PROCEEDINGS OF SCIENCE

Reconstruction of known particle decays in proton-proton collisions at energies of 900 GeV and 7 TeV with the ATLAS Inner Detector

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The ATLAS experiment is one of two general purpose detectors at the Large Hadron Collider. ATLAS is equipped with a charged particle tracking system consisting of three inner subdetectors, which provide high precision measurements with fine detector granularity. The pixel and microstrip subdetectors, which use silicon technology, are complemented with the transition radiation tracker. The reconstruction of known particle decays is an important tool to understand the performance of the ATLAS Inner Detector, the track and vertex reconstruction and particle identification capabilities. Using data taken at center-of-mass energies of 0.9 TeV and 7 TeV, decays of several different particles such as K^0_s, Λ, ϕ, Ξ, Ω etc. have been reconstructed and their properties compared to Monte Carlo predictions. The identification of these particles is important both for tuning different Monte Carlo generators that describes Minimum Bias events and for understanding the tracking performance. In fact the understanding of this low-p_{T} processes are important for the characterization of the underling event that is an important background for the high-p_{T} collisions. The data, taken with a Minimum Bias Trigger, are compared to Pythia non diffractive Monte Carlo simulation with MC09 tune and the full GEANT4 simulation of the detector without applying any correction for detector effects.

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1. $\phi \to K^+K^-$ in 900 GeV collision data

The $\phi \to K^+K^-$ meson have been identified and reconstructed using the dE/dx measurement for tracks coming from the primary vertex with an impact parameter significance $|d|/\sigma_d < 3$, at least 2 Pixel and 2 SCT Hits and $p_{\mathrm{T}} < 800$ MeV for a good $K-\pi$ separation from dE/dx measurement [1]. In figure 1 are shown the dE/dx as a function of reconstructed momentum and the observed invariant mass distribution in data compared to Monte Carlo distributions where the signal and background components have been separately normalized to the data. The experimental width and position of the mass peak are in agreement between data and Monte Carlo.

2. K^0_s and Λ decays reconstruction at $\sqrt{s} = 7$ TeV

In order to reconstruct K^0_s and Λ decays into two charged hadrons, opposite charge tracks with $p_{\mathrm{T}} > 100$ MeV and originating from a displaced vertex with respect to the collision vertex are used [2]. $K^0_s \to \pi^+\pi^-$ candidates are further selected requiring a transverse flight distance $L_{xy} > 4$ mm and the $\cos(\theta_{\mathrm{pointing}}) > 0.999$ where $\theta_{\mathrm{pointing}}$ is the angle between the momentum direction of the reconstructed K^0_s and the line connecting the primary and secondary vertex. Λ are selected requiring a flight distance larger than 30 mm and $\cos(\theta_{\mathrm{pointing}}) > 0.9998$. The K^0_s and Λ mass distributions for $\sim 190\mu\mathrm{b}^{-1}$ of data are shown in figure 2 and compared with simulation in which

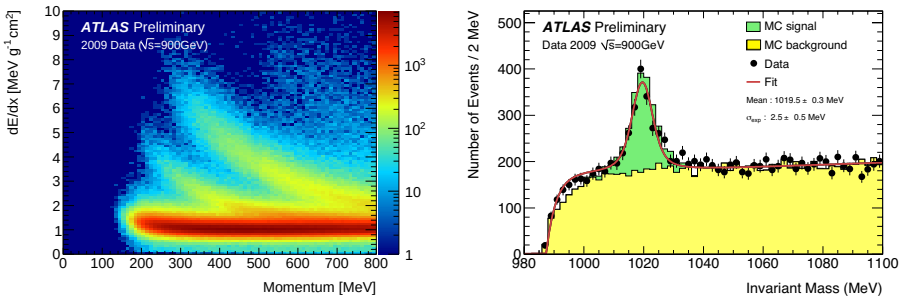

Figure 1: *(left)* Energy loss dE/dx as a function of reconstructed momentum for all selected primary tracks;*(right)* invariant mass distribution of the K^+K^- pairs.

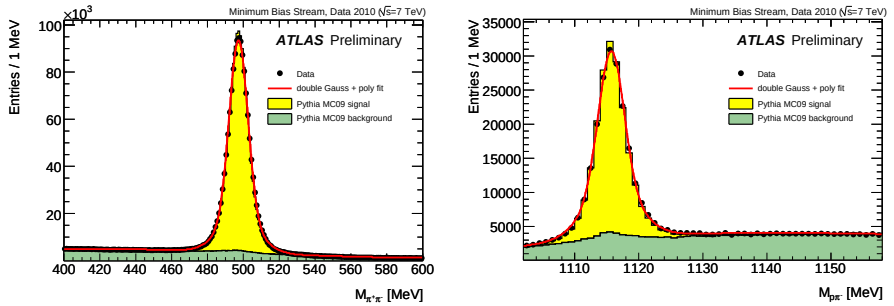

Figure 2: K^0_s *(left)* and Λ *(right)* mass spectra in data and simulation in the barrel region of the Inner Detector ($|\eta| < 1.2$ for both tracks).

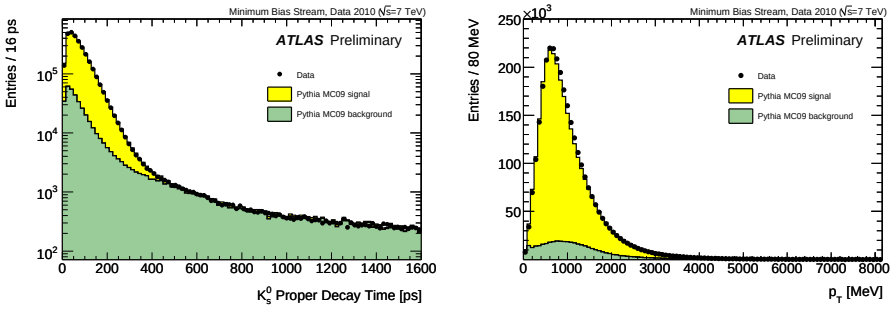

Figure 3: The proper decay time *(left)* and transverse momentum *(right)* of K^0_s for candidates with mass within 20 MeV from the PDG value [4] for data and the Monte Carlo sample.

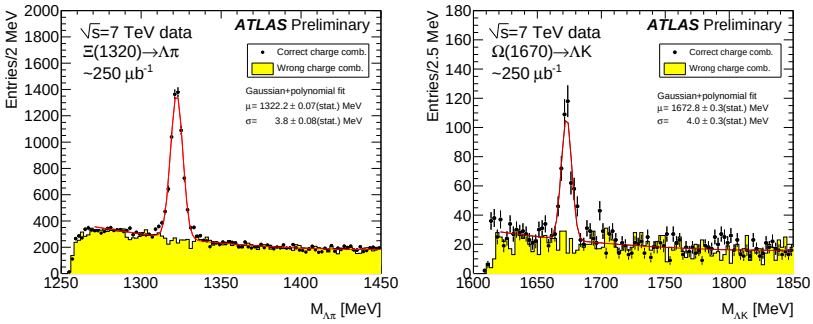

Figure 4: The invariant mass of the reconstructed $\Xi \to \Lambda\pi$ *(left)* and $\Omega \to \Lambda K$ *(right)* candidates.

signal and background components are separately normalized to data. Figure 3 shows proper decay time and p_{T} spectra of K^0_s candidates demonstrating a good agreement with simulation.

3. Ξ and Ω decays at $\sqrt{s} = 7$ TeV

$\Xi \to \Lambda\pi$ and $\Omega \to \Lambda K$ decays are reconstructed in their complete cascade chain imposing a mass window cut for the Λ candidate, pointing constraints between the vertices of the cascade and flight length cuts of 4 and 6 mm for Ξ and Ω respectively [3]. Transverse impact parameter and p_{T} cuts are imposed to the bachelor π ($d_0 > 0.5$ mm, $p_{\mathrm{T}} > 150$ MeV) and K ($d_0 > 1$ mm, $p_{\mathrm{T}} > 400$ MeV) tracks. The reconstructed invariant mass for both baryons is shown in figure 4, with the peak position in agreement with PDG [4] value.

References

[1] The ATLAS Collaboration: *$\phi(1020)$-meson production in $\sqrt{s} = 900$ GeV collision data*. ATLAS-CONF-2010-023, http://cdsweb.cern.ch/record/1277655.

[2] The ATLAS Collaboration: *Kinematic Distributions of K^0_s and Λ decays in collision data at $\sqrt{s} = 7$ TeV*. ATLAS-CONF-2010-033, http://cdsweb.cern.ch/record/1277668.

[3] The ATLAS Collaboration: *Observation of Ξ, Ω baryons and $K^*(890)$ meson production at $\sqrt{s} = 7$ TeV*. ATLAS-CONF-2010-032, http://cdsweb.cern.ch/record/1277666.

[4] K. Nakamura et al. (Particle Data Group), J. Phys. G 37, 075021 (2010)