We can make electronics for optical communications viable in the space environment

A 74 Gbps SiGe BiCMOS Electro-Absorption Modulator Driver for Space Applications

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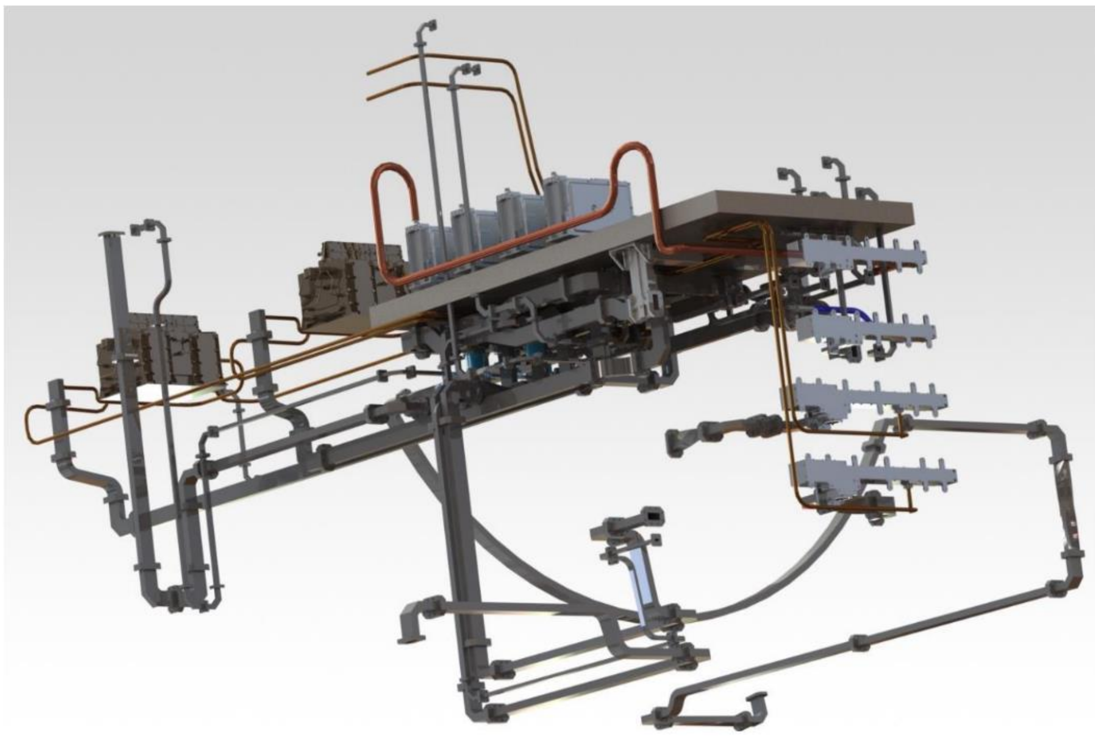
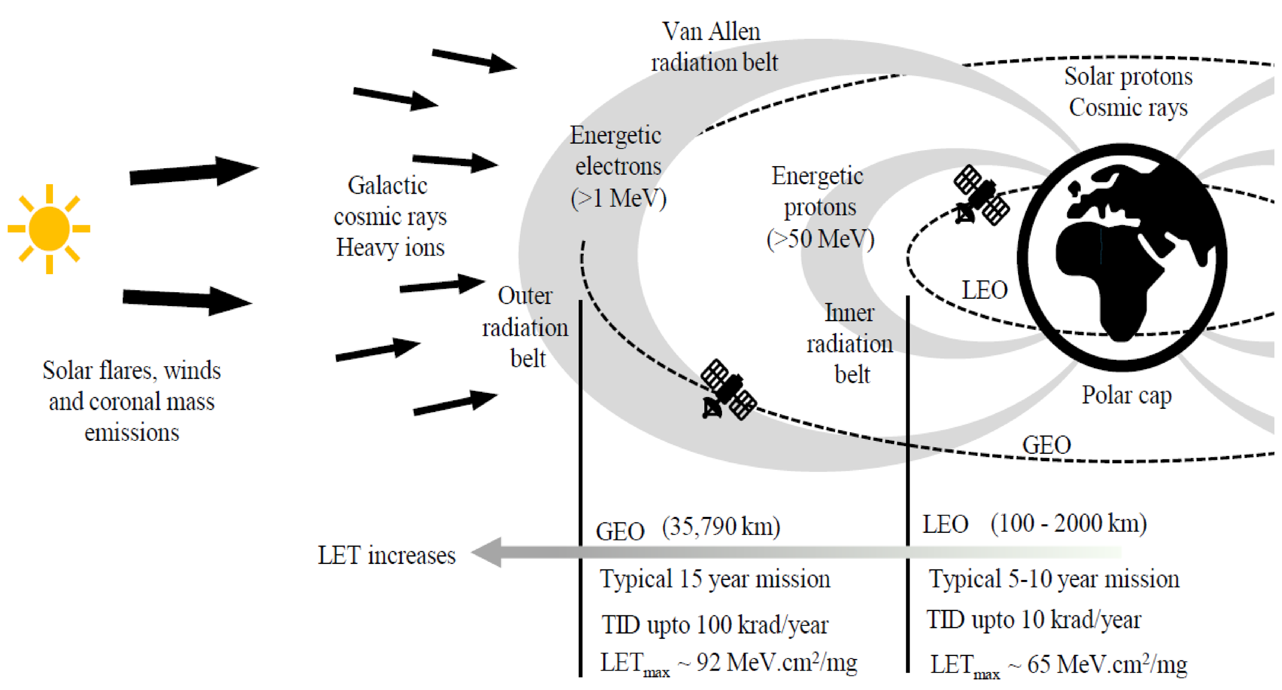
Intro

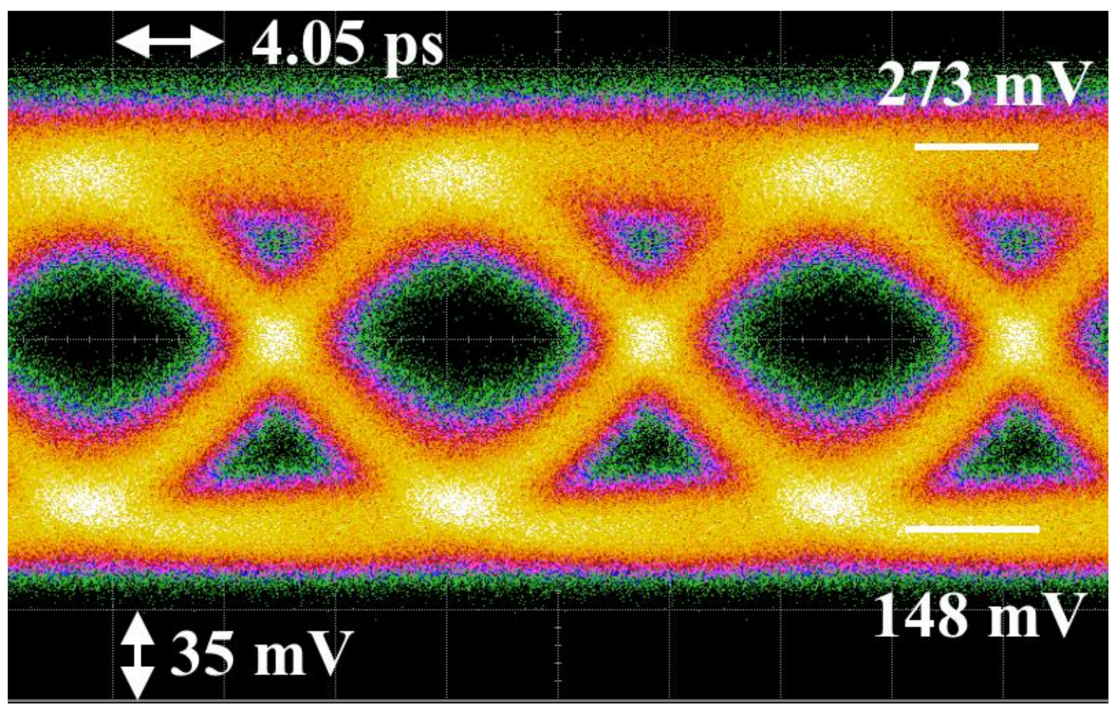
If we could reuse the decades of research that has gone into optical communications in the datacom and telecom fields, we could eliminate heavy metal waveguides in satellites. However, putting the electronics in orbit poses major hazards to those devices. Can we redesign them to be suitable in outer space? The answer turns out to be yes!



Depiction of the heavy waveguides used in a satellite (Courtesy of Antwerp Space)

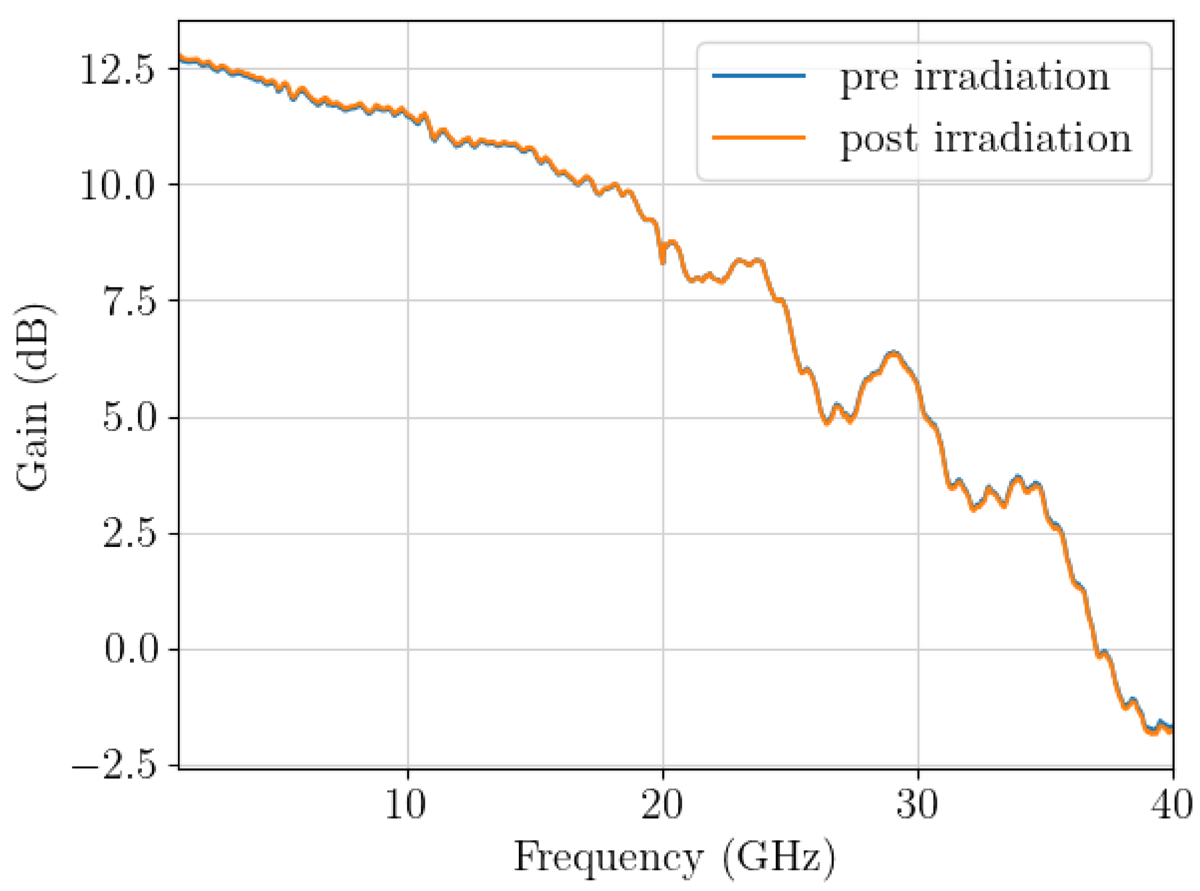


The radiation environment around the Earth that causes problems in our electronics.



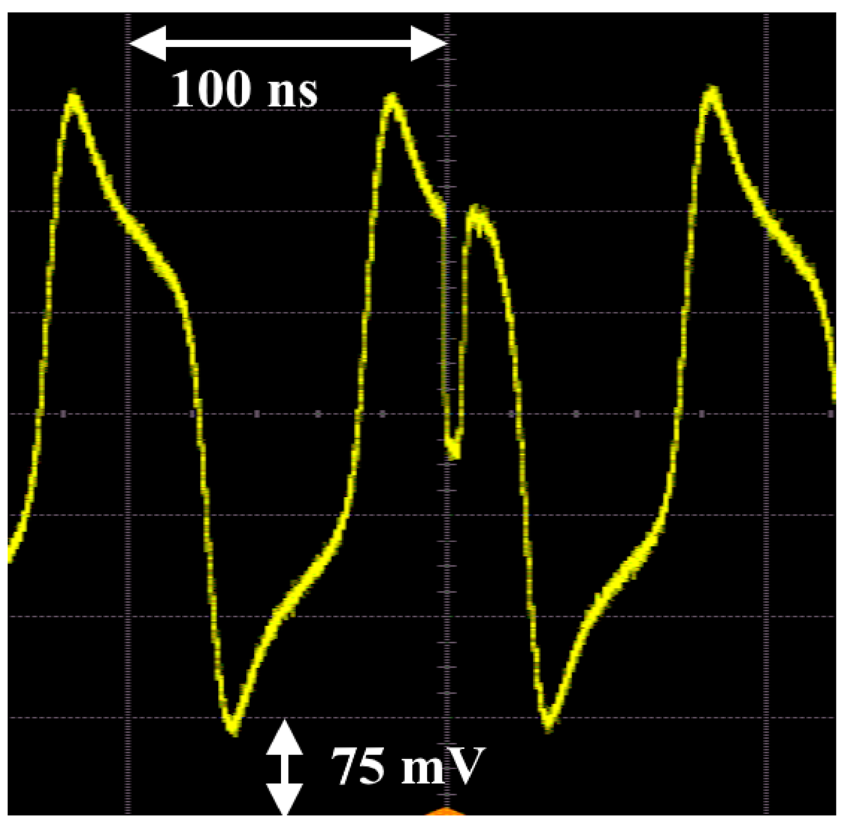
Measured electro-optical eye diagram. The driver provides a 1.5V signal to the EAMs, which reach an Extinction Ratio (ER) of 2.8 dB.

Radiation

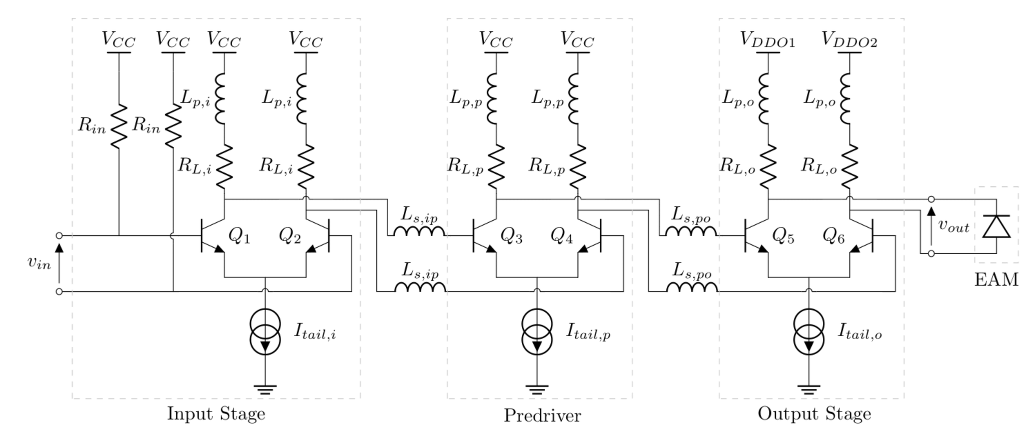


Measured frequency response of the driver including PCB traces and TR-70 connector before and after 1.2 Mrad(Si) irradiation.

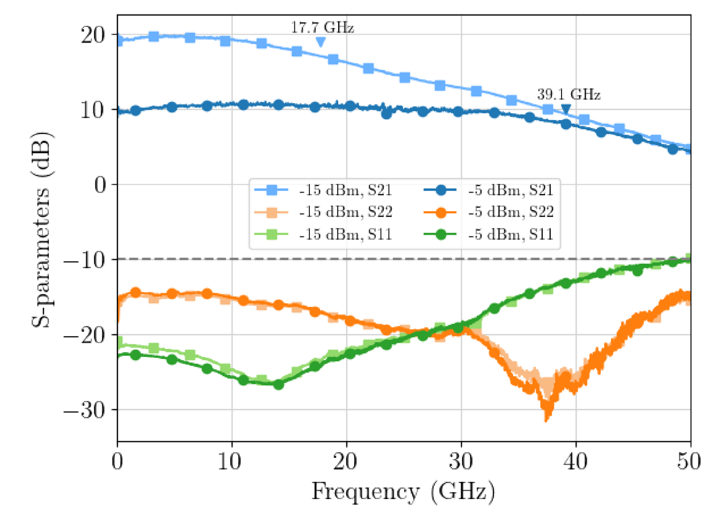
Heavy Ion Impact



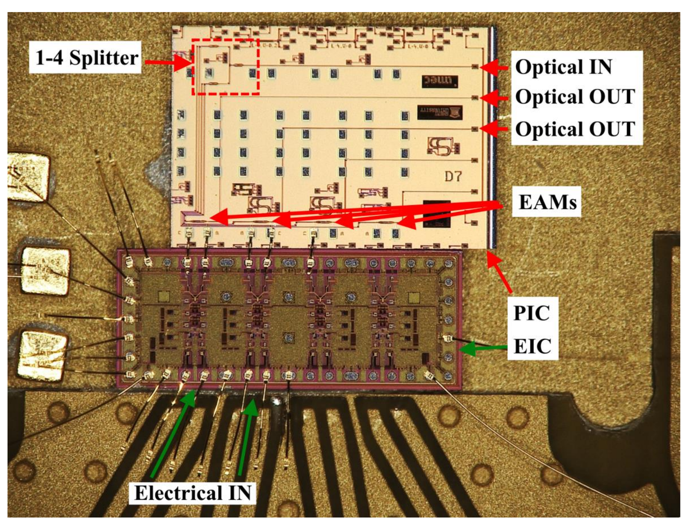
Closeup of Single Event Transient (SET) with a 10 MHz input signal. Converting to a 74 Gbps signal, this SET will cause a 280-bit burst error.



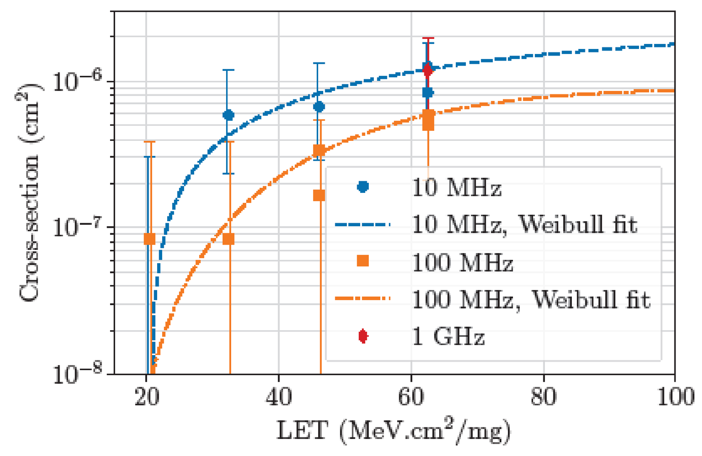
Simplified schematic of a single channel of the proposed driver.



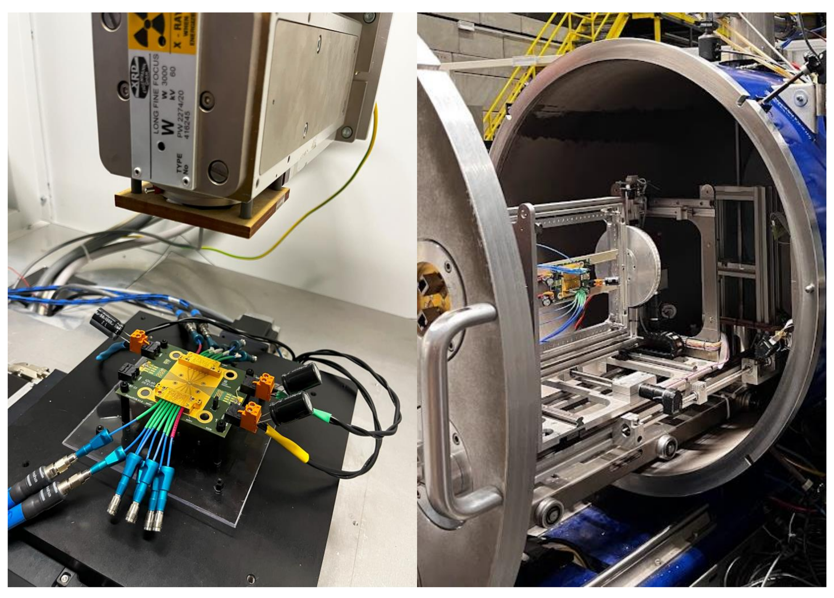
Pre-irradiation S-parameters of the EIC. Measured by RF probes to calibrate out PCB and cable losses.



Closeup of the EIC wirebonded to the PIC containing one EAM per channel. Dimensions EIC: 2720µm x 1070µm. Dimensions PIC: 2500µm x 1800µm



SET cross-section after a fluence of 1.2 x 10^7 particles/cm² has been reached. The error bars are defined by the 95%-confidence interval.



Measurement setups for the radiation test (left) and Heavy Ion test (right)

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