ABSTRACT

The tracker system of the CMS experiment, consists of two distinct types of silicon sensors known as 2S and PS-s. These sensors are employed in the construction of 2S and PS modules. The PS modules are designated for the inner part of the tracker system, whereas the 2S modules find their place in the outer section of the CMS tracker.

In the reported work 2S type silicon sensors are taken. For 2S sensor p-type is the bulk that has thickness of 300 μm and n-type implants, there are 2032 sensing elements at each sensor. A complex structure and additional p-stops are introduced in the 2S sensor to make it radiation hard by design, to mitigate the harsh radiation environment during high luminosity LHC (HL-LHC). It is paramount important to perform the detailed characterization of the 2S sensors before building the modules and integration into the CMS tracking system. For sensors characterization and quality control a dedicated and state of the art setup is built at Experimental High Energy Physics (EHEP) lab at NCP.

In first part of my M.Phil. project batch no. 43838 is characterized and sensors quality is checked carefully. There is a set of procedures that is followed during sensors characterization, such as: handling of the sensors, inspection under the microscope and performing tests in control temperature and humidity. There are total eight characterization parameters namely, (i). global IV, (ii). global CV, (iii). Strip current, (iv) Poly-silicon resistance, (v). Dielectric current, (vi). Interstrip resistance, (vii). Interstrip capacitance, and (viii). Coupling capacitance. In the thesis, sensors quality control setup, characterization procedure and results are presented.

In the second part of the project analysis is performed to investigate the generation of a pair of Weakly Interactive Massive Particles (WIMPs) along with a Z-boson decay to a pair of leptons. WIMPs pass through the detector without interaction, resulting in events with substantial missing transverse momentum and two energetic opposite-charge leptons. This analysis utilized simulated data from proton-proton collisions at 13TeV, generated using the MadGraph5_aMC@NLO Monte Carlo event generator. In this approach, utilized the 2HDM+a model for parameters optimization. Values such as $\sin\theta = 0.35$, $\tan\beta = 1$, and $M_\chi = 10$GeV are taken into account. Furthermore, conducted an analysis of standard model backgrounds, specifically ttbar, ZZ, and WW processes, within the framework of this signal study.