LHCb Muon System TDR Questions

Question 1:

Page 23, Table 9. Is the muon misidentification charge dependent ?

Answer:

The table below gives the muon identification and misidentification efficiencies for positive and negative charges with nominal background. Within the errors there is no asymmetry besides that for misidentified pions and kaons. However, it is not obvious how significant the results are. We will investigate this further.

	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 2:

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:

Geometrical effects, such as the detector efficiency, distortion of geometrical symmetry between the left and right etc. can be corrected by flipping the magnetic field (to 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->J/ψ 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 L0-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 3:

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:

MWPCs in the RPC regions would 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). Therefore, the material cost is essentially the same.

Assembling cost:

Additional resources would be required if only MWPCs would be used (manpower, space and tooling for additional construction sites). These are difficult to obtain within the muon group. A first estimate of the resulting additional cost is about 500kCHF.

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Question 4:

Your RPC aging test is still in progress. What will happen should you find that the chambers cannot meet the specifications?

Answer:

The requirements are significantly different for Region 3 and 4. In the two regions the maximum rate capability is respectively 750 and 250 Hz/cm^2, and the corresponding integrated charge over 10 years is expected to be 1.1 and 0.4 C/cm^2. Our latest measurements of the rate capability at GIF (August) correspond to 10 years integrated charge in R4 and about 4 years in R3 and show no reduction of efficiency for fluxes up to 800 Hz/cm^2 (even if some reduction of signal amplitude is observed for the irradiated chamber). The dark current increase (20 μA/m^2) is also below the specifications. Therefore, we don't expect problems in R4. Should the 10 year test for R3 show a serious degradation of performances, various options could be considered. These include replacing the chambers after 4 or 5 years. This could be done without too many problems and costs since the number of chambers in R3 is small (96 chambers or 20% of the total).

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Question 5:

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

Answer:

Chambers:

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.

Electronics:

FE-board production is scheduled from 04/2003 to 9/2004.
A reasonable date for 10% production is 06/2003, and for 50% 02/2004.
IM-, SB- and ODE-board production is scheduled from 10/2003 to 12/2004.
A reasonable date for 10% production is 01/2004, and for 50% 07/2004.

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Question 6:

What is the R&D status for the inner part of M1 and
how important is this part for the physics of the muon system?

Answer:

The technology options for the inner part of M1 are discussed in TDR section 2.2.3. Details on the ongoing R&D work (mainly on triple GEMs) are discussed in support notes referred to in the TDR. Given the small size of this area and the encouraging status of detector R&D, there should be no problem to have a working detector in this area in the second part of 2005.

In the present L0 muon trigger algorithm all 5 stations are used. About 40% of the total b -> μ X L0 muon triggers are found in R1 and R2. Alternative algorithms have been investigated, e.g. using M2 and M3 for the P_T measurement of regions R1 and R2. The P_T resolution would deteriorate from ~20% to ~40% in this regions, leading to a loss in the b -> μ X acceptance of between 10% and 20% for 3% and 1% MB-retention respectively.

For offline muon identification, M1 has no particular importance.