Contribution ID: **133** Type: **Poster**

Single-Event Upset testing of the Versatile Transceiver

Thursday, 29 September 2011 16:00 (2h 30m)

The Versatile Transceiver will be deployed on detectors that will be operated at the upgraded HL-LHC where the instantaneous luminosity will be increased by a factor of 5-10 with respect to the nominal LHC. All components housed at the front-ends must thus be immune to single-event upsets to a level compatible with the correct operation of the detector systems. We will carry out an irradiation test to validate correct operation and the results will be reported in this paper.

Summary 500 words

The Versatile Link project aims to propose a 5 Gb/s bi-directional optical data transmission link that bridges the 50-150 m from the front-ends of upgraded detectors at the HL-LHC with the back-ends located in the shielded counting rooms. The front-end component of the Versatile Link is the Versatile Transceiver (VTRx) that will be integrated in the upgraded detectors. The VTRx is versatile in the sense that it will support operation at 850 nm over multi-mode optical fibres as well as operation at 1310 nm over single-mode fibre. Being a transceiver, the VTRx houses one optical transmitter (TOSA) and its driver ASIC, and one optical receiver (ROSA) that is composed of a p-i-n photodiode and a trans-impedance and limiting amplifier.

The radiation environment of the tracking detectors at HL-LHC will be even more challenging than that of LHC due to the 5-10 fold increase in luminosity of the machine. At the innermost radii at which the VTRx is likely to be located (20 cm radially from the beam axis), the lifetime dose/fluence is expected to be 500 kGy and 1-2x1015 particles/cm2. For electronics located in the radiation zone the instantaneous particle flux is also important, as this is the rate at which single-event effects can be generated. For the innermost radii this rate will be 2-3x107 particles/cm2/s. Total dose/fluence testing has revealed a number of candidate opto-electronic components as well as verifying the correct operation of the custom-designed radiation-tolerant ASICs after irradiation.

Transient radiation effects at the expected particle fluxes may well also be important contributors to the ability (or not) of the VTRx to send and receive data correctly. Past radiation testing has shown that the photodiodes used to receive the digital data in the VTRx produce single-event upsets (SEUs). These tests were carried out with the photodiode signal being amplified by the custom-designed radiation-tolerant receiver ASIC (the GBTIA). The GBTIA was in fact also exposed to the beam during these tests and was not measured to contribute significantly to the SEU rate. The observed SEUs are fully correctable by the Forward Error Correction (FEC) protocol used by the GBT deserializer that will receive the data from the VTRx at the detector front-ends. Laser diodes such as the ones that will be used on the VTRx, being devices that are operated at relatively high forward currents, are generally assumed to be immune to transient radiation effects. The custom-designed ASIC, however, has not yet been evaluated for SEU.

We have designed a test to confirm the earlier SEU results obtained with the receiver on the full VTRx and also to measure the SEU rate in the transmit path. The VTRx will be exposed to a proton beam with a flux of ˜5x107 p/cm2/s that is slightly higher than the expected flux at the HL-LHC. The test is to take place in a 60 MeV proton beam at PSI, Villigen, Switzerland in July/August 2011. The beam spot is sufficiently large to allow the exposure of a complete VTRx module to enable us to test the response of the transmit and receive sections simultaneously. We will measure the SEU rate in terms of changes in the BER of both the transmitter and receiver that will be connected to a shielded reference receiver and transmitter respectively. In addition we will monitor the transmit optical eye diagram for evidence of transients. Detailed results of this test will be shown that will confirm that the VTRx as a whole is in fact sufficiently SEU immune for use in the front-ends of the upgraded HL-LHC detectors.

Primary authors: Dr TROSKA, Jan (CERN PH/ESE); Mrs STOREY, Sarah (CERN)

Co-authors: Mr SIGAUD, Christophe (CERN); Mr SOOS, Csaba (CERN); Dr VASEY, Francois (CERN); Mr

STEJSKAL, Pavel (CERN); Mr DETRAZ, Stephane (CERN)

Presenter: Dr TROSKA, Jan (CERN PH/ESE)

Session Classification: Posters

Track Classification: Opto