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# First Results on the Performance of the CMS Global Calorimeter Trigger

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The CMS Global Calorimeter Trigger(GCT) is the device within the CMS Calorimeter Trigger system which is assigned the tasks of finding and sorting forward, central and tau-jets, sorting isolated and non-isolated electron candidates and reading out all the calorimeter trigger data. The GCT system also provides for a cross-point switch which facilitates the connection between the Calorimeter and Muon Trigger systems. The GCT system uses 1.125 Gb/s optical links to concentrate the calorimeter data in eight processing cards and accomplishes the algorithm tasks by utilizing V2-Pro Xilinx devices. After a rapid development phase the GCT system has been produced and a large fraction of it has been installed at the CMS electronics cavern (USC-55). There it has been under test since March 07. Testing focused on two aspects of the GCT performance. First GCT was tested for synchronization and data transmission integrity using test pattern data injected in various places in the trigger chain. These tests aimed to establish that the GCT hardware performed as designed. Entire Monte Carlo events will also be propagated in the system to tests the algorithm performance. Results on the performance and testing of the GCT system at USC-55 are presented.

## Summary

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The CMS Global Calorimeter Trigger (GCT) is an integral part of the CMS trigger system. Its function is to receive and process data from all 18 Regional Calorimeter
Trigger (RCT) crates and send the highest ranking electron and jet candidates to the Global Trigger, where they are used for generating the First Level Trigger Accept decision. This system has been designed to be modular in design as well as commissioning. Due to a compressed development schedule, it borrows heavily from existing designs.

The primary requirements of the GCT are to sort electron triggers, and generate and sort jet triggers. The design has been optimized for these tasks. Secondary requirements include jet trigger counters, total jet transverse energy trigger, total transverse and missing transverse energy trigger, luminosity monitoring, and RCT readout. The GCT is composed of four module types, the Source, Leaf, Wheel, and Concentrator cards.

Source cards receive input directly from the RCT crates, and transmit the data via multi-Gigabit optical links to the GCT crate. They are located in the same racks as the RCT,
and provide differential ECL to high speed serial conversion. In addition, they provide a means of data capture and readout for the RCT. The Leaf cards are configured to receive either electron or jet trigger data on high speed optical fibers. Each electron leaf card processes the electron data from 9 RCT crates, selecting the four highest energy candidates for further processing. Similarly, the jet leaf cards process data from 3 RCT crates, and forward the 4 highest energy jets to the Wheel cards. However, the jet finding algorithm implements a sliding window –which requires data from adjacent RCT crates (corresponding to adjacent physical areas on the detector). Jet leaf cards are linked to their neighbours in a corresponding fashion to facilitate this algorithm. The Wheel cards are only used for processing jet data, and combine the output of 3 Leaf cards. These 3 Leaf cards process the data from 9 RCT crates, or ½ of CMS. The Wheel cards sort the jets generated by the Leafs, and forward the 4 with the highest energy to the Concentrator. The Concentrator card accepts data from 2 electron Leaf cards and 2 Wheel cards. It performs the final sorting of both electron and jet events, and sends the 4 highest energy candidates of each type to the Global Trigger. In addition, it provides a VME interface (slow control interface), and S-link data acquisition interface for the entire system.

Over the past year a major part of the GCT has been manufactured and installed at the CMS electronics room, USC-55. Half of the source Cards (30) have been installed in 6 crates at the USC-55 along with 2 Leaf cards and one Concentrator card. This system represents the final CMS electron trigger plus a large fraction of the Jet triggers. This system has undergone detailed testing and is in the process of being integrated in the CMS Trigger chain. This talk will focus on results from tests for synchronization, the performance of the trigger algorithms, and bit error rate tests which were preformed in the period between March and August 2007. The experience acquired from manufacturing, integrating and testing such a trigger system will also be discussed.

**Primary author:** Dr FOUNTAS, Costas (Imperial College)

**Presenter:** Dr FOUNTAS, Costas (Imperial College)

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