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Development of a serially powered, prototype pixel stave for the upgrade of the ATLAS Inner Tracker

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The ATLAS collaboration is planning a major upgrade of the current detector systems in order to operate at the increased luminosity provided by the High Luminosity LHC (HL-LHC) scheduled for operation from 2025.

In order to operate at these increased luminosities, the inner most detector system known as the Inner Tracker (ITk) must be lower mass, higher granularity and more radiation hard than the existing detector system, particularly the pixel layers that are closest to the interaction point. To help achieve this, pixel detectors are ganged together into groups of four known as 'quads' reducing the dead regions that are present at the edge of chips and minimising the overlaps needed to provide coverage of the required area. Additionally, thin, flexible PCBs and strong lightweight structures for support and delivery of services and serial powering will be employed to reduce the material budget of the ITk further.

We will present the development and testing of a carbon fibre, serially powered, double-sided stave containing 12 pixel quad modules readout by a total of 48 FEI4-B ASICs. Such a system is designed to allow the testing of multiple quad modules in a realistic environment and facilitate the development of quality assurance and control procedures needed during the production and assembly phases of the ITk pixel end-cap (one of which is to be built in the UK). The pixel quads are mounted on thin, flexible Kapton PCBs and read out with the High Speed Input Output DAQ (HSIO-II) developed by SLAC. For the first time, multiple quad modules have been calibrated and read out together and system tests including threshold and cross-talk scans have been made to assess the performance of the detectors in this configuration. Radiation tests with cosmic rays and a Sr-90 source will also be presented.

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