

Laboratory/research team

Laboratoire Leprince-Ringuet, École polytechnique / CMS

Title

Study of the Electroweak Symmetry Breaking at the HL-LHC with the High Granularity Calorimeter of the CMS experiment.

Overview of the research:

In Standard Model (SM)-like theories the gauge bosons acquire a longitudinal component via the Higgs mechanism and the scattering behavior of gauge bosons is regularized by the virtual exchange of a Higgs Boson. The Higgs boson is associated with the Higgs field responsible for spontaneous EWSB. After the discovery of the Higgs boson in 2012, the LHC experiments measured its mass and spin, as well as its couplings with gauge bosons and fermions. In the future, the study of its properties will continue during the High Luminosity period of the LHC (HL-LHC). Besides these measurements the role of the Higgs boson in the Electroweak Symmetry Breaking (EWSB) will be studied by the characterization of the vector boson scattering of the longitudinal component of the gauge bosons in their scattering ($W_L W_L$, $W_L Z_L$ or $Z_L Z_L$).

The vector boson scattering will be available when two quarks from the colliding protons emit vector bosons which in turn interact with each other. The two quarks get deflected from the beam direction and originate jets of hadrons in the forward direction which clearly identify this category of events.

A new radiation resistant and highly granular forward calorimeter (HGCal) is currently under design. In the harsh experimental conditions of the HL-LHC an average of about 140 proton-proton collisions will overlap at each beam collision (pile-up). This will induce contamination of the signal events by particles unrelated to the interesting pp collisions. The high segmentation of the proposed HGCal is pivotal for removing this contamination.

Thesis project

Triggering on forward electrons, photons, taus, jets with the HGICAL will be a very challenging task. The thesis should be concerned with the problematic of studying the potential benefit of introducing in the CMS L1 trigger a very precise (20-30 ps) time measurement giving an additional handle for the removal of the pile-up effects.

Master and doctoral school

- Master 2 in particle physics
- PHENIICS doctoral school – Université Paris-Saclay

Local team

The internship and the thesis will be conducted at LLR in the CMS group with frequent stays at CERN. The CMS group is a founding member of the CMS Collaboration. It has designed and built the ECAL L1 trigger and is responsible for its daily operation and monitoring. It has major involvement in particle reconstruction and identification (electrons, taus, particle flow). It is involved in Electroweak (di-bosons, triple gauge couplings, etc...), Heavy Ions and Higgs physics. The CMS group comprises 12 permanent researchers, 2 emeritus, 5 post-docs and 7 doctoral students.

Contact

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