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A Serially Powered ATLAS Strip Tracker Stavelet with Improved Referencing Connections

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The engineering challenges related to the supply of electrical power to future large scale detector systems are well documented. The ATLAS Upgrade Strip Tracker Community has previously presented results from two demonstrator stavelets, one serially powered and one built with DC-DC convertors. Both approaches have the potential to increase the efficiency of the powering system.

At the time of writing, construction of a new serially powered stavelet is underway. This uses a revised bus tape layout which facilitates additional referencing connections, devised as a result of earlier work. The latest results from this stavelet shall be presented.

Summary

The present ATLAS SCT (semiconductor tracker) comprises 4088 silicon microstrip detector modules, each powered by its own independent low and high voltage power supply channels. Given the requirements of the upgraded inner tracker needed for ATLAS running at HL-LHC, with over 10,000 detector modules in the short strip region alone, it becomes increasingly difficult to justify the retention of independent powering both in terms of system efficiency and overall cost. Therefore two alternative powering schemes are under active consideration within our community, namely Serial Powering and on-detector DC-DC conversion.

For the upgraded detector, it is natural to integrate groups of modules into intermediate scale structures, referred to here as “staves”. A stave functions both as a thermal-mechanical core, to precisely support and cool the modules, and as a “backplane” through which digital signals, power, and detector bias can be distributed to modules. A stave is also a convenient unit for which to implement the serial or DC-DC powering infrastructure.

For the purpose of prototyping, we have chosen to study 1/3 length staves, referred to as “stavelets”, using the ABCN-25 readout chip. This ASIC incorporates a number of features in support of the serial powering option, notably the integration of a pair of shunt transistors. A simple shunt control circuit was therefore integrated into the hybrid design such that a fully serially powered system may be easily realised.

Initial results from a serially powered stavelet comprising four short strip modules were presented at TWEPP 2010. Studies of a companion stavelet built using DC-DC converters (provided by the CERN group) were presented last year, concluding that a “star” configuration of the power feed and return was essential to obtain the best noise results.

This year we have fed back the results of our previous studies into the design of a new bus tape for a serially powered stavelet. This provides additional opportunities to make referencing connections between the hybrids. The stavelet may be configured in one of two ways, either as a chain of hybrids or, with the addition of custom PCBs which implement a star power fee within each module, a as a chain of modules. Another feature of the new tape design is that the mass of the reference plane under each sensor differs from location to location, with the base aluminium material having been etched away in various cross-hatch patterns. This approach may allow the further reduction of the material used in each of our production staves.

The latest results from the new stavelet will be reported to the conference.

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