

Measurement of Electroweak Parameters in the Decay of $Z^0 \rightarrow \tau\tau$ and the Upgrade of the CMS Detector for very High Luminosity

Directeur de thèse : ULRICH GOERLACH, CO-ENCADRANT : VLADIMIR CHEREPANOV
INSTITUT PLURIDISCIPLINAIRE HUBERT CURIEN (IPHC) ;
23 RUE DU LOESS, BP 28 – 67037 STRASBOURG CEDEX 2
TÉLÉPHONE: 03 88 10 66 44; FAX: 03 88 10 62 34
EMAIL: ULRICH.GOERLACH@IPHC.CNRS.FR

The CMS-group of the IPHC Strasbourg is seeking candidates for an experimental PHD thesis starting in October 2018 for three years.

This thesis will contain two activities, an analysis of Z^0 decays to a pair of tau leptons to determine electroweak parameters (mixing angle, universalities) and a detector oriented part, consisting in participating in the development and testing of detectors (including DAQ firmware) in the laboratory and beam tests for the upgrade of the CMS inner detector for the high-luminosity phase of the LHC (HL-LHC).

Description of the scientific project:

The LHC has started last year with proton-proton collisions at a centre of mass energy of 13 TeV. This energy and relative high luminosity will allow to probe the standard model of particle physics for possible deviations and new physics with high precision. The central subject of the thesis will concentrate on electroweak physics with tau-leptons, particularly the measurement of the effective electroweak mixing angle and testing the lepton universality in the weak neutral current with the decays $Z^0 \rightarrow \tau\tau$. The effective weak mixing angle, weak vector- and axial- couplings of tau leptons can be extracted from the polarization of tau leptons. This is a non-trivial task and requires besides a good theoretical understanding a careful optimization of the analysis. The high precision can be achieved by analysing a variety of tau decays ($\tau \rightarrow \pi, \rho, a_1$, leptonic decays) and their combinations. This part involves the application and further improvement of analysis software recently developed by the CMS group in Strasbourg in collaboration with other institutions. The research programme will be also of highest relevance for further studies of the CP nature of the Higgs Boson at the future high luminosity LHC machine.

The second part of the PhD thesis is related to the upgrade of the CMS detector, namely the replacement of the entire tracking system by a new silicon detector capable of providing fast selection of transverse momentum tracks for the high-level trigger. The Strasbourg group is involved in the testing of detector modules and the Data-acquisition framework of the entire new tracker. The PhD student will contribute to experimental tests of hardware and software and is expected to acquire an expert level in this domain of the future CMS detector.

The PhD thesis will start in October 2018 and should be preceded by a Master thesis in spring 2018. It will be carried out at the IPHC, Strasbourg within the group working on the CMS experiment. The twofold activity of the future PhD student, both in a physics analysis and in a hardware orientated activity will be an excellent training ground for future involvements in particle physics experiments, if the candidate is willing and capable to face this double challenge.

The potential PhD-candidate for this thesis should have an excellent academic record (Master, first year and first semester of the second year) in order to be preselected before the end of May for an interview in June at the “*école doctorale*”, which will decide whether or not a grant is available for this PhD thesis and the student. A solid knowledge of programming (C++ and Root) and some practical capabilities and the motivation to work with the detectors in our laboratory or during beam-tests are required as well. Further she/he should have the necessary communication skills to work across the international CMS collaboration.