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Performance of Specific Multi-Mode and Single Mode Passive Optical Components to Co60 Gamma Rays up to SLHC Integrated Doses

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The luminosity upgrade for the LHC (SLHC), will require new inner detectors capable of operating in the harsher SLHC environment. The expected SLHC doses are a factor of four times higher than those assumed for the LHC detectors. An optical readout system is planned for which all on-detector components must be significantly more radiation tolerant than was required for the current LHC detectors.

This paper presents first results on radiation tests of all the passive optical components that might be required inside the SLHC tracking detectors. The methodology for this testing will be described, so that meaningful comparisons can be made with data from other groups. Optical components based on 850 nm or 1310 nm were tested. A new more radiation tolerant and faster GRIN fibre than used by the current ATLAS detector was tested to the full SLHC dose. Tests were also done to study the dose rate dependence of the fibre damage. The SM fibre at 1310 nm used by the current CMS detector was also tested up to the SLHC dose. Radiation tolerance tests of fused taper and PLCC splitters and of small form factor connectors for 850 nm and 1310 nm were completed. The facility at the SCK-CEN reactor centre in Belgium was used. The exposures used Co60 gamma sources with dose rates of 15.2 kGy/hr and 1.5 kGy/hr. The results for the GRIN fibre will also be compared with results from the SMU group at even lower dose rates.

Summary

The luminosity upgrade for the LHC (SLHC), will require new inner detectors capable of operating in the harsher SLHC environment. The expected SLHC doses are a factor of four times higher than those assumed for the LHC detectors. The higher luminosity at the SLHC will require more granular tracking detectors and imply that a higher data transmission rate will be required. An optical readout system is planned for which the consequences will be that higher speed digital links will be required to read out the increased number of channels and all on-detector components must be significantly more radiation tolerant than was required for the current LHC detectors.

This paper will present first results on radiation tests of all the passive optical components that might be required inside the SLHC tracking detectors. The methodology for this testing will be described, so that meaningful comparisons can be made with data from other groups. The methodology is based on having reliable in-situ measurements during the radiation exposures. Fibre splitters are used in all the test systems to allow for any drifts in the optical power output of the lasers. Low drift amplifiers were used for the p-i-n receivers. The methodology will be verified by extensive testing before irradiation. At this stage it is not yet known if the SLHC optical readout will be based on 850 nm or 1310 nm. Therefore these tests will cover components for both 850 nm and 1310 nm transmission. A new more radiation tolerant and faster GRIN fibre (than used by the current ATLAS detector) was tested to the full SLHC dose. Tests were also done to study the dose rate dependence of the fibre damage. The SM fibre at 1310 nm used by the current CMS detector was also tested up to the SLHC dose. Radiation tests of fused taper and PLCC splitters were also tested. Small form factor connectors for 850 nm and 1310 nm were also evaluated for radiation tolerance. These tests have been performed at the SCK-CEN reactor centre in Belgium. The exposures used Co60 gamma source with dose rates of 15.2 kGy/hr and 1.5 kGy/hr. The results for the GRIN fibre will also be compared by tests done by the SMU group at even lower dose rates.

The plans for the next stages of the radiation tests for the passive optical fibre connectors will be discussed.

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