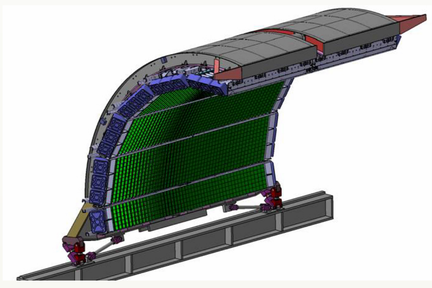
Measurement of π^0 production in pp collisions at $\sqrt{s}$=7 TeV with the ALICE EMCal

P.Ganoti, Oak Ridge National Laboratory, U.S.A.
for the ALICE collaboration

EMCal

The ElectroMagnetic Calorimeter, EMCal [1], is a recent upgrade to the ALICE detector.
In 2010, 4 SuperModules were installed covering $80^o<\phi<120^o$ and $|\eta|<0.7$
Only Minimum Bias events were taken.
In 2011, 6 additional SuperModules were installed, and the EMCal trigger is now in use [2].

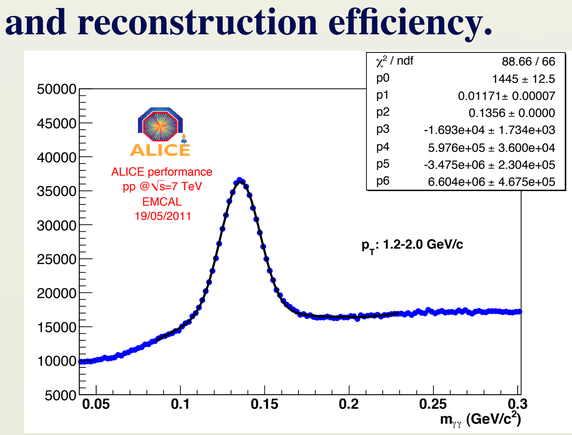


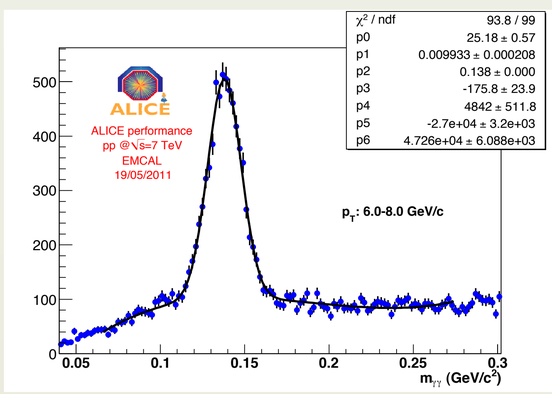
π^0 Analysis Details

π^0 is reconstructed via invariant mass analysis of the decay channel $\pi^0 \rightarrow \gamma\gamma$.
Clusters are identified as a contiguous group of towers above the zero-suppression threshold (3ADC ~ 48MeV) that contact neighboring towers on at least one side and have at least one tower above 100 MeV.
Clusters are corrected for energy non-linearity based on test beam results.

Cluster selection:
$E_{cluster} > 0.5$ GeV
Clusters with the most energetic cell at the edges have been removed
Clusters with more than one cell are kept.

With the EMCal geometry, clusters from symmetric π^0 decay begin to merge at 6 GeV/c. A cluster unfolding algorithm is used to enable π^0 reconstruction up to 15 GeV/c, and above with decreasing efficiency.
The yield extracted from the π^0 mass peak is corrected for acceptance and reconstruction efficiency.

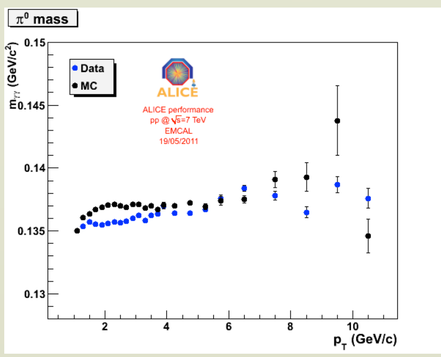


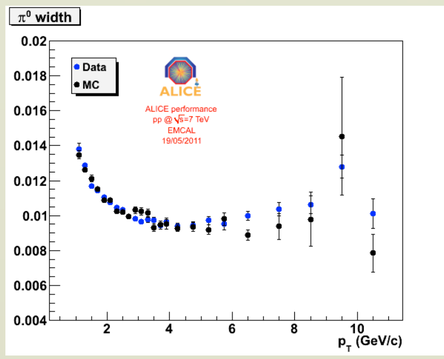


Systematic errors

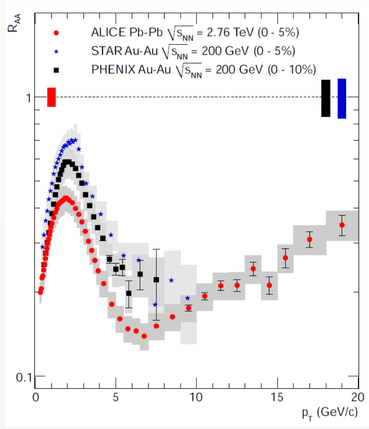
Systematic uncertainties on the current π^0 result:

- Peak extraction (fit with gaussian+polynomial 3d order). This uncertainty is 10-12% for the lower p_T bins where the background is large and diminishes with increasing p_T.
- An energy scale uncertainty of 1.5%, estimated from plots shown below, corresponds to a 9% uncertainty on the π^0 yield.
- Uncertainty of the acceptance correction, 2%.
- Secondary π^0s due to hadronic interactions with material in front of the EMCal (2% for 1-2 GeV, 1% for 2-3 GeV and negligible above).
- Efficiency correction procedure, 5%.
- Efficiency correction conversion effect 5-20%. Comparison of field on and field off results indicates that conversions are not treated correctly in simulation. The systematic error is taken to be equal to the correction, with an additional 10% uncertainty on the correction itself.





Motivation

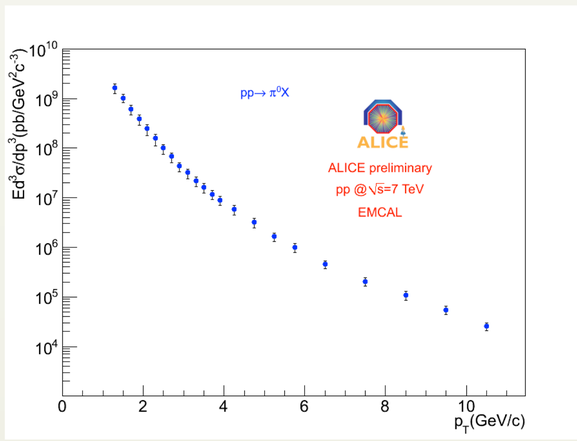


Neutral meson (π^0 and η) measurements in pp collisions ([3], [4]) are of significant physics interest such as for the R_{AA} [4] measurements and for studies of jet fragmentation.

In addition, the π^0 measurement is an important first result to demonstrate the capability and performance of the EMCal.

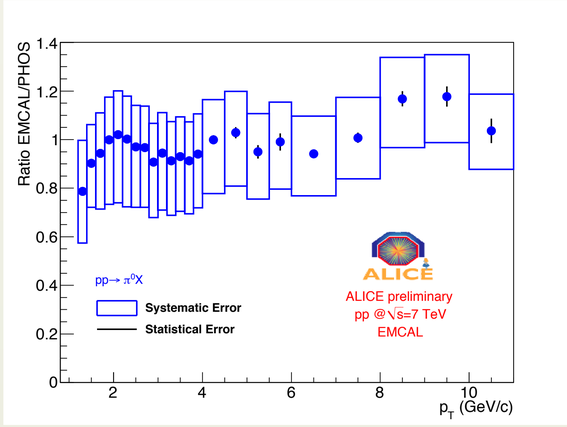
Results

For this analysis 195M Minimum Bias events have been used with magnetic field and 6.2M events without magnetic field.



π^0 pp cross section at 7TeV, measured with EMCal.
The error on the data points is the combined systematic and statistical uncertainty.

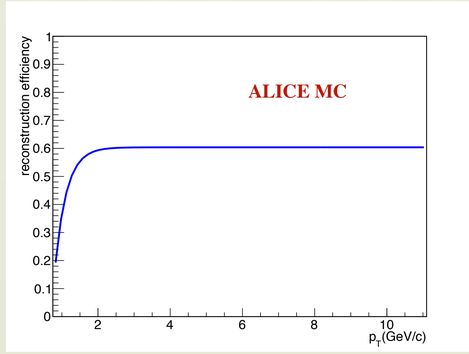
Ratio of the invariant yield measured with EMCal to the Tsallis fit to PHOS data.



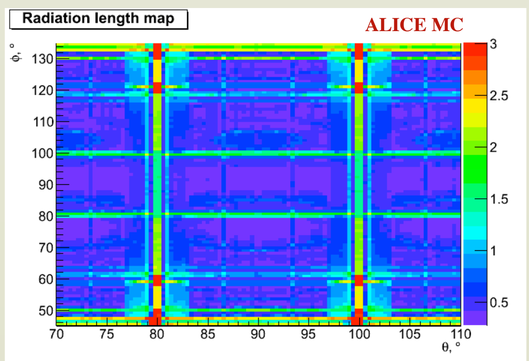
We are looking forward in analyzing the 2011 data where acceptance has been increased by a factor of 2.5 and the L0 trigger is being used.

Efficiency Correction

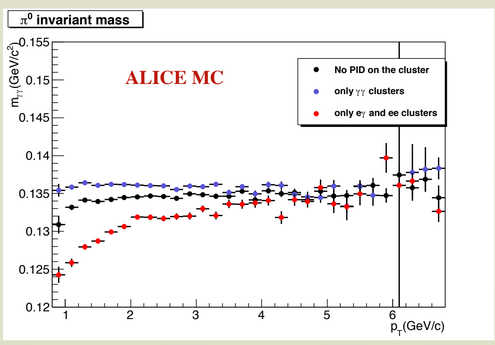
The π^0 reconstruction efficiency for the EMCal, as determined from simulations with magnetic field on, is shown. The efficiency reaches a plateau at a value of ~60%.
For field off, the efficiency increases to about 80%.



The π^0 reconstruction efficiency loss is dominantly due to conversion and subsequent loss of gammas in the materials of ALICE in front of the EMCal. The map of radiation lengths of material in front of the EMCal is shown in the adjacent figure.



With field off, the conversion pairs are undeflected and are more likely to be reconstructed as a single cluster, which then allows the π^0 to be reconstructed, if the energy loss is not too large.



Photons which convert prior to arrival at the EMCal will lose energy with the result of a decrease of the reconstructed π^0 mass as shown in the figure on the left.

References
1. Poster by Bjorn Nilsen, The ALICE EMCal Overview and Status
2. Poster by Jiri Kral, The Level-0 trigger of the ALICE Electromagnetic Calorimeter
3. Poster by Olga Driga, Measurement of eta meson production in pp collisions at √s = 7 TeV with the ALICE electromagnetic calorimeter
4. Poster by Hermes Braidot, Measurement of inclusive π^0 yields in pp and PbPb collisions at sqrt(s_{NN})=2.76 TeV with the ALICE EMCal
5. ALICE collaboration, Phys. Rev. Letters B 696 2011, 30-39