

Selection of tracks from primary particles.¹

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1 Cuts to select tracks from primary particles.

Simulation consists in: pp collisions, 14 TeV, minimum bias, 583300 events, data on CAF.

Tracks from primary particles are defined as tracks selected using the following cuts:

Quality/resolution cuts are default ESD tracks cuts.

$$N_{\text{clustersinTPC}} > 50 \tag{1}$$

$$\frac{\chi^2}{N_{\text{clustersinTPC}}} \leq 3.5 \tag{2}$$

$$\sigma_y^2 < 2\text{cm}^2 \tag{3}$$

$$\sigma_z^2 < 2\text{cm}^2 \tag{4}$$

$$\sigma_{\sin(\phi)}^2 < 0.5 \tag{5}$$

$$\sigma_{\tan(\theta)}^2 < 0.5 \tag{6}$$

$$\sigma_{\frac{1}{p_T}}^2 < 2(\text{GeV}/c)^{-2} \tag{7}$$

Track to vertex cut is made by cutting on distance of closest approach (DCA) normalized by the expected resolution (see PWG0).

$$N_\sigma < 3 \tag{8}$$

ITS cuts these cuts are implemented to guaranty the participation of ITS in the reconstruction, these cuts are:

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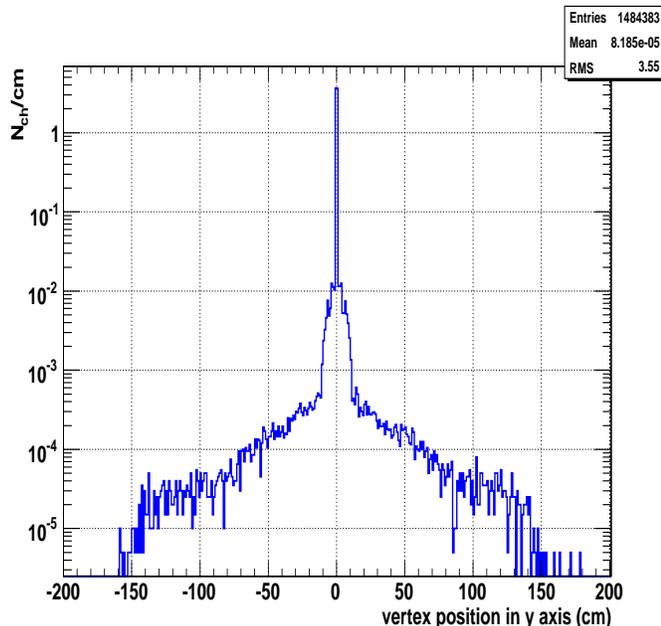


Figure 1: Vertex position distribution (in y axis, bin size: 1cm) for tracks from primaries. In vertical axis is the number of tracks per event which coming from the primary vertex. The beam has a radii of 3cm, and in this distribution we have production vertexes for primaries very far from the beam. The percent of tracks secondaries selected as primaries is 1.9%.

1. at least one cluster in ITS.

$$N_{\text{clusters in ITS}} > 1 \quad (9)$$

2. ITS refit is required.

Other flags: TPC has to contribute in the reconstruction.

1. TPC refit is required: in order to select tracks where TPC has contributed.
2. Not tracks labeled as kink daughters.

1.1 Vertex Distribution of Tracks from Primaries.

In figure 1, you can see vertex distribution in y axis (distribution in x axis is very similar) of tracks which were selected as primaries. In vertical axis we have number of tracks per event. I define tracks secondaries selected as primaries ($\sim 1.9\%$), as the tracks from primaries which have their production vertexes outside of the beam. To get the production vertex of tracks I used MC information, first I got the label of the selected track and after I got the particle from MC asociated to labeled track. So, I could obtain vertex production of the partice. In figure 2, you can see vertex distribution in z axis of tracks selected as primaries.

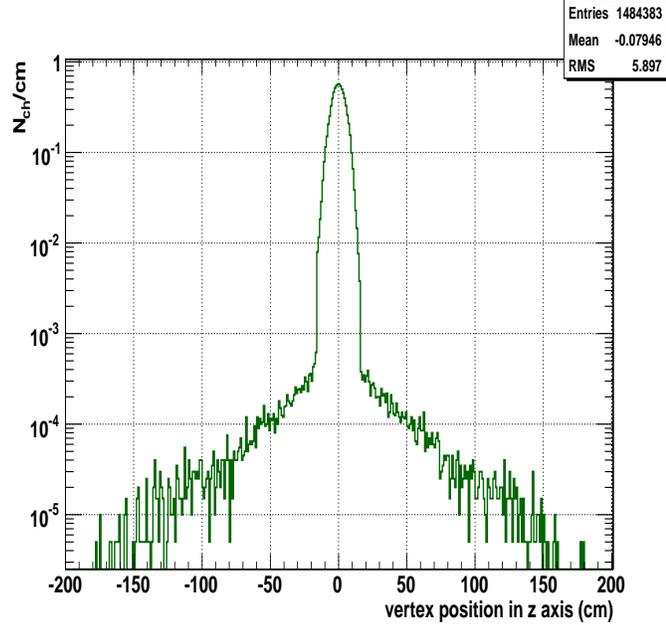


Figure 2: Vertex position distribution (in z axis, bin size: 1cm) for tracks from primaries. In vertical axis is the number of tracks per event which coming from the primary vertex.

1.2 Correlation: Vertex Position vs. P_T for tracks selected as primaries.

In figure 3, you can find correlation: vertex position in y axis (bin size: 1 cm) vs. P_T (bin size: 0.1) for all tracks from primaries. Tracks selected as primaries have momentum: $0.1 \text{ GeV}/c \leq P_T \leq 3 \text{ GeV}/c$. So, it is not possible to apply a cut in momentum to improve the primary tracks selection.

In figure 4, you can see correlation: vertex position in z axis (bin size: 1 cm) vs. P_T (bin size: 0.1) for all tracks from primaries.

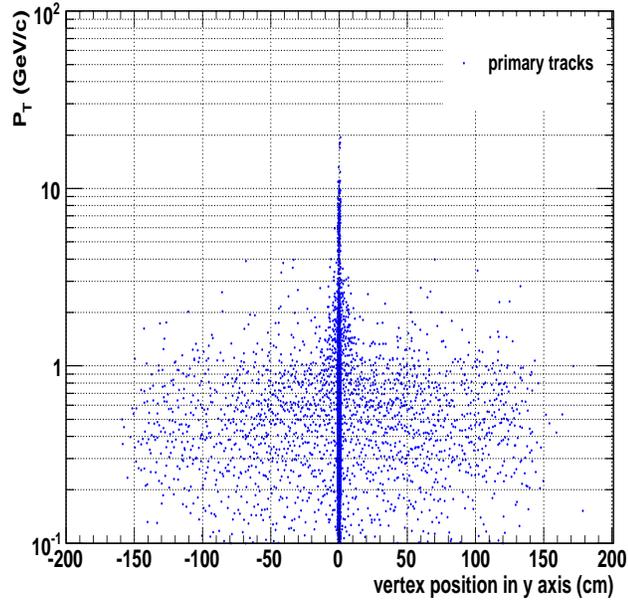


Figure 3: Production vertex (y axis) vs. P_T for tracks from primaries. Note that momentum of secondaries selected as primaries satisfies: $0.1\text{GeV}/c \leq P_T \leq 3\text{GeV}/c$.

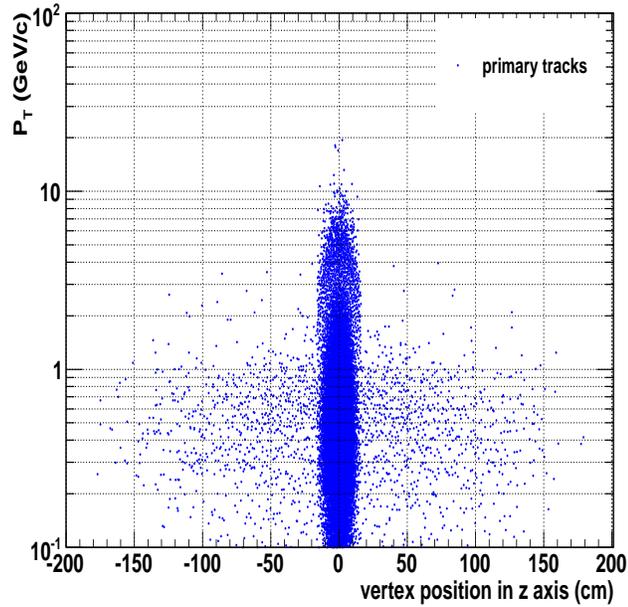


Figure 4: Production vertex (y axis) vs. P_T for tracks from primaries. Note that momentum of secondaries selected as primaries satisfies: $0.1\text{GeV}/c \leq P_T \leq 3\text{GeV}/c$.

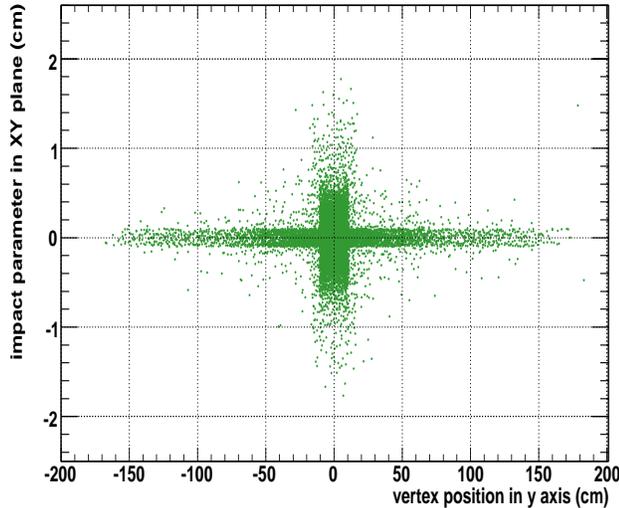


Figure 5: Vertex position (in y axis, bin size 1 cm) versus impact parameter in XY plane (bin size 0.1 cm) for secondary tracks selected as primaries. As you can see the impact parameter of these kind tracks is smaller than 2.5, for that reason these tracks are selected as primaries. Impact parameter was obtained from ESD information, production vertex was obtained from MC.

1.3 DCA of secondaries selected as primaries.

Now, it is very interesting to explore the impact parameter of secondaries selected as primaries, in order to understand the reason by which these secondary tracks look as primaries.

In figure 5, you can see the plot: vertex position (in y axis, bin size 1 cm) versus impact parameter in XY plane (bin size 0.1 cm) for secondary tracks selected as primaries. The impact parameter was obtained using the class `AliESDtrack`, and the production vertex using MC information. As you can see, the cut $N_\sigma \leq 3$ guarantees that tracks selected as primaries have their impact parameter (in XY plane) smaller than 2.5, but due to extrapolation of tracks which is done to compute DCA it is possible which secondary tracks, for example from Λ^0 decay, K^0_{short} decay, γ conversion, have almost the same DCA of their mothers. So, these kind of tracks could be selected as primaries. In figure 6, you can see the plot: vertex position (in z axis, bin size 1 cm) versus impact parameter in Z (bin size 0.1 cm) for secondary tracks selected as primaries. In this case the impact parameter of these kind of tracks is smaller than 16 cm. In both cases the value of the impact parameter is smaller than 0.5 cm when the particle is produced outside of the beam.

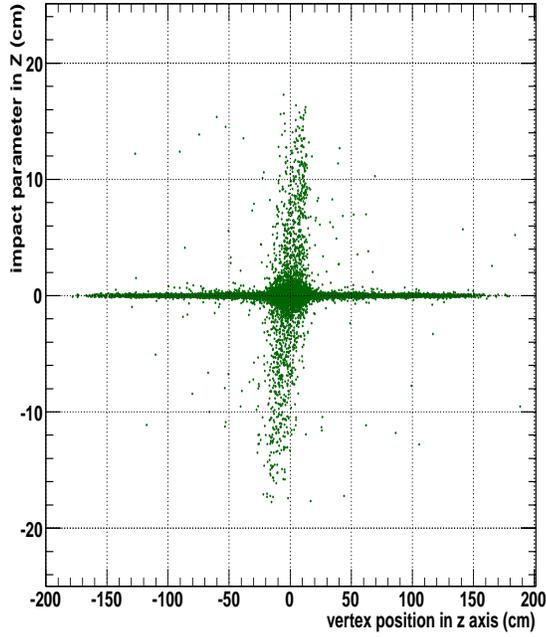


Figure 6: Vertex position (in z axis, bin size 1 cm) versus impact parameter in Z plane (bin size 0.1 cm) for secondary tracks selected as primaries. As you can see the impact parameter of these kind tracks is smaller than 16 cm. Impact parameter was obtained from ESD information, production vertex was obtained from MC.

1.4 Ratios: $\text{Number}_{\text{particles}}/\text{Number}_{\text{antiparticles}}$ for secondary tracks selected as primaries.

Using MC information I got the id of the particles associated with tracks secondaries selected as primaries. With this information in figure 7 you can see the plot: vertex position (in x axis, bin size 1 cm) versus $\text{Number}_{\text{particles}}/\text{Number}_{\text{antiparticles}}$ for all secondaries selected as primaries.

In figure 8 you can see the plot: vertex position (in x axis, bin size 1 cm) versus $\text{Number}_{e^-}/\text{Number}_{e^+}$ for all secondaries selected as primaries.

In figure 9 you can see the plot: vertex position (in x axis, bin size 1 cm) versus $\text{Number}_{\pi^+}/\text{Number}_{\pi^-}$ for all secondaries selected as primaries.

In figure 10 you can see the plot: vertex position (in x axis, bin size 1 cm) versus $\text{Number}_{K^+}/\text{Number}_{K^-}$ for all secondaries selected as primaries.

In figure 11 you can see the plot: vertex position (in x axis, bin size 1 cm) versus $\text{Number}_{\mu^-}/\text{Number}_{\mu^+}$ for all secondaries selected as primaries.

In figure 9 you can see the plot: vertex position (in x axis, bin size 1 cm) versus $\text{Number}_{p^+}/\text{Number}_{p^-}$ for all secondaries selected as primaries.

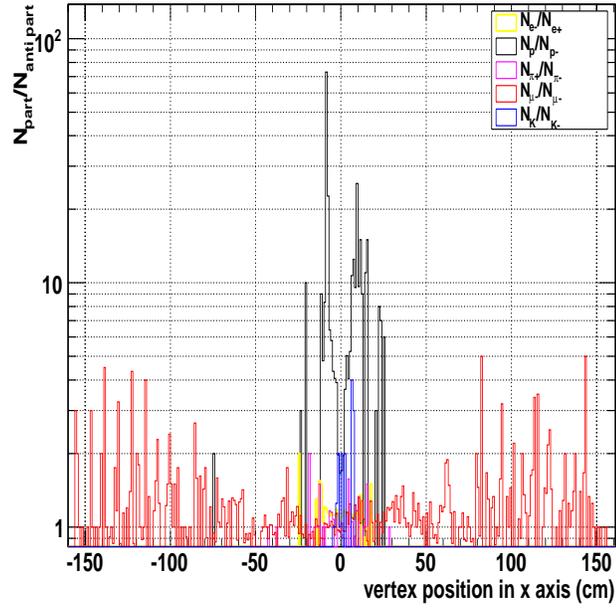


Figure 7: Plot: production vertex (in x axis, bin size 1 cm) versus $\text{Number}_{\text{particles}}/\text{Number}_{\text{antiparticles}}$ for all secondaries selected as primaries. ID of particles was obtained using MC information.

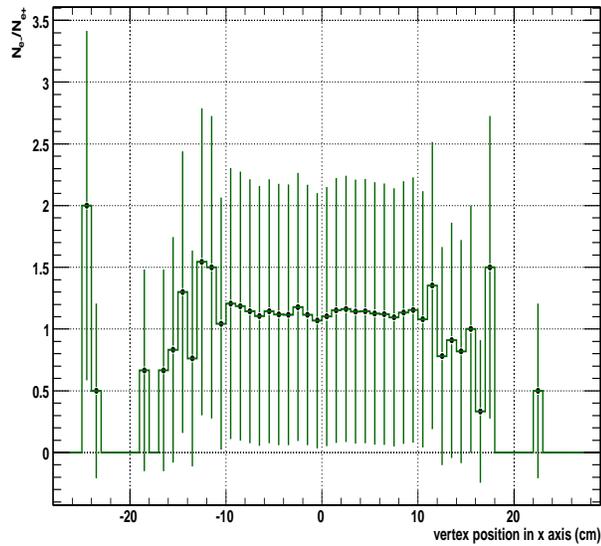


Figure 8: Plot: production vertex (in x axis, bin size 1 cm) versus $\text{Number}_{\text{electrons}}/\text{Number}_{\text{positrons}}$ for all secondaries selected as primaries. ID of particles was obtained using MC information.

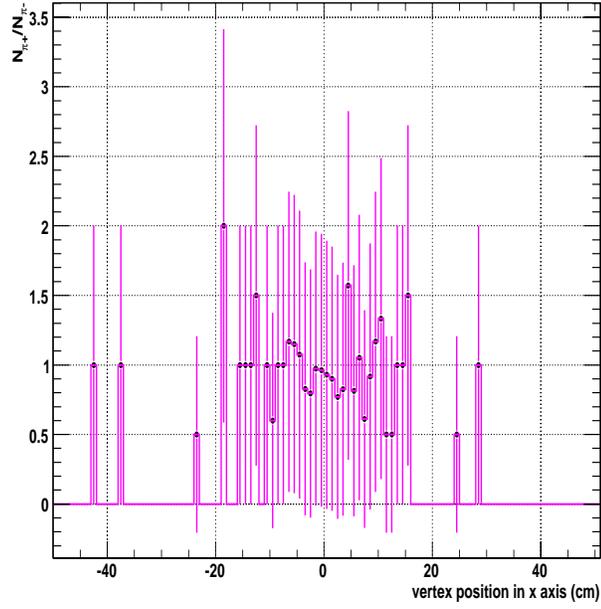


Figure 9: Plot: production vertex (in x axis, bin size 1 cm) versus $\text{Number}_{\text{pions}}/\text{Number}_{\text{antipions}}$ for all secondaries selected as primaries. ID of particles was obtained using MC information.

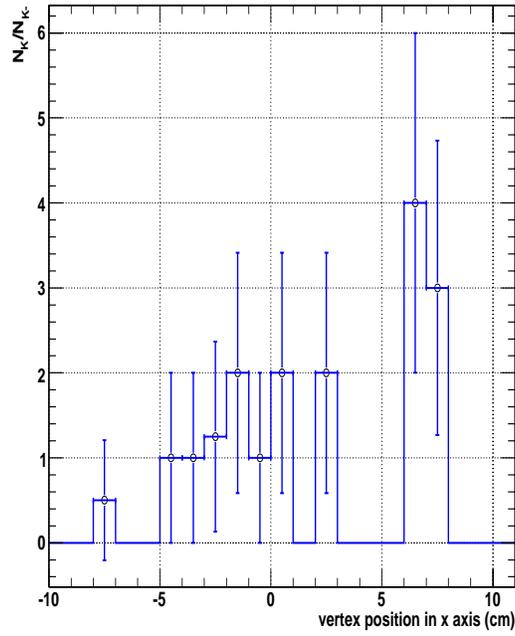


Figure 10: Plot: production vertex (in x axis, bin size 1 cm) versus $\text{Number}_{\text{kaons}}/\text{Number}_{\text{antikaons}}$ for all secondaries selected as primaries. ID of particles was obtained using MC information.

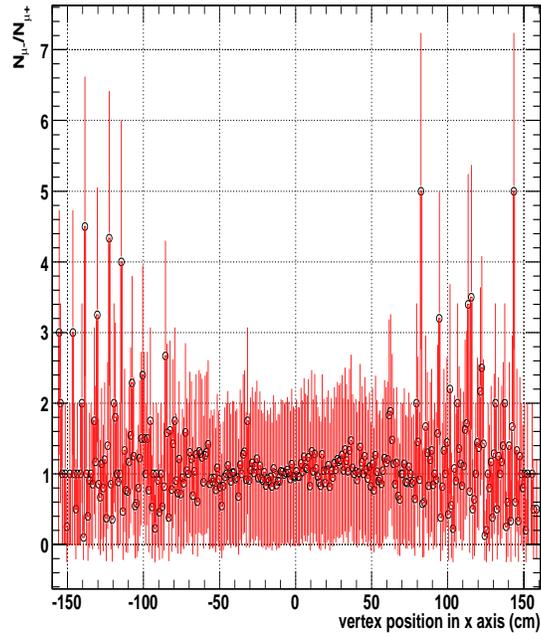


Figure 11: Plot: production vertex (in x axis, bin size 1 cm) versus $\text{Number}_{\mu\text{ons}}/\text{Number}_{\text{antimuons}}$ for all secondaries selected as primaries. ID of particles was obtained using MC information.

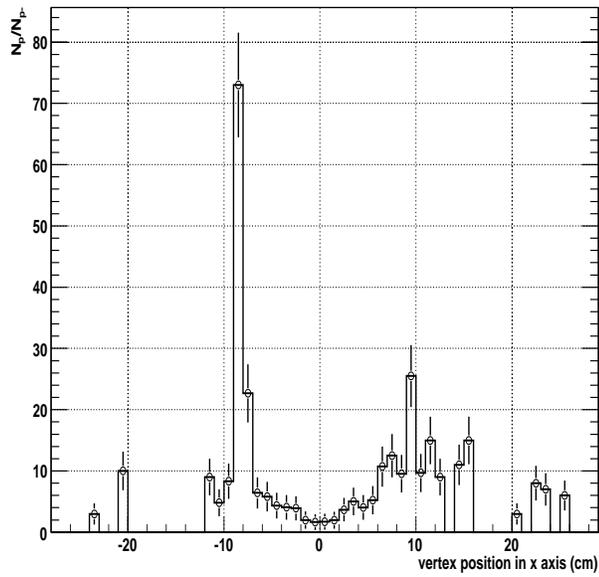


Figure 12: Plot: production vertex (in x axis, bin size 1 cm) versus $\text{Number}_{\text{protons}}/\text{Number}_{\text{antiprotons}}$ for all secondaries selected as primaries. ID of particles was obtained using MC information.

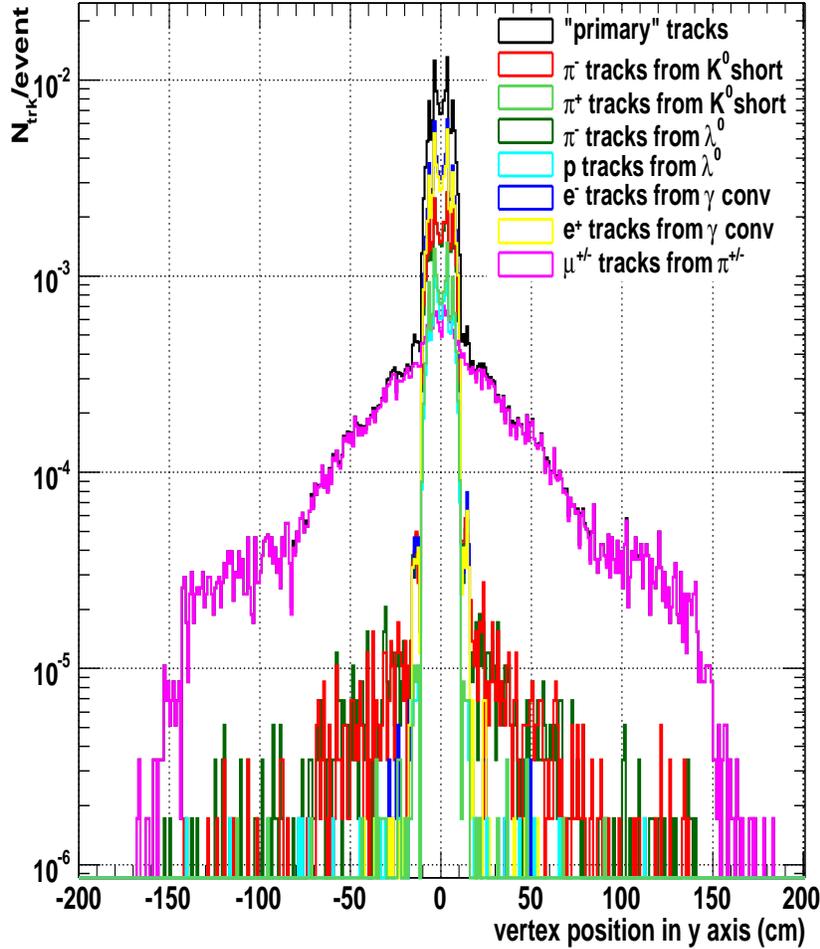


Figure 13: Plot: vertex position (in y axis, bin size: 1 cm) versus number of secondary tracks per event (which were selected as primaries). Different origins of these tracks are remarked.

1.5 Secondary tracks (selected as primaries) from: Λ^0 decay, K^0_{short} decay, γ conversion, π^\pm decay.

In this section I worked again with secondaries selected as primaries. To get tracks from Λ^0 I did the following (using ESD information): 1. Loop over V0 's. 2. Get the positive and negative daughters. 3. Select the hypothesis mass of the Λ^0 . 4. Using the class AliPID, I checked that negative daughter is a pion and the positive daughter is a proton. Similar to get tracks from K^0_{short} decay.

To get electrons (positrons) from gamma conversions I used MC information. 1. Get particles which coming from gamma (using the method GetMother). 2. Check that these particles are electrons and positrons. Similar to get tracks from π^\pm decays.

In figure 13 you can see the plot: vertex position (in y axis, bin size: 1 cm) versus number of secondary tracks per event which were selected as primaries. Different origins of these tracks are remarked. In the region in which vertex position smaller than ± 10 cm, we can see that tracks from gamma conversions, lambda zero decay and k0 short decay dominate. In the wide region, muons tracks from pions decay dominate.

In figure 14 you can see the plot: vertex position (in z axis, bin size: 1 cm) versus number of secondary tracks per event which were selected as primaries. Different origins of these tracks are remarked.

In order to get the number of gamma conversions in the ITS region, we can see figure 15. There we have: number of tracks per event (secondary electron conversion tracks selected as

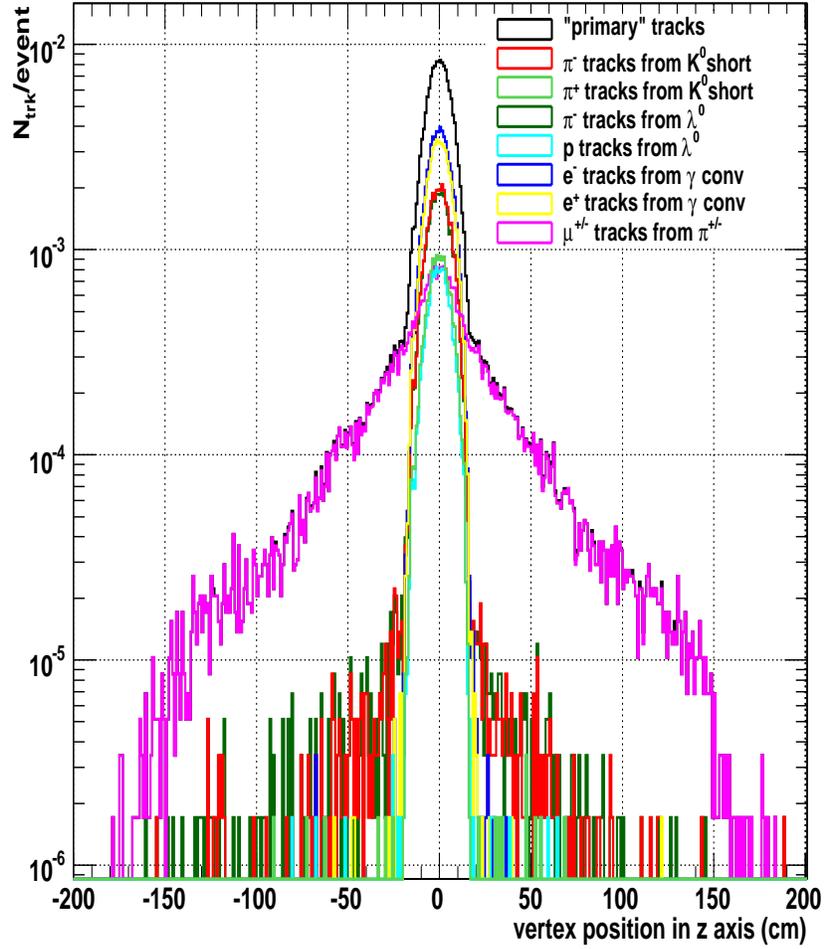


Figure 14: Plot: vertex position (in z axis, bin size: 1 cm) versus number of secondary tracks per event (tracks which were selected as primaries). Different origins of these tracks are remarked.

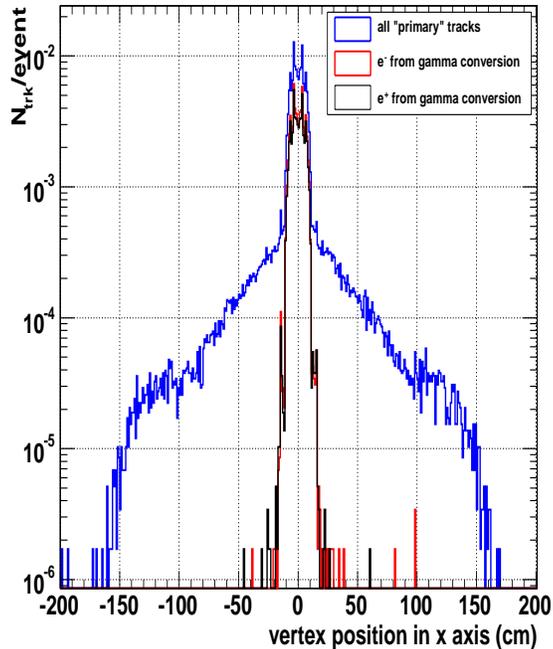


Figure 15: Plot: vertex position (in x axis, bin size: 1 cm) versus number of secondary electron (positrons) conversion tracks per event (which were selected as primaries). As you can see we have ~ 0.004 gamma conversions per centimeter and per event in the firsts ITS layers.

primaries) versus vertex position (in x axis, bin size: 1 cm). So, we can see that there are ~ 0.004 gamma conversions per centimeter and per event in the firsts ITS layers.

In figure 16, we have the plot: vertex position (in y axis, bin size: 1 cm) versus P_T for secondary tracks from k_0 decays. In figure 17 vertex position (in y axis, bin size: 1 cm) versus P_T for secondary tracks from λ decays. P_T was obtained using ESD information.

2 Conclusions

Selection of primary tracks is not 100% effective. We have contamination of $\sim 1.9\%$ of secondary tracks selected as primaries. For the reconstruction of tracks from primaries I demanded that tracks have at least 1 cluster in ITS, so there is a little problem with the association of clusters of the same particle, because we have for example, a muon produced to 100 cm from the beam axis, it is not possible that its track has a cluster in ITS. Other problem in the reconstruction is referred to the calculus of the DCA of the tracks, because all tracks are extrapolated and for this reason tracks from some decays are counted as primaries.

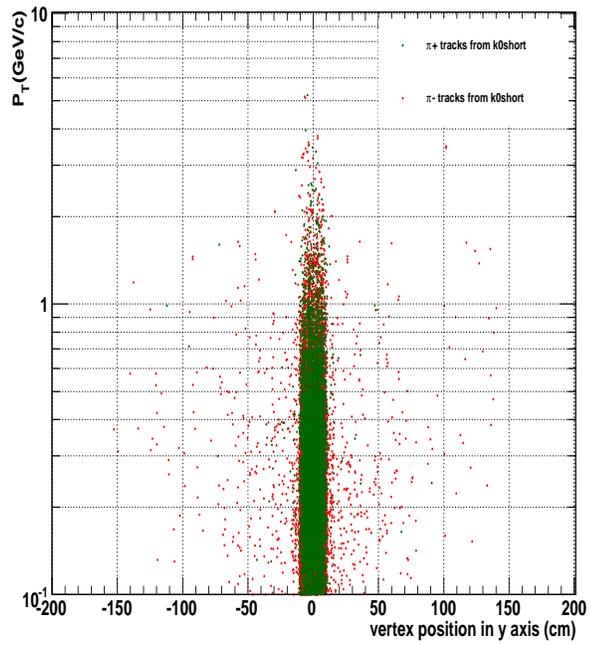


Figure 16: Plot: vertex position (in y axis, bin size: 1 cm) versus P_T for secondary tracks from k_0 short decays. These tracks were selected as primaries. P_T was obtained from ESD information.

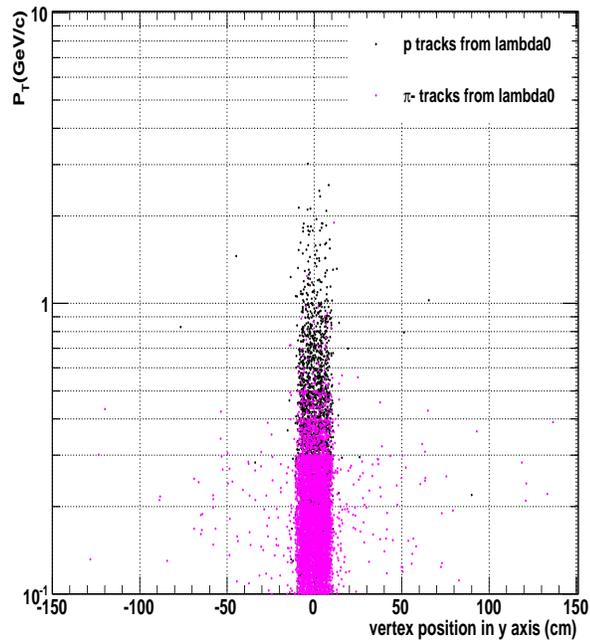


Figure 17: Plot: vertex position (in y axis, bin size: 1 cm) versus P_T for secondary tracks from λ^0 decays. These tracks were selected as primaries. P_T was obtained from ESD information.