LHCb Muon System TDR Questions

Question 1:

You say ε_G=0.19 the prompt muon hits M3. Then page 21 : 40% of the b-hadrons are in 600mrad. There is a factor of 2 between the muons and the hadrons. Are they lost forward ?

Answer:

The 19% is with a hit in M3, the 40% is within 600mrad. The factor 2 difference is on hand due to events with a polar angle smaller than the inner acceptance of the muon system (20 x 15mrad) or with a polar angle larger than the outer acceptance of the muon system (300 x 250mrad), but the first gives certainly the larger contribution.

Question 2:

Figure 14 What is the scale for the MB suppression?

Answer:

With a p_T-cut of 0.5 GeV/c you keep 1 out of 25 MB-events, with a pT-cut of 2.9 GeV/c you keep 1 out of 205 etc.

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Question 3:

Page 22. I am glad to see that the trigger efficiency varies a little with the single gap efficiency. Now, if it happens that M3 is less efficient is that affecting more the trigger efficiency ?

Answer:

We assumed for the figure the same efficiency everywhere in the system. The way how the trigger is set up, each station must provide a hit within the FOI. From that point of view, there is no station affecting more the trigger inefficiency. Inefficiency in M3 means that you don't start the track finding. Inefficiency in M2, M4 an M5 that you might not find the track candidate because of the missing hit in the FOI (the occupancy is low). Inefficiency in M1 is somewhat less effecting the total inefficiency, as the FOI occupancy is about 15%, but this is a minor correction.

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Question 4:

I can't reproduce the trigger acceptance of 5.7%. ε_G = 0.19 and ε_{Trig} =55.2% for 2% MB total=10.48% where am I wrong ??

Answer:

This numbers are indeed a bit confusing, sorry, but they refer **not** to the data sample we used normally (the b-> μ X, where the b is forced to decay directly to a muon, not via charm), but to b-inclusive events, as pointed out in the text. So you should not relate the 5.7% with the 55.2% in Table 8, these numbers have no direct relation to each other.

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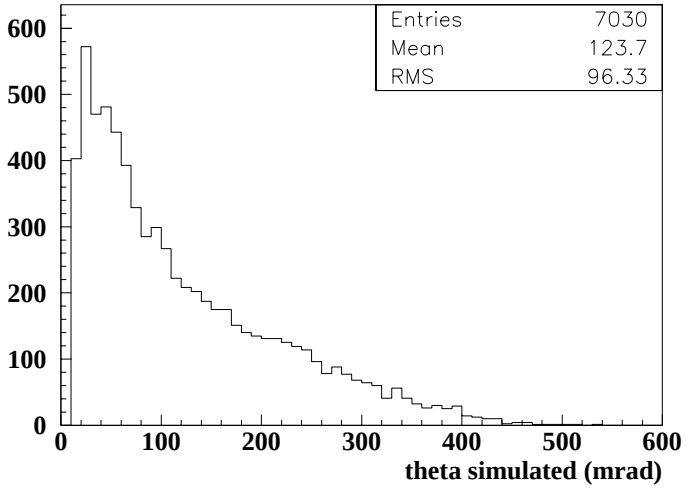
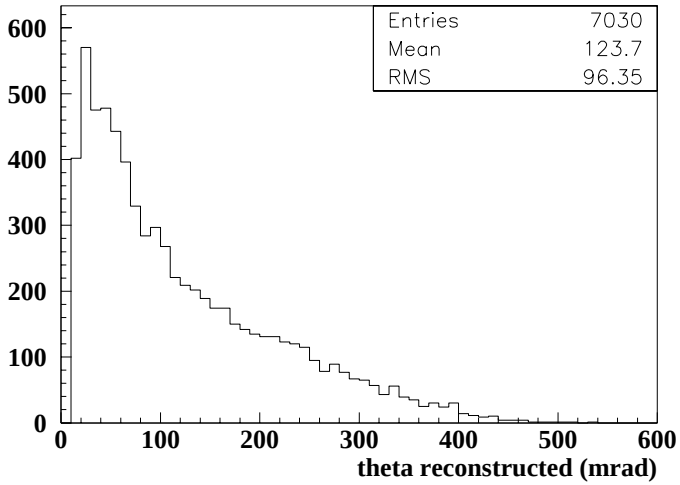
Question 5:

I wished to see an angular distribution of tagging and signal ($J/\psi K_s$ or $B_s \rightarrow \mu^+\mu^-$) muons at the generator level.

Answer:





Generated and reconstructed angular distributions of the muons in the $B_s \rightarrow \mu^+\mu^-$ sample, for reconstructed muons within 400mrad.

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Question 6:

Page 23, Table 9. Are the misid charge dependent ??

Answer:

The table below gives the muon identification and misidentification efficiencies for positive and negative charges with nominal background. We don't see any big asymmetry, and it is not obvious how significant the results for pions are. If you insist we can follow this further. The important point for us is that, within the errors, there is no asymmetry for muons.

	ε (negative charge)	ε (positive charge)
muons:	0.9360 +- 0.0063	0.9416 +- 0.0034
electrons:	0.0074 +- 0.0012	0.0082 +- 0.0013
pions:	0.0140 +- 0.0004	0.0161 +- 0.0005
kaons:	0.0148 +- 0.0012	0.0182 +- 0.0013
protons:	0.0027 +- 0.0007	0.0044 +- 0.0008

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Question 7:

Page 27: The total tagging efficiency e=5.3% includes the trigger ?

Answer:

Yes, the efficiency is for fully reconstructed triggered events.

Question 8:

Have you considered additives to the MWPC gas to face ageing ? For ex. I see you run with H20 < 50ppm while in theory water helps.

Answer:

No. CMS-EMU, using the same mixture didn't find the addition of water necessary, and we neither up to know. However, we are still discussing the final gas mixture, in view of running at lower HV for example, and might think of the water issue again.

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Question 9:

What is the relative price for RPC and MWPC to demonstrate the cost savings.

Answer:

Construction cost has two aspects: Material cost and Assembling cost.

Material cost:

For a Muon System with only MWPC, the material cost is essentially the same. The additional chambers cost 600-700kCHF; the savings due to a single technology are of the same order, (coming from the RPCs itself, the fact that only one gas system and one FE-chip is needed, and less cost for HV).

Assembling cost:

However additional resources are required (manpower, space and tooling for additional construction sites), which are difficult to determine at present. A first estimate is about 500kCHF.

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Question 10:

Does the GEANT muon simulation include pair production and other catastrophic energy losses at high energy? Probably not relevant as only a major effect above 100 GeV.

Answer:

The LHCb event simulation uses the standard GEANT routines for modeling physics processes involving muons. The effects taken into account are:

- decays in flight;
- multiple scattering;
- ionisation energy loss (without generation of delta rays),
- muon bremsstrahlung;
- muon-induced pair production;
- muon-nucleus interactions.

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Question 11:

What is the statistical and systematic precision with which you can measure the trigger and reconstruction efficiencies in the muon system, in particular charge asymmetries.

Answer:

C and P violation in the detection is indeed a general problem for the all components of the LHCb detector. So clearly some global strategy has to be developed. However specific to the muon system...

Geometrical effect, such as the detector efficiency, distortion of geometrical symmetry between the left and right etc. can be corrected by flipping the magnetic field, to the first order at least.

Physics effects should be tested with data as much as possible: for example a possible difference in the muon tagging efficiency between $\mu+$ and $\mu-$. This could be tested by measuring CP asymmetry where no CP violation is expected. Using $B \to J/\psi X$ decays and reconstructing J/ψ only with the tracking detector, without muon system, we can also measure $\mu+$ and $\mu-$ identification efficiency of the muon system. The trigger efficiency could be cross calibrated by the events where they are L-0 triggered with muon and something else. Our data sample for those studies must be higher than those for any CP violating channels.

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Question 12:

What are the 10% and 50% production milestones for the muon chambers?

Answer:

MWPC production is scheduled from 01/2003 to 12/2004.

A reasonable date for 10% production is 06/2003, and for 50% 03/2004.

RPC production is scheduled from 05/2003 to 12/2004.

A reasonable date for 10% production is 09/2003, and for 50% 06/2004.