

π^0 and η meson production
in pp collisions
at 0.9, 2.76 and 7 TeV
measured with ALICE

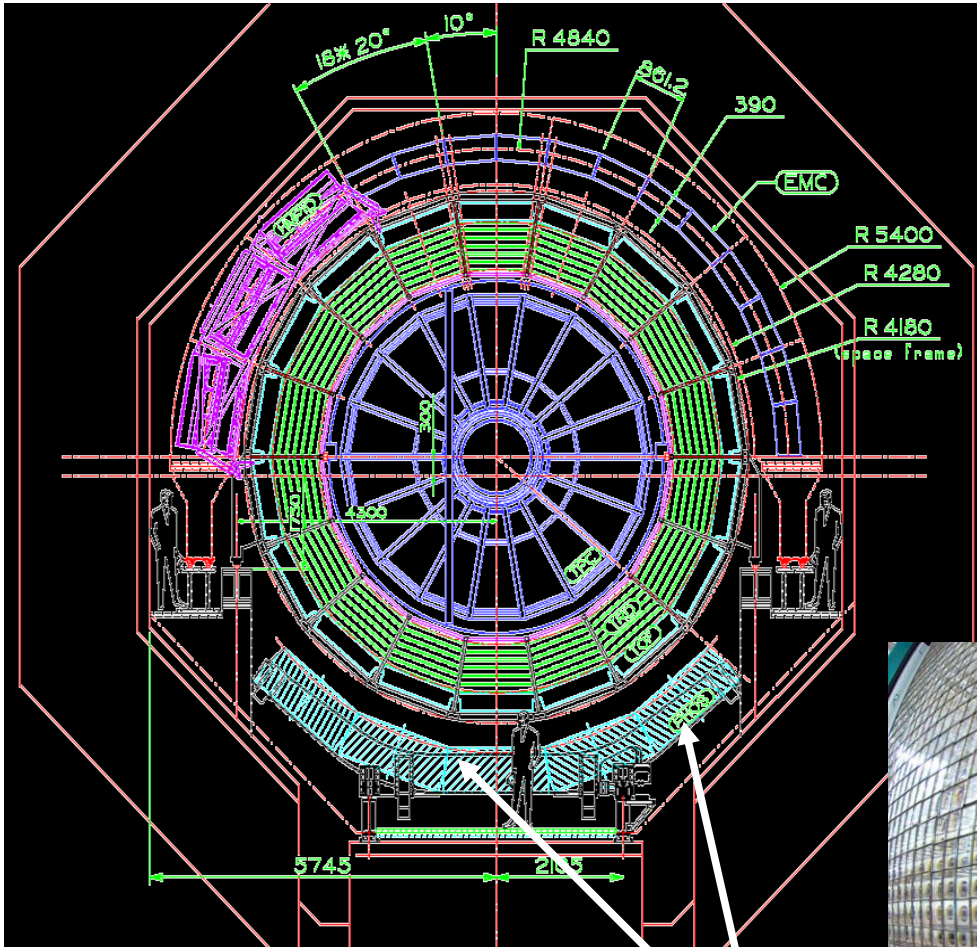
LHC on the march
16-18 November 2011

Boris Polishchuk (IHEP, Protvino),
for the ALICE Collaboration

Why neutral mesons spectra in pp?

- Test perturbative QCD at highest energies ever reached
 - important constraint for $g \rightarrow \pi^0, \eta$ fragmentation functions
 - gluon fragmentation not well constrained from e+e- data
 - gluon fragmentation is more important at higher energies
 - MC tuning
- Test phenomenological rules observed at lower energies (e.g., m_T scaling, p_T scaling) in a new energy regime

Neutral Mesons measurements: Photon Spectrometer (PHOS)



PbWO₄ calorimeter

10752 crystals in 3 modules:

$R_M=20$ mm

$X_0=8.9$ mm

$\rho=8.28$ g/cm³

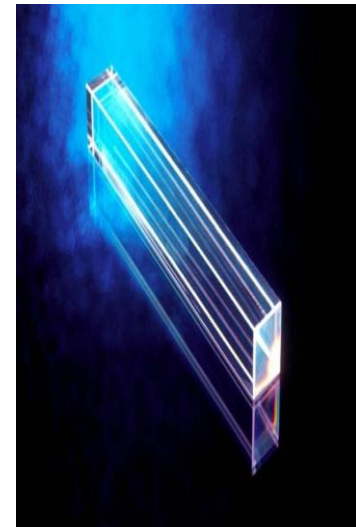
$n=2.16$

size = 22x22x180 mm

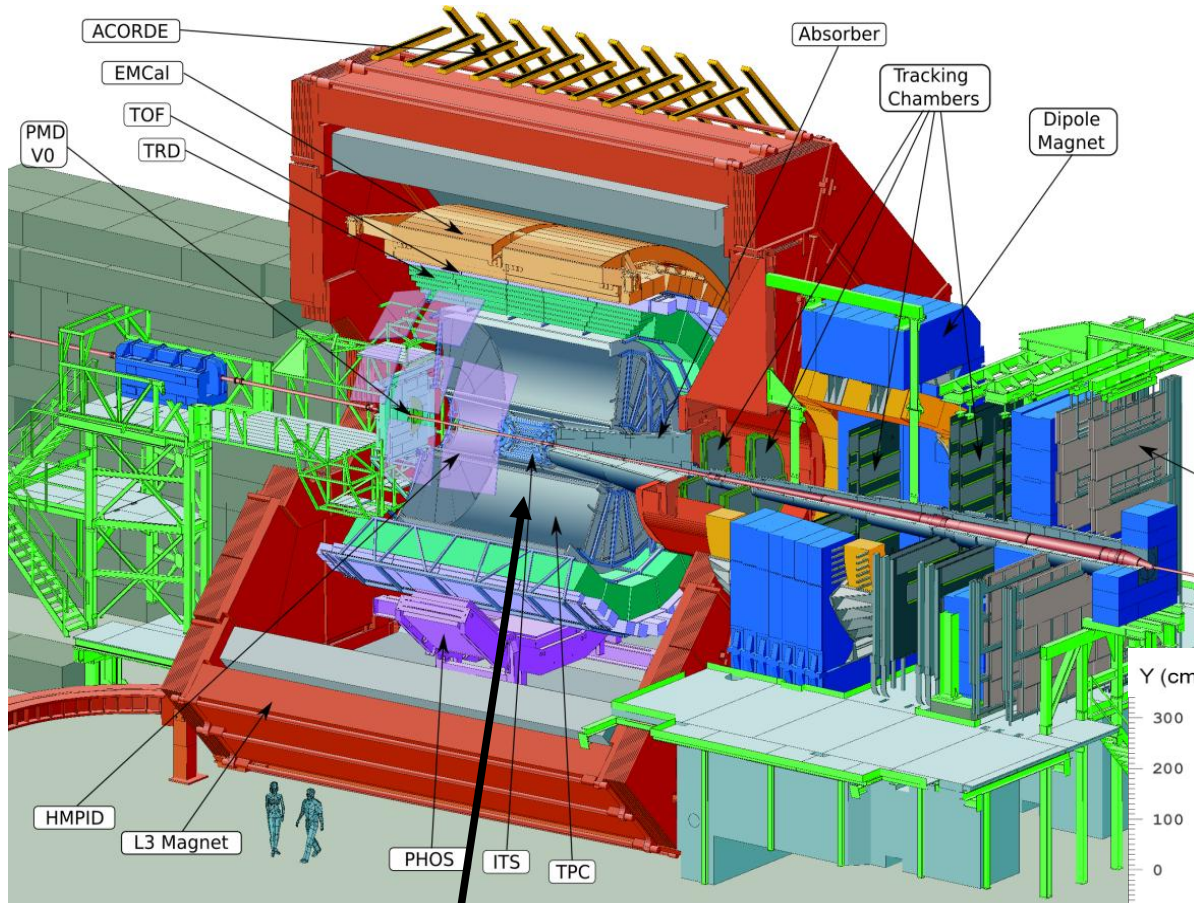
Installed at a distance of 4.6m from IP

Acceptance: $|\eta|<0.13, \Delta\phi=60^\circ$

PHOS



Neutral Mesons measurements: Photon Conversion + Tracking

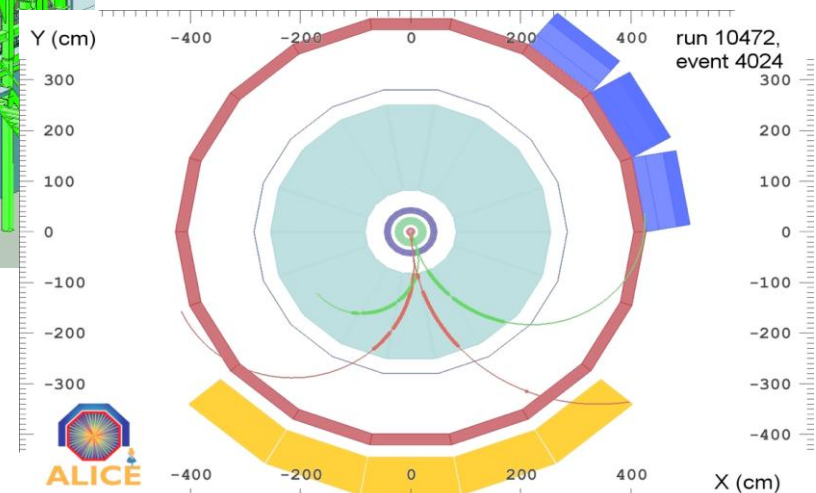


TPC

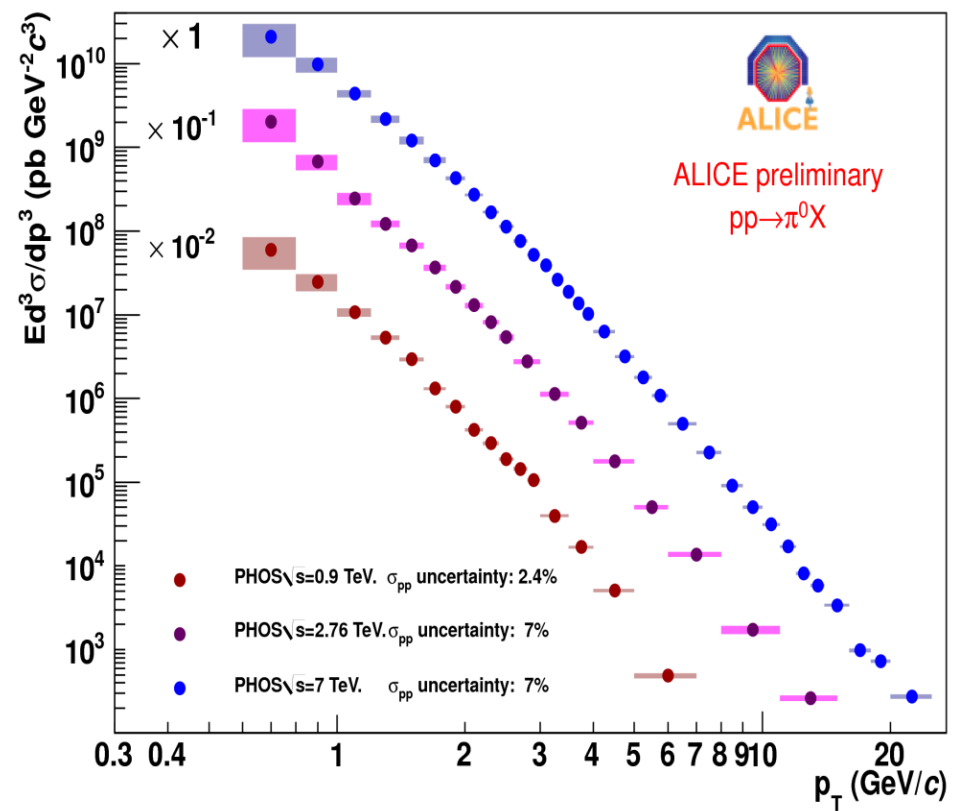
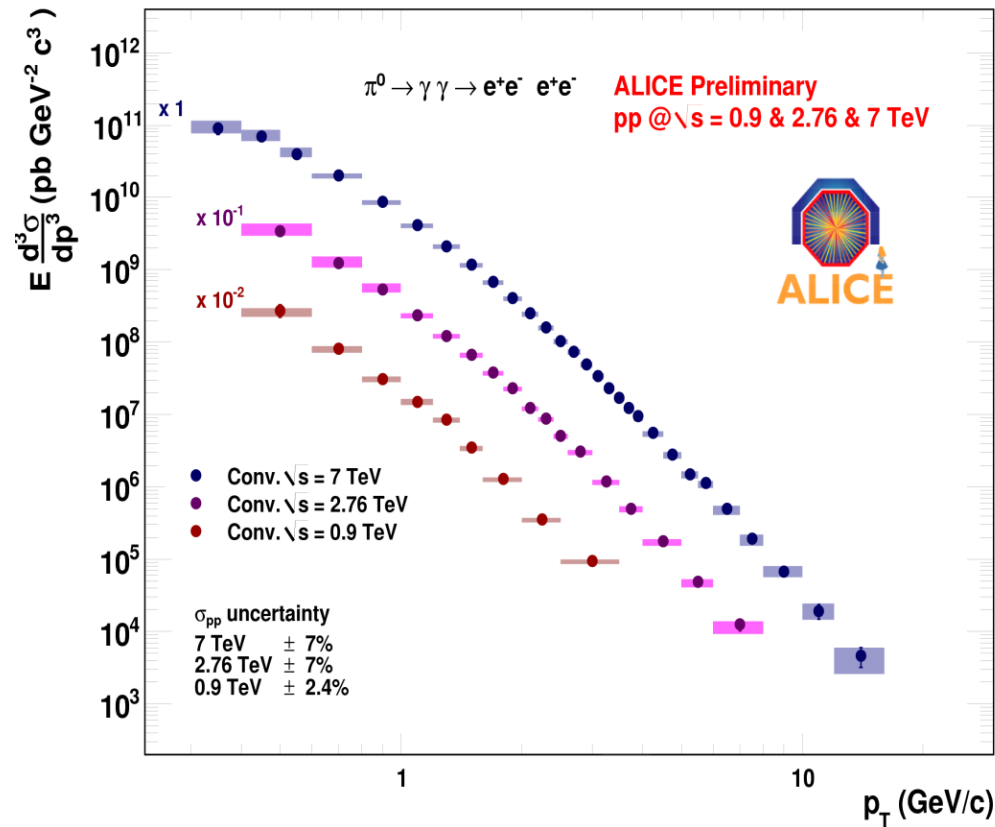
γ 's between beam pipe and the middle of TPC can be detected via conversion electrons in the tracking system

$p_T(e^{+-})_{\min} = 50 \text{ MeV}/c$
 $|\eta| < 0.9$, full ϕ coverage

Probability of conversion $\sim 8\%$
Reconstruction efficiency $\sim 67\%$

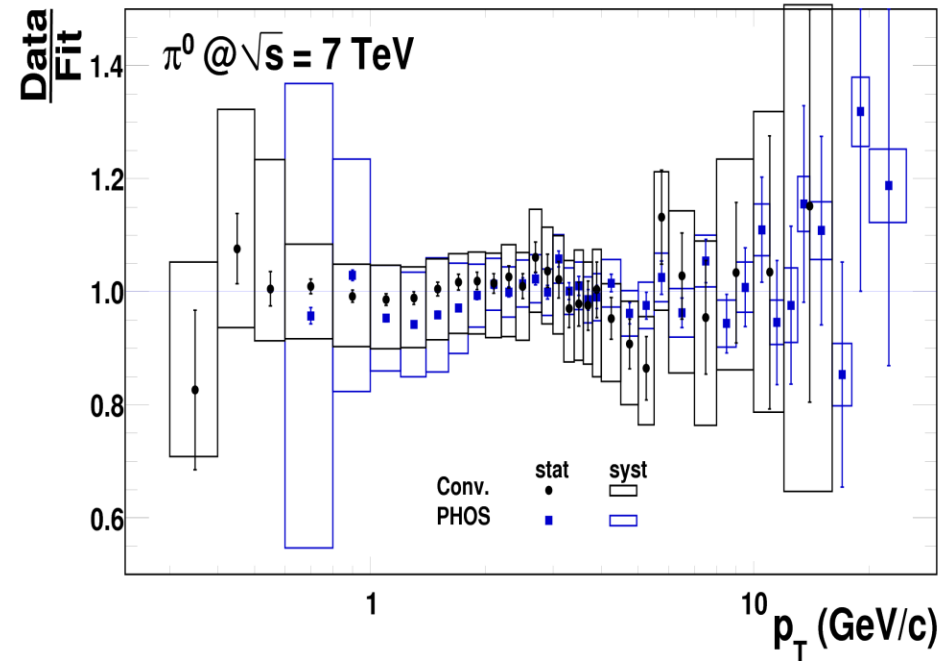
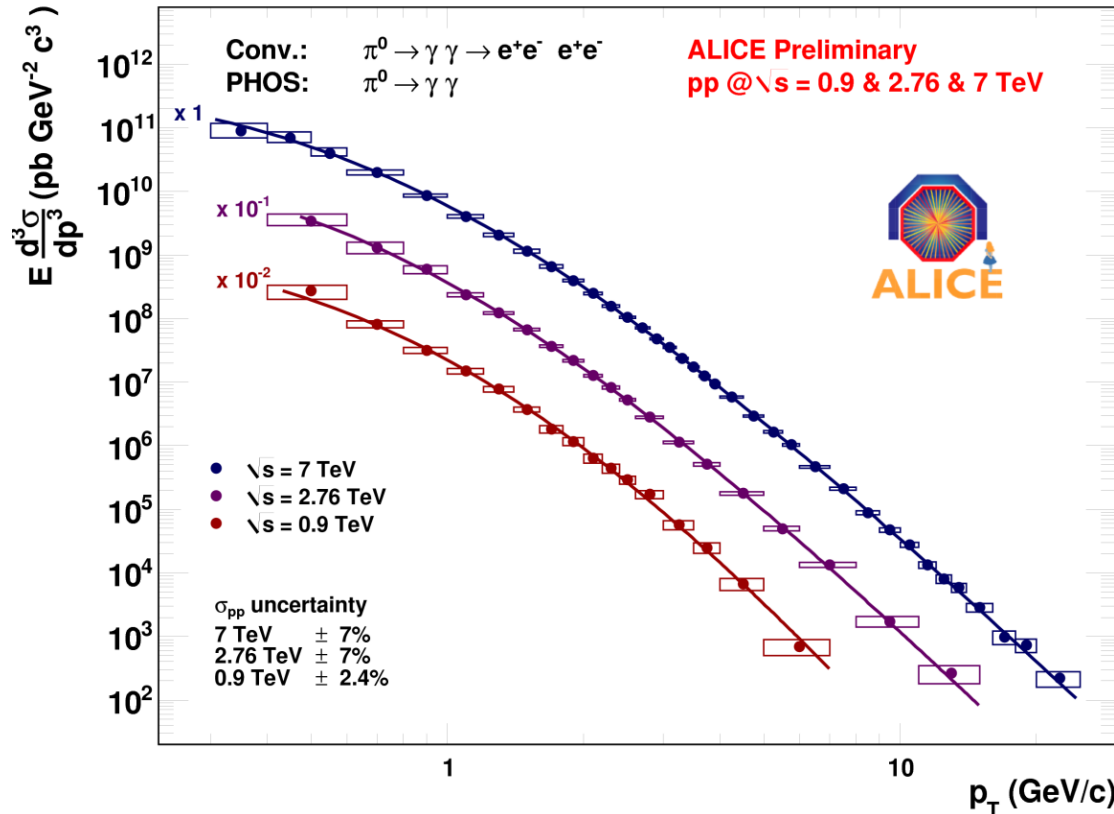


Invariant π^0 cross section: Conversion, PHOS



- **Completely different techniques with different systematics: excellent cross check!**
- Conversion method provides very good inv. mass resolution at very low p_T
- Calorimeter provides wide p_T coverage

Invariant π^0 cross section: Combined result (conversion+PHOS)

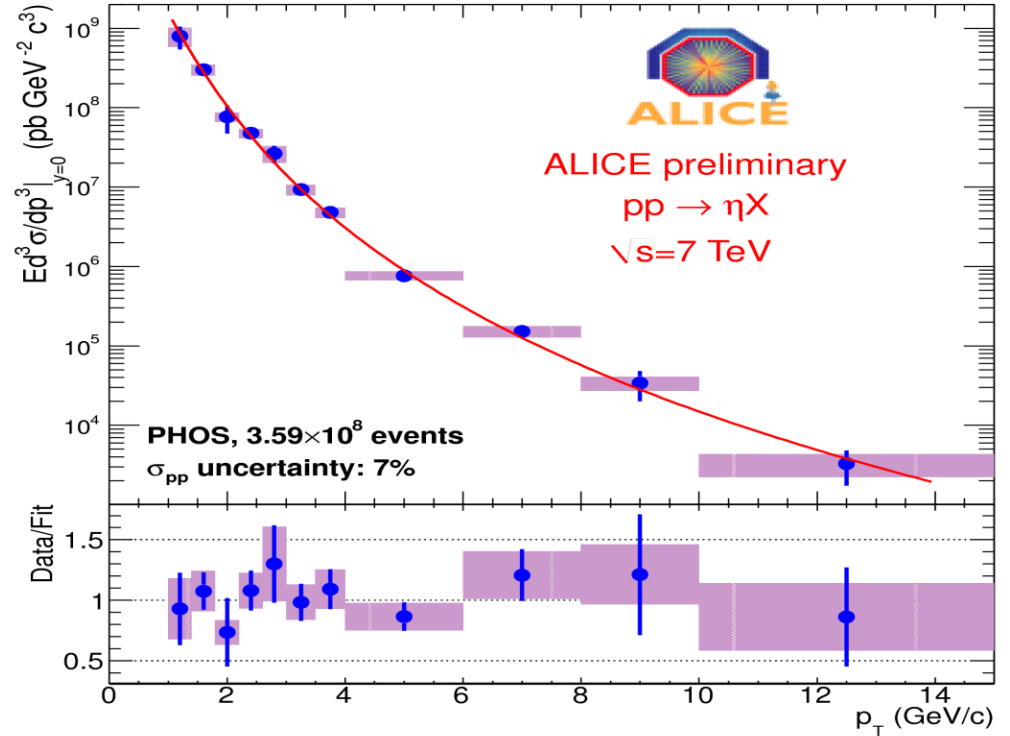
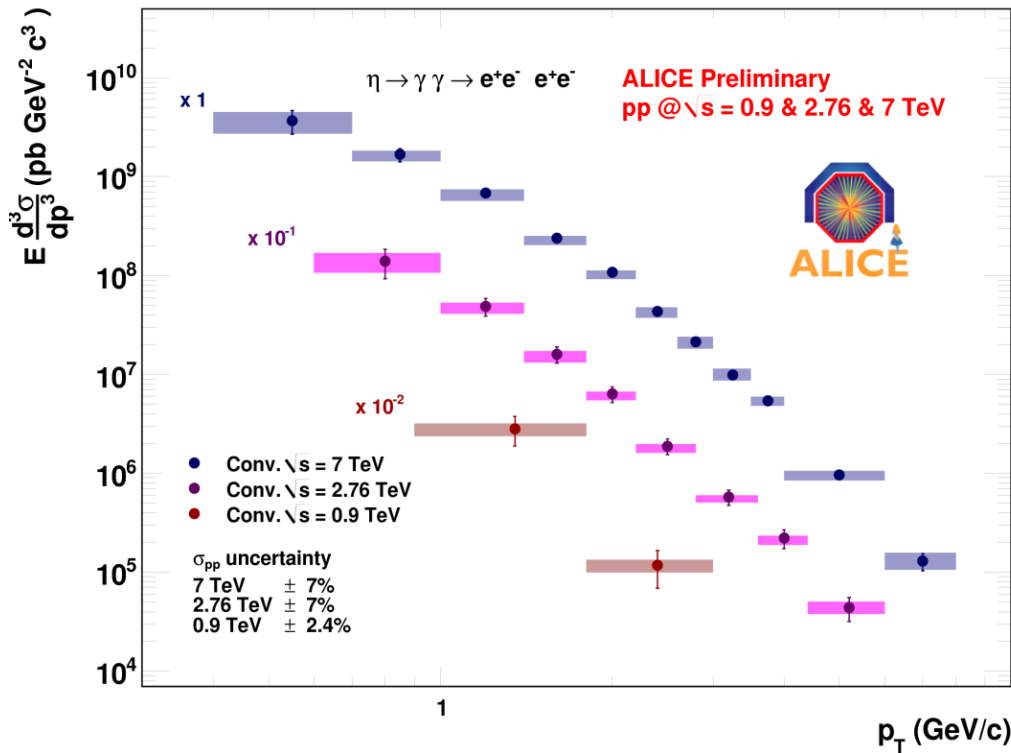


Tsallis function:

$$E \frac{d^3\sigma}{dp^3} = \frac{\sigma_{pp}}{2\pi} \frac{dN}{dy} \frac{(n-1)(n-2)}{nT(nT + m(n-2))} \left(1 + \frac{m_T - m}{nT}\right)^{-n}$$

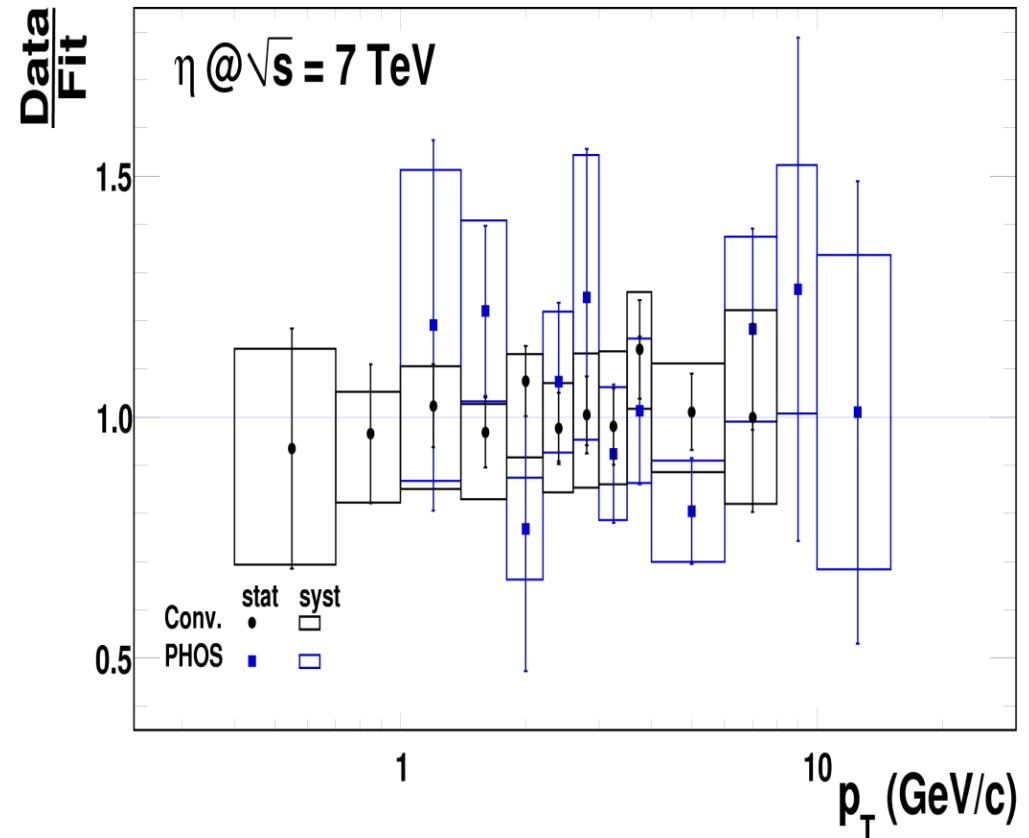
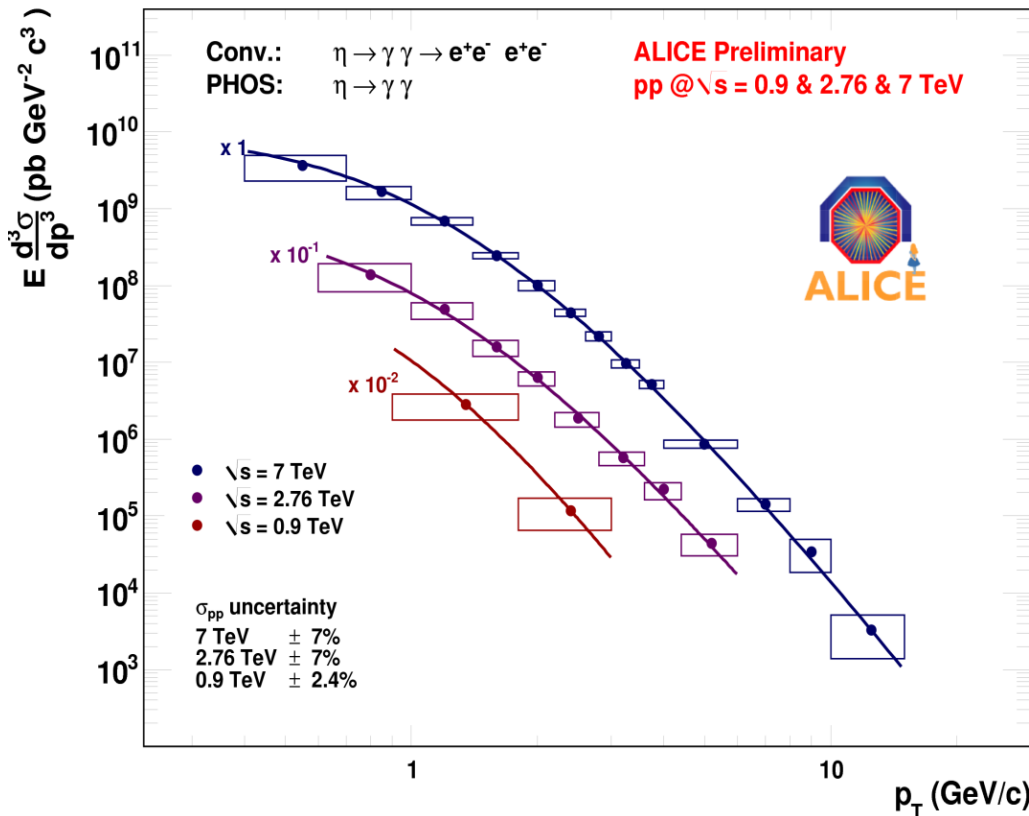
- Good agreement between two techniques
- Tsallis function provides a good description at all energies

Invariant η cross section: Conversion, PHOS



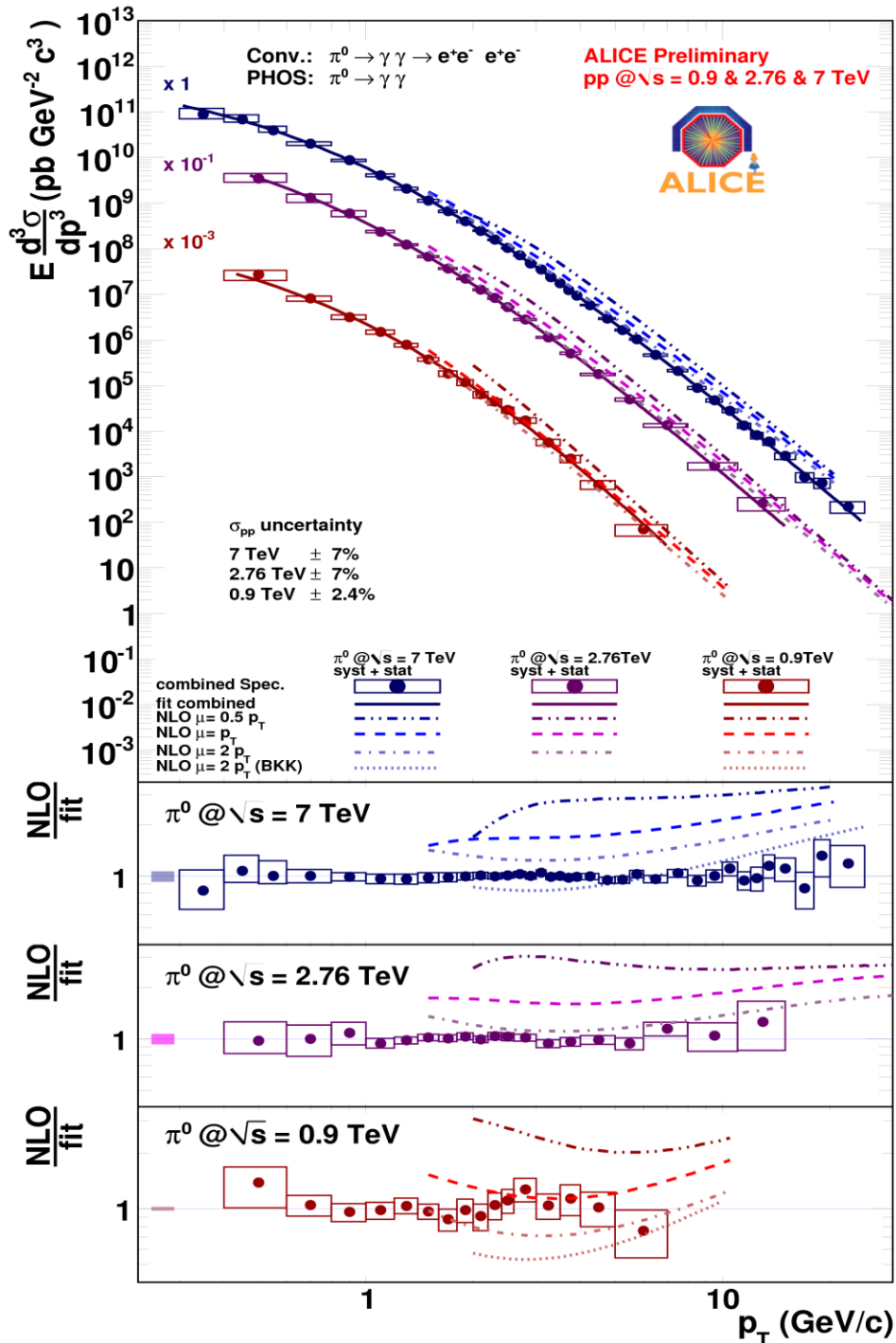
- η at $\sqrt{s} = 7$ TeV measured up to 7 GeV with conversion method and up to 12 GeV/c with PHOS
- No approved PHOS measurements at 0.9 and 2.76 TeV (lack of statistics, limited PHOS acceptance for η)

Invariant η cross section at $\sqrt{s} = 7\text{TeV}$: Combined result (conversion+PHOS)



- Good agreement between conversion method and PHOS
- Tsallis function provides good parametrization

π^0 vs. NLO pQCD



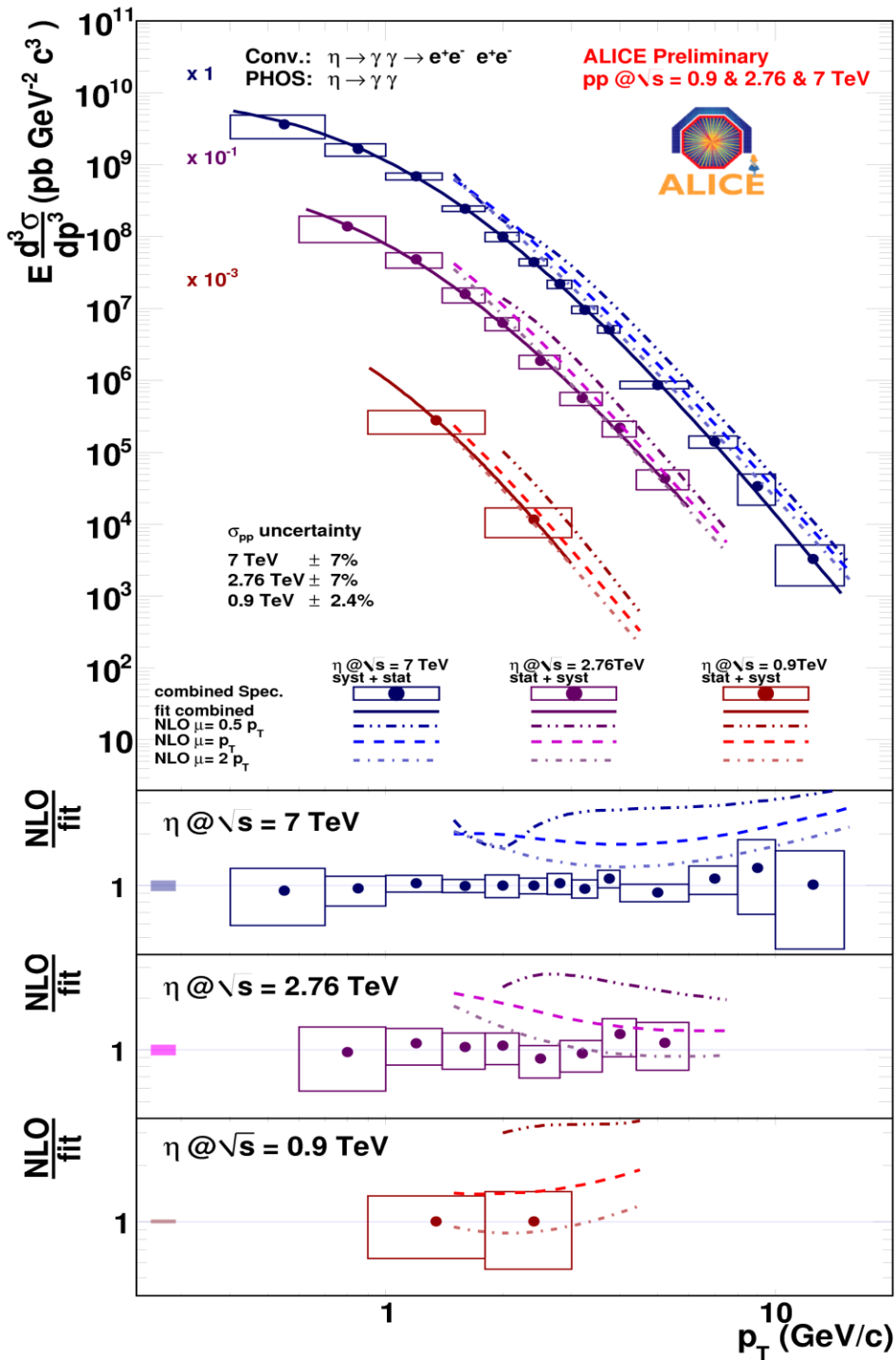
NLO pQCD (W. Vogelsang)

PDF: CTEQ6M5, FF:DSS, scales:0.5 pT,pT,2pT

- While pQCD calculations at $\sqrt{s}=0.9$ TeV describe data well, they fail to describe data at $\sqrt{s}=7$ TeV for all possible choices of FF

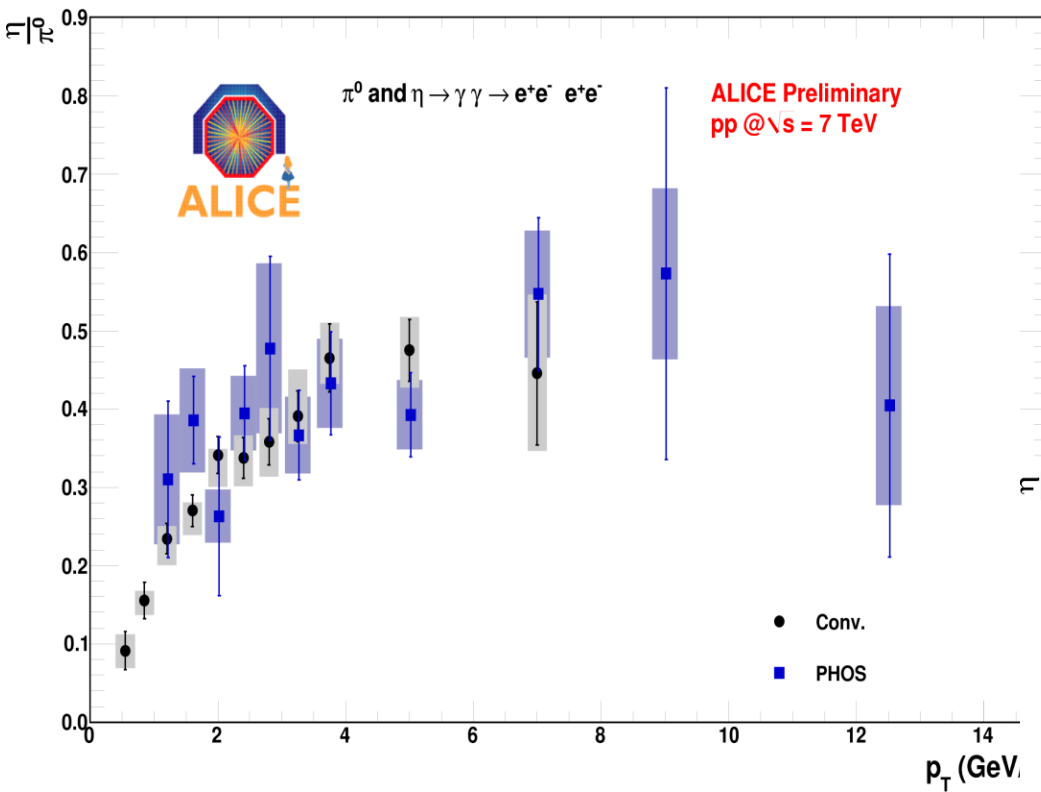
- **pQCD predictions demonstrates different behaviour at high pT then data**

η vs. NLO pQCD



- Agreement with pQCD for 0.9 TeV
- 7 TeV data overestimated

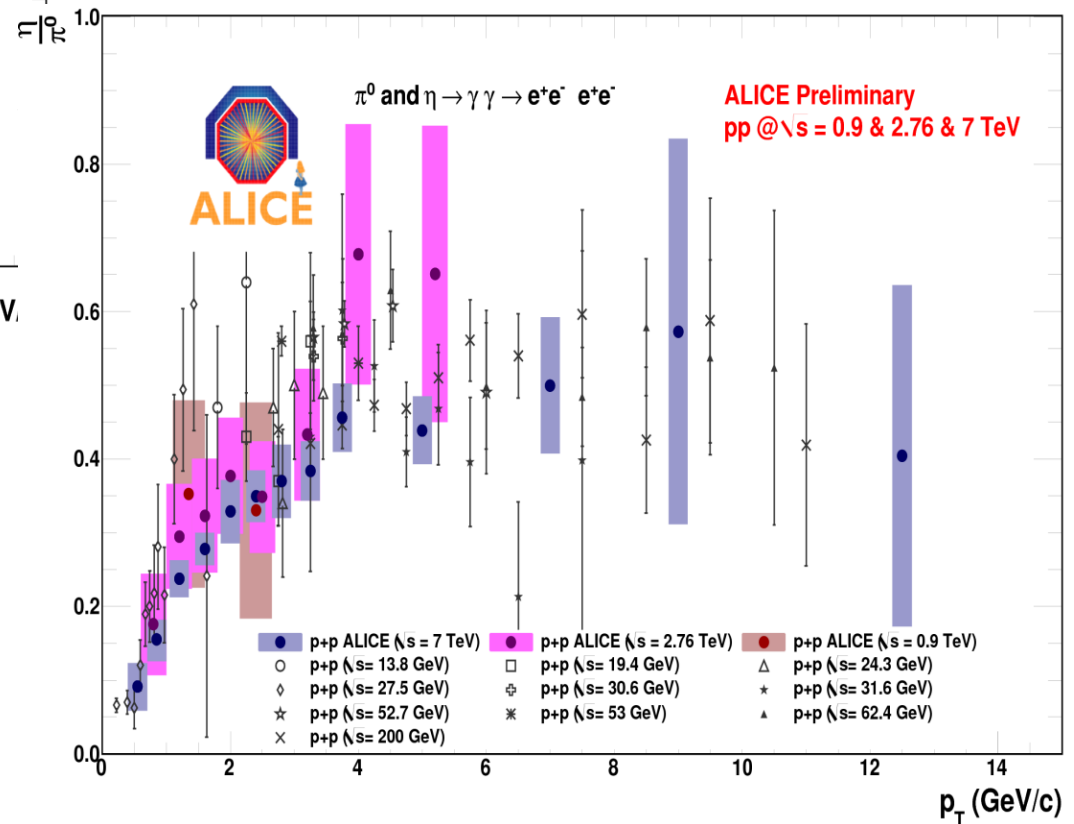
π^0/η ratio



η/π^0 ratio at $\sqrt{s}=7$ TeV agrees with NLO pQCD

η/π^0 ratio measured in ALICE is consistent with the previous measurements

Comparison with world data



Conclusions

- NLO pQCD calculations cannot provide a consistent description of measured data at both beam energies: $\sqrt{s}=0.9$ TeV and $\sqrt{s}=7$ TeV
- State-of-the-art calculations describe the data at 0.9 TeV, however the calculations do not describe the measured cross section at 7 TeV, where the calculations overestimate the cross section and exhibit a different slope compared to data.