11th International "Hiroshima" Symposium on the Development and Application of Semiconductor Tracking Detectors (HSTD11) in conjunction with 2nd Workshop on SOI Pixel Detectors (SOIPIX2017) at OIST, Okinawa, Japan

Contribution ID: **68** Type: **POSTER**

Investigation of the impact of mechanical stress on the properties of silicon strip sensors

Sunday, 10 December 2017 20:23 (1 minute)

on behalf of the ATLAS ITk strip sensor working group.

The new ATLAS tracker for phase II will be composed of silicon pixel and strip sensor modules. The strip sensor module consists of silicon sensors, boards and readout chips. Adhesives are used to connect the modular components thermally and mechanically. It was shown that the silicon sensor is exposed to mechanical stress, due to temperature difference between construction and operation.

Mechanical stress can damage the sensor and can change the electrical properties. The thermal induced tensile stress near to the surface of a silicon sensor in a module was simulated and the results are compared to a cooled module. A four point bending setup was used to measure the maximum tensile stress of silicon detectors and to verify the piezoresistive effects on two recent development sensor types used in ATLAS (ATLAS07 and ATLAS12). Changes in the inter-strip, bulk and bias resistance and capacitance as well as the coupling capacitance and the implant resistance were measured. The Leakage current was observed to decrease by bending. The surface and bias resistance was measured to increase for tensile stress along the strip direction and compressive stress perpendicular to the strip direction. These changes influence the noise which are quantified in signal measurements with a beta source.

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Session Classification: POSTER

Track Classification: Strip sensors