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Establishing the Quality Assurance Programme for the Strip Sensor Production of the ATLAS Tracker Upgrade Including Irradiation with Neutrons, Photons and Protons to HL-LHC Fluences

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The successful pre-production delivery of strip sensors for the new Inner Tracker (ITk) for the upgraded ATLAS detector at the High Luminosity LHC CERN has completed and based on their performance full production has commenced. The overall delivery period is anticipated to last 4 years to complete the approximately 22000 sensors required for the ITk. For Quality Assurance (QA), a number of test structures designed by the collaboration, along with a large area diode and miniature version of the main sensor, are produced in every wafer by the foundry (HPK). As well as Quality Control (QC) checks on every main sensor, samples of the QA pieces from each delivery batch are tested both before and after irradiation with results after exposure to neutrons, gammas or protons to doses corresponding to those anticipated after operation at the HL-LHC to roughly 1.5 times the ultimate integrated luminosity of 4000fb⁻¹.

Since the QC testing cannot reliably catch all the possible variations in production parameters that may influence deterioration during operation at the HL-LHC, the QA procedures are essential for guaranteeing long-term survival and are beyond the scope of what any manufacturer can reasonably check themselves. It is therefore vital that these procedures are as robust as possible and seen by the manufacturer to be fully reliable as they have the potential to lead to rejection of batches otherwise satisfying all the agreed QC tests. As a result ATLAS, with input from independent experts, has developed detailed sensor QA plans, looking at the planned sampling rate; the proposed acceptance criterion; the measurement and irradiation procedures; along with the required standards of precision, consistency and reproducibility, among the participating irradiation facilities and QA institutes.

This presentation outlines these procedures and the studies carried out to establish that the seven ITk QA Strip Sensor irradiation and test sites meet all the requirements to support this very extensive programme throughout the strip sensor production phase for the ITk project.

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