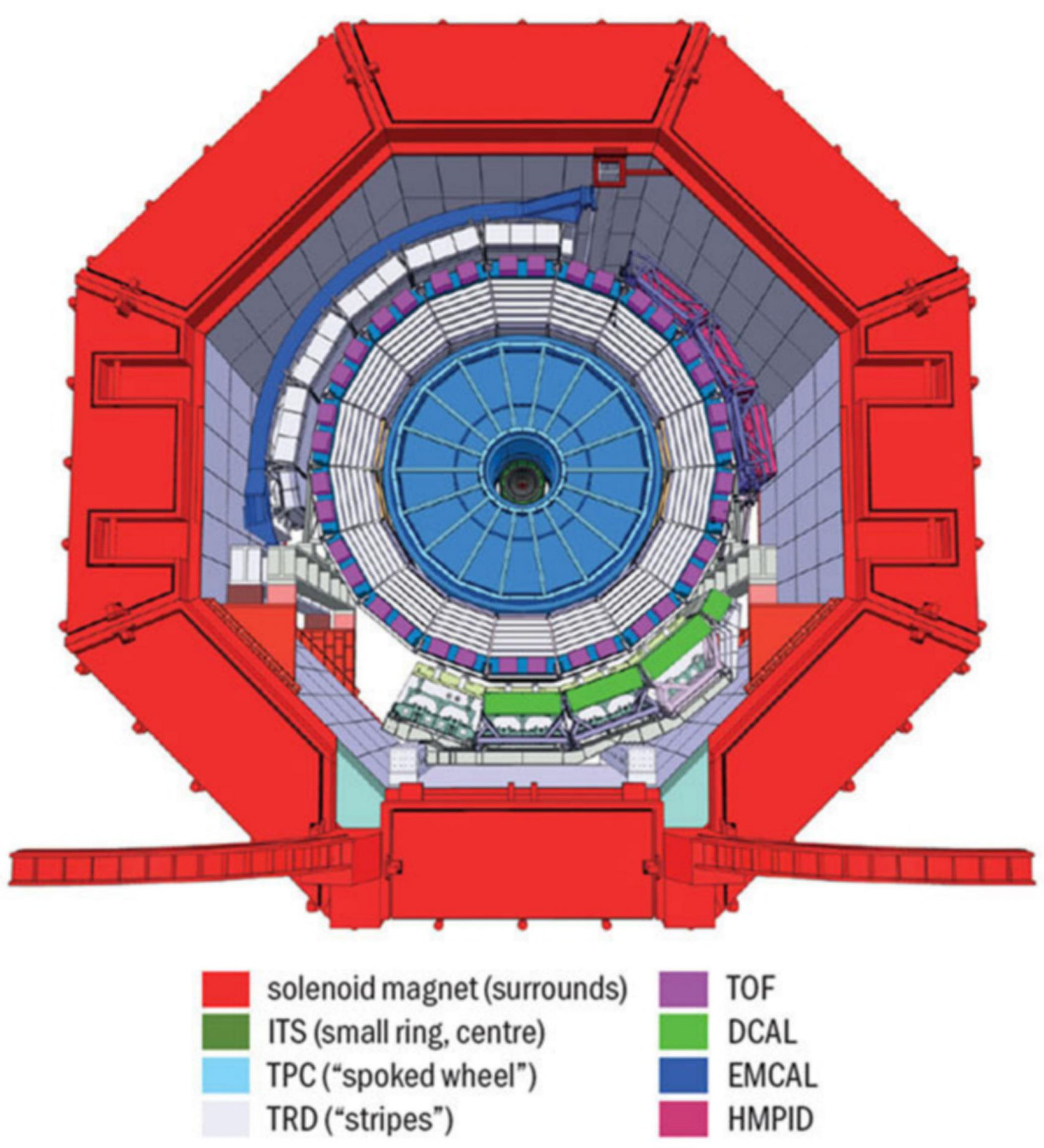
A Large Ion Collider Experiment

ABSTRACT

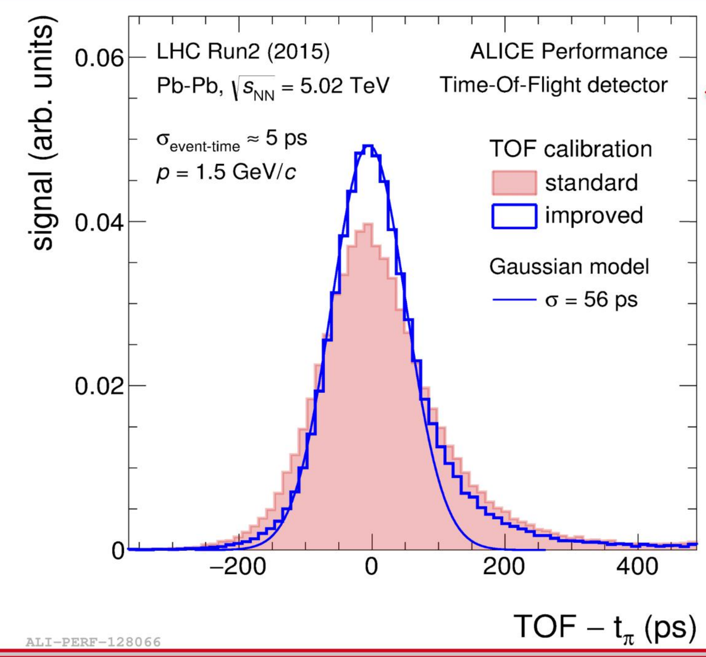
In late 2017, the ALICE collaboration recorded data from Xe-Xe collisions at the unprecedented energy in AA systems of $\sqrt{s_{\mathrm{NN}}} = 5.44$ TeV. The p_{T}-spectra at mid-rapidity ($|y| < 0.5$) of pions, kaons and protons are presented. The final p_{T}-spectra are obtained by combining independent analyses with the Inner Tracking System (ITS), the Time Projection Chamber (TPC), and the Time-Of-Flight (TOF) detectors. This presentation focuses on the details of the analysis performed with TOF and in particular on the performance implications of the special Xe-Xe run conditions. The peculiarity of these data comes from the experimental conditions: because of the lower magnetic field ($B = 0.2$ T, less than the usual 0.5 T) we expect to explore a p_{T} region unattainable before. A comparison between the yields at different centrality bins will also be provided.



The ALICE detector is dedicated to heavy ion physics at the LHC. Its main task is to investigate the properties of the strongly interacting, dense and hot matter created in high-energy heavy-ion collisions: the QGP. Its strong point is the Particle IDentification (PID) using different and complementary techniques. To obtain the complete spectra of the charged π, K, and p, different subdetectors (namely ITS, TPC and TOF as shown above) have been combined, keeping track of the momenta ranges where they can be used, as shown below.

	pions GeV/c	kaons GeV/c	protons GeV/c
ITS	0.08 - 0.70	0.20 - 0.45	0.30 - 0.5
TPC	0.25 - 0.70	0.25 - 0.45	0.40 - 0.80
TOF	0.40 - 5	0.40 - 5	0.50 - 5

Tab: p_{T} ranges where the subdetectors have been considered



TOF SIGNAL

$1.6 \cdot 10^5$ channels $|\eta| < 0.9$

$$\sigma_{TOF} = 56 \text{ ps}$$

The shape of the TOF time signal can be described with a Gaussian function plus a right exponential tail. The resolution associated to the Gaussian component was determined via a fit to data and corresponds to about 56 ps. The performance is the same for both Pb–Pb and Xe–Xe collisions.

Fig: TOFβ against p for the Xe–Xe data

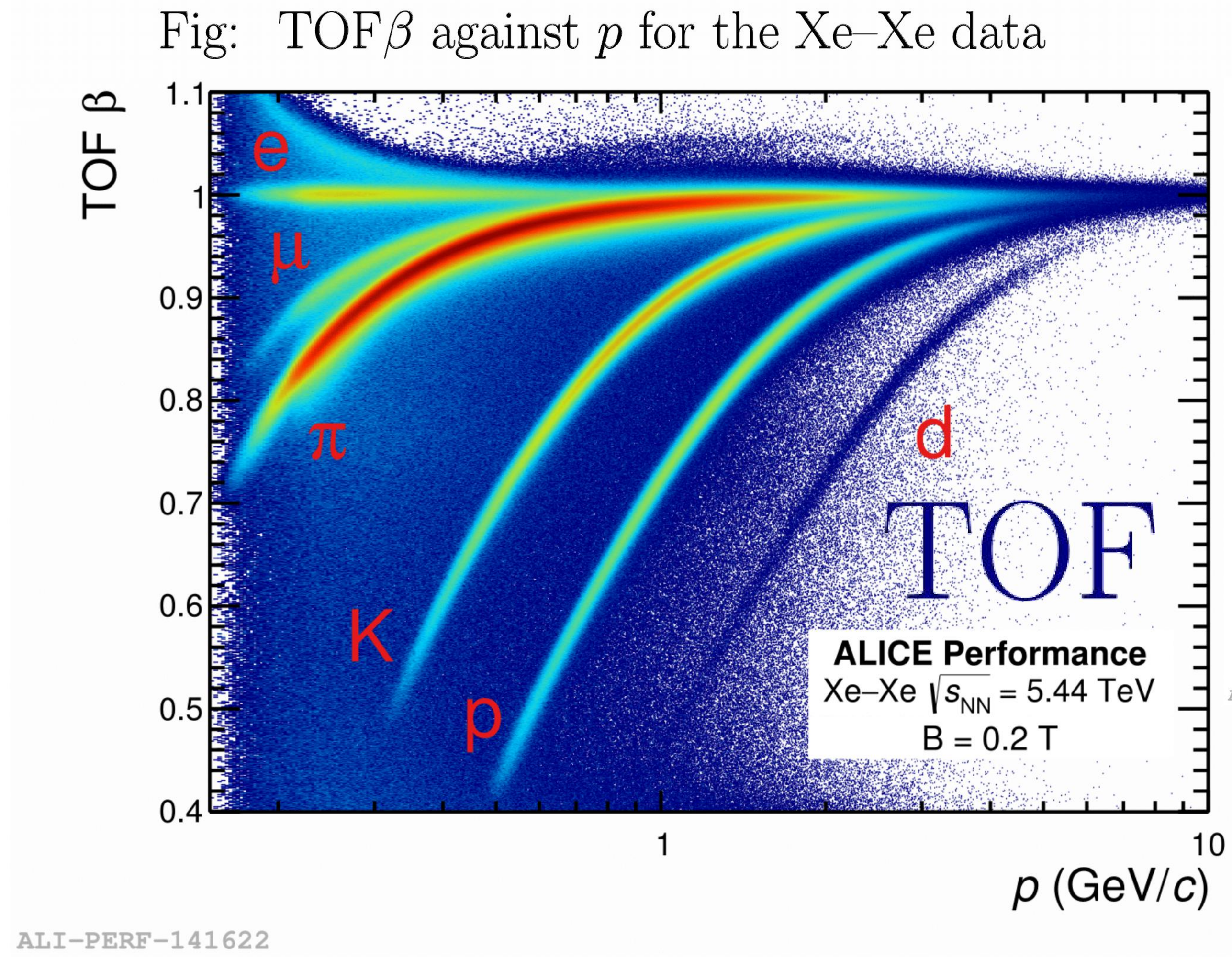
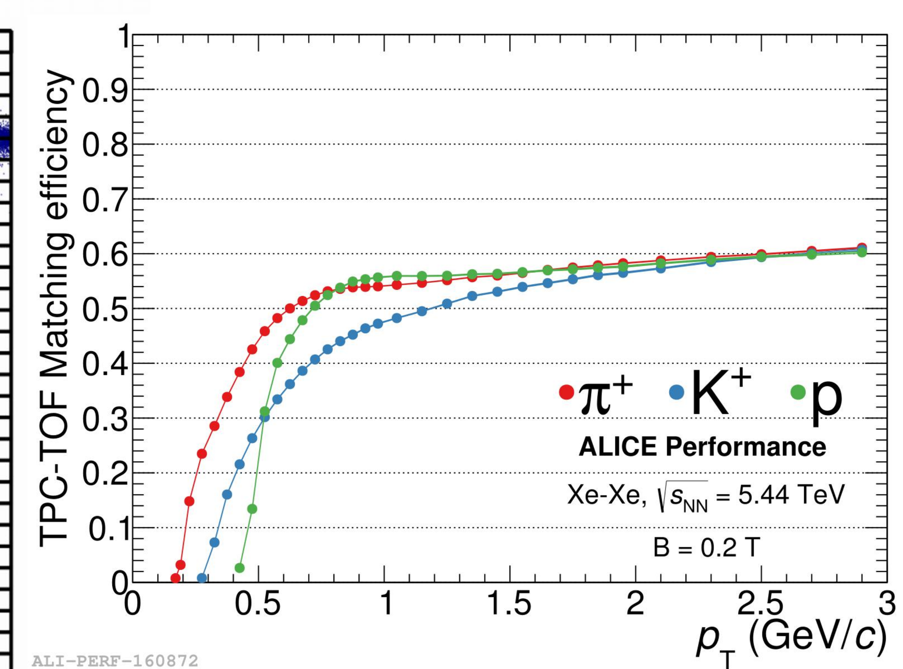


Fig: TOF matching efficiency



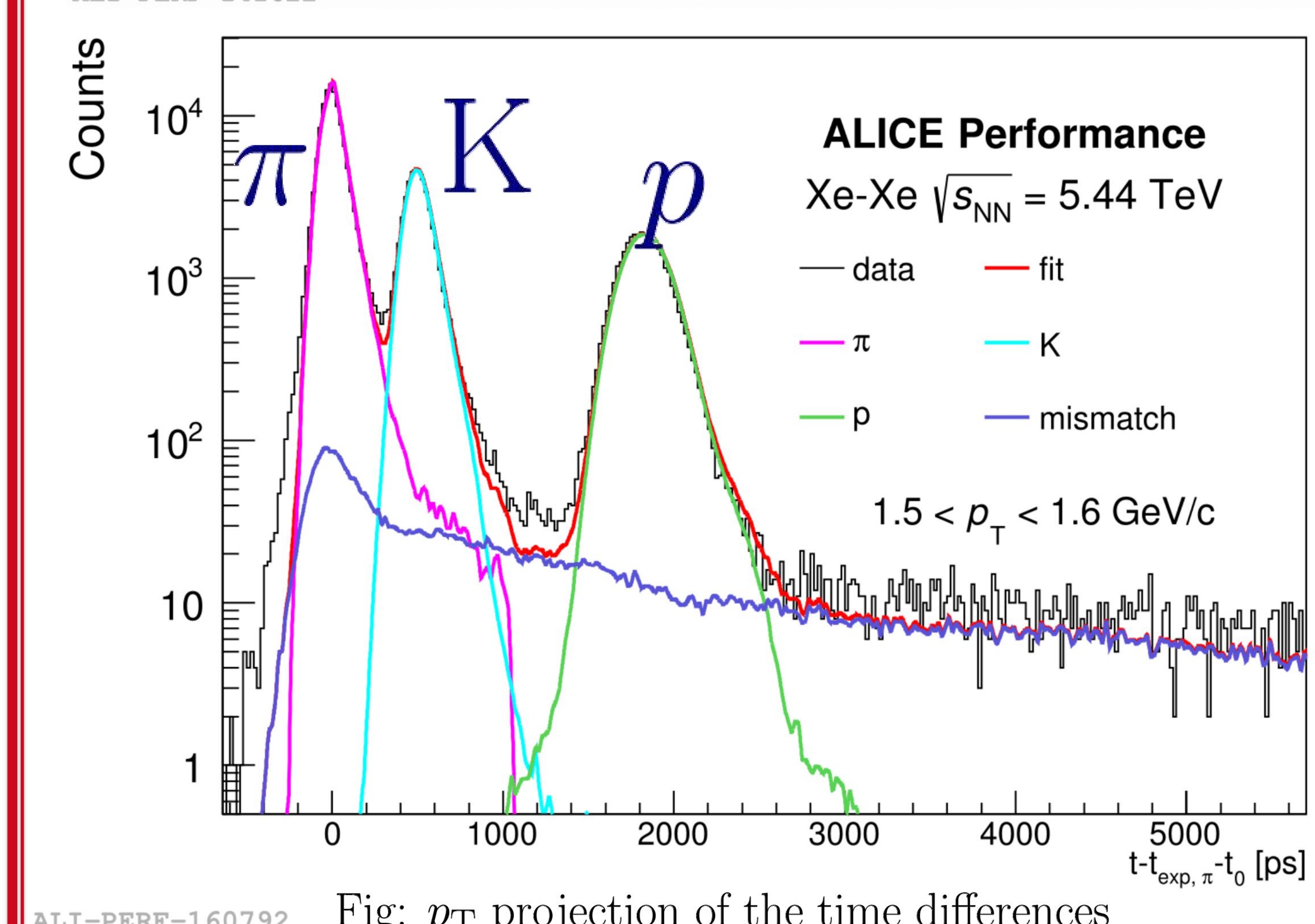
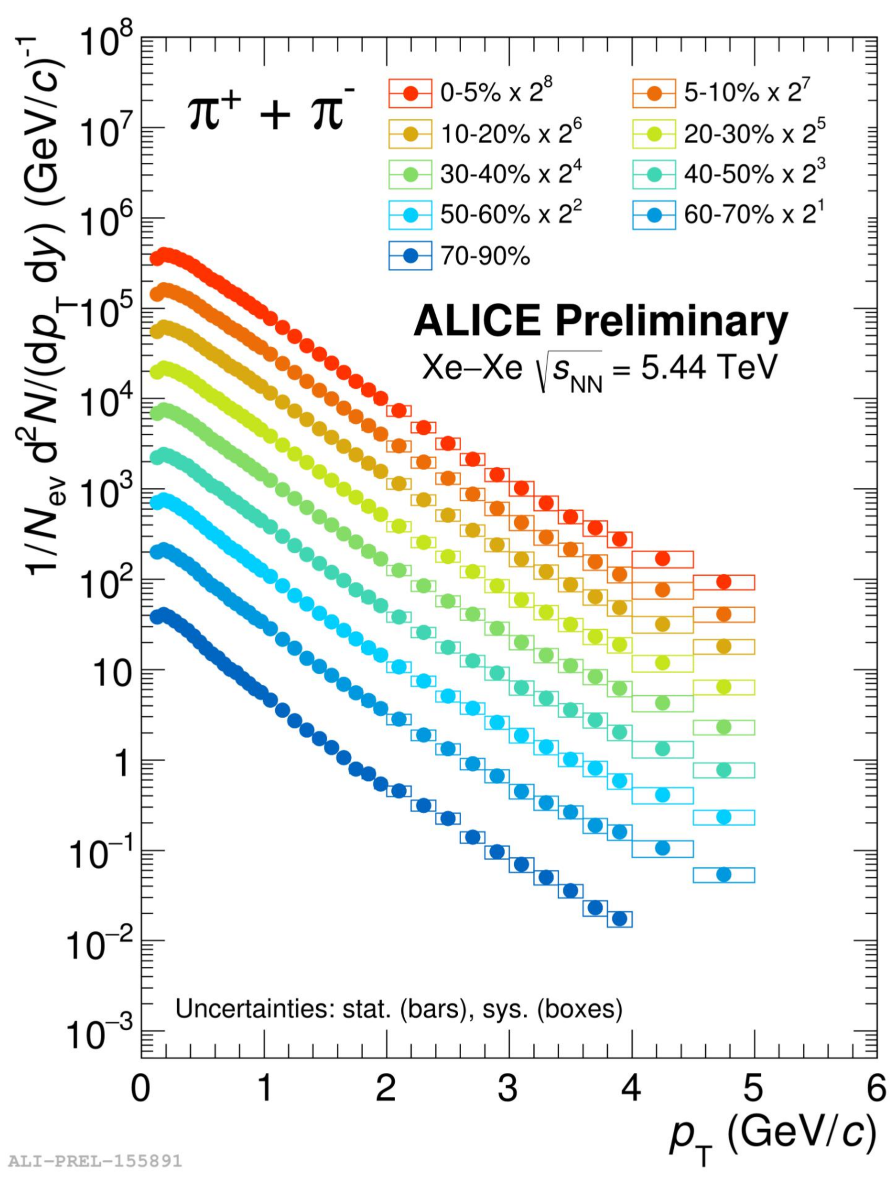
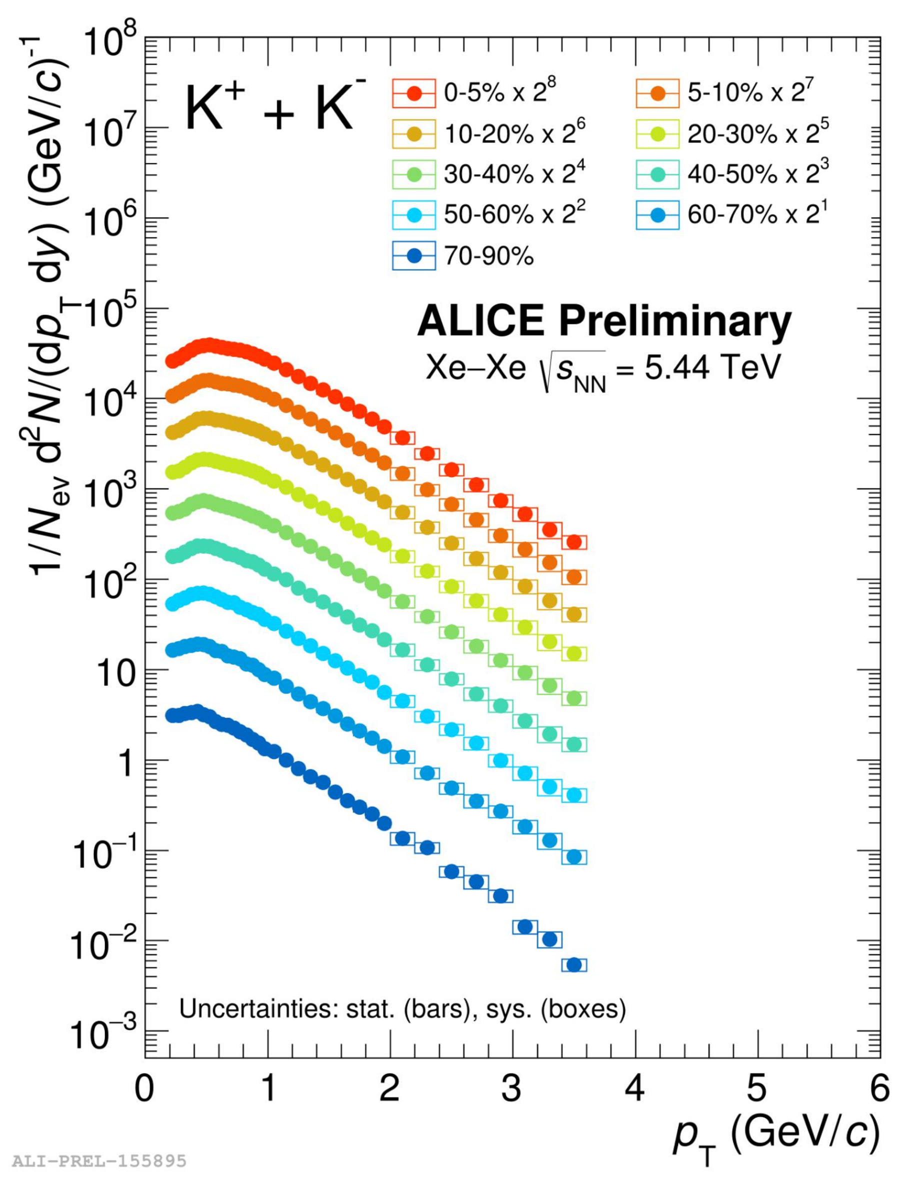
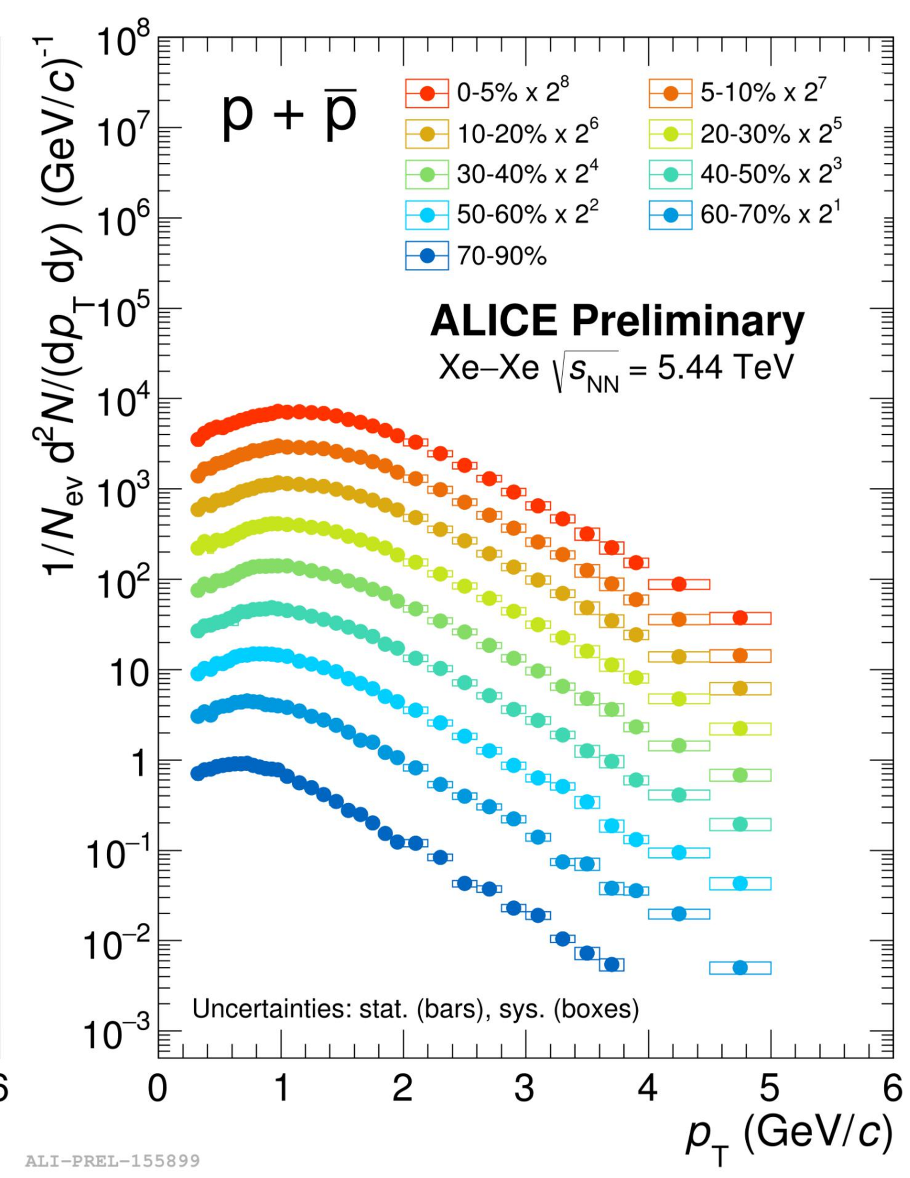


Fig: p_{T} projection of the time differences

Turning to the TOF analysis, the focus of this presentation, it can be said that the starting point for the extraction of pion, kaon, and proton spectra is the investigation of the variable $t - t_{EXP,i} - t_0$ where the i index is the species of interest, whether it be pions, kaons or protons. Once the particle type has been fixed, the projection of the time difference is studied for each p_{T}-bin separately. The approach is to fit the obtained shapes with a set of carefully tuned templates. In this analysis, not only templates from pions, kaons, and protons were considered, but also from electrons, muons, and deuterons in order to achieve the necessary precision for the raw yield extraction of the particles under study.







The spectra present the same features we expect from radial flow, such as how the spectra gets harder and harder going from peripheral to more central collisions, and how this effect is stronger for heavier particles, i.e. going from pions to protons.

COMBINED CORRECTED SPECTRA