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# PHOS4BRAIN: Design and operation of Silicon Photonics optical links, as enabling technology for quantum communications

Silicon-photonic design capability is useful in implementing quantum communication apparatus, where light-based data transfer is envisioned, or for quantum key distribution in quantum cryptography.

To this aim, PHOS4BRAIN is a project funded by INFN CSN5 to design and operate high-speed radiation hard links using Photonic Integrated Circuits (PIC): custom-designed Mach-Zehnder Modulators (MZM) have been shown able to withstand NIEL up to  $1E16$  n/cm<sup>2</sup> and doses of  $\sim 1$  Grad. Key to the exploitation of this technology is the ability to drive the MZM with suitable electronic circuits. A driver chip has been fabricated in 2019, in TSMC 65 nm and successfully operated, with single ended amplitude of 1.2 V and bandwidth of 3.5 GHz. After 800 Mrad the output voltage dropped by 25%. Used to drive a MZM and Ring Resonators (RR) shows a 3 dB bandwidth of about 2 GHz.

We are now co-designing a PIC with MZM and RR in ISIPP50g technology and a new driver in TSMC 28 nm targeting 12 GHz, due in 2020.

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