

PPS OFFLINE SOFTWARE IN CMS

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On behalf of the UERJ and CBPF group in PPS

Outline

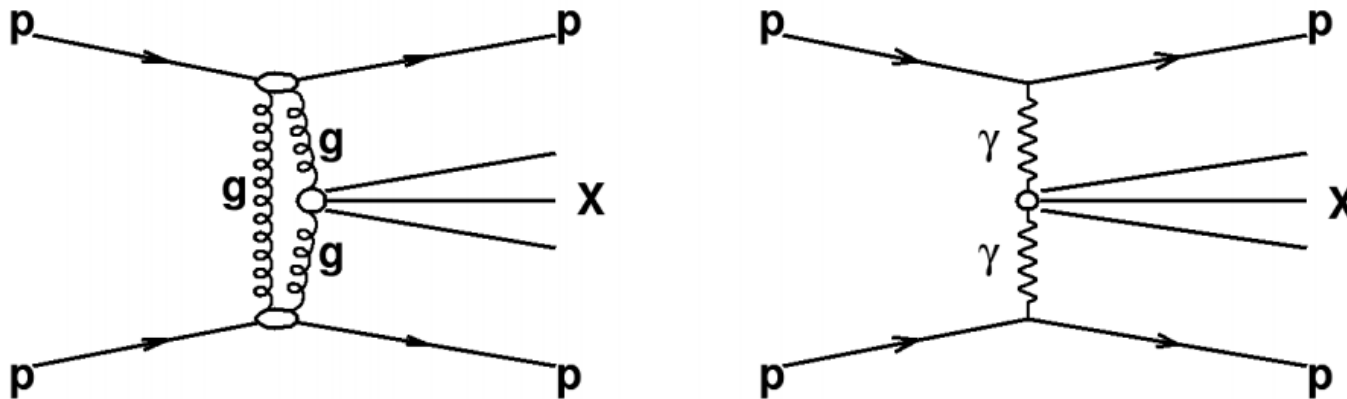
- The PPS (*Precision Proton Spectrometer*) detectors
- The main contributions of the CMS Rio group to the PPS offline software are in the following subjects:
 - the Technical Design Report*
 - the Proton Transport
 - the Fast Simulation**
 - the Full Simulation and Reconstruction
 - the Detector conditions Database

*CERN-LHCC-2014-021

**CMS DN-2017/015

The PPS detectors

The aim of the PPS project was to build and operate detectors for studying central exclusive production (CEP) in proton-proton collisions, by tagging and reconstructing the scattered protons.

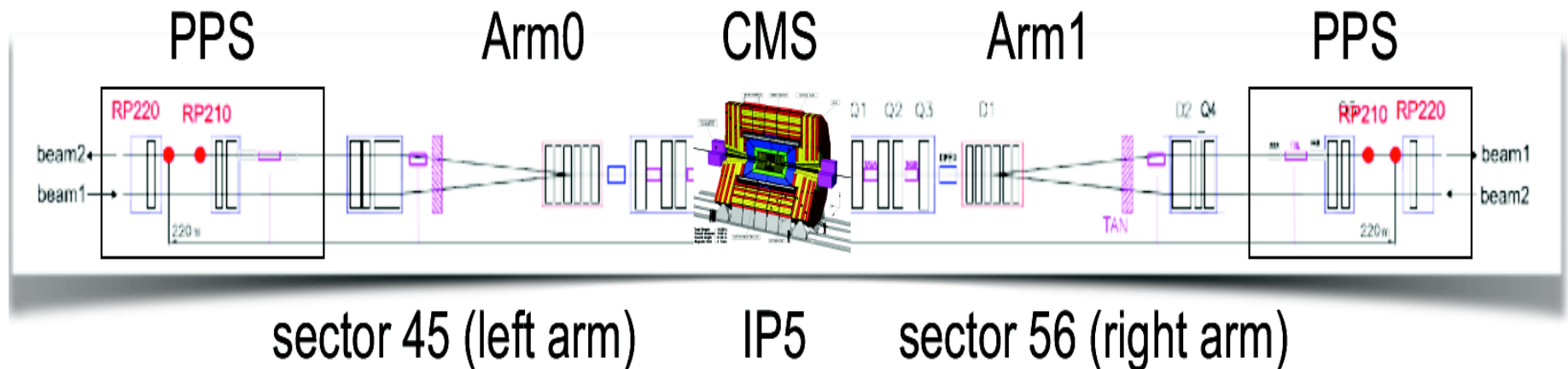


gluon-gluon and photon-photon CEP

See contribution in this workshop from Antonio Vilela

The PPS detectors

The PPS detectors are located around 210m from the CMS IP and have different components: Si strips and pixels to measure the proton momentum, and timing counters to disentangle the pileup CMS vertices.



Software in the TDR

The group developed a simplified simulation of the detectors, located in the actual places with an estimated resolution of 10%.

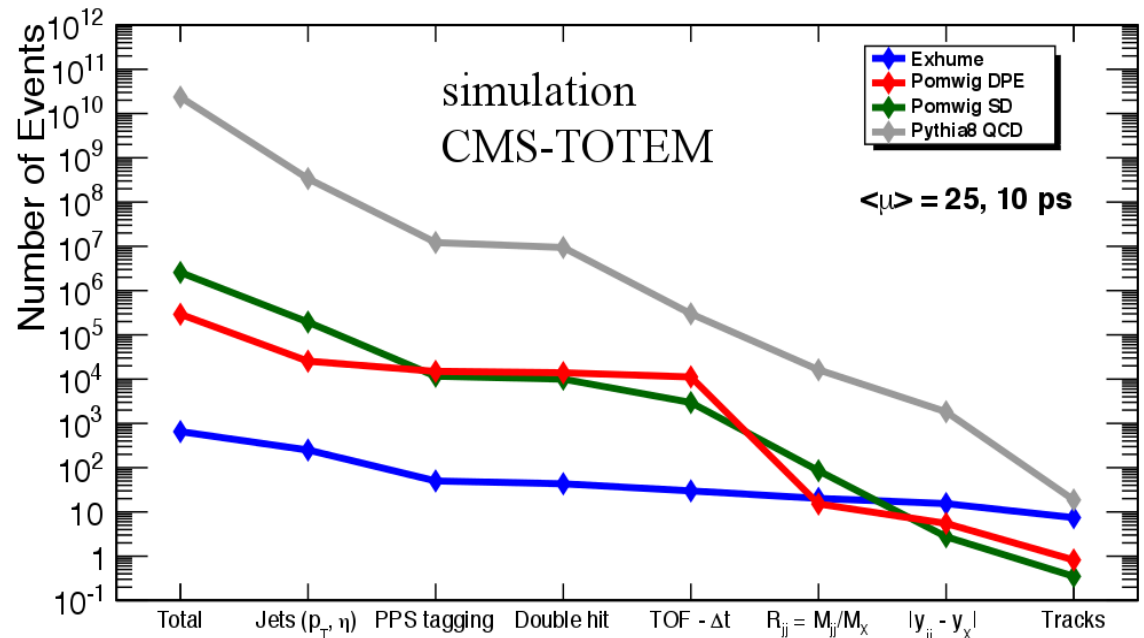
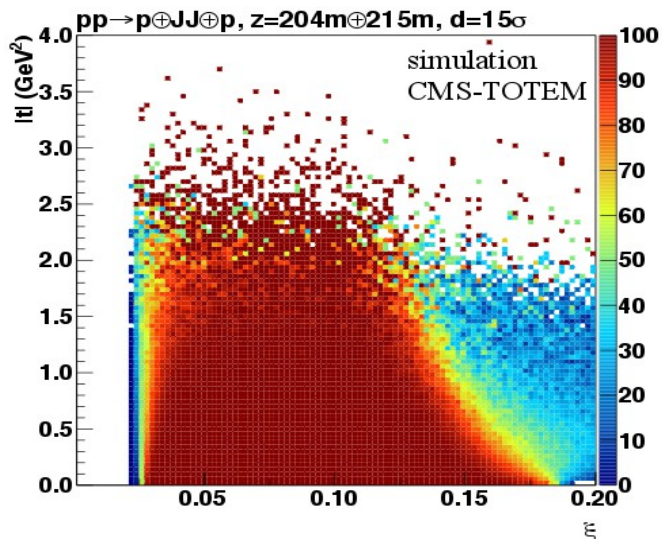
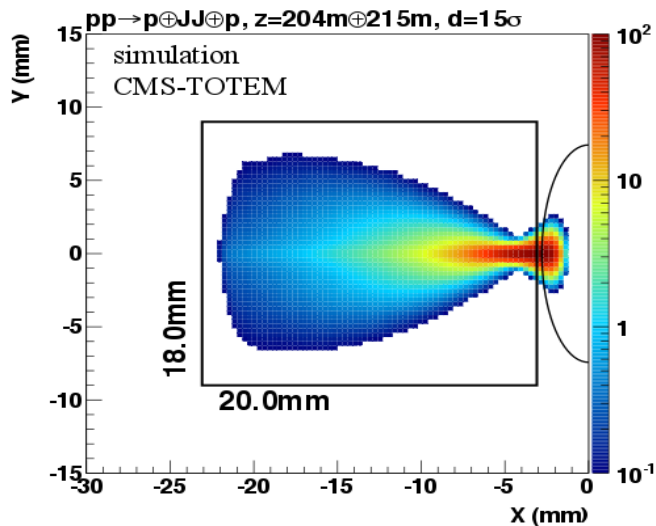
The protons were transported from the CMS IP to the PPS location with an adapted version of HECTOR*, implemented in CMSSW.

Hits were simulated at the detectors planes, local tracks were reconstructed and propagated back to the IP with HECTOR, determining the kinematical variables t and ξ .

Different generators, like Pythia, ExHuME, FPMC and Pompyt, were used to generate samples that were simulated and reconstructed using the CMS software, together with this code.

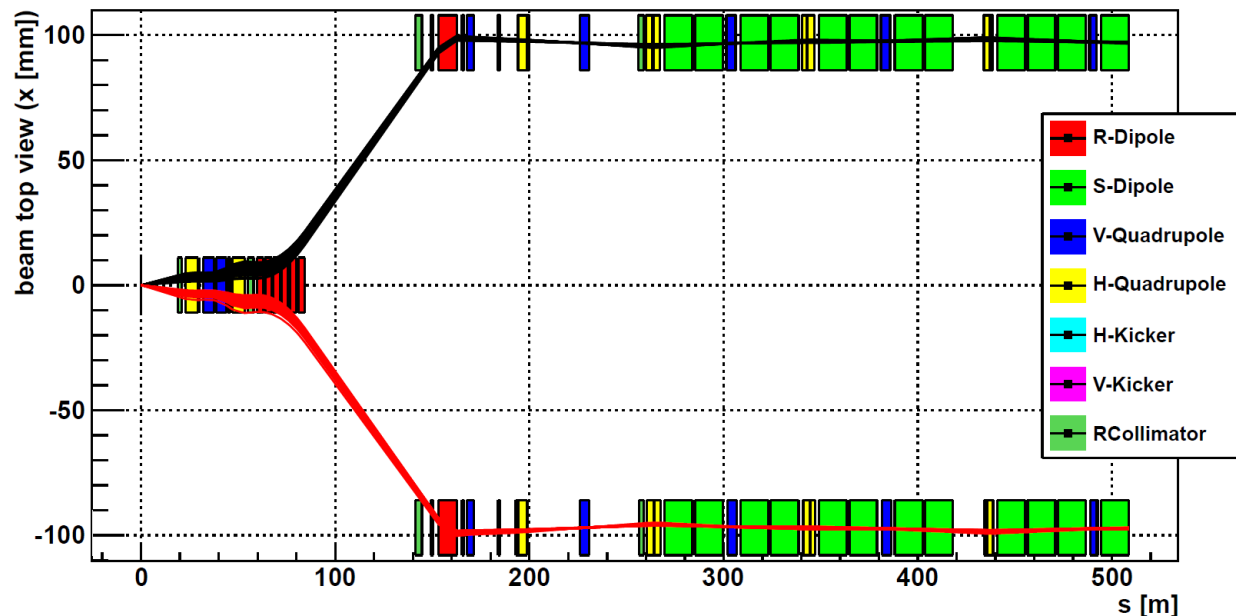
Software in the TDR

The Rio group studied the channel $pp \rightarrow p + jj + p$



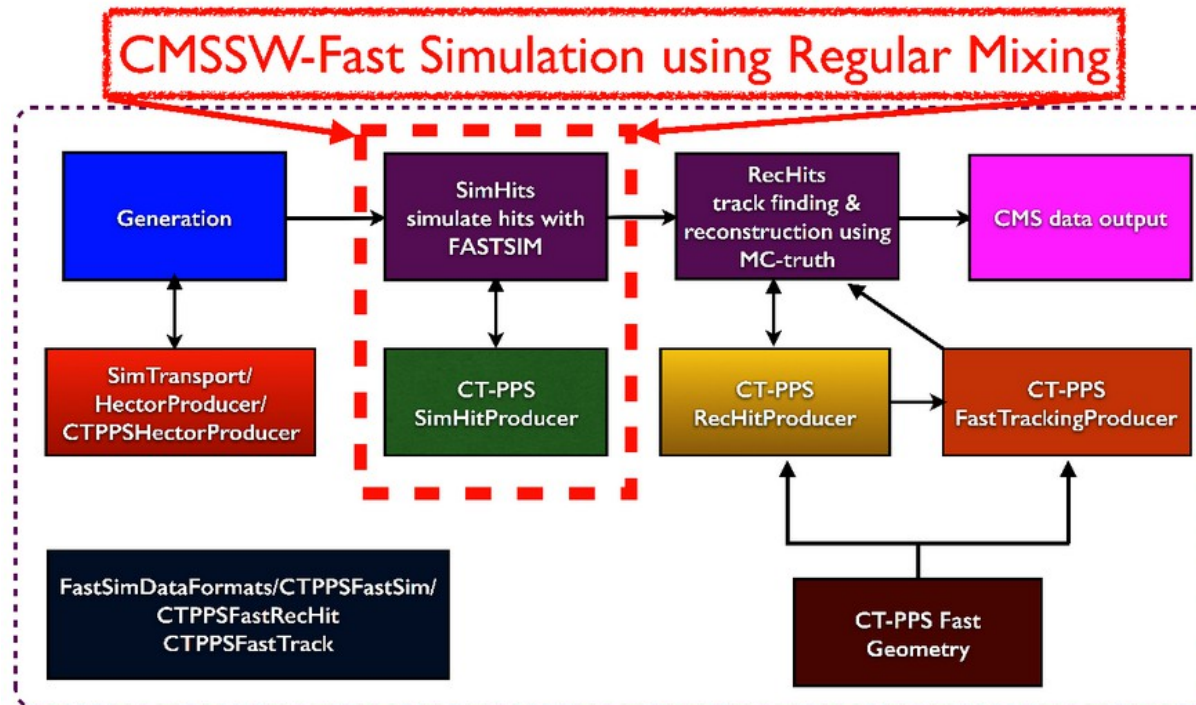
The Proton Transport

The scattered protons from the collisions pass through the accelerator magnet optics components before reaching the PPS. The software that simulates this behaviour is based on HECTOR and the beamline parameters provided by the LHC division are corrected for alignment and real optics conditions, for each data taking period.



The Fast Simulation

The PPS module of the CMS Fast Simulation was implemented based in the TDR code and fully integrated to CMSSW. Current physics analysis are using it*.



*See contribution in this workshop from Maurício Thiel

The Full Simulation

The *GEANT* simulation of the PPS detectors (strips, pixel and timing) was done by the groups which built them.

The Rio group works in the following activities to implement the code into *CMSSW*:

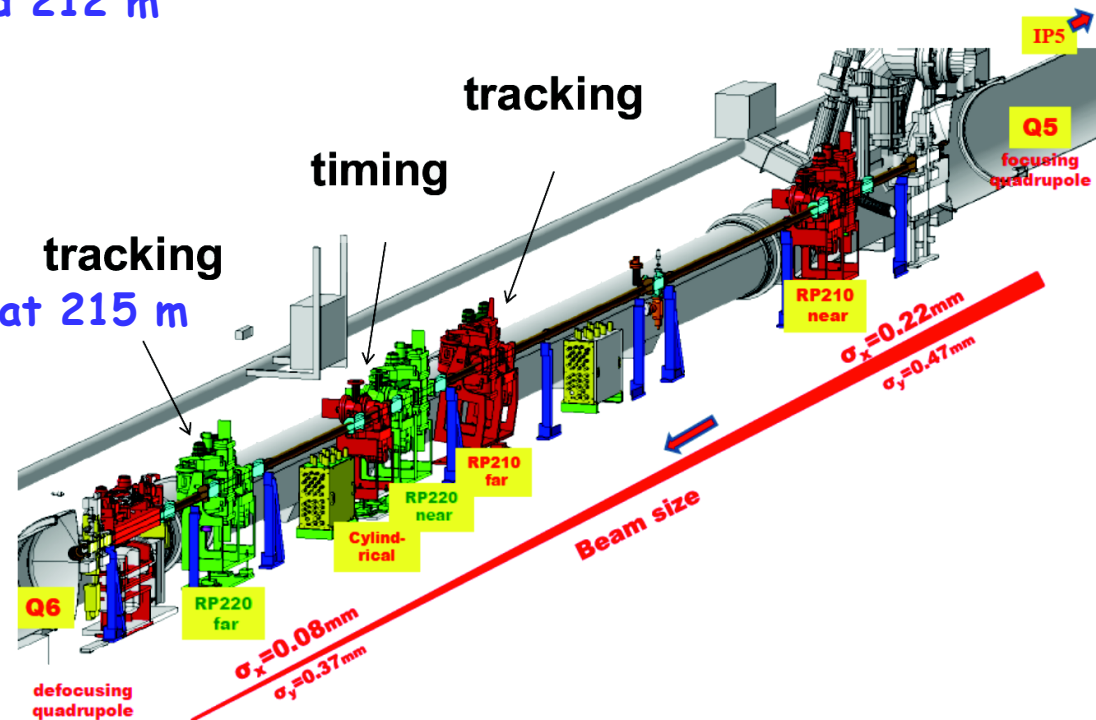
- the integration of the *GEANT* part
- contribution to the development of the pixel digitization
- the conversion from digitization to raw data format
- the development of the conditions database* used both for simulation and reconstruction
- the reconstruction code is the same as the one used for real data, where a contribution on the clusterization and calibration of the pixel detector was also done.

*See contribution in this workshop from Helena Malbouisson and Clemencia Mora Herrera

The Full Simulation

We also adapted the PPS geometry to the CMS setup for the simulation of the different detector scenarios

- 2016
 - Tracking Silicon Strips at 204 and 212 m
 - Fast Timing (Diamond) at 215 m
- 2017
 - Tracking Silicon Strips at 212 m
 - Fast Timing (Diamond and UFSD) at 215 m
 - Tracking 3D Pixels at 220 m
- 2018
 - Tracking 3D Pixels at 212 m
 - Fast Timing (Diamond) at 215 m
 - Tracking 3D Pixels at 220 m



Summary

- The simulation code developed for the TDR was successfully implemented
- The fastsim code inside CMSSW is running and being used for physics analysis
- The fullsim code is being certified for the different setups
- The conditions database was implemented both for simulation and real data
- The pixel reconstruction contribution to the development code were implemented