Contribution ID: **158** Type: **Poster**

Flex Based Data and Power Transmission for the ATLAS Pixel Upgrade

Tuesday, 27 September 2016 17:11 (1 minute)

The replacement of the whole ATLAS inner detector is foreseen for 2023/2024. The requirements of the data transmission rates for the upgraded pixel detector will be particularly difficult to meet as the projected transmission rates per chip are 5 GBit per second for each readout chip at the inner-most radius. Results from a first prototype (intended for the Alpine layout) of a flex based solution where data, power and bias voltages are transmitted through a common stave flex will be presented.

Summary

The replacement of the whole ATLAS inner detector is foreseen for 2023/2024. The motivation for this effort is twofold: the radiation damage received by that time will have decreased the detector efficiency sufficiently and the new requirements regarding granularity, bandwidth and radiation hardness posed by the high luminosity LHC cannot be fulfilled by the current inner detector. Particularly, the demands on the data transmission rates within the upgraded ATLAS pixel detector will be challenging.

Taking the expected trigger rates, pixel size and occupancy into consideration results in projected transmission rates of 5 GBit per second for each readout chip at the inner-most radius. Due to the harsh radiation environment the first segment of that connection has to be realized by electrical transmission instead of using directly optical fibre. Experience gained with the current inner detector encourages to place the opto converter in an easily accessible location for maintenance purposes. The exact length of the part to be achieved with an electrical transmission is dependent on the used stave layout but can amount to 7 m.

The presented study focuses on the application of a flex based solution to the Alpine layout. This layout employs so-called mountains which are extrusions set at an angle towards the flat stave on which sensors are mounted. The connection between the module flexes and their corresponding stave flex requires folding. The actual connection between the two parts is realized with micro connectors which were tested for their high voltage capability as they have to carry the sensors' bias voltages as well. A full scale stave flex prototype based on the Alpine layout and designed for FE-I4 based modules (successor frontend is not yet available) has been built and characterized.

The first iteration of the stave flex prototype was implemented in form of three separate single core flexes. In order to minimize matter very thin copper layers of 5 μm were used which results in a X0 below 0.3 %. Its maximum length of 120 cm allows to realize the connection from the modules until the end of stave. The achievable data transmission rates were verified by standard BER tests using a dedicated FPGA board. Pre-emphasis and equalization were employed in order to optimize the transmission and the fulfilment of all prerequisites could be proven. A hybride solution consisting of the stave flex and passive conversion on an end-of-stave board to a twinax cable has been studied as well.

The prototype also provides traces for the front end power and sensor bias voltage. Serial powering is foreseen and the necessary communication and supply lines for the module control chip PSPP are included as well. The power losses over the stave flex have to be minimized in order to avoid introducing heat. This was studied using an infrared camera and temperature sensors. Emulated modules with resistors were used to emulate the load of the real modules. The results were very positive as a loss of less than 10 % was measured.

Primary author: RUMMLER, Andre (Centre National de la Recherche Scientifique (FR))

Co-authors: NAPPA, Jean-Marc Charles (Centre National de la Recherche Scientifique (FR)); LAFAYE, Remi (CNRS Annecy); VILALTE, Sebastien (Centre National de la Recherche Scientifique (FR)); JEZEQUEL, Stephane (Centre National de la Recherche Scientifique (FR))

Presenter: RUMMLER, Andre (Centre National de la Recherche Scientifique (FR))

Session Classification: POSTER

Track Classification: Opto