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Proton Irradiation Hardness Investigations of 60 GHz Transceiver Chips for High Energy Physics Experimentations

The replacement of wired readout systems with the broadband wireless links will significantly reduce the number of cables and their connectors at the LHC. These cables notably contribute in the active detector volume and cause multiple scattering. The availability of 60 GHz license free band (57-66 GHz) provides the opportunity to achieve 10's of Gbps wireless data rate for a single link. This paper presents the experimental results of 17 MeV proton irradiation on 60 GHz wireless transceiver (TRX) chips. These are low power, half duplex chips implemented in 65 nm CMOS technology and support the short range point-to-point data rate up to 6 Gbps by employing OOK modulation scheme. To investigate the irradiation hardness for high energy physics applications, two TRX chips were irradiated in turn with total ionizing dose (TID) of 74 kGy and 42 kGy and fluence of 1.38×10^{14} N_{eq}/cm^2 and 0.78×10^{14} N_{eq}/cm^2 for RX and TX modes, respectively. The chips were characterized by the pre and post-irradiation analog voltage measurements for different circuit blocks as well as through the analysis of wireless transmission parameters like BER, eye diagram, jitter etc. Post irradiation measurements have shown 1 dB reduction in the TX output power, while 4.5 dB fall in RX gain but both TRX chips are found functional through over the air measurements at 5 Gbps. Moreover, no shift in the operational frequency has been observed during the experimentation.

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