Neutral mesons production at midrapidity in Pb–Pb collisions
at $\sqrt{s_{NN}} = 2.76$ TeV with ALICE

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Motivation

Neutral mesons, such as $\pi^0$ and $\eta$, are probes for the study of the energy loss of partons traversing the hot and dense medium, the Quark-Gluon Plasma, that is formed in heavy-ion collisions. In addition, photons are created during the entire space-time evolution after the collision and leave the medium unaffected; ideal probe to study collective expansion and temperature of the system, but have large background from decay photons $\Rightarrow$ accurate measurement is necessary to determine their contribution.

Photon detection with the ALICE experiment

ALICE measures $\pi^0$ and $\eta$ mesons via two-gamma decay channel. The photon detection can either be direct, using the electromagnetic calorimeters EMCal and PHOS, or by reconstructing the electron-positron pairs from photon conversions in the detector material (photo conversion method, PCM).

**PHOS:**
- PbWO$_4$ crystals
- coverage in $|\eta| < 0.13$, $260^\circ < \phi < 320^\circ$

**EMCal:**
- 77 sampling layers, (Pb + scintillator)
- coverage in $|\eta| < 0.7$, $80^\circ < \phi < 180^\circ$

**PCM:**
- ITS and TPC, full coverage
- conversion in detector material: conv. prob. $\sim 8$
  
  $X/X_0 = (11.4 \pm 0.5)\%$ ($|\eta| < 0.9$, $R<180$ cm)

Results

To study medium effects (e.g. from a QGP), results from pp collisions (vacuum scenario) are compared to A–A collisions

- 2010 Pb–Pb run: combined PCM + PHOS measurement of $\pi^0 \Rightarrow$ comparison to pp collisions via nuclear modification factor:
  
  \[ R_{AA}(p_T) = \frac{d^2N/dp_Tdy|_{AA}}{(T_{AA})} \times \frac{d^2\sigma/dp_Tdy|_{pp}}{\sigma_{pp}} \]

  $\Rightarrow$ stronger supression for higher collisions energy: higher energy density dominates over increase expected from harder initial parton spectra

- 2011 Pb–Pb run: higher luminosity runs delivering 10 times more statistics, combined PCM + EMCal measurement of $\pi^0$ and $\eta$ mesons: $\pi^0$ consistent with 2010 data and first $\eta$ measurement in Pb–Pb at the LHC $\Rightarrow$ comparison to pp collisions via $\eta/\pi^0$ ratio

\[ \text{pQCD NLO calculation for 0-10\% cent. class agrees} \]

$\Rightarrow$ with current uncertainties, no differences are observed between $\eta/\pi^0$ ratio in Pb–Pb and pp collisions that may hint to collective behaviour

Conclusions and outlook

- first $\eta$ measurement in heavy-ion collisions to reach down to $p_T = 1$ GeV/c
- with current uncertainties, no clear dependence of $\eta/\pi^0$ on collision system is observed
- $\pi^0$ and $\eta$ meson measurements from 2011 data soon to be published