Measurement of neutral mesons in pp collisions at √s = 5.02 TeV via photon conversion method with ALICE

Hikari Murakami* for the ALICE Collaboration, *University of Tokyo (Japan)

Physics motivation

Measurement of neutral mesons, such as π^0 and η plays an important role to study parton energy loss in the Quark-Gluon Plasma created in high-energy heavy-ion collisions. Such measurement in pp collisions at √s = 5.02 TeV provides a good reference for understanding the mechanisms appearing in p-Pb [1] and Pb-Pb [2,3] collisions at the same collision energy.

Analysis strategy

π^0 and η are reconstructed via two photon decay channel. In ALICE, two different detection methods enable the neutral meson measurement in a wide p_T range.

1. the measurement of e^+e^- pairs from photon conversions (PCM).
2. the measurement of photons directly by the electromagnetic calorimeters. (PHOS, EMCal)

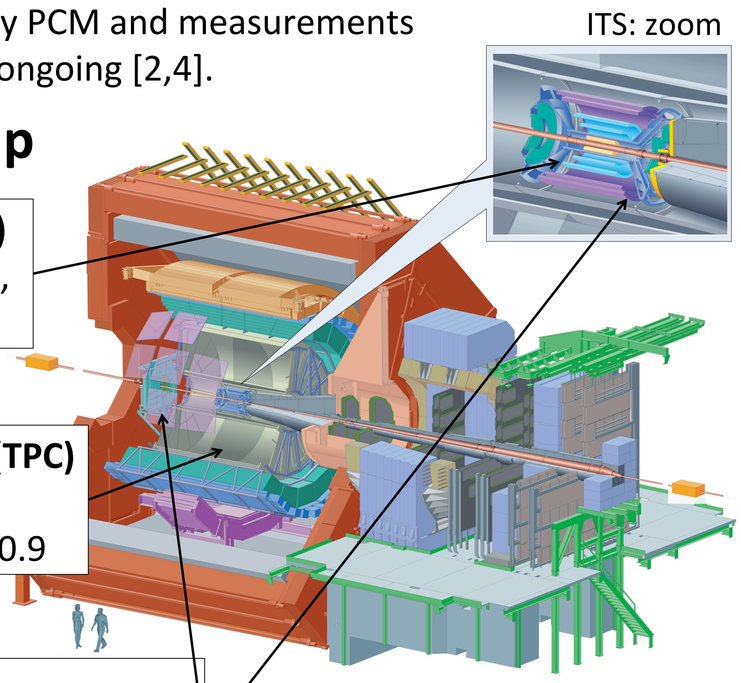
This analysis is performed by PCM and measurements using calorimeters are also ongoing [2,4].

Experimental setup

Inner Tracking System (ITS)
6 layers of silicon detectors, vertexing, tracking.

Time Projection Chamber (TPC)
Track reconstruction, d*E*/d*x* measurement, |η|< 0.9

V0 detectors
Two arrays of scintillation counters used for minimum bias trigger.



Photon Reconstruction

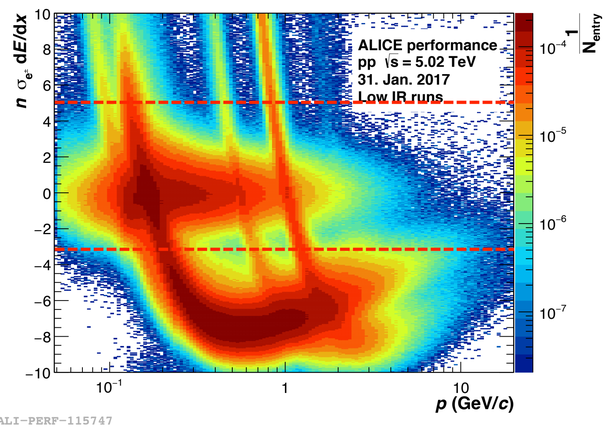
Photons converted in the material of ITS and TPC are detected with the following steps:

(1) Track & V^0 selection

Secondary vertex (V^0) reconstruction by combining two opposite charged tracks from non-kink daugthers. Minimum track p_T is 50 MeV/*c*. Cut on position of secondary vertex is 5 < *R* < 180 cm.

(2) Electron identification

Based on the specific energy loss d*E*/d*x* measurement in the TPC, electrons are distinguished from other charged particles. V^0 particles, which are reconstructed from other particles than electrons are excluded.

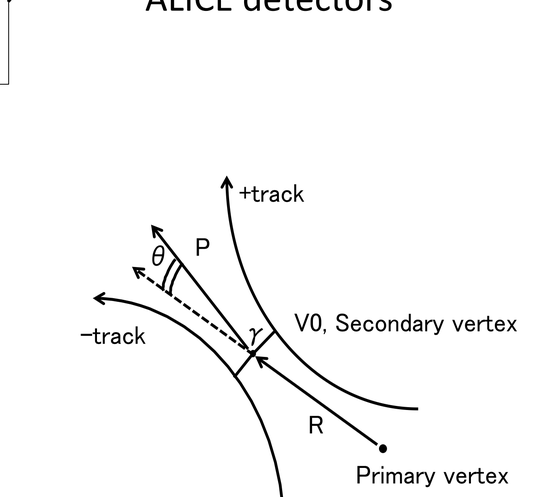


$n\sigma_{e+e-}$ TPC d*E*/d*x* vs *p* (GeV/*c*).
A clear separation between different particle species is seen. Electrons in the region of $-3 < n\sigma_{e-} < 5$ are selected.

Schematic view of a secondary vertex.

(3) Photon selection

Remaining V^0 (K^0_s, Λ, anti Λ,) particles are further excluded by imposing several photon cuts based on Armenteros-Podolanski plot, Cosine pointing angle etc.



Photon and other particles are clearly separated. In order to select photons, elliptical cut is applied.

Dataset and Event selection

180 M events of minimum bias triggered data sample are used in this analysis. After the event selection cuts (background events rejection, cut on vertex z position within ± 10 cm, in-bunch pileup rejection, at least one contributing track/tracklet to the vertex), 110 M events are analyzed.

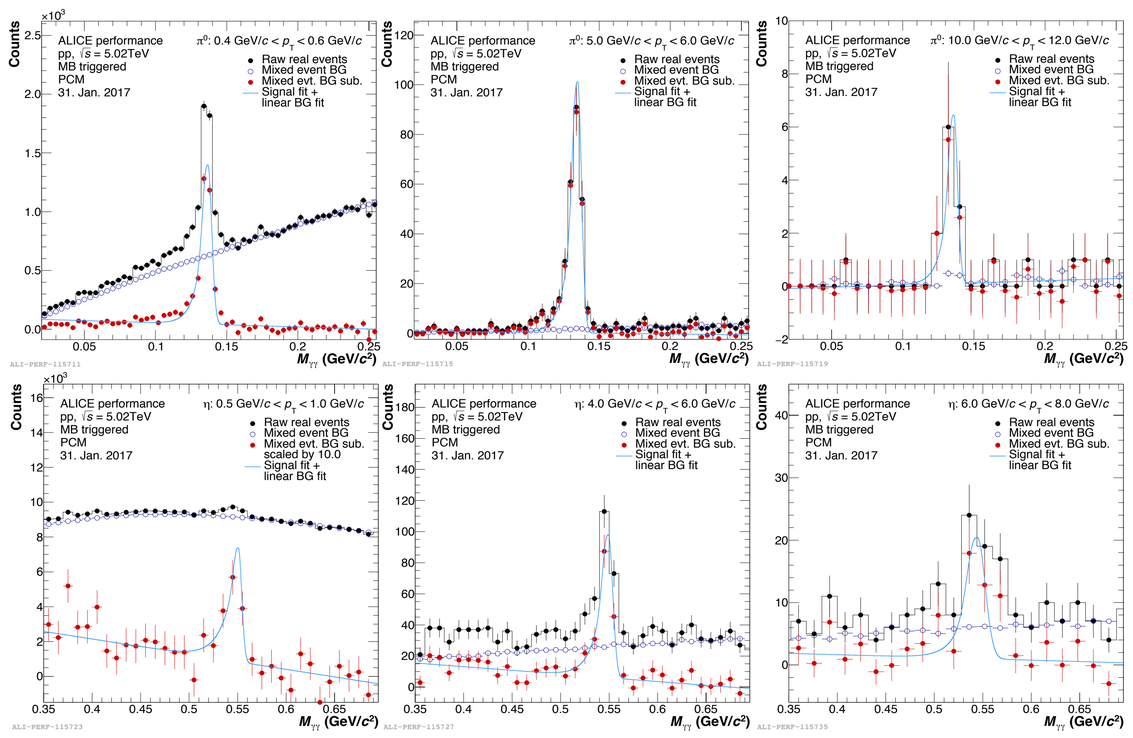
Signal extraction

Selected photon candidates are paired: $M_{\gamma\gamma} = \sqrt{2E_{\gamma_1}E_{\gamma_2}(1-\cos\theta_{12})}$
The pairs with an opening angle smaller than 5 mrad are excluded. Uncorrelated background is calculated using event mixing technique and subtracted, Resulting invariant mass distributions are fitted with the following function:

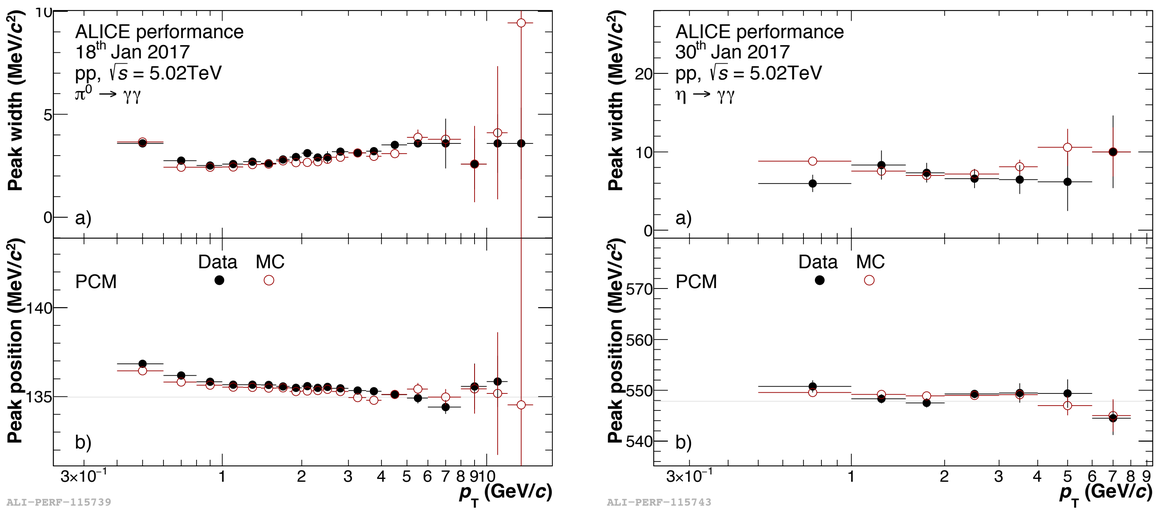
$$y = A\cdot\left(G(M_{\gamma\gamma}) + \exp\left(\frac{M_{\gamma\gamma}-M_{\pi^0(\eta)}}{\lambda}\right)(1-G(M_{\gamma\gamma}))\theta(M_{\pi^0,\eta}-M_{\gamma\gamma})\right) + B + C\cdot M_{\gamma\gamma}$$

$$\text{with } G = \exp\left(-0.5\left(\frac{M_{\gamma\gamma}-M_{\pi^0,\eta}}{\sigma_{M_{\gamma\gamma}}}\right)^2\right)$$

Raw yield is obtained by bin counting after further subtraction of residual backgrounds.



Invariant mass distributions of reconstructed photon pairs (black circles) for different p_T slices. π^0 (top) and η (bottom).



Comparison of peak width and peak position between data and Monte Carlo simulations for π^0 (left) and η (right).

Summary and outlook

- ✓ Clear π^0 (η) peaks are observed in 0.4 (0.5) < p_T < 12.0 (8.0) (GeV/*c*)
- ✓ Peak width and peak position are consistent between data and Monte Carlo simulations.
- ☐ Evaluation of correction factors and systematic uncertainties will be done and invariant cross section will be extracted.

Related posters on ALICE neutral mesons measurements

[1] A. Passfeld, #138, p-Pb collisions at $\sqrt{s_{NN}}$=5.02TeV with PCM+PHOS+EMCal
[2] D. Sekihata, #122, pp collisions at √s=5.02TeV and Pb-Pb collisions at $\sqrt{s_{NN}}$=5.02TeV with PHOS
[3] M. Danisch, #89, Pb-Pb collisions at $\sqrt{s_{NN}}$=5.02TeV with PCM
[4] A. Matyja, #107, pp collisions at √s=5.02TeV with EMCal

THE UNIVERSITY OF TOKYO

Quark Matter 2017