Yields of Pion, Kaon, and Proton Production in p-Pb Collisions at $\sqrt{s_{\mathrm{NN}}} = 8.16$ TeV

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ALICE

About Me

Name:
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Education:
Bachelor of Science in Physics and Mathematics,
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CERN Summer Studentship:
High Momentum Particle Identification Detector (HMPID) group at the ALICE collaboration

After CERN?
PhD in Physics

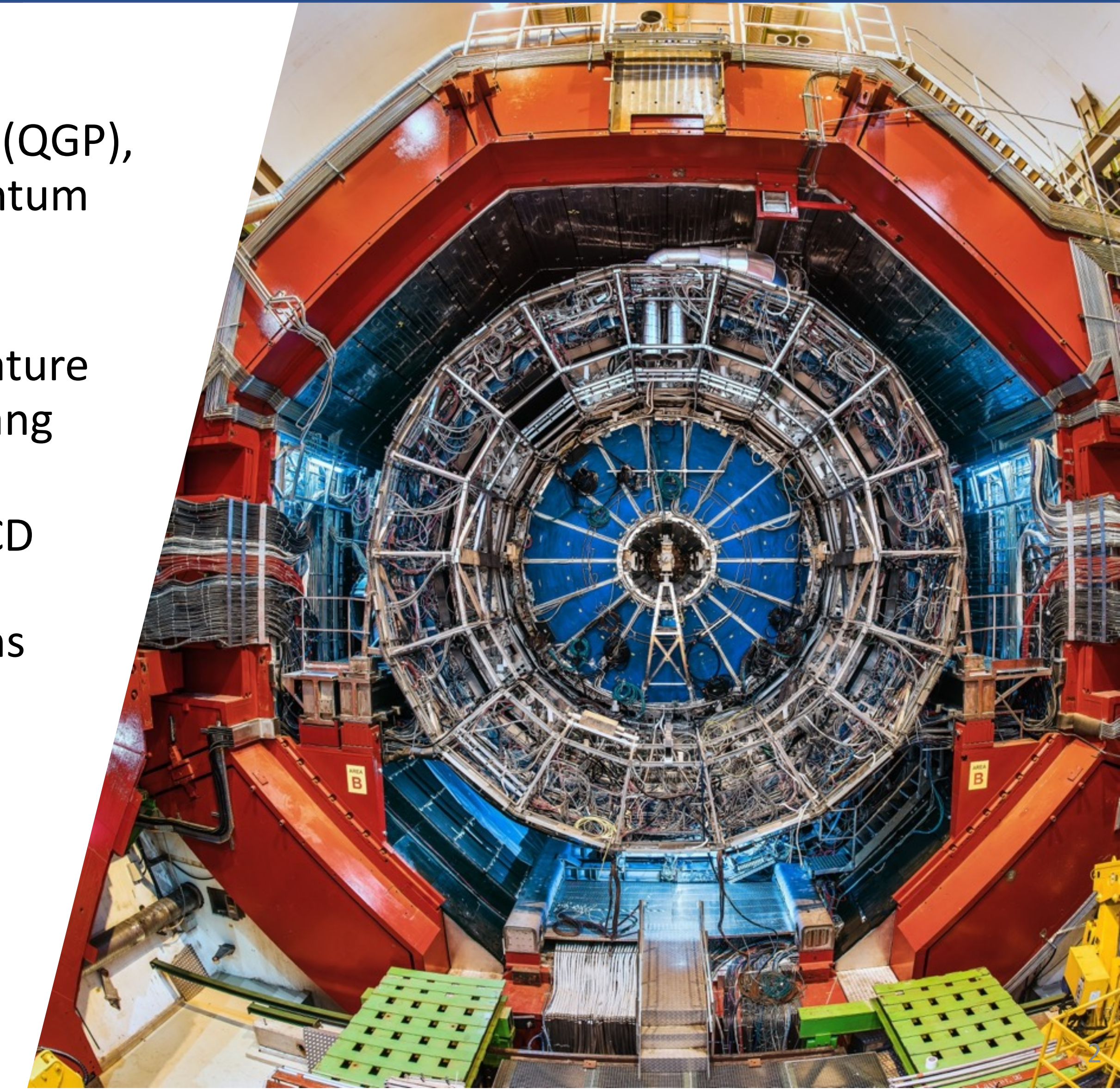
The ALICE Experiment

Designed to study the properties of quark-gluon plasma (QGP), answering questions about quark confinement and quantum chromodynamics (QCD) chiral symmetry restoration

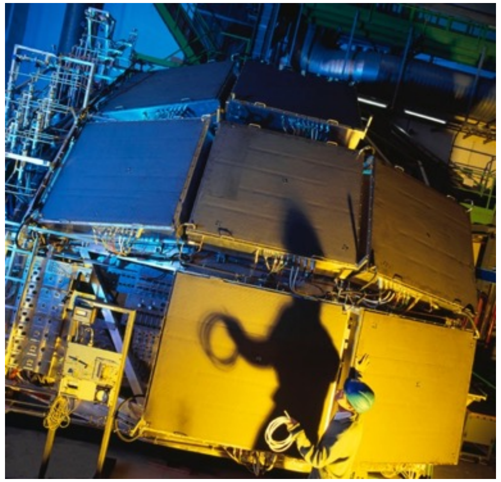
QGP is a state of matter created under extreme temperature and/or density conditions, similar to just after the Big Bang

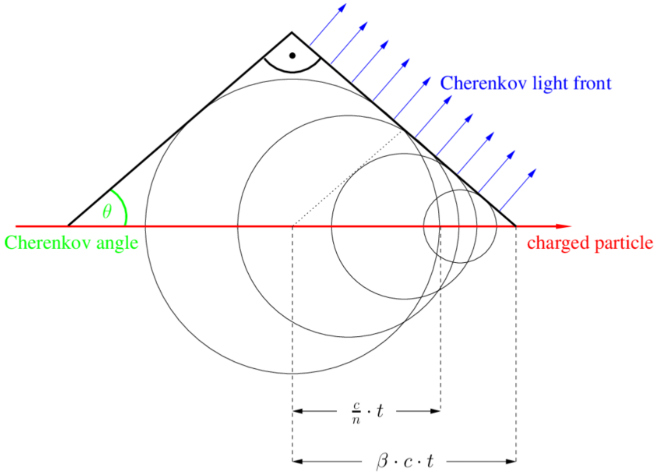
ALICE studies proton-proton collisions as high energy QCD reference, proton-nucleus collisions to test cold nuclear matter/initial state effects, and nucleus-nucleus collisions where QGP is supposed to form

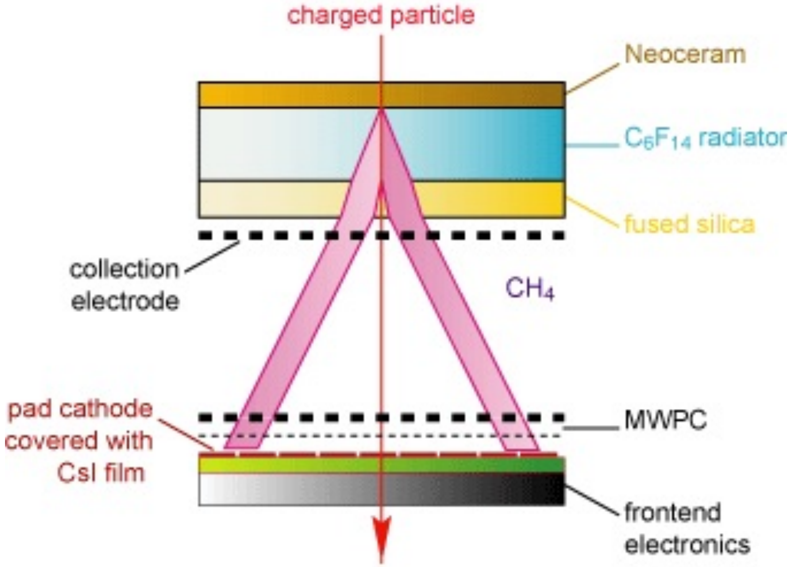
ALICE contains 19 subdetectors used for triggering, tracking, and particle identification purposes



HMPID Detector







HMPID consists of seven Ring Imaging Cherenkov (RICH) chambers and covers 5% of the central barrel geometrical acceptance

When a charged particle passes through a dielectric medium with speed greater than light in that medium, photon are produced by the Cherenkov effect

HMPID identifies pions, kaons, and protons produced from pp, p-Pb, and Pb-Pb collisions based on the Cherenkov photons emitted

By exploiting the Cherenkov effect, HMPID can identify with 3σ separation π/K up to 3.0 GeV/c and K/p up to 5.0 GeV/c

Cherenkov Angle vs Track Momentum

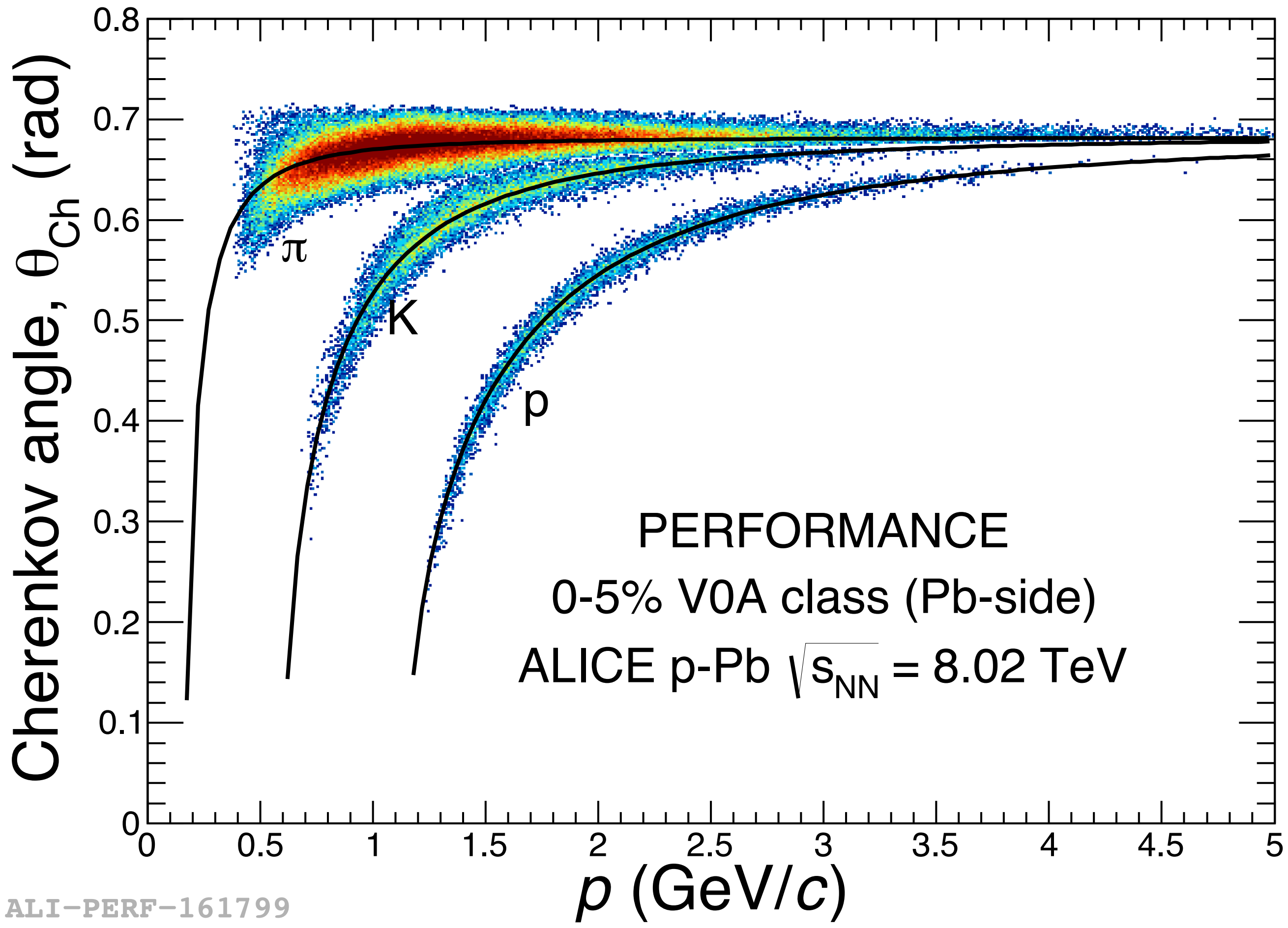
Cherenkov angle relates to velocity by

$$\cos\theta = \frac{1}{n\beta}$$

where

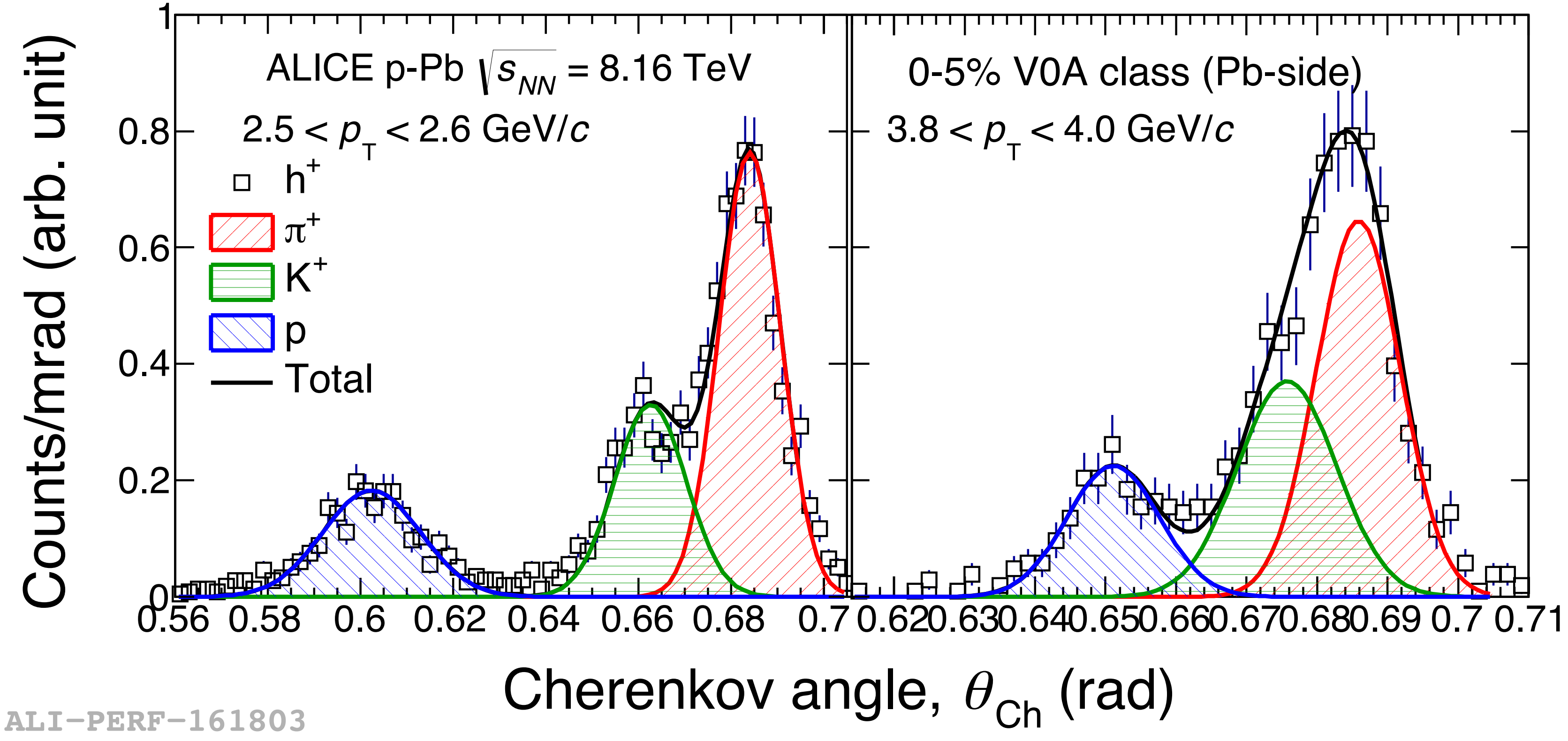
θ = Cherenkov angle
n = refractive index of radiator
$\beta = v/c$

By measuring the Cherenkov angle and momentum, we can calculate the particle mass and identify it!



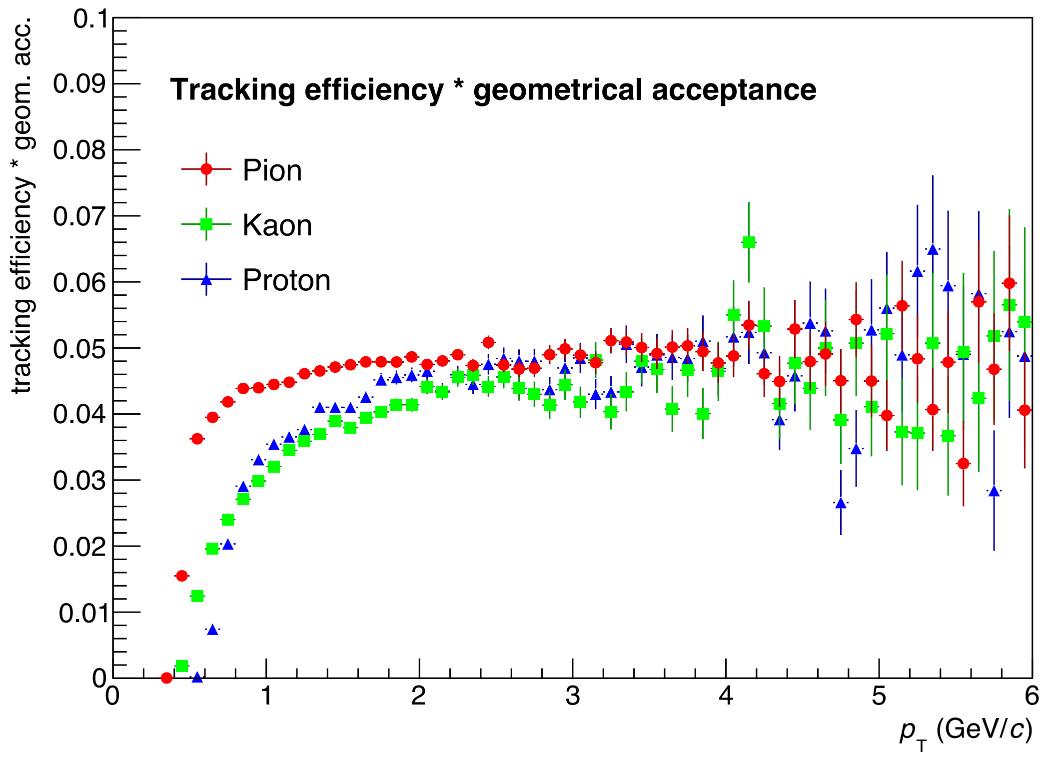
Cherenkov Distribution Gaussian Fit

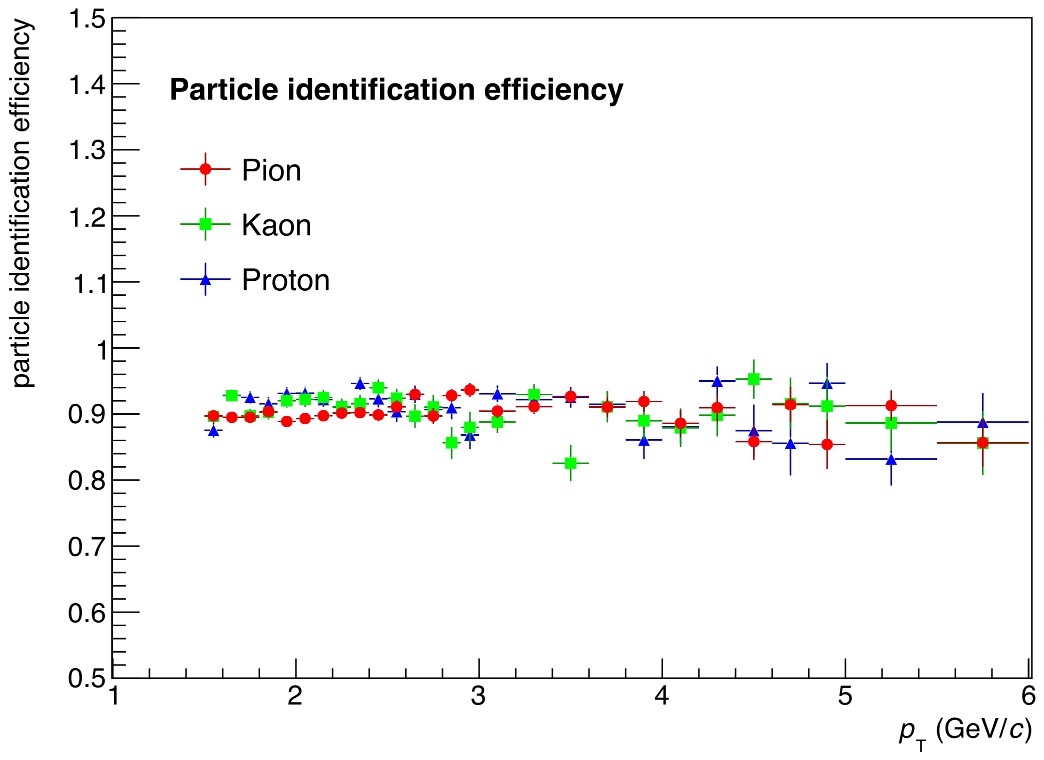
- Particle identification is performed by statistical unfolding of the Cherenkov angle
- Cherenkov distribution is fit using the sum of three gaussians, corresponding to pions, kaons, and protons
- Initial values for parameters are set to theoretical means and expected resolutions using Monte-Carlo



Corrections for tracking & PID efficiency

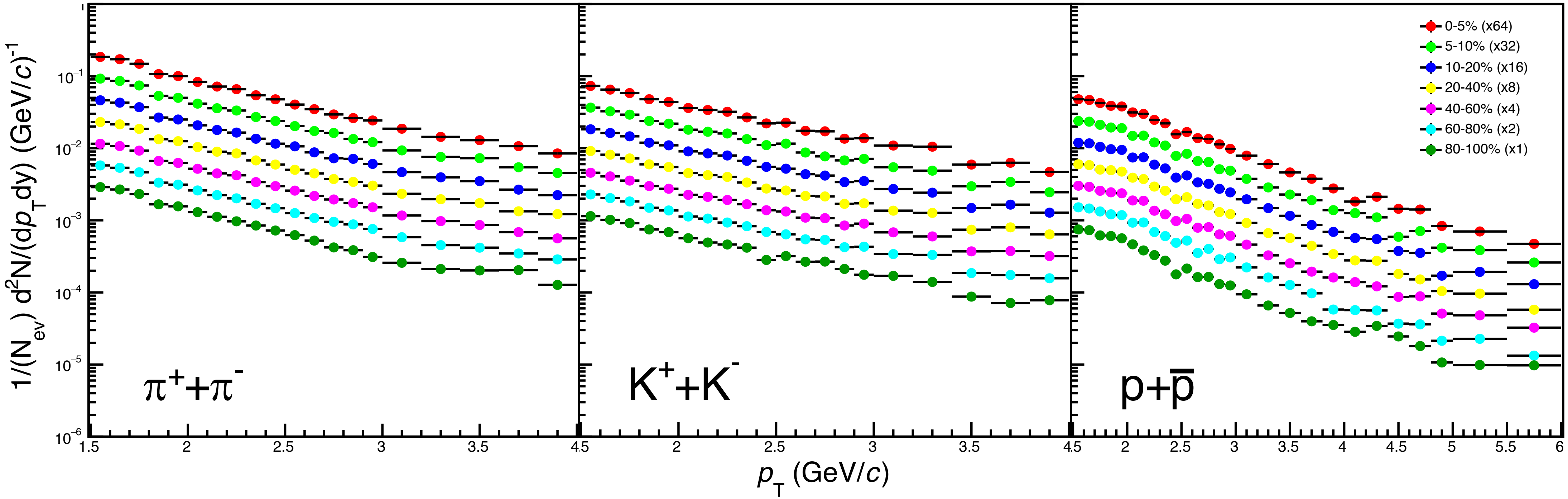
- Measurements need to be corrected to deduce the total number of particles produced during collision
- Such corrections include geometric acceptance, tracking efficiency, and particle identification efficiency
- These efficiencies are calculated from real data and Monte-Carlo simulations





Particle Yield

- Particle yield calculated for one 2016 p-Pb run (LHC16r)
- Yield for each particle species is calculated as integral of the gaussian fits
- There is a strong momentum dependence for particle production

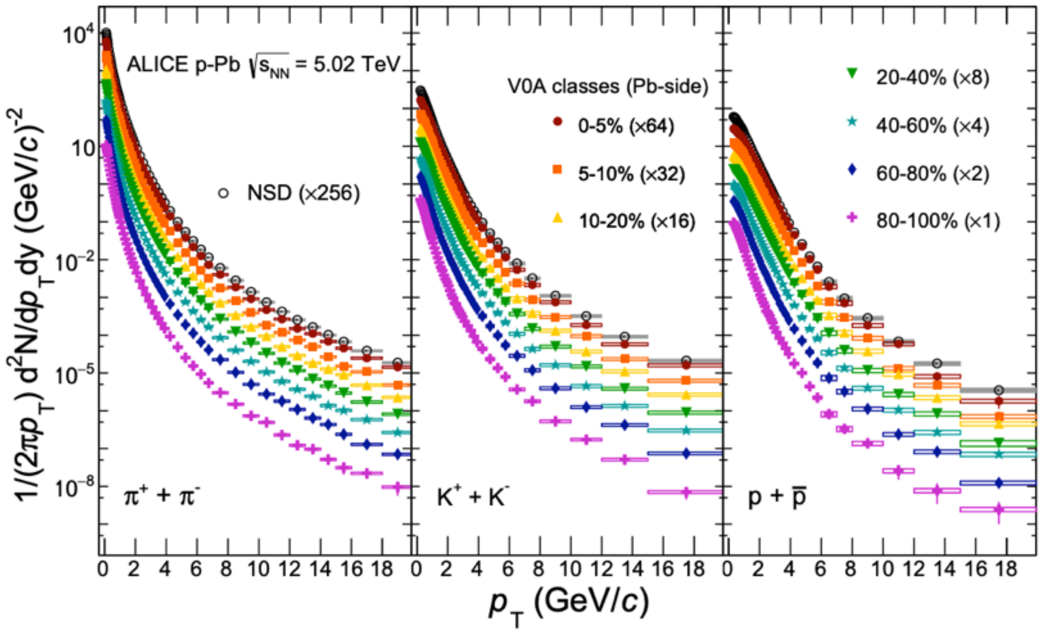


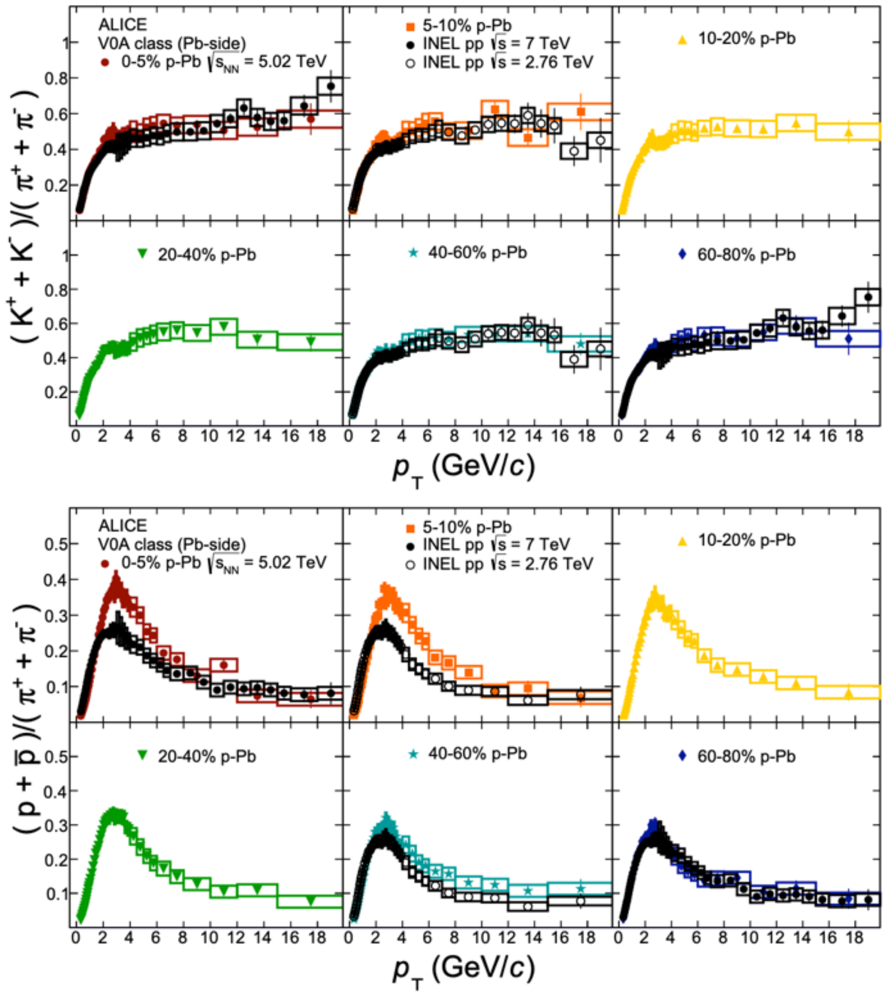
This data will be combined with that from other detectors to complete the full momentum spectrum up to 20 GeV/c

What's Next?!

By combining analysis from ITS, TOF, HMPID, and TPC, the ALICE experiment can identify pions, kaons, and protons up to 20 GeV/c

The information extracted from p-Pb collisions can be compared with that from Pb-Pb collisions to probe the properties of QGP!

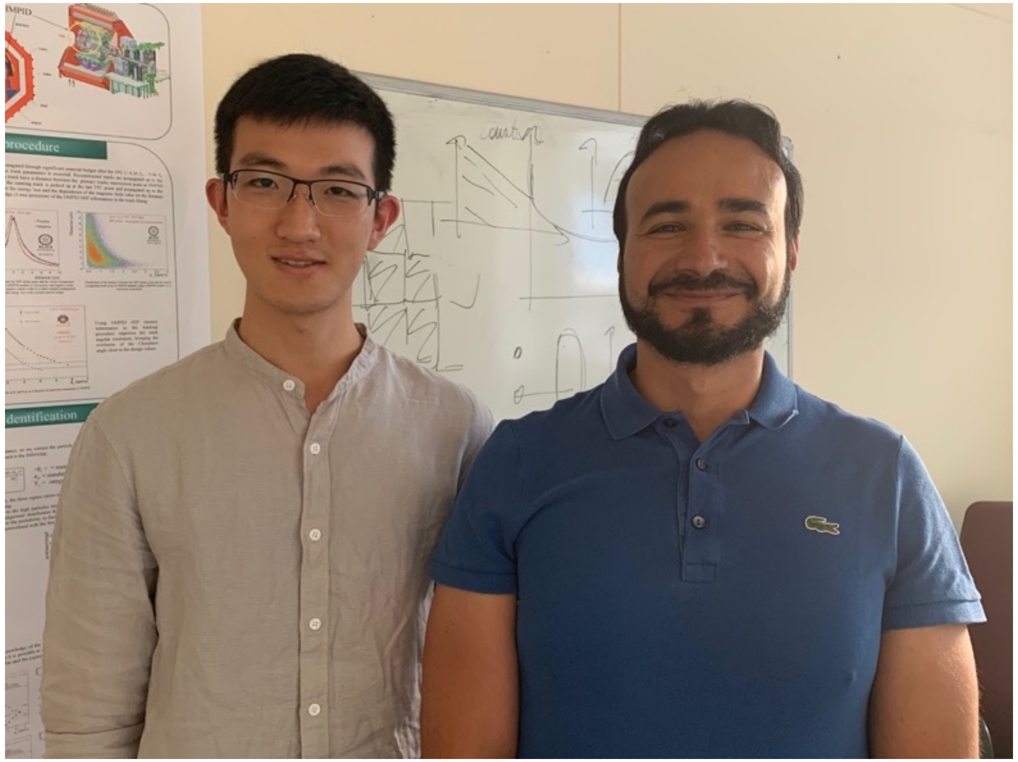




Multiplicity dependence of charged pion, kaon, and (anti)proton production at large transverse momentum in p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV
Phys. Lett. B 760 (2016) 720

Summary

- ALICE studies QGP using pp, p-Pb, and Pb-Pb collisions, answering questions about confinement and chiral symmetry restoration
- HMPID identifies particles at an intermediate momentum range by statistical unfolding of the Cherenkov angle
- Completed calculation of pion, kaon, and proton yields for one 2016 p-Pb run (LHC16r)
- Introduction to the next steps in analysis



Thank you for your attention!