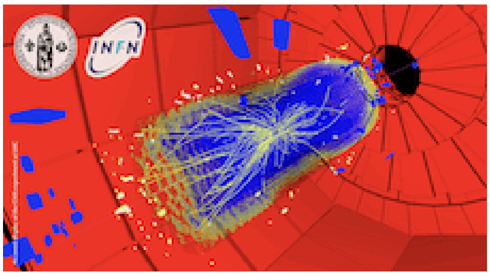

Contribution ID: **14** Type: **Talk**

Silicon Strip Detectors for the ATLAS sLHC Upgrade

Thursday, 7 July 2011 10:20 (20 minutes)

While the Large Hadron Collider (LHC) at CERN is continuing to deliver an ever-increasing luminosity to the experiments, plans for an upgraded machine called Super-LHC (sLHC) are progressing. The upgrade is foreseen to increase the LHC design luminosity by a factor ten. The ATLAS experiment will need to build a new tracker for sLHC operation, which needs to be suited to the harsh sLHC conditions in terms of particle rates and radiation doses. In order to cope with the increase in pile-up backgrounds at the higher luminosity, an all silicon detector is being designed. To successfully face the increased radiation dose, a new generation of extremely radiation hard silicon detectors is being designed.
Silicon sensors with sufficient radiation hardness are the subject of an international R&D programme, working on pixel and strip sensors. The efforts presented here concentrate on the innermost strip layers. We have developed a large number of prototype planar detectors produced on p-type wafers in a number of different designs. These prototype detectors were then irradiated to a set of fluences matched to sLHC expectations. The irradiated sensors were subsequently tested with prototype sLHC readout electronics in order to study the radiation-induced degradation, and determine their performance after serious hadron irradiation of up to a few 1015 1-MeV neutron-equivalent per cm2.
One key figure of merit is the signal that can still be measured with a silicon detector after irradiation to increasing radiation doses representative of the severe sLHC conditions. Due to radiation-damage effects such as carrier trapping and growing depletion voltage of the detectors, the measurable signal is degraded as a function of irradiation. We measure a signal of roughly 25,000 electrons for an unirradiated sensor, which reduces to about 17,500 electrons after 2·1015 1-MeV neutron-equivalent per cm2 . We have also measured signals around 9,500 electrons for radiation doses expected for the pixel detectors in the ATLAS tracker upgrade. From these data, it is evident that sufficient charge can still be recorded even at the highest fluence.
In our presentation, we will give an overview of the ATLAS tracker upgrade project, in particular focusing on the crucial innermost silicon strip layers. Results from a wide range of irradiated silicon detectors will be presented, and layout concepts for lightweight yet mechanically very rigid detector modules with high service integration will be shown.
We will draw conclusions on what type and design of strip detectors to employ for the upgrades of the tracking layers in the sLHC upgrades of LHC experiments.

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Session Classification: DAY 2