PRELIMINARY RESULTS FOR MUON DISCRIMINATION

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I Introduction

Four different cases will be discussed in terms of discriminant analysis comparing single muons with single pions of known momentum. All four cases use the same pad segmentation: $\Delta\theta = 1°$ and $\Delta\phi = 2.813°, 2.813°, 5.625°, 5.625°, 5.625°, 5.625°$. In addition, all four cases use the same discriminant variables: 1, 2, 5, and 9. These numbers represent the following variables:

1: Last Plane Hit

2: Total Hits

5: Rho Max

9: Front to Back Ratio.

We use PISA/PISORP and the muon arm group's MUN code developed at GSU, ORNL, and VU for these studies.

The cases differ in their "per plane efficiencies."

Case #1 has a "per plane efficiency" of 98% on each of the 6 planes.

Case #2 has a "per plane efficiency" of 98% on the first 3 planes and 90% on the last 3 planes.

Case #3 has a "per plane efficiency" of 98% on the first plane and 90% on the last 5 planes.

Finally, one more issue is addressed. This issue is that of the importance of the last plane. For this purpose, Case #4 is to be compared to Case #2.

Case #4 has a "per plane efficiency" of 98% on the first 3 planes, 90% on the next 2 planes, and only 1% on the last plane.

II Case #1

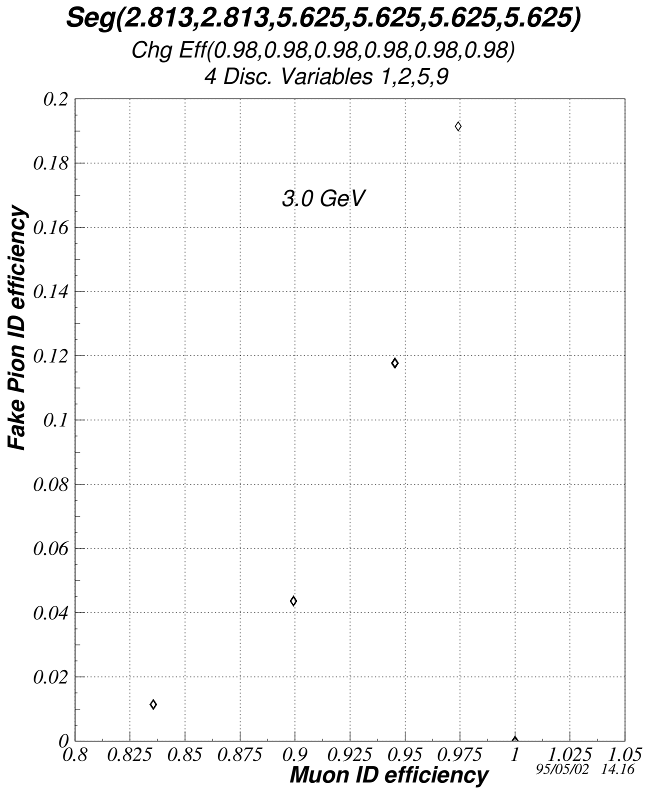

Figure 1: Effect of different Discrimination Function cuts for Case #1.

The result for this case is that if one requires 95% of the muons to be correctly identified and sets the discrimination function cut accordingly, then 88% of the pions are rejected. Figure 1 shows that the curve falls sharply from this point, which means that a lower muon ID efficiency would lead to many more of the pions being rejected. For example, if one wants to accept only 90% of the muons, 96% of the pions are rejected.

One can also observe that the discrimination functions for muons and pions are fairly well separated. Figures 2 and 3 show values of the discrimination function for each. These figures show how well the muons can be distinguished from the pions using the discrimination function.

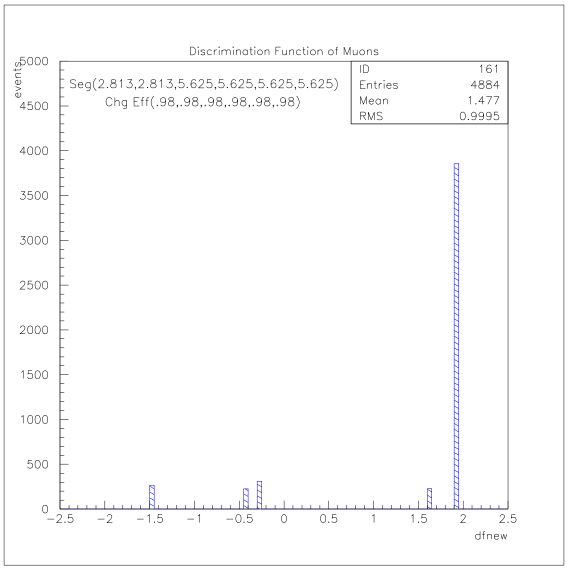

Figure 2: D.F. for Muons for Case #1.

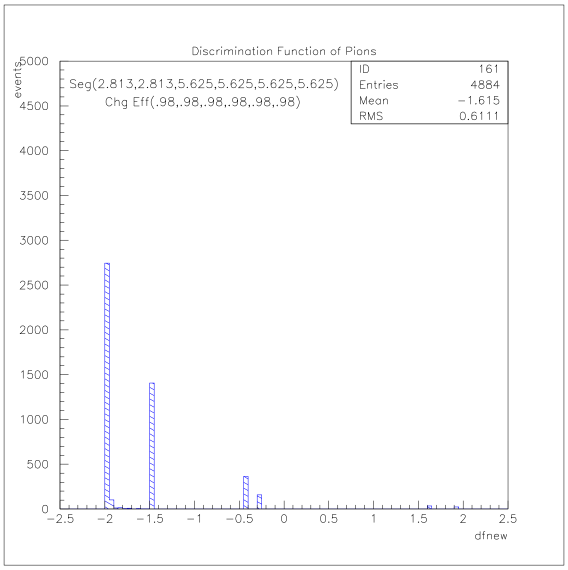

Figure 3: D.F. for Pions for Case #1.

III Case #2

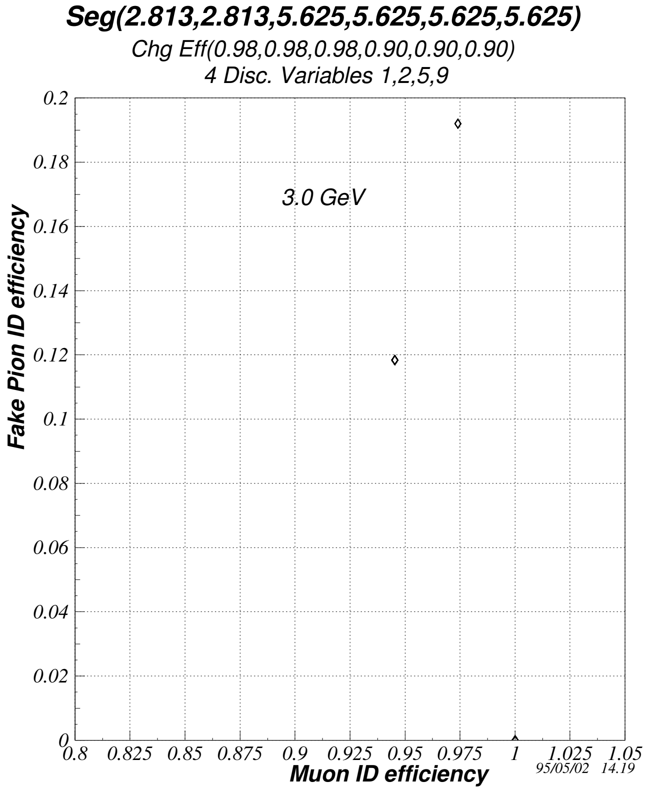

Figure 4: Effect of different Discrimination Function cuts for Case #2.

The results for this case are similar to Case #1. Again a required acceptance of 95% of the muons would reject 88% of the pions. The discrimination function values have changed to some degree, but not enough to alter this result.

Comparing the discrimination functions of Case #2 to those of Case #1 (Figures 5 and 6 compared to Figures 2 and 3), one can see that they are not quite as well separated. This shows that lower efficiency leads to poorer separation between muons and pions, although the final result is the same as for Case #1.

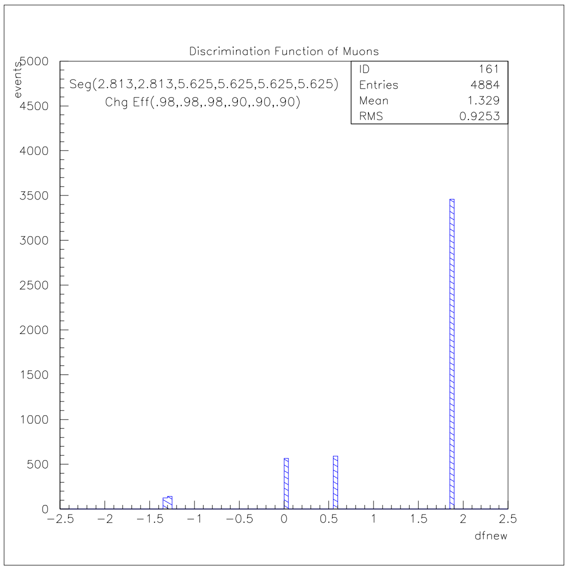

Figure 5: D.F. for Muons for Case #2.

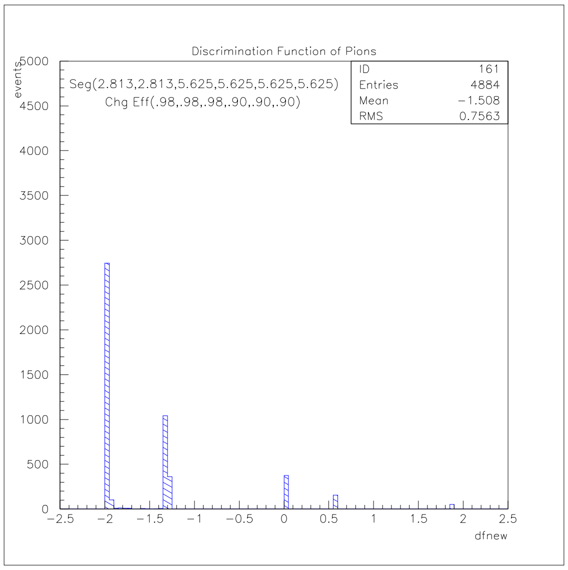

Figure 6: D.F. for Pions for Case #2.

IV Case #3

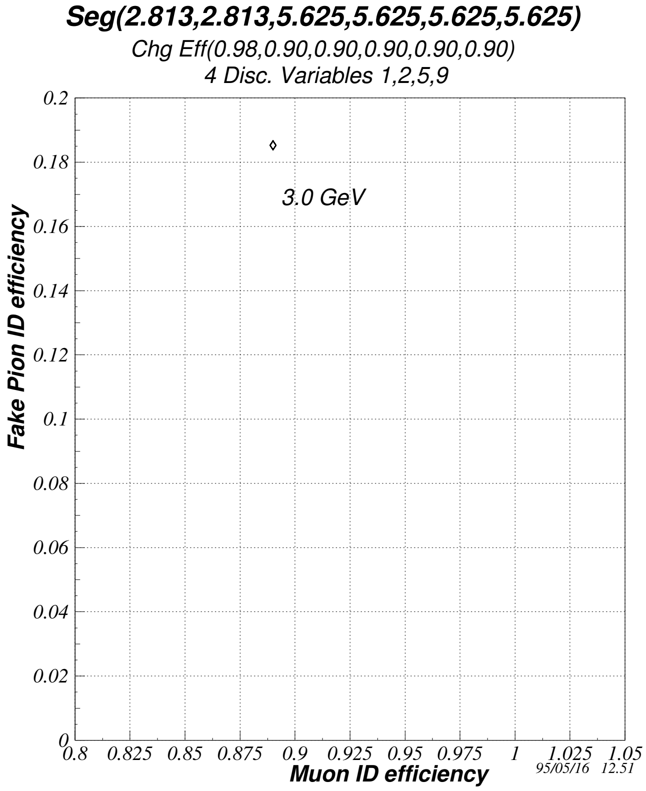

Figure 7: Effect of different Discrimination Function cuts for Case #3.

In this case the fake pion ID efficiency does not fall as sharply for muon ID efficiency between 100% and 90%. If one requires an acceptance of 95% of the muons, or even 90% of the muons, only 82% of the pions are rejected. Contrary to Case #1 and Case #2, small sacrifices in muon ID efficiency do not lead to better fake pion ID efficiency. In fact, rejecting 95% of the pions leads to accepting only 60% of the muons.

For this case, the discrimination functions are much less separated than for Case #1. Comparing figures 8 and 9 to figures 2 and 3, it is obvious that this "per plane efficiency" (Case #3) leads to poorer discrimination between muons and pions.

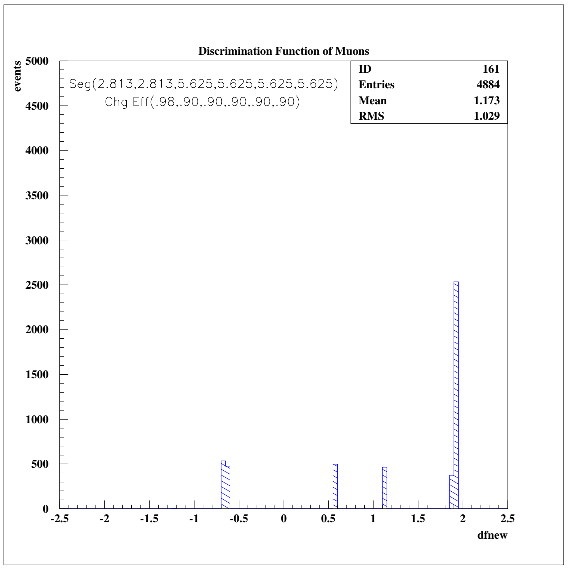

Figure 8: D.F. for Muons for Case #3.

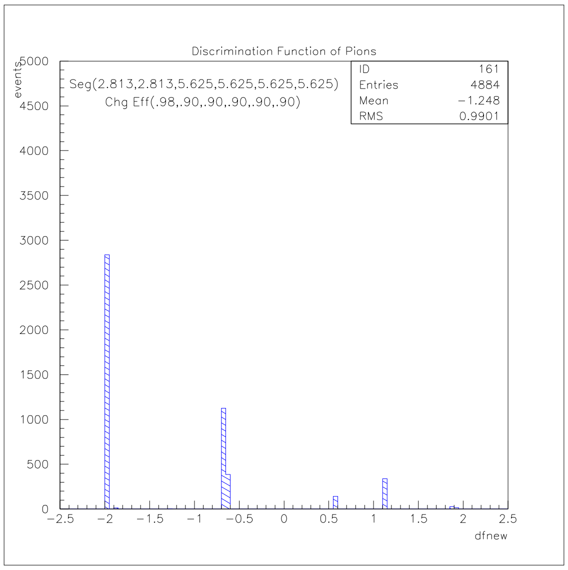

Figure 9: D.F. for Pions for Case #3.

V Case #4

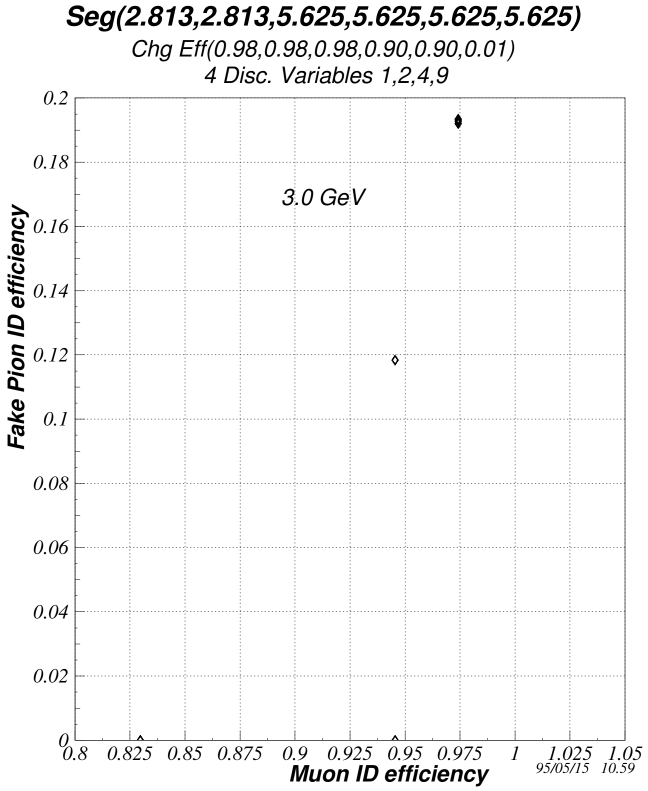

Figure 10: Effect of different Discrimination Function cuts for Case #4.

This case is the same as Case #2, except with the last plane having an efficiency of only 1%. Comparing this case to Case #2, the results were found to be virtually the same. Again, with a specified muon ID efficiency of 95%, 88.2% of the pions are rejected. The results imply that using only five planes may be satisfactory for discrimination purposes.

It may be of interest to compare the plots of the variable Last Plane Hit for these two cases as well. These plots are just shown to give an idea of how many muons make it to any one of the planes. Figure 11 is the case where the last plane is neglected, and Figure 12 is just Case #2 as a comparison.

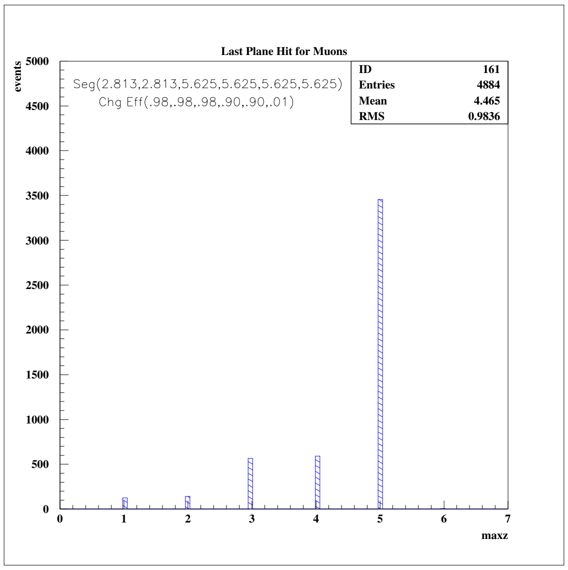

Figure 11: Last Plane Hit for Case #4.

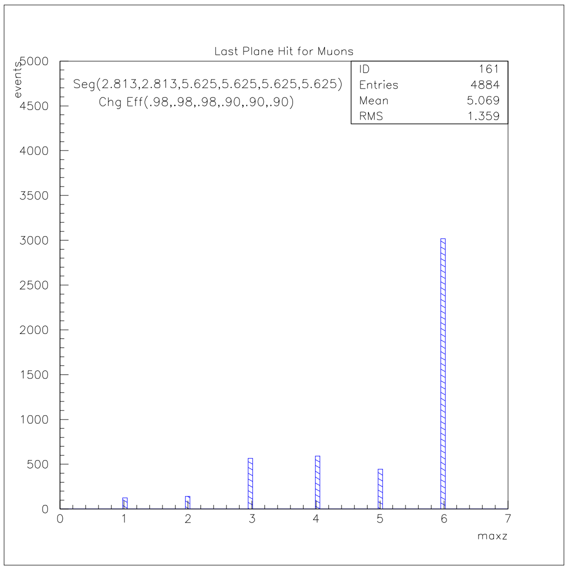

Figure 12: Last Plane Hit for Case #2.