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Subject: PID combiner with different detector  
Posted by [donghee](#) on Mon, 04 Nov 2013 21:02:28 GMT  
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Hi all,

I have a fundamental question about PID combiner.  
In our analysis we are using PID combiner, which combines the probability values from different detectors.

Let assume a simple situation.

I want to identify electron from EMC+MUO+STT+DRC combination.

In some cases, I assume that the probability from MUO should be zero due to absorbing the electron already in EMCalorimeter.

In practice, MUO doesn't contribute electron PID.

If I multiply  $P(\text{EMC}) \times P(\text{MUO})$ , then total probability should be zero because of  $P(\text{MUO})=0$  and will be set as 0.2 which is an equal probability of 5 hypothesis.

So effective way to identify the electron should be EMC+STT+DRC combination without MUO. This means that one need to define best combination for 5 different particles.

Is there some study on this issue? or can we recommend simply EMC+STT+DRC+MUO+DISC+MVD combination for each particle hypothesis in practice at PID analysis?

Best regards,  
Donghee

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Subject: Re: PID combiner with different detector  
Posted by [Ronald Kunne](#) on Mon, 04 Nov 2013 21:32:15 GMT  
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> In practice, MUO doesn't contribute electron PID.

Why not ?

The fact that MUO doesn't give a signal \*is\* information.

But in PandaRoot by convention "no signal" results in  $P=0.2$  for all five particles. As a result  $P_e(\text{EMC}) * P_e(\text{MUO})$  will be equal to  $P_e(\text{EMC})$ .

Greetings,  
Ronald Kunne

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Subject: Re: PID combiner with different detector  
Posted by [StefanoSpataro](#) on Mon, 04 Nov 2013 22:16:57 GMT  
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In particular, if there is no MUO signal, the probability should be 0 to be muon and 0.25 to be pion kaon electron proton.

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Subject: Re: PID combiner with different detector  
Posted by [donghee](#) on Tue, 05 Nov 2013 10:05:24 GMT  
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Dear Ronald,

Now I am clear for the equal probability for absent PID info in certain detector.

If I use EMC and MUO, and an electron will identify with a single piece of detector as like  
 $P_e(\text{EMC}) = 0.9$  (90% probability at EMC)  
 $P_e(\text{MUO}) = 0$  (no information at MUO)

For other particles with EMC,  
 $P_{\mu}(\text{EMC}) = 0.1$   
 $P_{\pi,k,p}(\text{EMC}) = 0.5$

And for MUO detector, the probabilities will be reset as 0.2 even for all other particles.  
 $P_e(\text{MUO}) = 0.2$   
 $P_{\mu,\pi,k,p}(\text{MUO}) = 0.2$

Then will calculate a global probability as like  
 $P_e(\text{EMC}, \text{MUO}) = P_e(\text{EMC}) * P_e(\text{MUO}) = 0.9 * 0.2 = 0.18$   
 $P_{\mu}(\text{EMC}, \text{MUO}) = P_{\mu}(\text{EMC}) * P_{\mu}(\text{MUO}) = 0.1 * 0.2 = 0.02$   
 $P_{\pi}(\text{EMC}, \text{MUO}) = P_{\pi}(\text{EMC}) * P_{\pi}(\text{MUO}) = 0.5 * 0.2 = 0.1$   
 $P_{ka}(\text{EMC}, \text{MUO}) = P_{ka}(\text{EMC}) * P_{ka}(\text{MUO}) = 0.5 * 0.2 = 0.1$   
 $P_{pr}(\text{EMC}, \text{MUO}) = P_{pr}(\text{EMC}) * P_{pr}(\text{MUO}) = 0.5 * 0.2 = 0.1$   
and so on.

After that will be normalized with  
 $P_e(\text{EMC}, \text{MUO}) + P_{\mu}(\text{EMC}, \text{MUO}) + P_{\pi}(\text{EMC}, \text{MUO}) + P_{ka}(\text{EMC}, \text{MUO}) + P_{pr}(\text{EMC}, \text{MUO}) = 0.5$

So finally I can have normalized global PID probabilities  
 $P_e(\text{EMC}, \text{MUO}) = 0.18 / 0.5 = 0.36$   
 $P_{\mu}(\text{EMC}, \text{MUO}) = 0.02 / 0.5 = 0.04$   
 $P_{\pi}(\text{EMC}, \text{MUO}) = 0.1 / 0.5 = 0.20$   
 $P_{ka}(\text{EMC}, \text{MUO}) = 0.1 / 0.5 = 0.20$   
 $P_{pr}(\text{EMC}, \text{MUO}) = 0.1 / 0.5 = 0.20$

This is a story of PID!  
If I am wrong, correct me again.

Thanks,  
Donghee

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Subject: Re: PID combiner with different detector  
Posted by [donghee](#) on Tue, 05 Nov 2013 10:26:30 GMT  
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Dear Ronald and stefano,

If I see a band at 0.2 in PID with usage of global probability and many detector types, that means  
there are very poor information from all detector or  
are most likely ghost tracks and low energetic electrons.

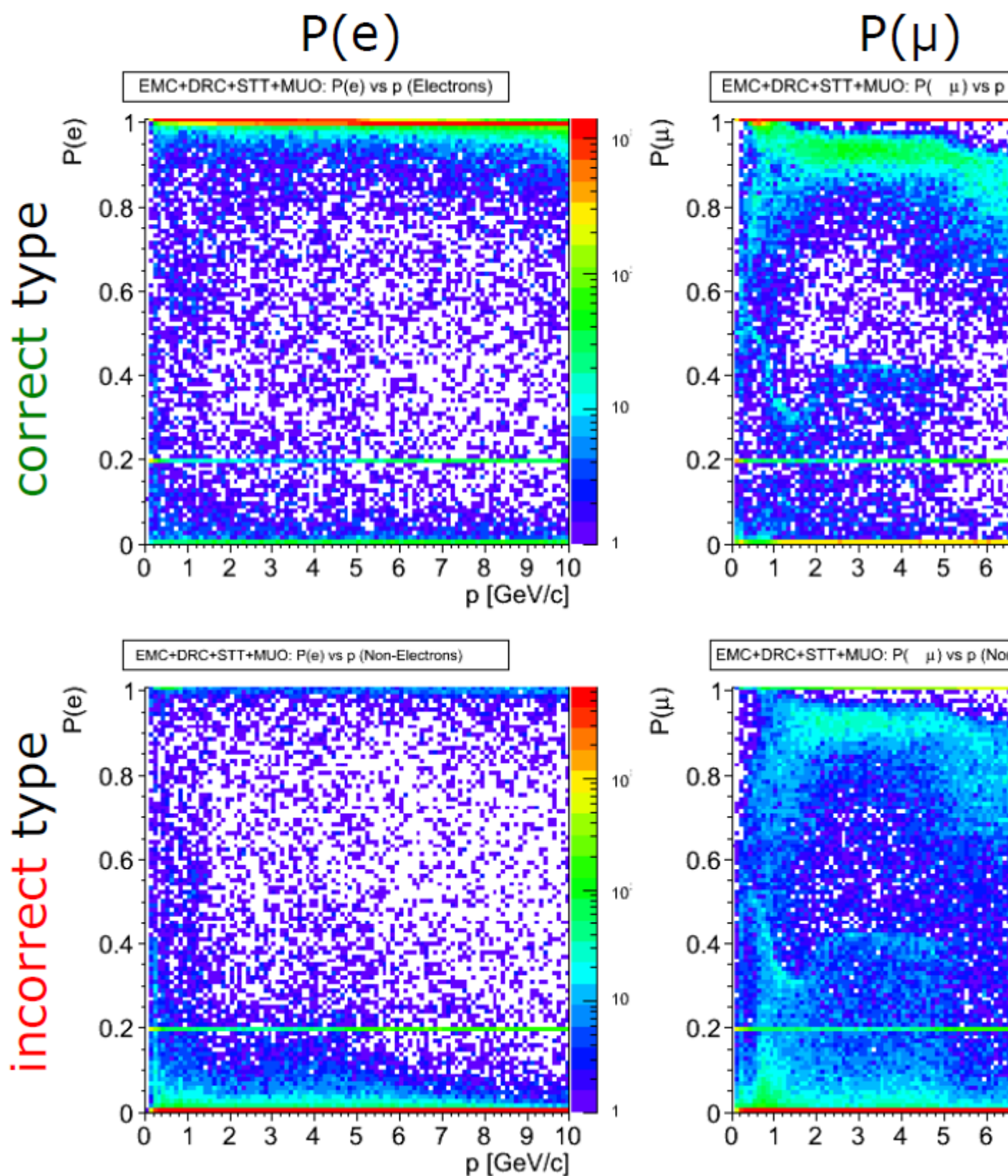
(see attached plot from Klaus Gotzen)

Best wishes,  
Donghee

#### File Attachments

1) [Screenshot from 2013-11-05 11:23:49.png](#), downloaded 559 times

# Combined Probabilities: EM



Subject: Re: PID combiner with different detector  
Posted by [Stefano Spataro](#) on Tue, 05 Nov 2013 10:29:39 GMT  
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This means that most probably some information was missing in the candidate, i.e. the track was not correlated to EMC DRC etc. Most probably they will be forward tracks, where no PID info is present.

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Subject: Re: PID combiner with different detector  
Posted by [donghee](#) on Tue, 05 Nov 2013 10:31:21 GMT  
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Thanks to all teachers.

close session!

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Subject: Re: PID combiner with different detector  
Posted by [Ronald Kunne](#) on Tue, 05 Nov 2013 10:39:20 GMT  
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Your example is a bit off, as all the probas should add up to 1.

$p(\text{EMC}) = 0.9$  for electron, 0.025 for each of the others  
 $p(\text{MUO}) = 0.2$  for all particle.

Then we have:

$p(\text{EMC}) * p(\text{MUO}) = 0.9 * 0.2 = 0.18$  for the electron

$p(\text{EMC}) * p(\text{MUO}) = 0.025 * 0.2 = 0.005$  for the others

This adds up to 0.2, so the final result is

$p(\text{EMC}) * p(\text{MUO}) = 0.18 / 0.2 = 0.9$  for the electron,  
 $0.005 / 0.2 = 0.025$  for each of the others, as expected.

Quote: If I see a band at 0.2 in PID with usage of global probability and many detector types, that means

there are very poor information from all detector or  
are most likely ghost tracks and low energetic electrons.

Or particles falling outside the acceptance of the detector, or outside the momentum range  $0.2 < p < 5$  GeV/c for which the calculation was made.

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