Contribution ID: **53** Type: **not specified**

Test-beam results of irradiated and un-irradiated prototypes for the ATLAS ITk Strip detector

Friday 27 January 2017 12:35 (15 minutes)

During the High-Luminosity phase of the LHC the luminosity will be almost five times larger than the present LHC luminosity. In order to cope with the higher radiation level and the higher pile-up, the ATLAS experiment will need a complete replacement of the current tracking system with an all silicon detector, the Inner Tracker (ITk).

The ATLAS ITk Strip detector will be subjected to a radiation level up to 1.2x10^15 1MeV neq/cm^2, more than one order of magnitude larger than the maximum radiation expected for the current strip detector, the Semiconductor Tracker (SCT). For this reason, new radiation-hard sensors and front-end chips will be used and are now under development. It is vital to study the performance of these new components when they are subjected to a radiation close to the one expected at the end of the lifetime of the HL-LHC.

In this talk, we will present test-beam results obtained with several prototypes with various strip length (1 cm, 2.5 cm and 5 cm) and subject to high radiation fluences (up to 2x10^15 1MeV neq/cm^2). The strips are wire-bonded to the front-end chips, the ABC130 (ATLAS Binary Chip), which provide a binary read-out. The measurements were performed with EUDET-type telescopes at DESY in May and CERN in July 2016 and the track reconstruction was performed with the General Broken Lines algorithm implemented in the EUTelescope framework. The main focus of the analysis lies in the study of the degradation of the efficiency, collected charge and noise occupancy after irradiation. The results provided crucial information to understand the performance and the radiation-hardness of these new sensors and front-end chips.

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Session Classification: Data Analysis and Test Beam Results