Abstract

ATLAS is a general purpose experiment which will start operation at the LHC proton-proton collider in 2007. This thesis presents work carried out towards the preparation of the experiment in two aspects: detector development for the semiconductor tracker (SCT), and a Monte Carlo simulation of a Higgs search.

Finite element analysis was carried out to investigate the thermal properties of the SCT cooling blocks. Several possible designs were studied, and the results agreed with previous measurements of prototype blocks. The analysis confirmed that the SCT modules can be safely operated with a cooling block which is thermally split with a 1-mm layer of polyether ether ketone plastic.

The common mode noise performance of SCT modules with binary readout was tested by analysing coherent fluctuations in the occupancies of groups of channels. The measured levels of common mode noise at the system test were less than 200 electrons equivalent noise charge, which is within the limits imposed by ATLAS.

A simulation analysis was performed of exclusive Higgs production and decay to $WW^{(*)}$. The signal was generated using the ExHuME Monte Carlo, which implements the Durham model of exclusive diffraction. Events were selected by applying the ATLAS leptonic trigger criteria and requiring both protons to be tagged by the forward proton detectors at 215 m or 420 m downstream from the interaction point. It was found that the Higgs signal can be detected for masses in the range $140 < M_H < 200$ GeV. Between 3 and 6 events are expected in 30 fb^{-1} of data, the equivalent of three years of LHC running at initial luminosity.