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Radiation-Hard/High-Speed Parallel Optical Links

We have designed an ASIC with four radiation-hard drivers to operate a VCSEL array at 10 Gb/s for possible applications in the pixel detector of ATLAS at HL-LHC. The ASIC has been fabricated in a 65 nm CMOS process. We have also designed an optical module that couples the ASIC to a VCSEL array. The optical module had been exposed to an intense beam of protons to study the radiation hardness of the high-speed optical links. The irradiated devices will be extensively characterized after the radiation cool down. We will present the results from the study.

Summary

The LHC at CERN is now the highest energy and luminosity collider in the world. The collider and detectors have recently completed an upgrade to operate at higher energy and luminosity. In addition, there are plans to further upgrade the collider and detectors to operate at even higher energy and luminosity. This requires the optical links to transmit data at much higher speed to handle the much increased luminosity. We will present results from an R&D program for a possible application in the optical link upgrade for the pixel detector of the ATLAS experiment.

We have designed an ASIC that contains an array of four high-speed/radiation-hard drivers to operate a VCSEL (Vertical Cavity Surface Emitting Lasers) array. The bandwidth of each driver is 10 Gb/s. The ASIC has been fabricated using a 65 nm CMOS process. We have designed an optical module, opto-board, to characterize the ASIC. The opto-board is a high-speed version of the optical modules that have been successfully deployed in two generations of optical links for the pixel detectors of the ATLAS experiment. We have characterized the performance of the ASIC at 10 Gb/s. Although the ASIC is operational at 10 Gb/s, some improvements would be needed. However, the performance of the ASIC is quite satisfactory at 5 Gb/s, the target bandwidth for the pixel detector of the ATLAS experiment at the high-luminosity LHC.

We have irradiated some ASICs on opto-boards with and without VCSEL arrays using 24 GeV/c protons. The total ionized dosages are 10 and 74 Mrad, respectively. This irradiation scheme will allow us to study the degradation of the ASIC and VCSEL separately for high-speed operation. We will present the performance of the ASICs before and after irradiation.

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