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Irradiation and Testing of ATLAS Silicon Strip Sensors

Continuing the LHC at its current rate of collisions beyond 2022 will no longer provide the same statistical gain per year as it has so far provided. Instead, the LHC will proceed with plans to upgrade the rate of collisions during a 30-month shutdown starting at the end of 2022 and enter the High Luminosity (HL) LHC phase, with the aim of increasing the annual integrated luminosity by a factor 10 and the peak luminosity by a factor of up to 7.5 . Such a large increase in collision rate will demand more from the two General Purpose Detectors (ATLAS and CMS) than was foreseen in their initial designs. The ATLAS Inner Detector (ID) is ill-equipped to handle the environment at the HL-LHC and will be entirely replaced by an all-silicon Inner Tracker (ITk). Track multiplicities will be so large that the occupancy in the current SCT strips and TRT would be be too high. Therefore, shorter silicon strips will be used, the TRT will be entirely replaced by silicon strips and there will also be an expansion of the coverage of the pixel detector. The design of silicon sensors used in the ID is too susceptible to radiation damage to maintain a high performance for the duration of the HL-LHC and, therefore, have been redesigned with a particular focus on improving their radiation hardness.

The University of Birmingham is amongst a consortium of institutes that characterise prototype silicon strip sensors pre- and post-irradiation using the University of Birmingham Medical Physics cyclotron, to assess the consequences on detector performance after a high dose of proton irradiation equivalent to the expected fluence over the HL-LHC lifetime. The poster will outline the irradiation testing procedure that uses an ALiBaVa (RD50) readout system and include some of the recent results obtained from sensors irradiated at the cyclotron; such as the collected charge, peak signal-voltage scans and cluster widths.

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