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HVMUX, the High Voltage Multiplexing for the ATLAS Tracker Upgrade

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The increased luminosity of the HL-LHC will require more channels in the upgraded ATLAS Tracker, as a result of the finer detector segmentation.Thus, a more efficient power distribution and HV biasing of the sensors are among the many technological challenges facing the ATLAS Tracker Upgrade. A number of approaches, including the sharing of the same HV line among several sensors and suitable HV switches, along with their control circuitry, are currently being investigated for this purpose. The proposed solutions along with latest test results and measurements will be described.

Summary

In the ATLAS Semiconductor Tracker system (SCT) the High Voltage biasing to the strip sensors is provided by individual High Voltage supplies, remotely located in a service cavern. This solution is optimal in terms of robustness and redundancy, as it simplifies the operation of disabling malfunctioning sensors without disturbing the others. It also allows easy monitoring of the individual current drawn by each sensor, an important requisite to assess their proper functioning.
The ATLAS Tracker Upgrade will consist of an all silicon tracking detector, to fulfill the requirements of the High Luminosity upgrade of the Large Hadron Collider.
The baseline solution for the strip barrel is the stave concept, in which a number of up to 13 single sided silicon strip detector modules are glued directly to each side of a composite support carbon fibre structure, which embeds the cooling pipe.
On the stave the routing of signals and power between the modules and the stave's interface, the End Of Stave (EoS) board, is provided by a Bus Tape, a long kapton flex circuit, glued to the carbon fibre skin of the stave.
Owing to the increased number of sensors in the Tracker Upgrade it will be not feasible to use the existing HV conductors to implement the individual biasing approach: lack of space for cables and traces will not permit each sensor to have its own HV bias.
For example, if existing cables are re-used, groups of 4 sensors or more will need to be connected in parallel and this would lead to the loss of the other modules on the same bias line, should one sensor fail short.
To avoid such potential losses, the approach currently being investigated consists of having all the 13 modules on one side of the stave powered by a single line. Each sensor can be disconnected from the bias line with a DCS controlled HV multiplexer switch (MUX).A number of different HV devices, based on Si and other wide bandgap materials, have been investigated for this purpose. A detailed description of the proposed HV MUX approach, along with radiation tests results, up to the maximum doses of radiation envisaged for the strip sensors,of the investigated HV devices switches and related control board, will be presented.

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