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CERN - LHCC - 97-57

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CERN/LHCC 97-57

LEB Status Report / RD27

10 October 1997

## FIRST-LEVEL TRIGGER SYSTEMS FOR LHC EXPERIMENTS

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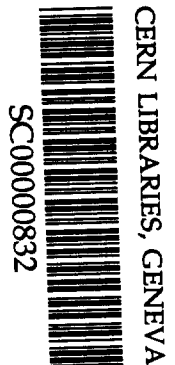
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## 1. Introduction

The RD27 project [1.1] was approved in June 1992 [1.2] to perform a broad-based study of first-level trigger systems. The progress of the project was reported in Summer 1993 [1.3], January 1995 [1.4] and in January 1996 [1.5]. In February 1996, continuation of the project for a further year was approved [1.6] with the following milestones:

- Test and validation of very high speed ( $\geq 800$  Mbit/s) synchronous serial data links, including the serial receiver circuit developed in the collaboration.
- Test of high speed ( $\geq 160$  Mbit/s) custom backplanes based on BTL and differential ECL signals, to prove the feasibility of compact point-to-point sub-system interconnects at the required speed.
- Construction and test of a Central Trigger Processor based on FPGAs, to demonstrate the use of FPGA technology in a fast, synchronous, high-density design.

Members of RD27 are very active in ATLAS [1.7] and CMS [1.8]. In particular, design work for the ATLAS calorimeter, muon and central trigger processors, and for the CMS calorimeter trigger processor, is being performed by RD27 groups. Members of RD27 (N. Ellis and W. Smith) are the trigger co-ordinators for ATLAS and CMS.

Given that ATLAS and CMS are now approved, and that the work that was started within RD27 is now organised and mainly funded through the LHC experiments, we wish to conclude the RD27 project with this report. However, based on the good working relationship established between members of ATLAS and CMS in the RD27 project, we intend to continue a dialogue between the first-level trigger groups in the two experiments. Joint meetings will be organised on an ad hoc basis to discuss issues of mutual interest.

In this document we describe the work that has been performed since our last report. We also give a complete list of publications related to the project. In the following, we discuss in turn the muon, calorimeter and central triggers.

## 2. Muon Trigger

The work by the Rome group on the level-1 muon trigger, initiated within the RD27 collaboration, is being continued within ATLAS. A description of the system can be found in the 1996 RD27 Status Report [1.5] and only a brief update is given here. More details can be found in Ref. [2.1].

The programme of tests of the level-1 muon trigger at the H8 test beam, using signals from RPC detectors, was continued during 1996. A full size trigger tower was constructed using three chamber doublets of size  $270 \times 90$  cm<sup>2</sup>. Data were collected with a high flux of muons (up to 900 Hz/cm<sup>2</sup>) and using a radioactive gamma source to simulate LHC conditions in the chambers.

The design of the ATLAS barrel muon trigger has been extended to include all of the processing chain that is specific to the RPC detectors. The CERN group has started design work on the interface between the muon trigger systems for the barrel and end-cap regions, and the Central Trigger Processor.

The ATLAS barrel muon trigger will use a coincidence-matrix ASIC based on the design developed in RD27. Work is in progress to specify the ASIC for the final system. It will include the following features: