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Characteristics of silicon strip sensors irradiated up to proton fluence of 10^17 n_eq/cm^2

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Silicon semiconductor detector technology has been adopted by the experiments at the high-luminosity upgrade of the CERN Large Hadron Collider (HL-LHC) to perform precision tracking in the inner region surrounding the collision point where the traversing particle fluence will reach 1×10^16 1-MeV n_eq/cm2. Hadron colliders in future should provide even larger luminosity for rare physics searches and the detector needs to be more radiation hard. The n+-in-p microstrip detectors developed for the HL-LHC and fabricated by Hamamatsu Photonics were irradiated by 70-MeV protons up to fluence of 10^17 n_eq/cm2 and the changes in basic strip detector characteristics have been evaluated to investigate the impacts on the silicon detector designing for the future experiments.
The characterization was conducted based on the methods developed for the ATLAS ITk strip sensor characterization. The charge collection measured with penetrating 90Sr -rays and fast ALIBAVA readout system is severely degraded above 10^16 n_eq/cm2, as reported previously. The interstrip capacitance and aluminum strip resistance are barely influenced, while the poly-silicon bias resistance showed to increase gradually with the fluence and the implant strip resistance to increase at 10^17 n_eq/cm2. The punch-through protection is found to be degraded but its functionality is sustained to occur below 100 V as required even at 10^17 n_eq/cm2. The presentation will cover these measurement results.

Submission declaration

Original and unpublished

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