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Tracking results from LHC collisions at 900 GeV with CMS

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Summary. — At the end of 2009 LHC started to provide p-p collisions at a center-of-mass energy of 900 GeV. About 500 k collisions events have been recorded by the CMS experiment. This paper describes briefly the performance of the tracking and vertexing algorithms as obtained by the analysis of the first data using only mesurements in the inner silicon tracker of CMS. The reconstruction of the invariant mass of several resonant states and the precise determination of the primary and secondary vertex position are the best indication that the detector is ready to face the challenging physics program of CMS.

PACS 07.77.Ka – Charged-particle beam sources and detectors.
PACS 29.40.Gx – Tracking and position-sensitive detectors.
PACS 29.40.Wk – Solid-state detectors.

1. – Primary vertex spatial resolution

The reconstruction of the primary vertex of interaction starts from the tracks. They are first filtered using cuts based on the impact parameter, number of hits, and the normalized χ^2 and then clustered in z. Clusters are split when there is a gap greater than 1 mm. The tracks in the cluster are then fitted with an *Adaptive Vertex Filter* [1] that performs a linear rewheighted least-squares fit based on the *Kalman Filter*. The primary vertex spatial resolution depends strongly on the number of tracks used in the fit and their average p_T. It is possible to evaluate the spatial resolution with a data-driven method: the tracks in an event are split into two different sets and used to independently fit the primary vertex. The distribution of the difference in the fitted vertex positions can then be used to extract the resolution. When comparing the two vertices we impose that the number of tracks in the two sets be equal and their average p_T is within 10%. Figure 1 shows the results obtained with this method, as the number of tracks and their average p_T increase the resolution improves reaching a plateau of about 35 μm in x and y and 50 μm in z. A very good agreement with the simulation is observed. This good resolution permits to identify with a good efficiency secondary vertices and hence long-lived particles decays, as shown in the next section.

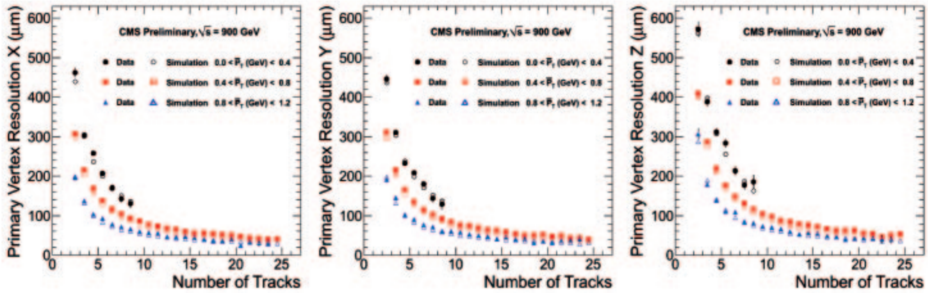

Fig. 1. – Spatial resolution on the primary vertex position as a function of the number of tracks in the fit in three bins of the average p_T.

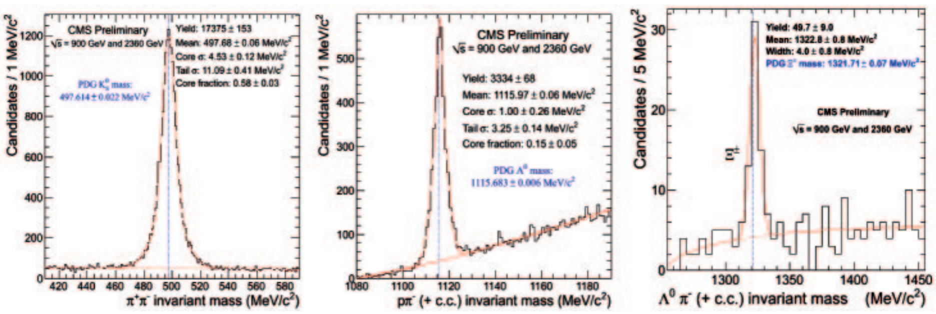

Fig. 2. – Spatial resolution on the primary vertex position as a function of the number of tracks in the fit in three bins of the average p_T.

2. – Resonances

The reconstruction of V^0 decays, such as $K_s^0 \to \pi^+\pi^-$ or $\Lambda_0 \to p\pi^-$, starts by selecting good tracks. The requirements are as follows: normalized $\chi^2 < 5$, more than 6 valid hits, and a transverse impact parameter with respect to the beamspot of at least 0.5σ where σ is the uncertainty. Pairs of opposite-charge tracks are then selected and a fit to a common vertex is performed. If a vertex is found, the innermost hits on the daughter tracks are checked to make sure they do not lie inside the primary vertex region. Finally, invariant-mass requirements are used to select K_s^0 and Λ_0. The Ξ^- (and charge conjugate) is reconstructed through its decay to $\Lambda_0\,\pi^-$. The data selection is the same as for the V^0. For each candidate, the charged tracks with the same sign as the pion in the Λ_0 decay are fit with the Λ_0 candidate with a mass constraint. Figure 2 shows the reconstructed invariant mass for the three resonances described, the measured peak values are within a few per mil to PDG ones. For more details on the resonance analysis see [2].

REFERENCES

[1] Fruehwirth F., Waltenberger W. and Vanlaer P., *Adaptive Vertex Fitting*, CMS NOTE-2007/00.

[2] The CMS Collaboration, *Tracking and vertexing results from first collisions*, CMS PAS TRK-10-001.