High Speed Links for High Energy Physics

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Brief Recent History:

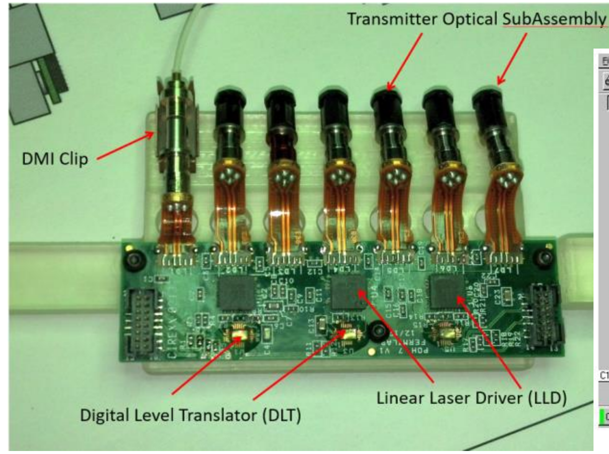
CMS Phase 1 Upgrades

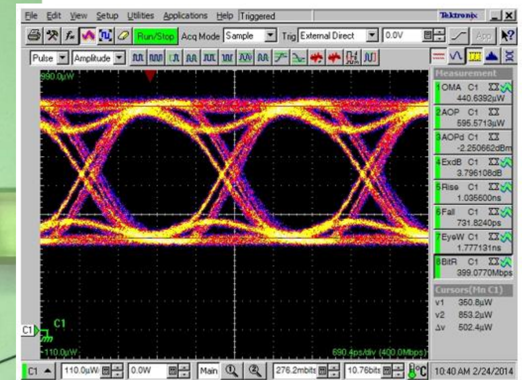
1310 nm, Single Mode Fiber

Single Channel, Discrete Design
400 Mbps

Full Production and Qualification
for CMS Forward Pixel Detector

Pixel OptoHybrid (POH)





Optical Output from Ch3 TOSA

HL-LHC Upgrades

850 nm, Multi-Mode Fiber

Optical Array, Parallel Channels

10 Gbps Uplink; 2.5 Gbps Downlink

Back End (off detector) Specification
and Pre-Production Testing

System Specification and
Demonstrator

Modeling

10.1.1. Link penalty calculation of MM_VL (Uplink @ 10.24 Gbps

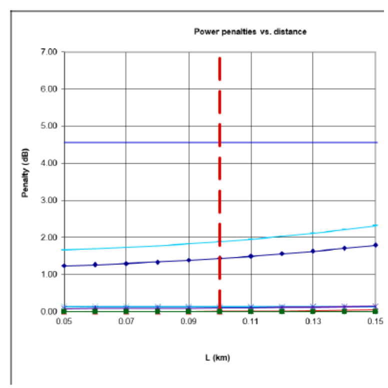
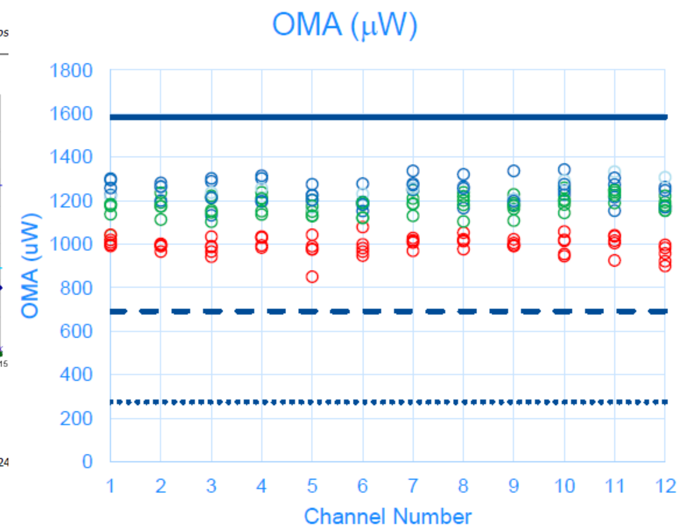
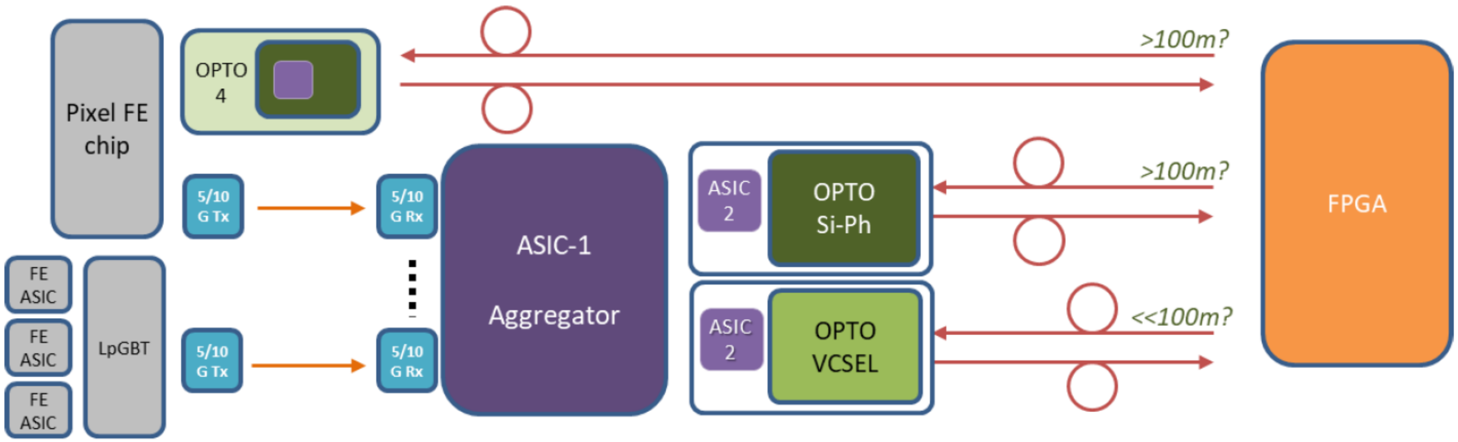


Figure 10.1
Link Power Penalties vs. Link Distance (Uplink @ 10.24

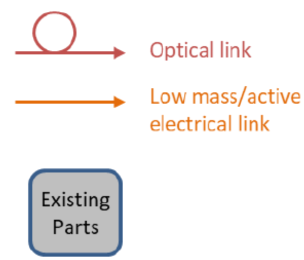
Test and Verification



Future Optical Links for HEP:



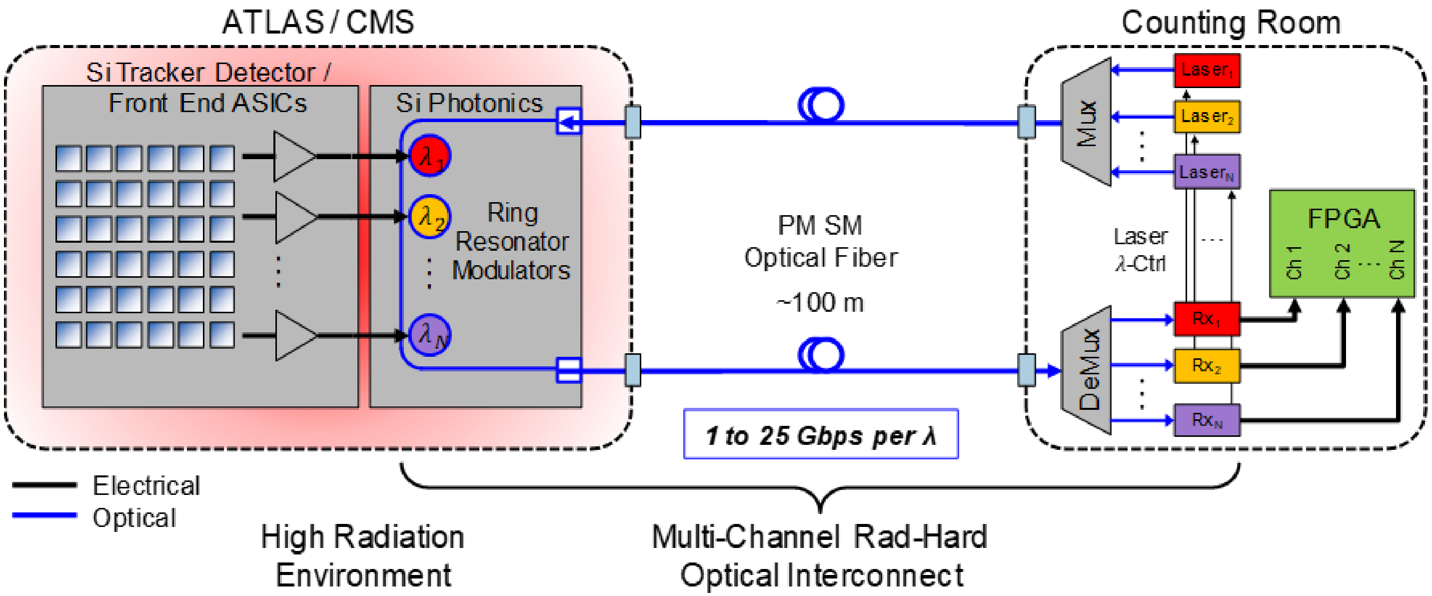
Activity	Task	Description
ASICs	ASIC-1	Very high data rate aggregator/transmitter
	ASIC-2	Optoelectronics drivers
	ASIC-3	Low-mass electrical cable transmission (active cable)
FPGA	FPGA-1	FPGA-based system testing and emulation
OPTO	OPTO-1 & 2	Silicon Photonics System & Chip Design
		Silicon Photonics Radiation Hardness
	OPTO-3	Next-generation VCSEL-based optical link
	OPTO-4	Silicon Photonics packaging



Source:

"Strategic R&D Programme on Technologies for Future Experiments", CERN, Experimental Physics Department, CERN-OPEN-2018-006

Silicon Photonics: Rad-Hard Detector Readout



Combining:

Silicon Photonics

Wavelength Division Multiplexing

Also of Interest for Superconducting Magnet Technology Test Stands

Collaborating Institutions

Freedom Photonics (PI, Steven Estrella)

Lawrence Berkeley National Laboratory

University of California Santa Barbara

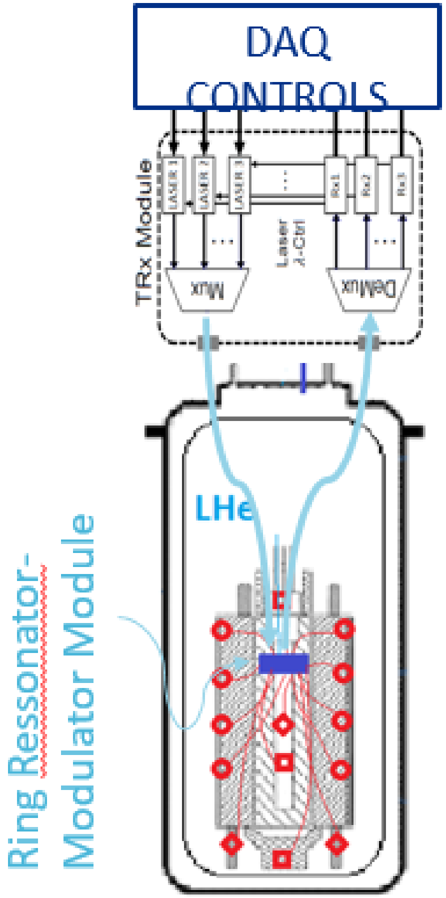
Fermilab

*Steven Estrella, Freedom Photonics, UCSB

Silicon Photonics: Cryogenic Test Stands*

Possible Improvement Utilizing Photonic Modulators

- One ring resonator-modulator module can read multiple sensors;
- Single fiber optic pair necessary for reading the whole sensor suite;
- Optic fiber provides galvanic isolation making the readout system safer;
- More than one resonator-modulator module can be used to provide redundancy;
- Minimal power dissipation inside the cryostat as the resonator-modulator module is extremely low power. Furthermore, the optical fiber doesn't work as heat sink as it is the case for the copper pairs.



*Marcos Turqueti, LBNL