

Reply from the Muon Group to the reviewers' report on "LHCb muon timing"

The muon group members would like to thank the reviewers for their work in carefully analysing the complex and important subject of synchronising the muon system.

We think that the work done in preparing the review has been useful in clarifying the issues related to system synchronization both to the reviewers and to ourselves. We also think that a comparable analysis would be useful for the other LHCb sub-systems.

Concerning the conclusions and recommendations we would like to point out the following:

System reliability and control are crucial issues for the entire LHCb apparatus. Therefore, reliability has been an important consideration in the muon detector and electronics design. In this respect features, which are not strictly necessary such as TDCs, are included in the system design to increase its redundancy. The possibility of measuring the same things in independent ways gives the possibility of a better control of the correct operation of detector and electronics.

We are perfectly aware that the schedule for the design of some system components is very tight. However, the proposal to realise the basic SYNC functionality first in an FPGA will avoid the delay of the full electronics chain test. This gives a wider margin of additional nine months before the SYNC chip final submission, without affecting the full system schedule. The use of a daughter board, housing either the FPGA or ASIC, allows the rest of the components and the board to be designed to a large extent independently of each other. Using this approach, we think that the schedule is reasonable.

We consider it worthwhile to carefully study the proposed implementations of other LHCb groups to solve similar problems, in particular the OTIS chip. We will soon try to contact the OTIS designers and evaluate the possibilities for collaboration, in particular the use of existing building blocks. The use of an existing TDC implementation inside the ODE board will also be evaluated, taking into account the overall complexity of the board in both cases (integrated or separated TDC with multiplexing), and the fact that the design of the ODE board is already in progress.

The present architecture of the muon system electronics is the result of a great deal of effort, which has been spent in comparing a number of possible solutions according to system reliability, robustness and cost. We think that our baseline solution is not far from the optimal one. Obviously, there is also still room for improvements, and some changes will certainly be made during system development. However, in order to avoid further delays in the project, we wish to avoid drastic changes of the architecture. Nevertheless, suggestions and constructive criticisms for system improvements, as given in this review, are welcome and will be taken into account when considered feasible and useful.