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Optical links for high energy physics experiments in the next decade

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Optical data links have become ubiquitous in modern High Energy Physics experiments. Since their first large scale use in LHC detectors, they have proven to be extremely robust, reliable and resistant to radiation and magnetic fields. Based on this positive experience, optical links operating at higher and higher data rates have been qualified for use in a broad range of detectors worldwide. For instance, current developments for HL-LHC target data rates of 10 Gb/s, radiation resistance levels as high as 1 MGy and 10^15 n/cm2, and a tolerance to magnetic fields up to 4 T.

Unfortunately, radiation tests of multiple types of active optoelectronic components (semiconductor lasers and photodiodes) clearly indicate that they will reach the limits of their radiation resistance at HL-LHC. A novel optical link technology must thus be developed to address the requirements of future detectors aiming at extreme radiation hardness.

This presentation will review the performance of the common optical link system being developed for HL-LHC experiments and will highlight its limitations. It will then explore the available options to achieve higher data rates and better radiation resistance in the future. Finally, it will expand on silicon photonics as one of the candidate technologies to reach extreme radiation resistance and high integration density, at the expense however of a much more complex optical system.

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