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MEMORANDUM

To: E. Iarocci, Chairman of the DRDC, Members of the DRDC

FIRST-LEVEL TRIGGER SYSTEMS FOR LHC EXPERIMENTS

(proposal P37)

Following comments received from the referee, V. Radeka, we would like to clarify some points from our proposal.

Milestones

Our objectives for the first year of the project are the following:

- Outline design of a level-1 trigger system including a central trigger processor to correlate information from calorimeter and muon trigger processors, distribution of the trigger decision to front-end systems and interaction with the level-2 trigger.
- Detailed design studies for a digital calorimeter trigger processor and beam tests of a prototype trigger together with prototype calorimeters.
- Detailed design studies for a muon trigger system based on RPCs.

Scope of the Project

We are aware that the proposed project covers a large number of activities related to first-level triggering and that some of these will be very demanding. Many members of our collaboration have extensive experience of first-level trigger systems in large experiments. This includes fixed target (e.g. muon trigger in WA92) and collider experiments at the Sp$\bar{p}$S, LEP and HERA (e.g. calorimeter triggers for UA1, triggers for Aleph, Delphi and OPAL, calorimeter and muon triggers for H1). We will also be building on R&D work on calorimeter and muon trigger systems, and on timing and control systems, which has already started. We believe that we have the necessary strength to carry out the programme of R&D described in our proposal.

Central Trigger Processor

We recognise the importance of studying how trigger information from different subtriggers (electron/photon, muon, etc) is combined in a central level-1 trigger processor to form the overall "yes/no" trigger decision. The groups from Rutherford Laboratory and Heidelberg will perform a top-down systems design study for the central trigger processor, in which the timing and control system being developed at CERN will be integrated. In parallel, the groups studying calorimeter and muon subtrigger processors will include in their system designs an

interface to the central trigger processor. In the case of the muon trigger, this will consist of a global muon trigger processor which will gather trigger information from different parts of the detector and reduce it to a form suitable for input to the central trigger processor.

Physics Simulation

We will not repeat work being done in the context of protocollaborations on general simulation of physics signatures and backgrounds. However, we do see a need for physics simulation specifically related to first-level triggers. In some cases it will be natural for this work to be done within protocollaborations to avoid duplication of effort. However, given that the P37 collaboration contains members from more than one protocollaboration, we think it would be appropriate to have a separate computer budget for trigger-specific studies.

Some examples of issues that are specific to first-level triggering are the following:

- The background rejection power of trigger algorithms that use reduced detector granularity and precision.
- The efficiency of these trigger algorithms. This work will initially be concerned with inclusive signatures (electron, photon, muon, etc), including the study of isolation requirements. However, we may also study the trigger efficiency for selecting events for a number of physics processes of interest.
- The occupancy of trigger channels when reduced granularity is used, which has important implications for the use of data reduction techniques.

Author List

The group from MPI, Munich has now received approval from the institute to participate in the P37 project. The group from Rutherford Appleton Laboratory has been expanded with the addition of N. Gee, A. Gillman and J. Leake.