Contribution ID: **115** Type: **Oral**

The TOTEM electronics system

Friday 7 September 2007 11:00 (25 minutes)

TOTEM is an LHC experiment around the same interaction point as CMS. It contains cathode strip chambers (CSC) and gas electron multiplier detectors (GEM) in the CMS cavern and 24 Roman Pots with silicon strip detectors in the LHC tunnel. TOTEM should run both standalone and together with CMS, and should be fully compatible with CMS. All three sub-detectors provide level one trigger building signals and use the same chips: VFAT2 providing both tracking data and fast trigger generation signals, the programmable Coincidence Chip, and the LVDS repeater chip. The same counting room hardware receives and handles both trigger building and tracking data.

Summary

TOTEM is an LHC experiment in construction around the same interaction point as CMS. The cathode strip chambers (T1) and the GEM detectors (T2) are two gas detectors located within the CMS cavern. Four groups of six Roman Pots with silicon strip detectors are mounted in the straight sections of the LHC tunnel on both sides of the interaction point at 150 and 220 m distance.

The TOTEM electronics system is fully compatible with CMS. Limited manpower, resources and time imposed significant standardization with the same chips for all three sub-detectors and the same hardware in the counting room for data acquisition and level 1 trigger generation.

The TTC system was adopted with the CMS specific TTCci card. The slow control system of CMS tracker/ecal is used with the CMS FEC-CCS card and the CCU token ring. All programmable chips on the TOTEM detector have been equipped with an I2C interface which can be connected to the CCU.

The TOTEM experiment requires all three sub-detectors to participate in the trigger building with a high degree of flexibility. To realize this, three new chips (the VFAT2, the Coincidence Chip and the LVDS repeater chip) were designed in a collaboration with C4i funded by the Departement de la Haute Savoie and produced in a single run. All were designed using special layout techniques for total radiation dose tolerance, with additional measures for robustness against single event upsets.

The VFAT2 front end ASIC provides tracking and trigger building data and can be configured to match the geometry of the three different sub-detectors. It also contains a special circuit to protect itself against gas discharges.

The Coincidence Chip provides on-detector coincidences to reduce the trigger data sent to the counting room. Both VFAT and Coincidence Chip are programmable through their I2C interface and include counters on the fast trigger outputs to monitor hit rates.

Both trigger building and tracking data are optically transmitted to the counting room using the GOH hybrid. The Roman Pots at 220 m from the interaction point are too far removed for the optically transmitted trigger data to arrive within the allowed latency and electrical transmission was adopted. The LVDS repeater chip is inserted at regular distances along the 270 m long cable and preserves the electrical signals.

The HOST board in the counting room with opto-receiver mezzanines receives both trigger and tracking data. This was a shared development: the CMS preshower designed the opto-receiver mezzanine and TOTEM the HOST board. The fully CMS compatible system is equipped with SLINK, USB and VME interface. The level 1 trigger generation is also carried out by HOST boards. Trigger building signals can be sent to the CMS global trigger or a level 1 trigger signal can be generated directly for TOTEM standalone operation.

In conclusion, the TOTEM electronics system, fully compatible with CMS, became possible through standardization across its sub-detectors, adopting the same hardware for trigger building and tracking data, the collaboration with the CMS preshower, and the support of the Departement de la Haute Savoie for the collaboration with C4i.

Author: Dr SNOEYS, Walter (CERN)

Co-authors: Mrs PEDRESCHI, Elena (INFN Pisa); Dr RADICIONI, Emilio (INFN Bari); Dr ROBUTTI, Enrico (NFN Genova); Mr OLIVERI, Eraldo (Siena University); Dr SPINELLA, Franco (INFN Pisa); Dr RUGGIERO, Gennaro (CERN); Dr ANELLI, Giovanni (CERN); Mr ANTCHEV, Gueorgui (Sofia); Mr MUGNIER, Herve (C4i); Dr KAPLON, Jan (CERN); Dr KLOUKINAS, Kostas (CERN); Dr ROPELEWSKI, Leszek (CERN); Dr DEILE, Mario (CERN); Dr LOVETERE, Maurizio (INFN Genova); Dr TURINI, Nicola (INFN Pisa/Univ Siena); Dr VICHOUDIS, Paschalis (CERN); Dr ASPELL, Paul (CERN); Mr CHALMET, Pierre (C4i); Dr MINUTOLI, Saverio (INFN Genova); Mr REYNAUD, Serge (CERN); Dr LAMI, Stefano (INFN Pisa); Ms AVATI, Valentina (CERN/Penn State U)

Presenter: Dr SNOEYS, Walter (CERN)

Session Classification: Parallel session A7 - Systems, Installation and Commissionning 6