The TOTEM experiment and its topology

The TOTEM physics program covers the following phenomena and measurement: total cross section, elastic scattering, single diffraction, double diffraction, central diffraction and hard diffraction (with CMS).

The TOTEM electronics overview

All detectors vary in size and in type of sensors but share components and technologies for the read out, the data transmission and control.

Tree structure of the TOTEM Trigger System

A dedicated real-time Trigger System is used to evaluate events and activating DAQ. It uses a tree structure divisible in two parts:

1) Detector side (based on ASIC chips VFAT and Coincidence Chip)
2) Counting Room side (based on FPGA)

Trigger System firmware

The Optical Trigger firmware uses the hardware module to receive a serial bit stream. In a consecutive step, the combinatorial logic is used to process the Trigger information on the detector level and propagate it the final stage of the Trigger logic.

In the Electrical Trigger firmware, we perform a bit-by-bit synchronization of the LVDS bus (the spread of individual channels is on the level of several clock cycles). Once synchronized, the Roman Pot Trigger logic is applied and the information is propagated.

TOTEM Trigger "Menu" and CMS integration

In LONEG, each detector is represented by a set of bits (related to the detector state). The bits enter the programmable delay blocks to synchronize all Trigger bits accordingly to the time frame. Once synchronized, they enter the blocks of combinatorial logic (related to the physics). For the optimal Trigger exchange with CMS, there is a bidirectional communication between both experiments. Four TOTEM Trigger bits are sent to CMS and combined together with its own. Two signals return:

1) CMS L1 Trigger bit - the final Trigger bit for the CMS HLT trigger,
2) L1SA - Level One Special Accept (special sub-sample of CMS L1).

Those signals enter the second block of the LONEG firmware and the final Level One Trigger bit for TOTEM is generated.

The tracking data of CMS and TOTEM are stored separately but each event is tagged by two numbers:

1) Orbit number,
2) Bunch number.