Comparison of the scifi event categorization with the monte carlo prediction

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Internal report

Abstract

Monte Carlo can be used to predict what should be observed in the scifi detector and a qualitative agreement with the data should be expected. Here we limit ourselves to the event categories and such details as track length, angle etc. are not considered.

1 Event categories

Some of the currently defined scifi event categories that are considered here are:

- Penetrating track.
- Stopping track.
- Two stopping tracks.
- Vee tracks.
- Two vee tracks.
- H decay topology.

2 Monte Carlo prediction for different reactions

A new GEANT Monte Carlo was written. The scifi geometry is shown in Fig. 1. The cascade stopping rate predicted by the new Monte Carlo is consistent with the old one. Also, the number of protons from non-mesonic Λ decay, that are detected by Neutron Detector is predicted to be a few times below the observed number, due to the large amount of material between the vertex and Neutron Detector. Therefore the observed weak dependence of the number of protons detected in Neutron Detector on the missing mass is not a problem.

It is interesting to compare the scifi event categorization with the Monte Carlo prediction shown in Table 1. The same cut on missing mass is used as for the scanned events: $\mathrm{MM} < 11.65\ \mathrm{GeV/c^2}$. The first column is the reaction, second and third are the fraction of the events with at least one penetrating and stopping track respectively. Decays products from decays at rest are generated

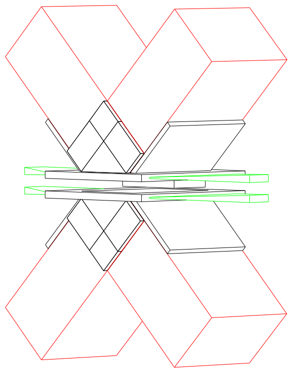

Figure 1: Scifi, hodoscope and diamond target, drawn by GEANT.

isotropically. Λ's and protons are generated at the cascade stopping point and are put in to simulate possible outcomes of the cascade hypernuclei formation. There is a very high probability of producing a penetrating track for cascade decays, due to the relatively high energy π^- from $\Xi^- \to \pi^- + \Lambda$. Then the regions of MM with higher cascade stopping rate are expected to have a relatively lower fraction of events in the penetrating track category.

Reaction	events with penetrating track(s), %	events with stopping track(s), %
Λ decay, $T_\Lambda = 0$	3.1	29.3
Λ decay, $T_\Lambda = 20$ MeV	11.9	24.1
proton from non-mesonic decay	6.0	22.3
Ξ^- decay in flight	60.1	34.3
Ξ^- decay at rest	60.4	29.4

Table 1: Monte Carlo prediction for populating "penetrating" and "stopping" track categories for different reactions.

As the result of events scanning, the fractions of penetrating and stopping events have been found to be about 60% for both penetrating and stopping track categories. So there is a good agreement in penetrating track category rate and not a very good one for stopping track one. This could be explained by background mainly contributing to the stopping track category.

The rate of scifi event production for a given category vs. MM is shown in Fig. 6 for all 6 categories. There is only weak dependence of penetrating track rate on the MM, that does not agree with estimates. For example, the probability of penetrating track production for 11.65 GeV/c^2 and 11.6 GeV/c^2 is estimated to be 55% and 40% respectively, even if assuming 20% probability of producing a penetrating track by a stopped cascade.

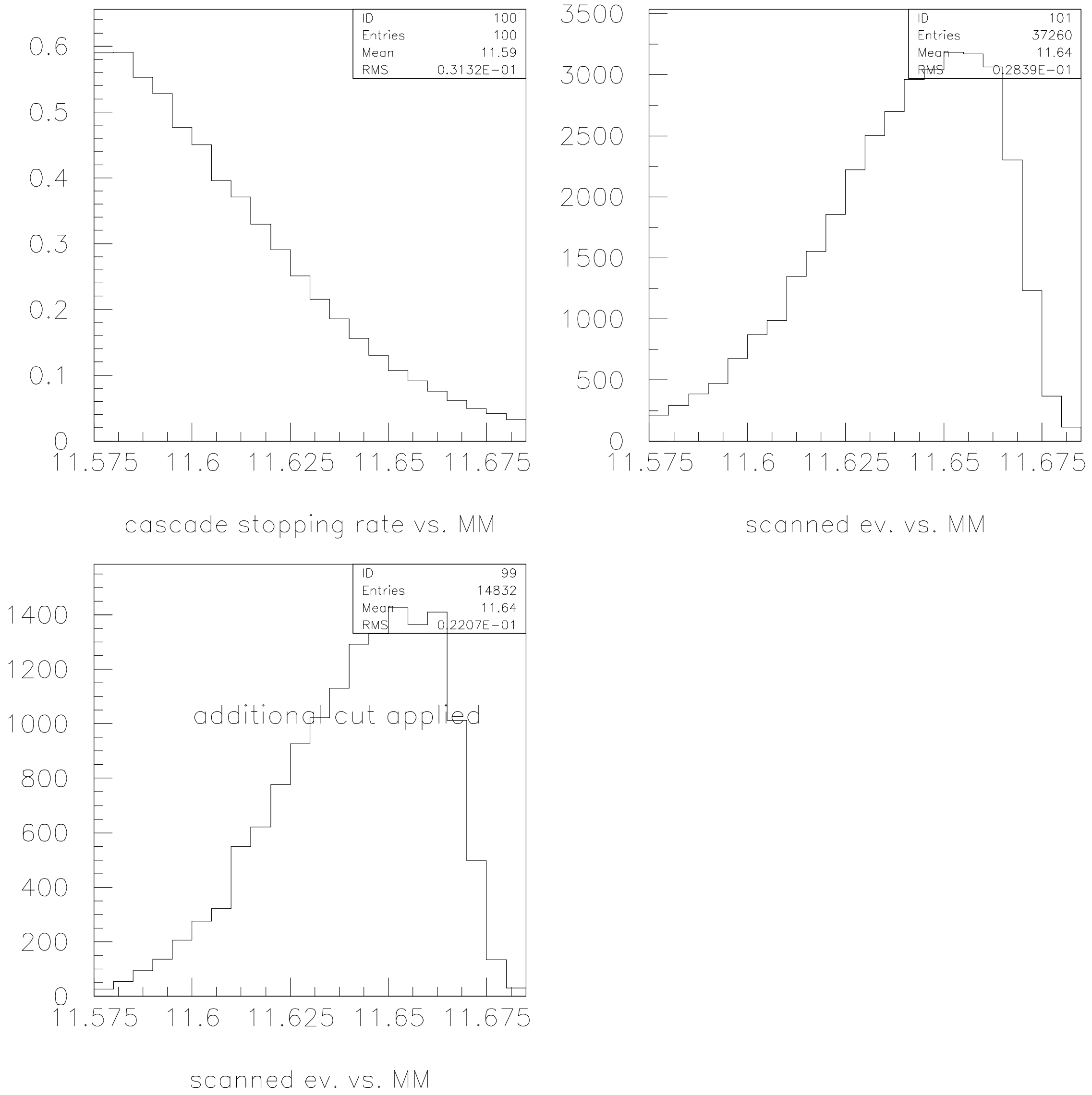

Figure 2: Shown are the cascade stopping rate from the Monte Carlo simulation, MM spectrum of all and cut scanned events.

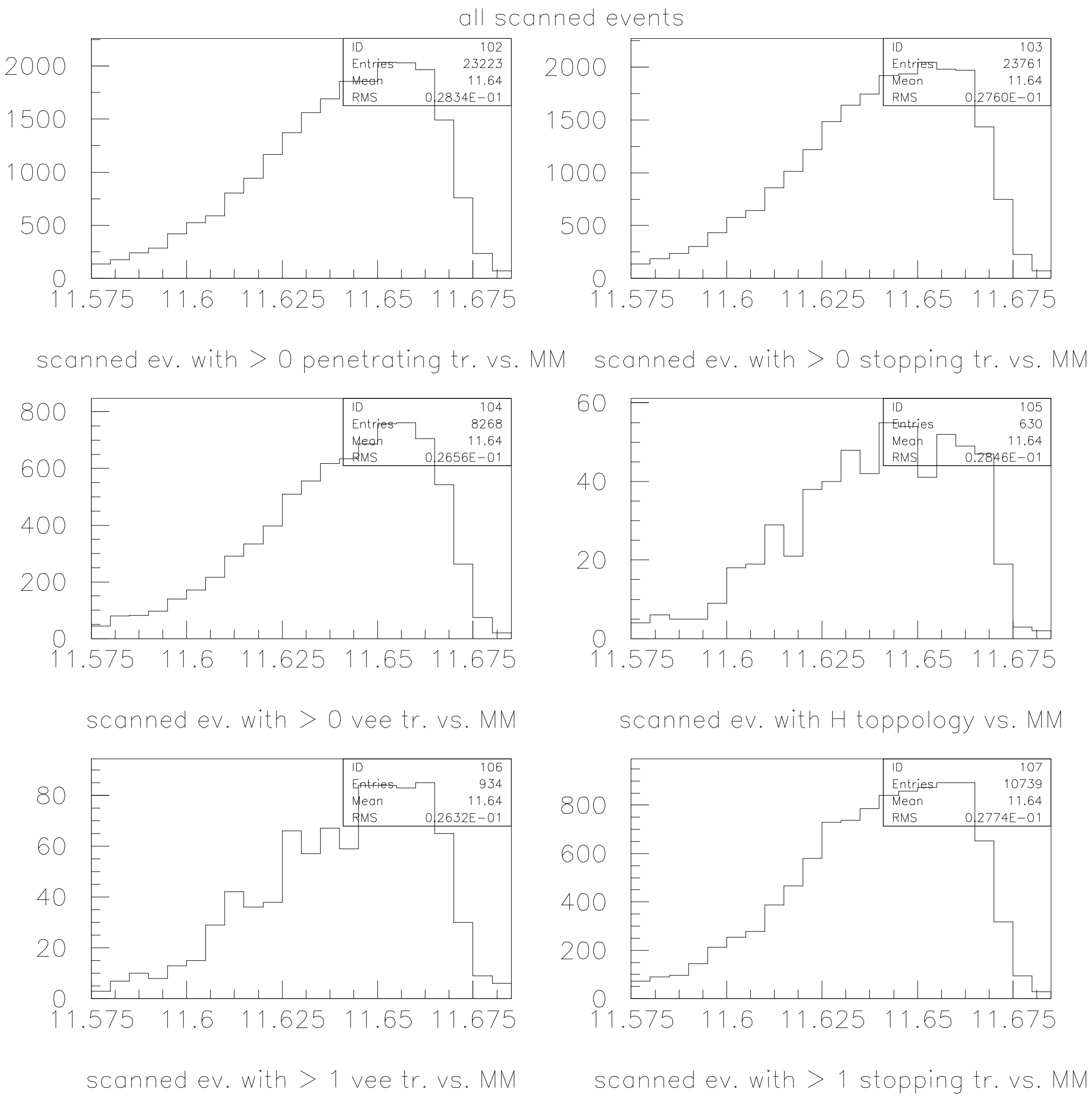

Figure 3: Number of scanned events vs. MM for different categories.

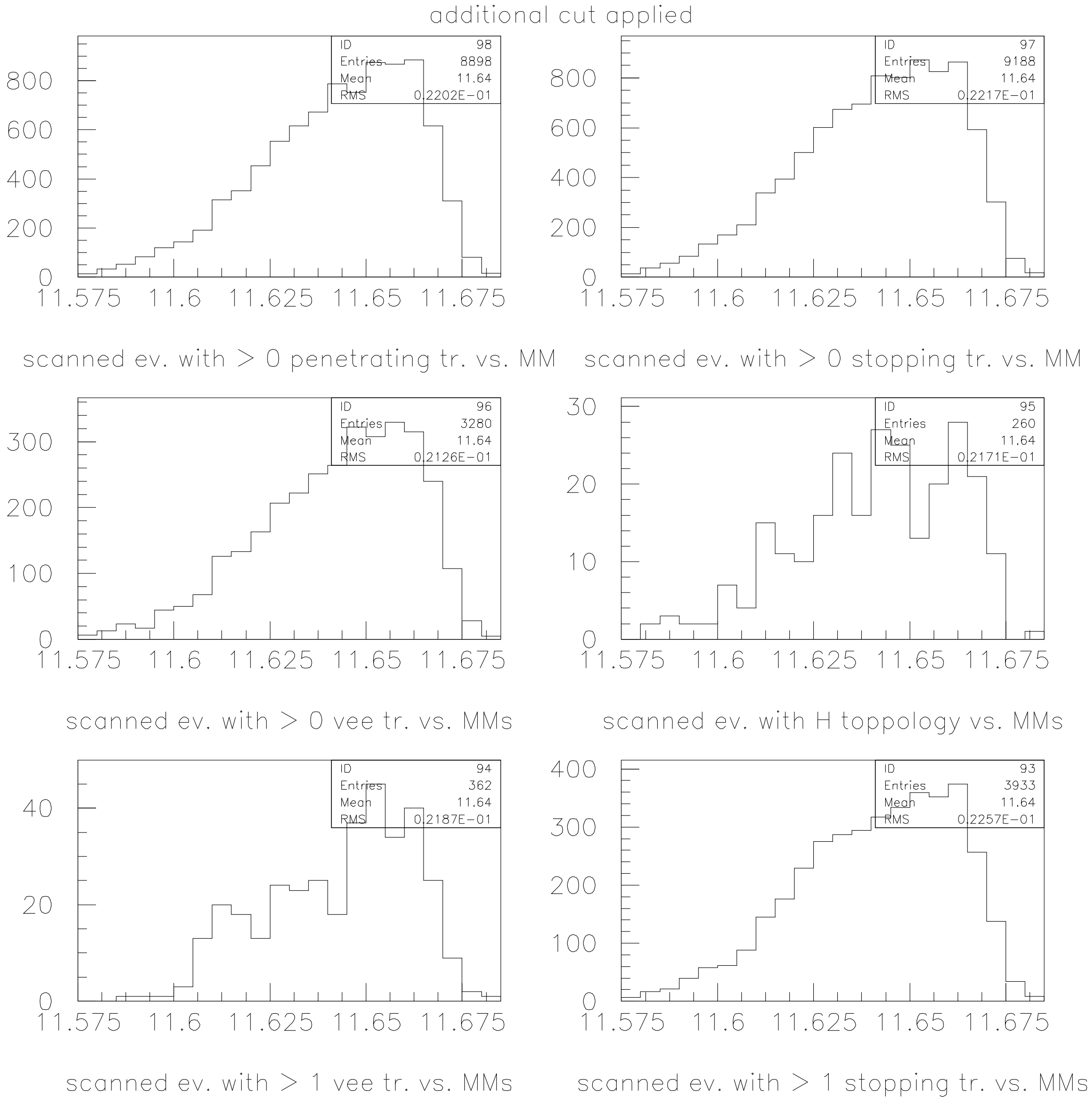

Figure 4: Number of scanned events vs. MM for different categories, additional cut is applied to reduce basckground in the lower MM region.

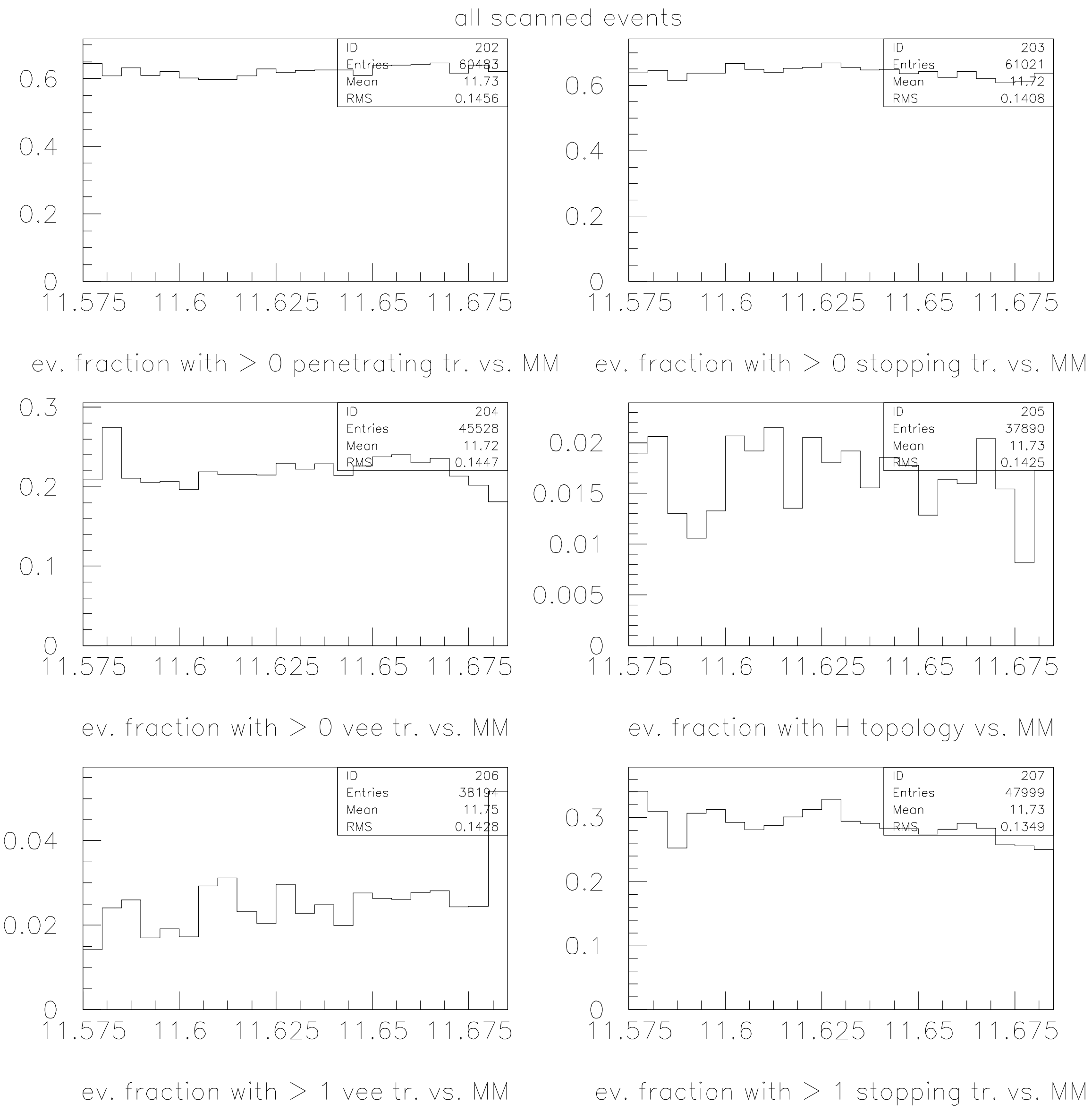

Figure 5: Fraction of events of a given category to the total number of events vs. MM.

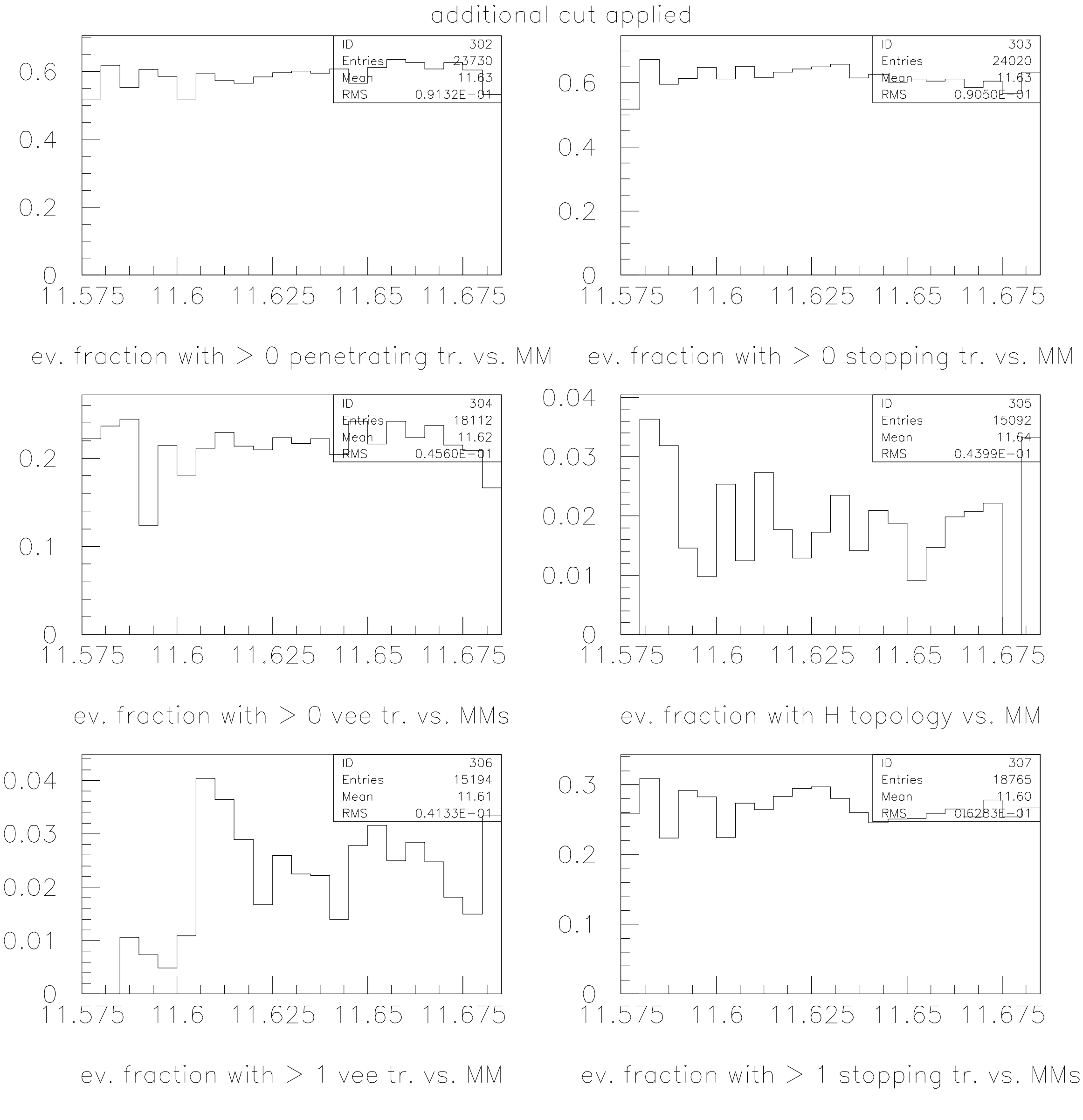

Figure 6: Fraction of events of a given category to the total number of events vs. MM, additional cut is applied to reduce backgroung in the lower MM region.