Measurement of identified charged particle spectra in p-p collisions with the ALICE detector

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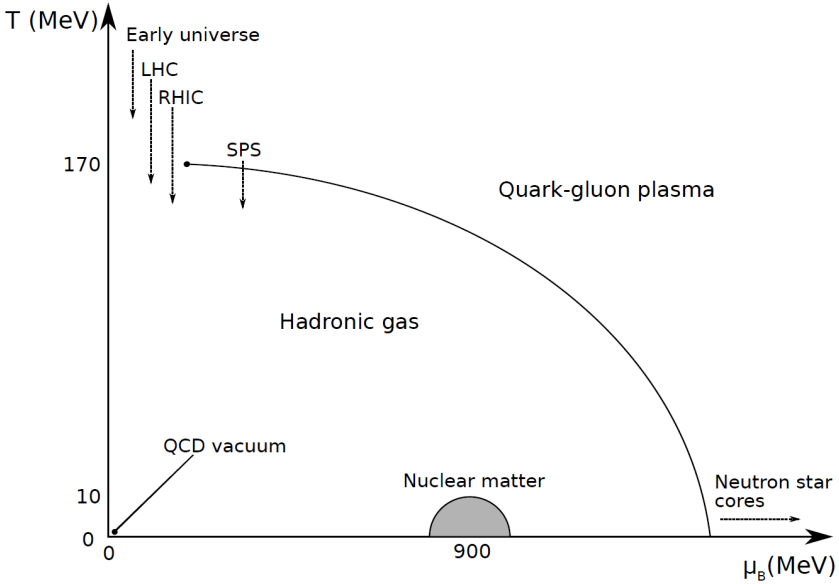
ALICE Collaboration

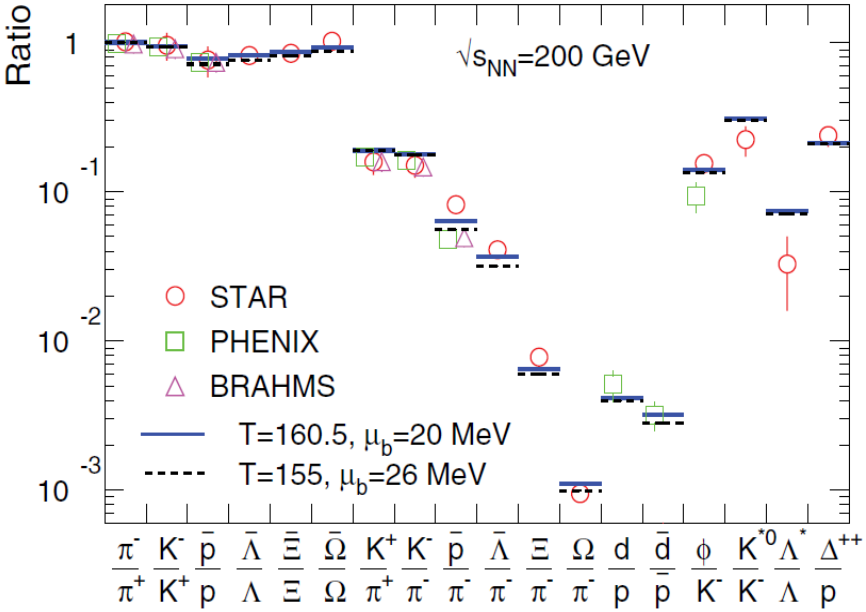
Outline

- Motivation for studying the hadron spectra
- The ALICE detector
- The ALICE Time Projection Chamber (TPC)
- Particle ID with the TPC
- Particle ID with the ITS and TOF
- Charged hadron spectra
- Particle ratios and mean transverse momentum
- Conclusions

Motivations

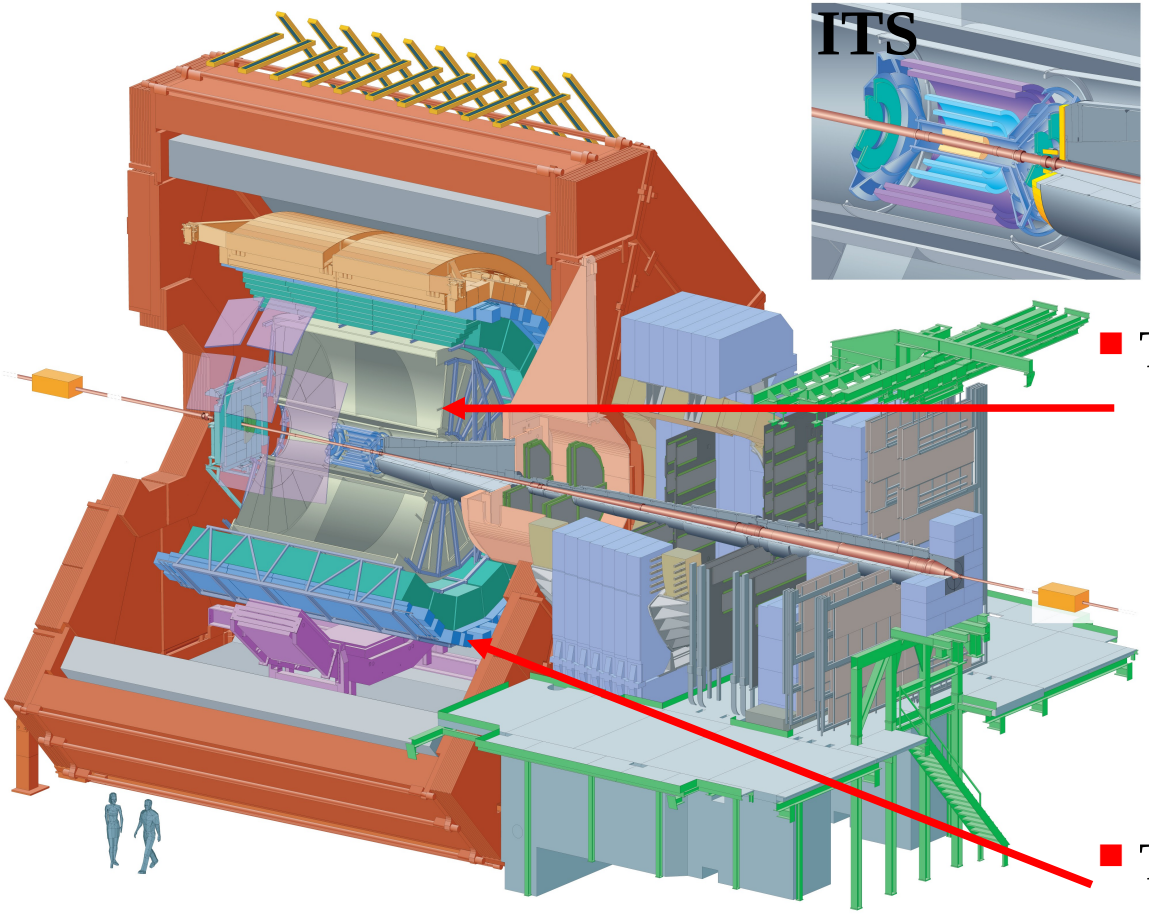
- Probing the phase diagram of QCD matter with heavy ion collisions
- The hadron yields tell us about T and μ_B of the system
- Can we learn something from p-p collisions?





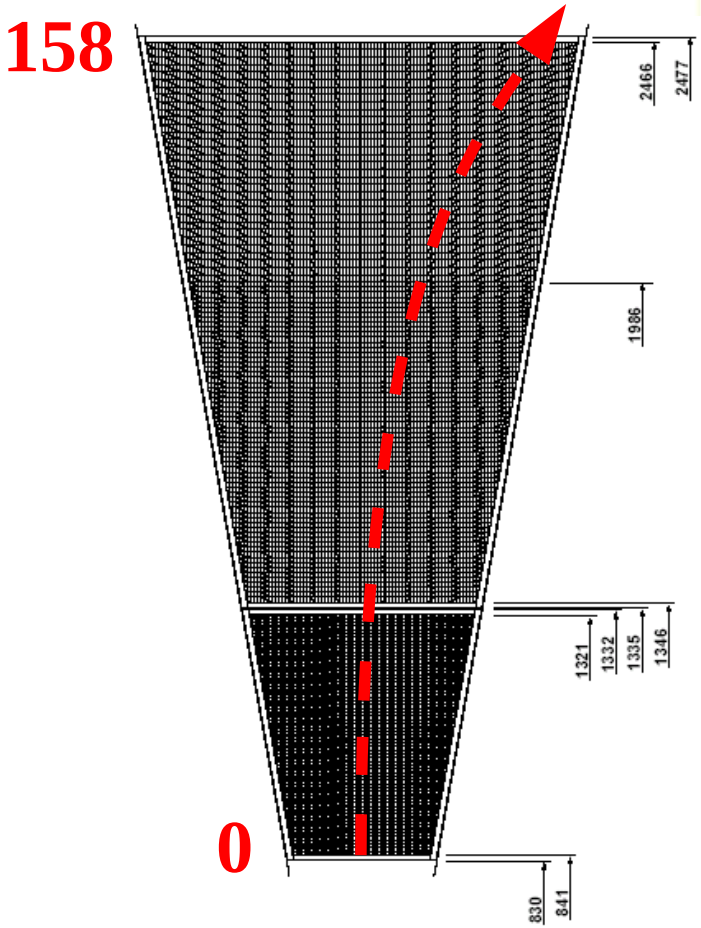
Andronic A, Braun-Munzinger P and Stachel J 2006 Nucl. Phys. A 772 167

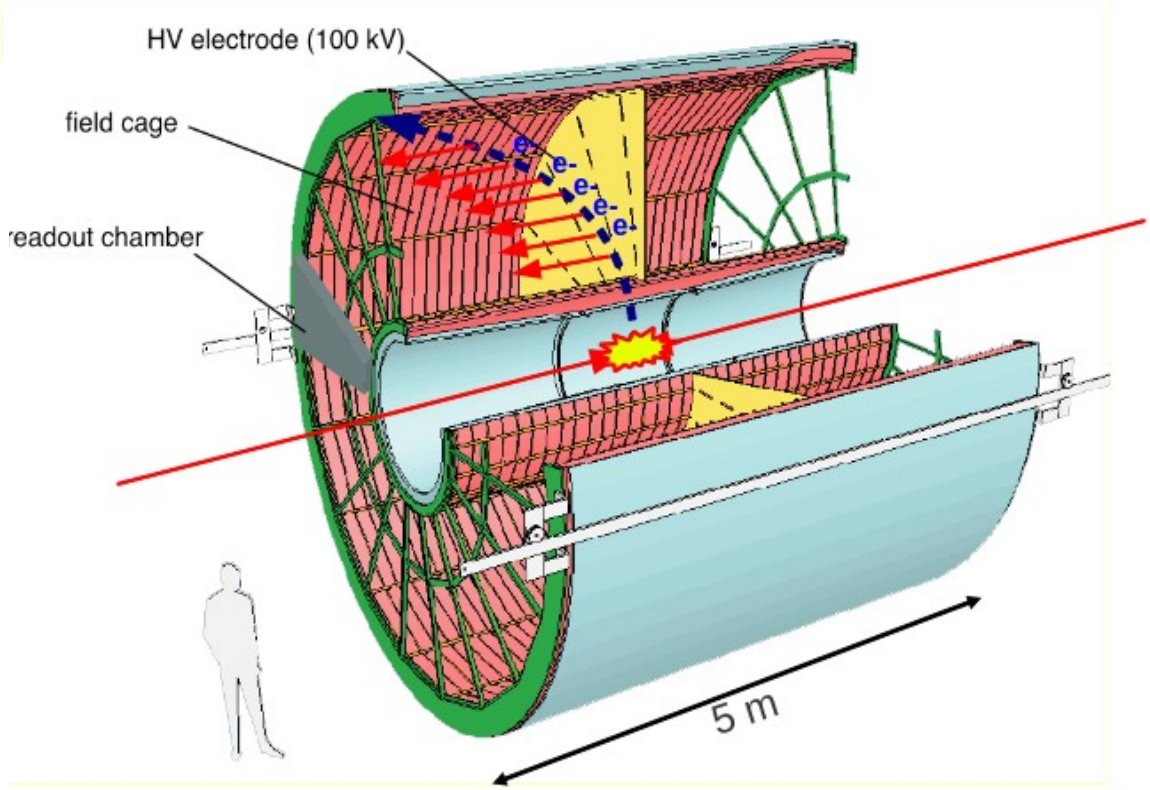
The ALICE detector



- Inner Tracking System (ITS)
  - Low momentum tracking and vertex reconstruction
  - Particle ID
- Time Projection Chamber (TPC)
  - Track finding at high multiplicities (20 000 tracks in the TPC)
  - Momentum measurement
  - Particle ID
- Time of Flight (TOF)
  - Particle ID

The ALICE TPC

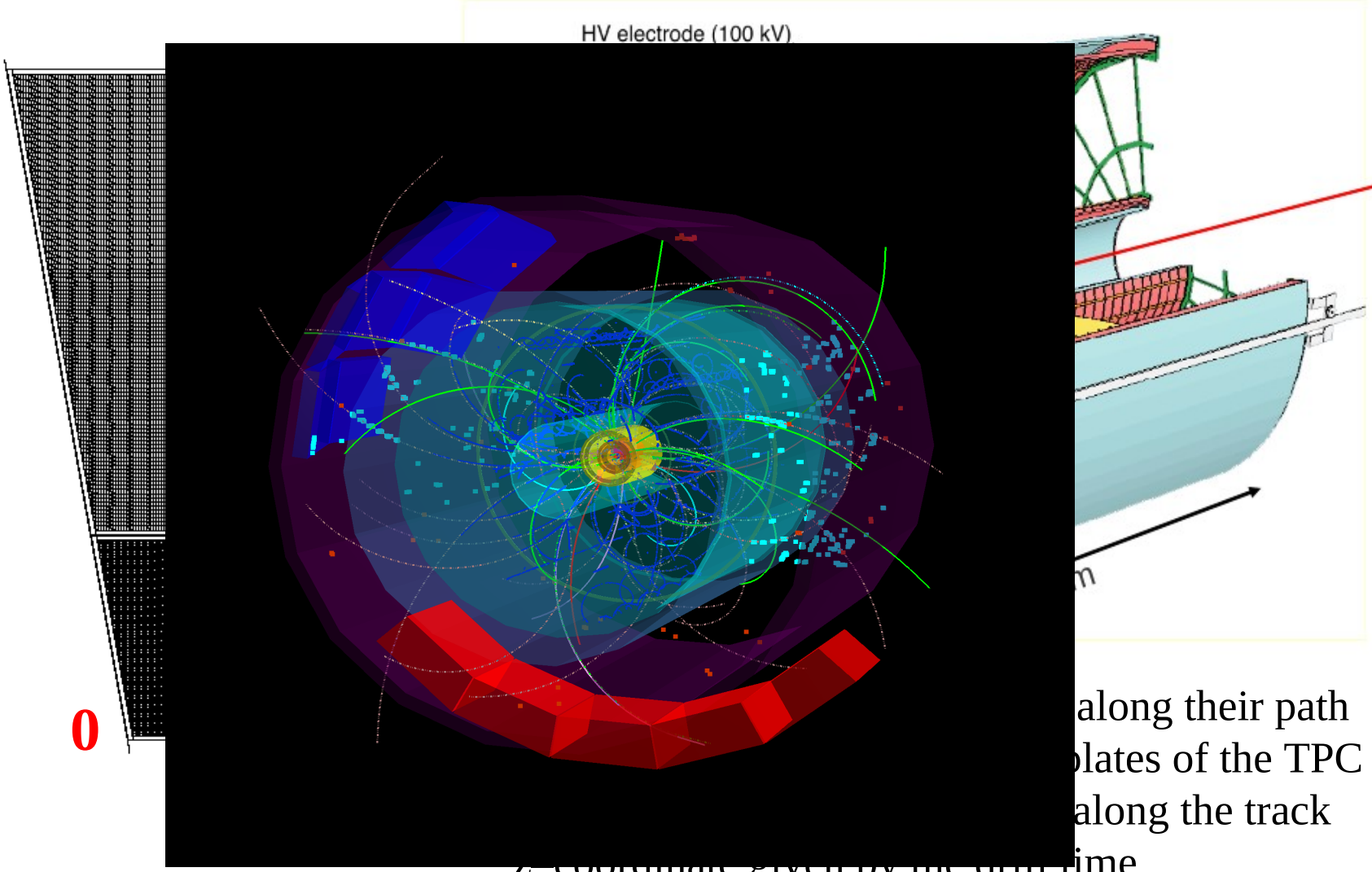




- Charged particles ionise the gas along their path
- Electrons drift towards the end plates of the TPC
- Up to 159 dE/dx measurements along the track
- z–coordinate given by the drift time

The ALICE TPC

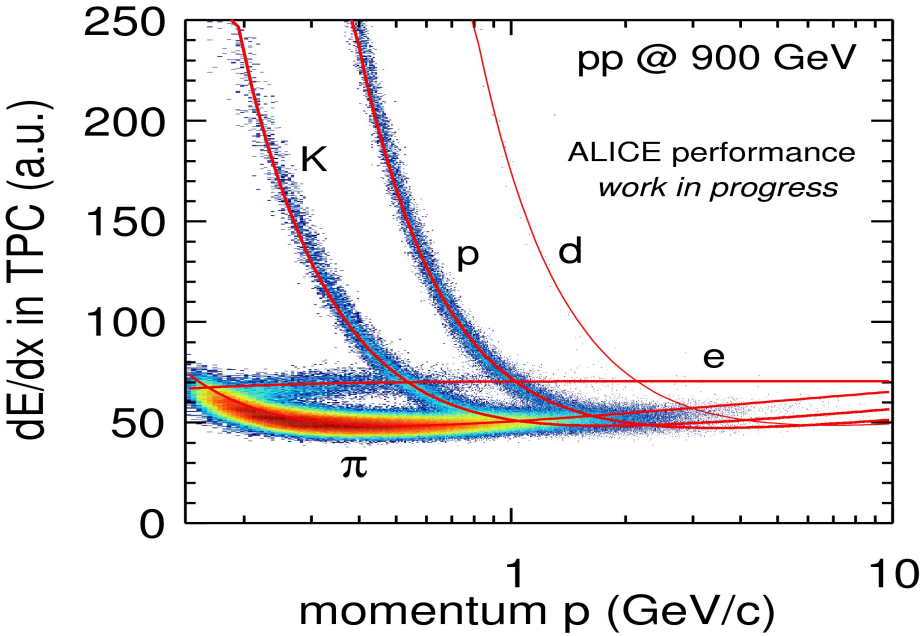
158



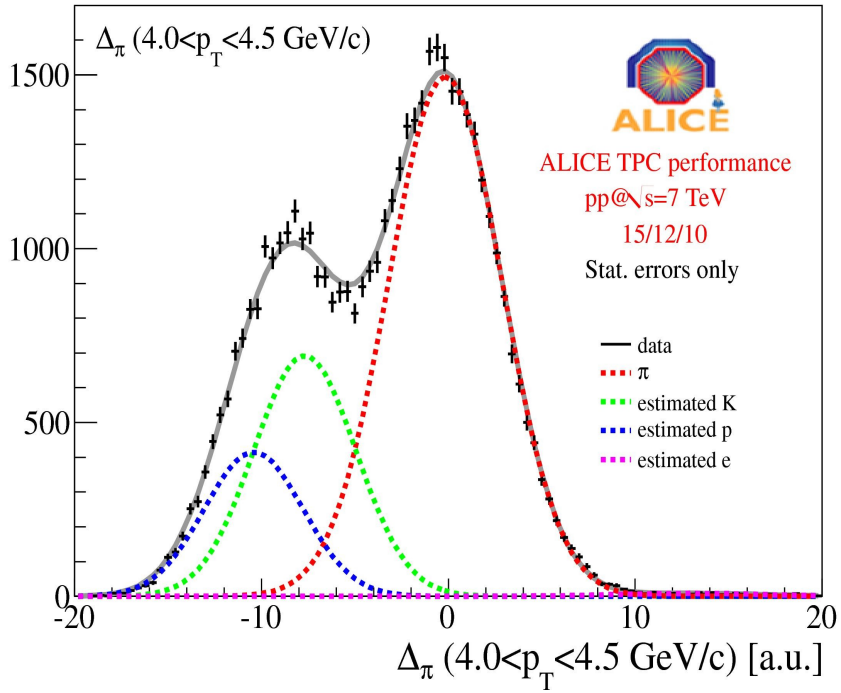
0

along their path
plates of the TPC
along the track
z-coordinate given by the drift time

PID with the TPC



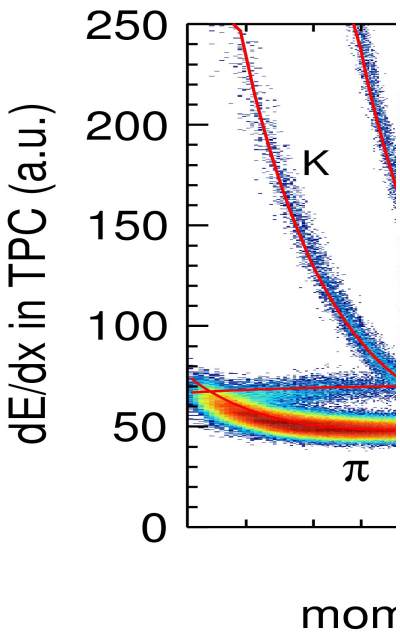
- dE/dx - <dE/dx>(π) for different p_T
- Fitted with 4 Gaussians to extract the yields

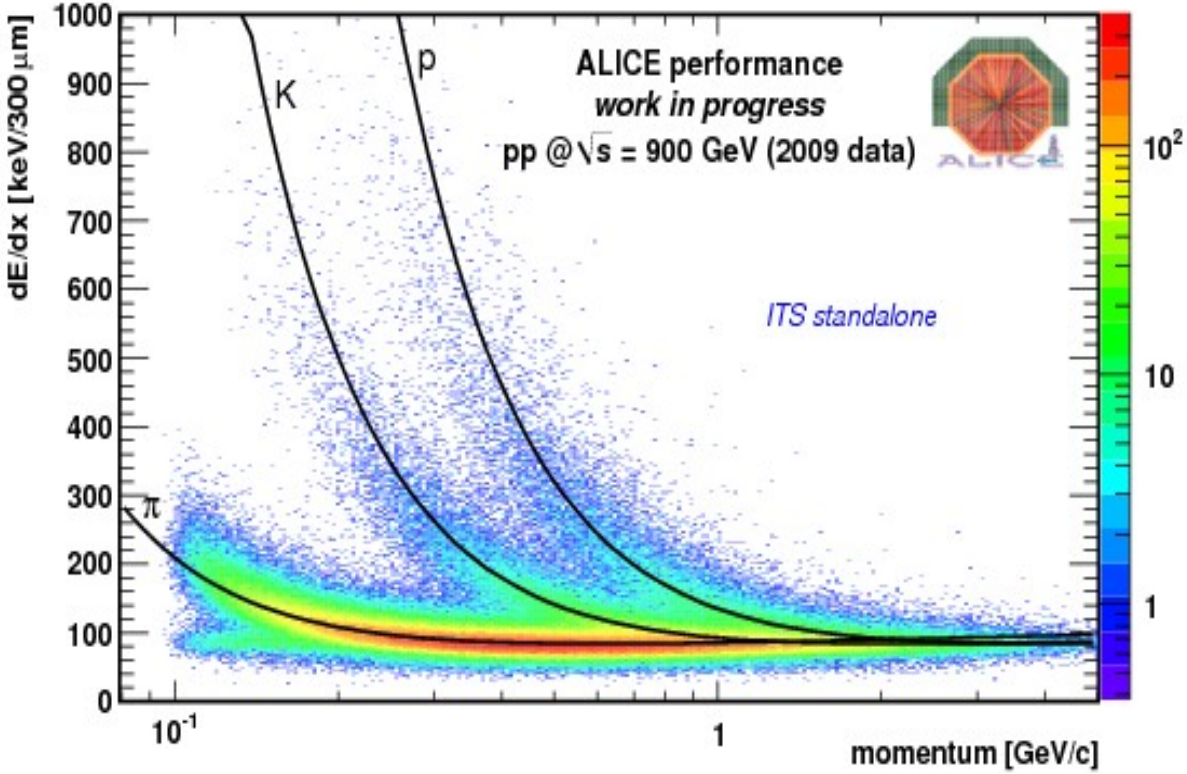


- The mean dE/dx of the tracks is described well by the Bethe-Bloch formula:

$$\langle \frac{dE}{dx} \rangle = \frac{4\pi N e^4}{mc^2} \frac{Z^2}{\beta^2} \left(\ln \frac{2mc^2\beta^2\gamma^2}{I} - \beta^2 - \frac{\delta(\beta)}{2} \right)$$

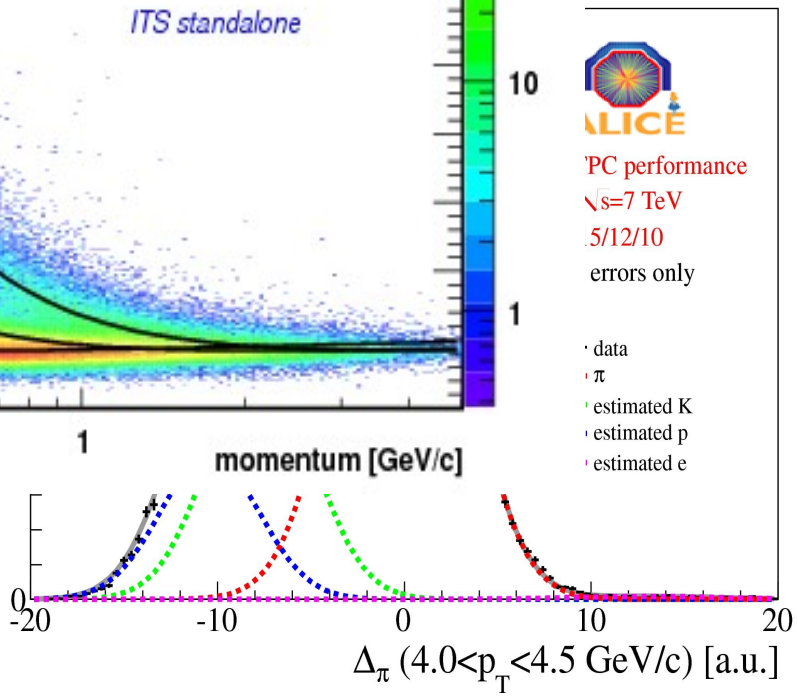
PID with the TPC





nt p_T

act the yields



- The mean dE/d
well by the Bethe

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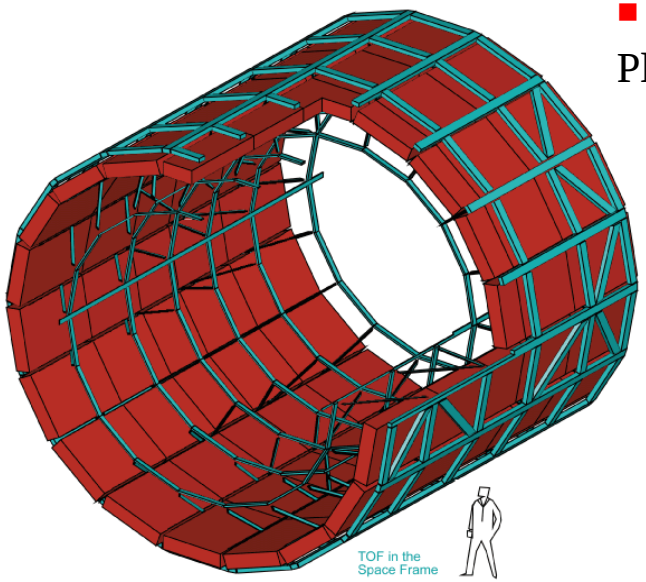
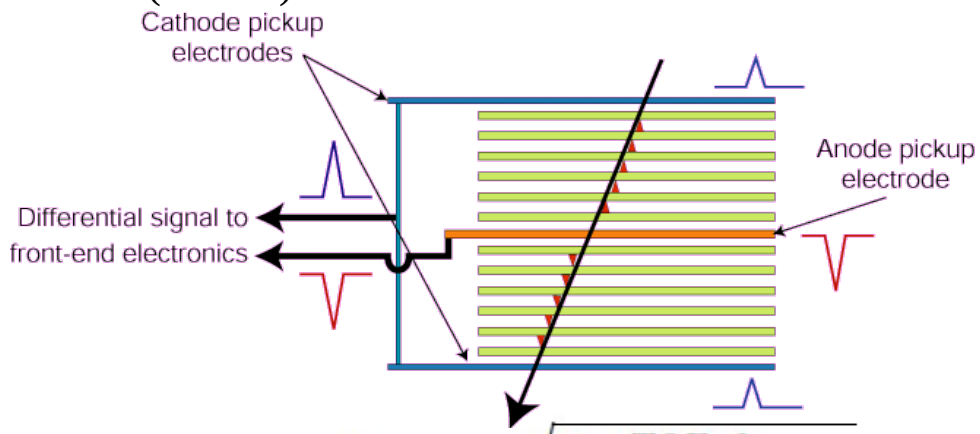
PID with TOF

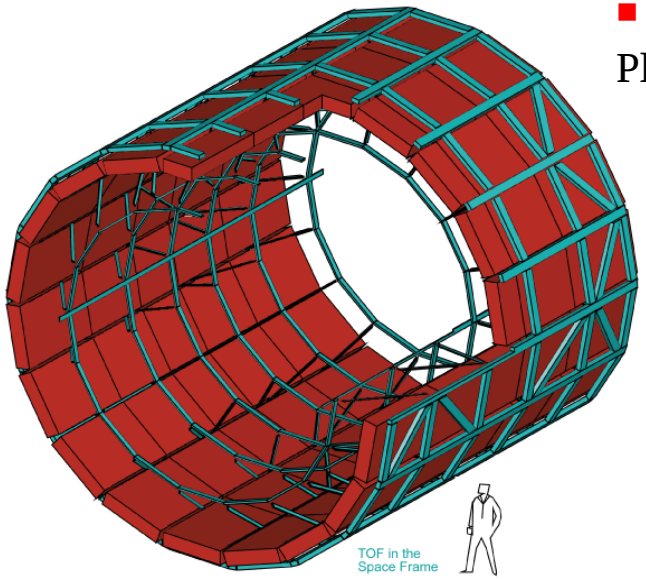


- The detector chosen for the ALICE TOF is a Multigap Resistive Plate Chamber (MRPC)



$$M = \frac{p}{\beta\gamma} = p\sqrt{\frac{(ct^{\mathrm{TOF}})^2}{l^2} - 1}$$

PID with TOF



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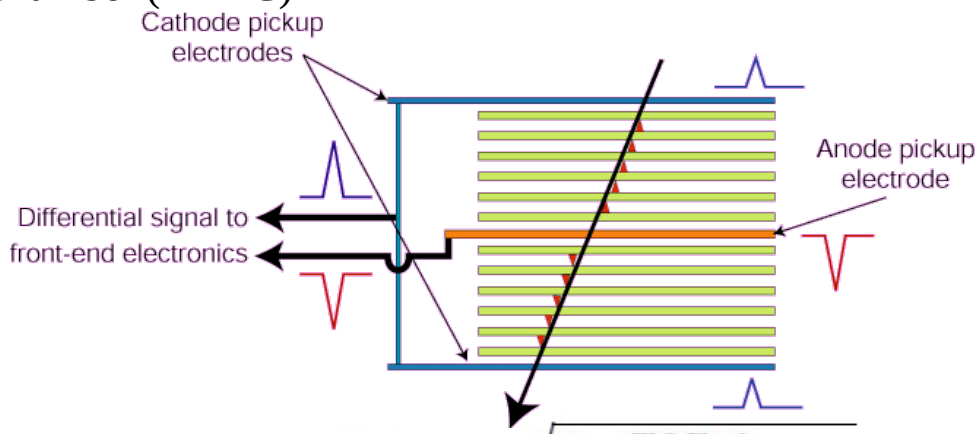

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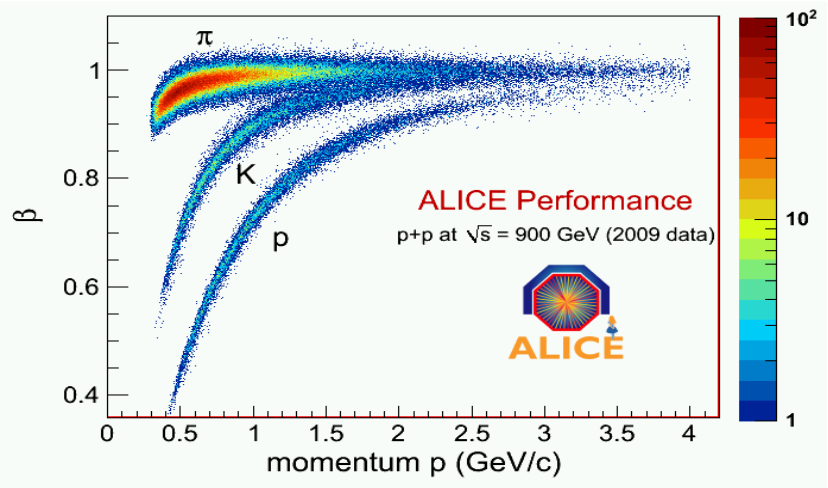
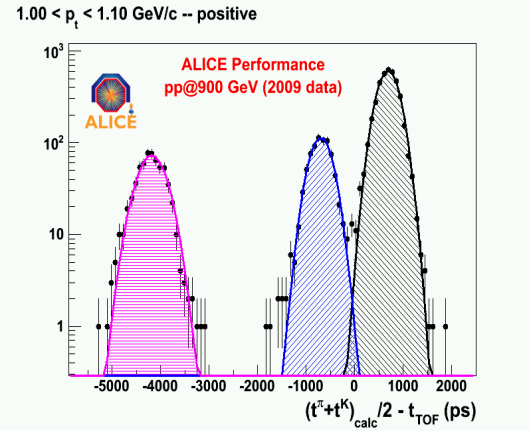
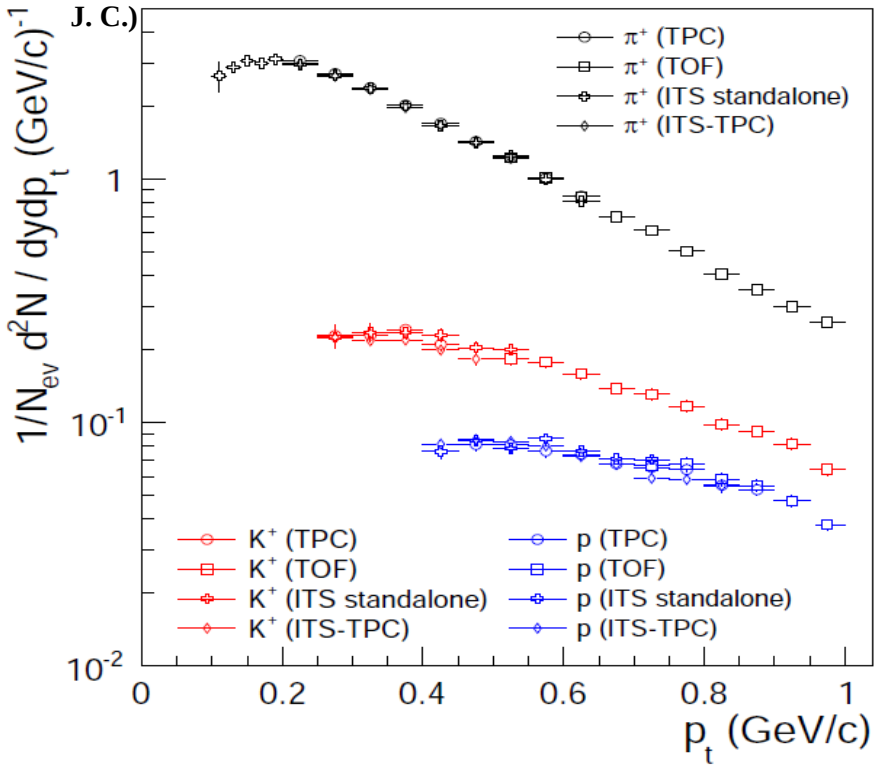
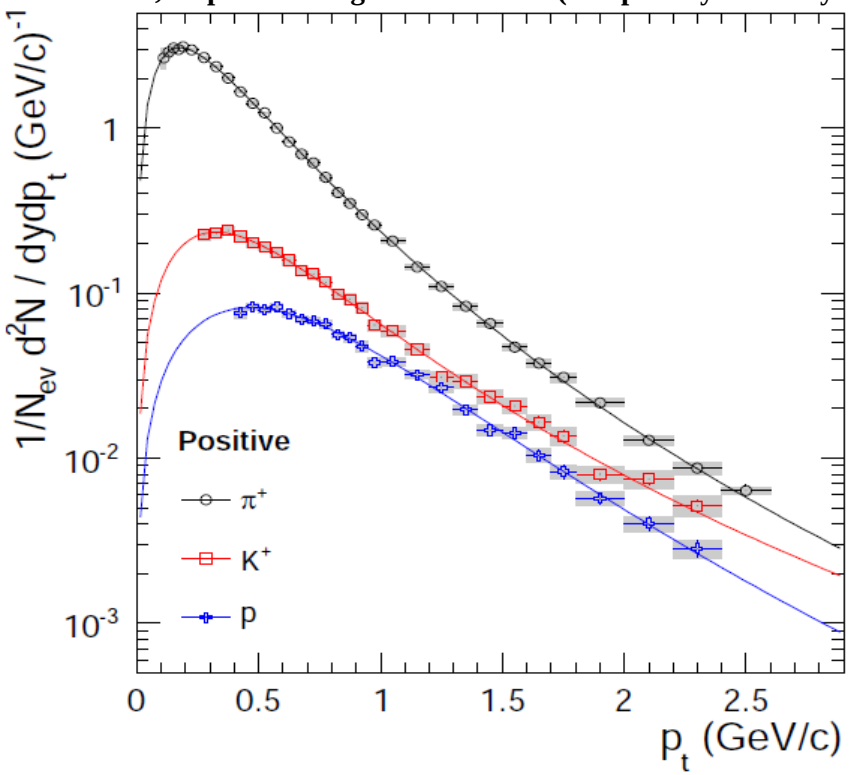




Charged hadron p_T spectra

"Production of pions, kaons and protons at $\sqrt{s}$ = 900 GeV with ALICE at the LHC", http://arxiv.org/abs/1101.4110 (accepted by Eur. Phys J. C.)



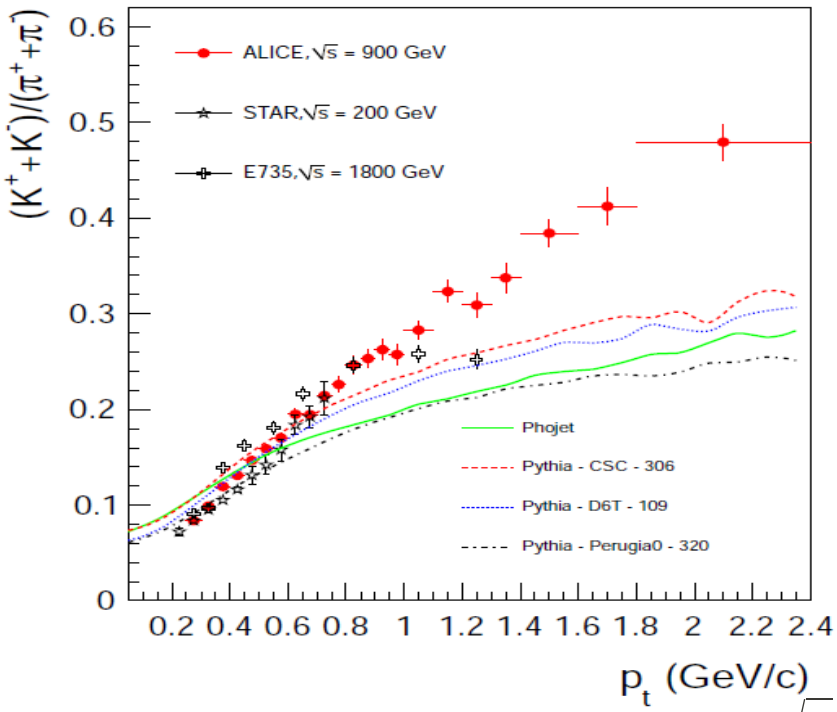


- Combine the ITS, TPC and TOF measurements of the p_T spectra
- Fits with the Lèvy (Tsallis) function to extract total yields and mean p_T

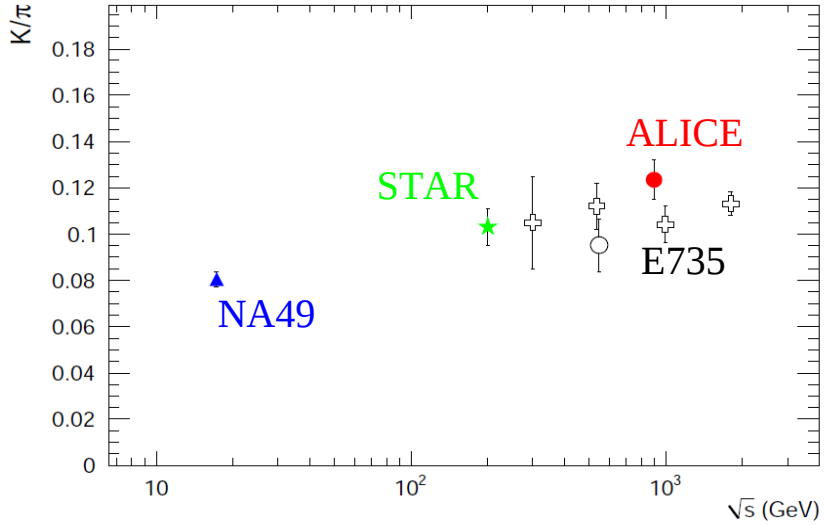
$$\frac{dN}{dp_T} \propto p_T \left(1 + \frac{\sqrt{m^2 + p_T^2} - m}{nT}\right)$$

Particle ratios

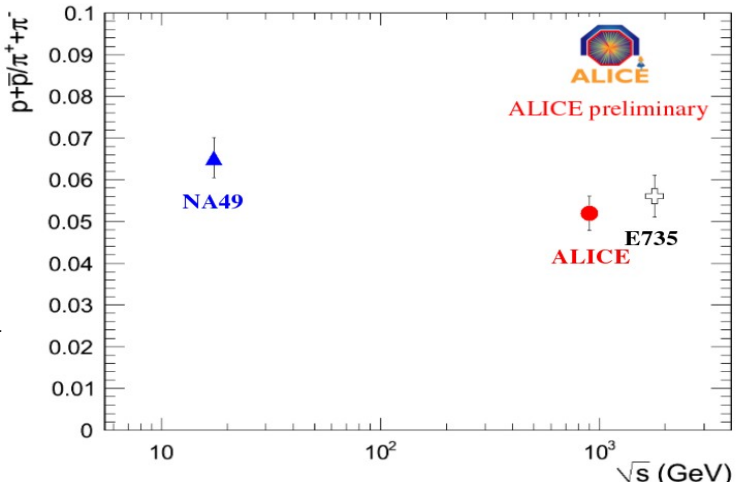
- K/π ratio as a function of p_T



- K/π ratio as a function of center of mass energy



- p/π ratio as a function of center of mass energy



- K/π and p/π ratios in p-p collisions at $\sqrt{s} = 900$ GeV measured with ALICE
- Comparison with other minimum bias measurements at different energy shows little energy dependence
- A measurement at 7 TeV will help...

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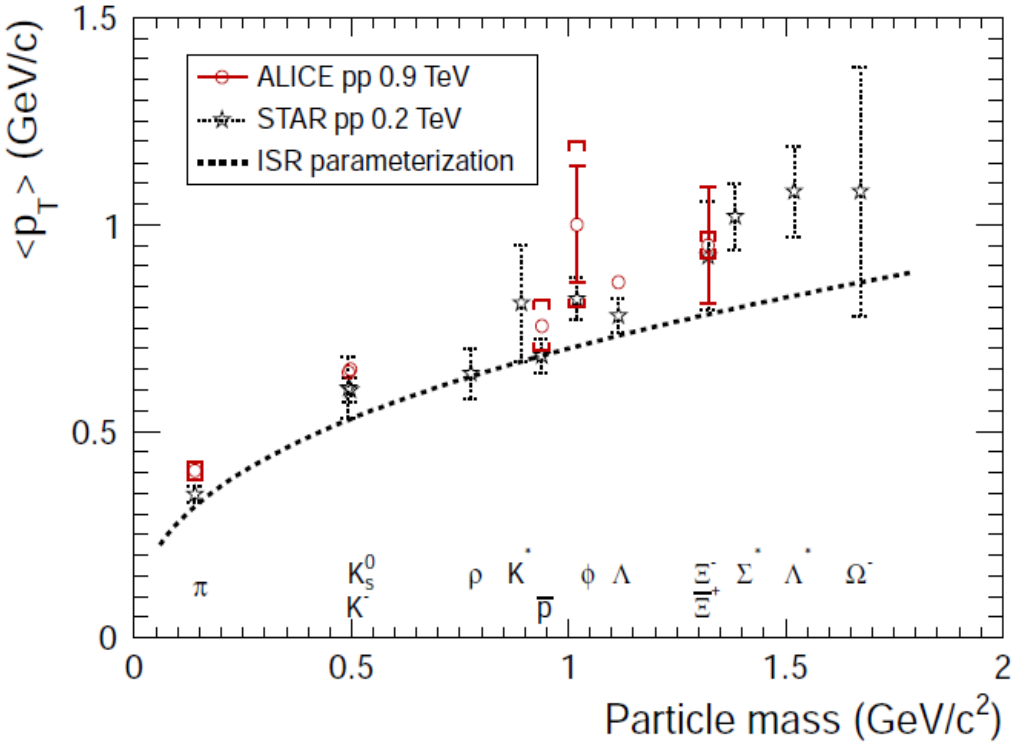
Mean p_T

"Strange particle production in proton-proton collisions at $\sqrt{s}$ = 0.9 TeV with ALICE at the LHC", http://arxiv.org/abs/1012.3257v2



- $\langle p_T \rangle$ in p-p collisions at 900 GeV (ALICE), 200 GeV (STAR) and 63 GeV (ISR results parametrisation)
- The $\langle p_T \rangle$ measured with ALICE remains close to the STAR and ISR results even though the energy has changed significantly

Conclusions

- ALICE has several techniques for PID
- These allow for cross-checks and a wide span of momentum
- PID needed to do tuning of Monte Carlo generators and for “chemical” analysis of heavy ion data
- PID techniques now commissioned with 900 GeV (p-p) data
- New results at 7 TeV (p-p) and 2.76 TeV (Pb-Pb) are in preparation