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A Software Toolkit for local Quality Control of ATLAS Itk Pixel Modules

The High-Luminosity upgrade of CERN's Large Hadron Collider will greatly increase the number of particle collisions recorded by experiments such as ATLAS. This creates more scientific opportunities but also exposes the detectors to higher particle densities, radiation levels, and data rates. To meet these demands, the current ATLAS tracking detector will be replaced by the new all-silicon Inner Tracker (ITk).

ITk will contain more than 8000 pixel detector modules, which must operate reliably for approximately ten years in a harsh radiation environment. Before installation, each module therefore undergoes extensive quality-control testing. This process involves more than assigning a simple pass-or-fail result. When unexpected behaviour occurs, it must be determined whether the root-cause lies in the module, the measurement setup, communication with the hardware, or an earlier production and handling step. Reliable documentation and traceability are consequently essential, particularly when several modules and test stations are operated in parallel.

This project develops and evaluates software tools for local ITk pixel-module quality control (QC). A data-base-backed graphical interface combines information from scans, logs, configuration files, and manually maintained records. It supports test-resource allocation and module handling, visualises measurement results, and records errors systematically. This simplifies the testing procedure, prevents operator errors and allows for full path traceability of any module in the QC pipeline.

The tools are integrated into the existing QC workflow and continuously evaluated during laboratory operation. Feedback from daily use guides their iterative improvement. By reducing manual bookkeeping and centralising information, the toolkit improves the traceability, reproducibility, and efficiency of QC procedures. It also lowers the entry barrier for new team members by providing a more accessible interface to the workflow than direct interaction with the core QC software. The underlying approach could be transferred to other ITk production sites or comparable laboratory environments.