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Modulator Based High Bandwidth Optical Links for HEP Experiments

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Optical links will be an integral part of intelligent tracking systems at various scales from coupled sensors through intra-module and off detector communication. These links will be particularly useful if they utilize light modulators which are very small, low power , high bandwidth, and are very rad-hard.

Because of concern with the reliability, bandwidth, power, and mass of future optical links in LHC experiments, we are investigating the use of CW lasers external to the tracking, along with light modulators at the detector, as an alternative to VCSELs.

We have constructed a test system with 3 such links, each operating at 10 Gb/s. We present the quality of these links (jitter, rise and fall time) and eye mask margins (10GbE) for 3 different types of modulators: LiNbO3-based, InP-based, and Si-based.

We present the results of radiation hardness measurements with up to ˜10ˆ12 protons/cmˆ2 and ˜65 krad total ionizing dose (TID), confirming no single event effects (SEE) at 10Gb/s with all 3 types of modulators.

In addition we present results on free space data links, utilizing
steering by MEMS mirrors and optical feedback paths for the control loop. Laser, modulator, and lens systems used are described, as well as two different electronic systems for a free space steering feedback loop. Results at 10 Gb/s are shown.

Some future developments of optical modulator-based high bandwidth
optical readout systems, and applications based on both fiber and
free space data links, such as local triggering and data readout
and trigger-clock distribution, are also discussed.

Summary

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