

COTS #3 Photonics, Optocoupler Experiment on STRV-1D

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OBJECTIVE

The COTS3 STRV-1d radiation experiment is designed to investigate Single Event Transients (SETs) and displacement damage effects of high speed, state of the art (SOTA) and commercial off the shelf (COTS) optocouplers.

The overall experiment goal is to reduce uncertainties regarding space radiation effects on commercial optocoupler devices

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BACKGROUND

Hubble Space Telescope (HST) Second Servicing Mission

- Installed new instruments in Feb. 1996.
- Anomalies occurred during passes through the South Atlantic Anomaly (SAA).
- Traced to SET in high-speed optocoupler.
- Mission operation profile and flight software modifications
- No instrument operation in SAA.
- Sporadic SETs occur outside of SAA, Galactic Cosmic Ray (GCR) induced.

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BACKGROUND (Cont.)

STRV-1d

- Much harsher radiation environment than HST (Highly Elliptical Orbit vs LEO).
- Provides flight data beyond HST's limited set.

Why no previous optocoupler SET issues?

- Older technology devices.
- Slower devices.
- Often used with noise filter circuitry.

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DEVICES UNDER TEST AND INCLUDED ON COTS3 BOARD

Hewlett Packard HCPL	6651	10 Mbps high-speed, see also data on HCPL5631, 6N134 equivalent, 4 channel device.
Micropac	66099	“Rad tolerant - better than the 4N49” single channel device.
Micropac	66123	6N134 equivalent, 5 Mbps 2 channel device.
Micropac	66124	Equivalent to the 6N140, 2 channel device.
Micropac	66168 (4N49S)	“Proton tolerant” for displacement and SETs, equivalent to 4N49, with new LED at 660 nm, 2 channel device.
Hamamatsu	P2824	Used in some Interpoint DC-DC converters, single channel device.

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EXPERIMENT

- DUTs biased with LED off during SET portion of experiment.
- Output of each optocoupler channel fed into a discriminator circuit that bins the SET pulses into <50 ns, 50-100 ns, 100-200 ns, and >200 ns bins.
- Validation of COTS3 experiment conducted at TRIUMF.
- Active and passive filtering schemes tested.

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TESTING at TRUIMF

- Test energy: 58 MeV with additional energies obtained through use of a degrader.
- Test fluxes $\sim 5 * 10^7$ protons/cm²/sec.
- Test fluence $\sim 2 * 10^9$ protons/cm²/test run
- All devices placed at normal incidence to beam
- Validation data gathered only, flight predictions require angular data not gathered here.

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HP6651 Optocouper Proton SET for STRV-1D Validation

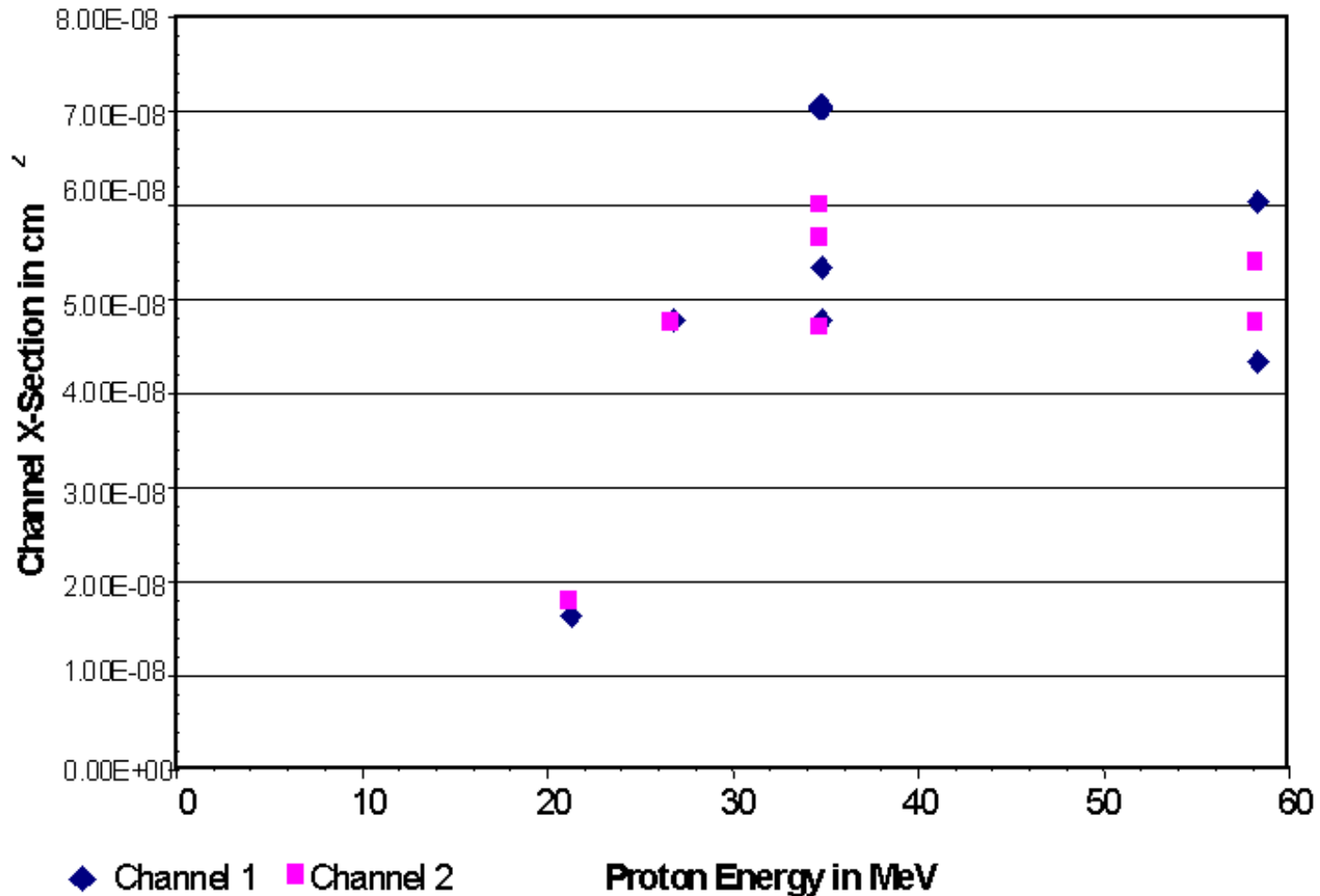


Figure 1 illustrates the measured error cross-section versus proton energy for the HP 6651. All transients measured were in the <50 and 50-100 nsec bins.

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MP66123 Optocouper Proton SET for STRV-1D Validation

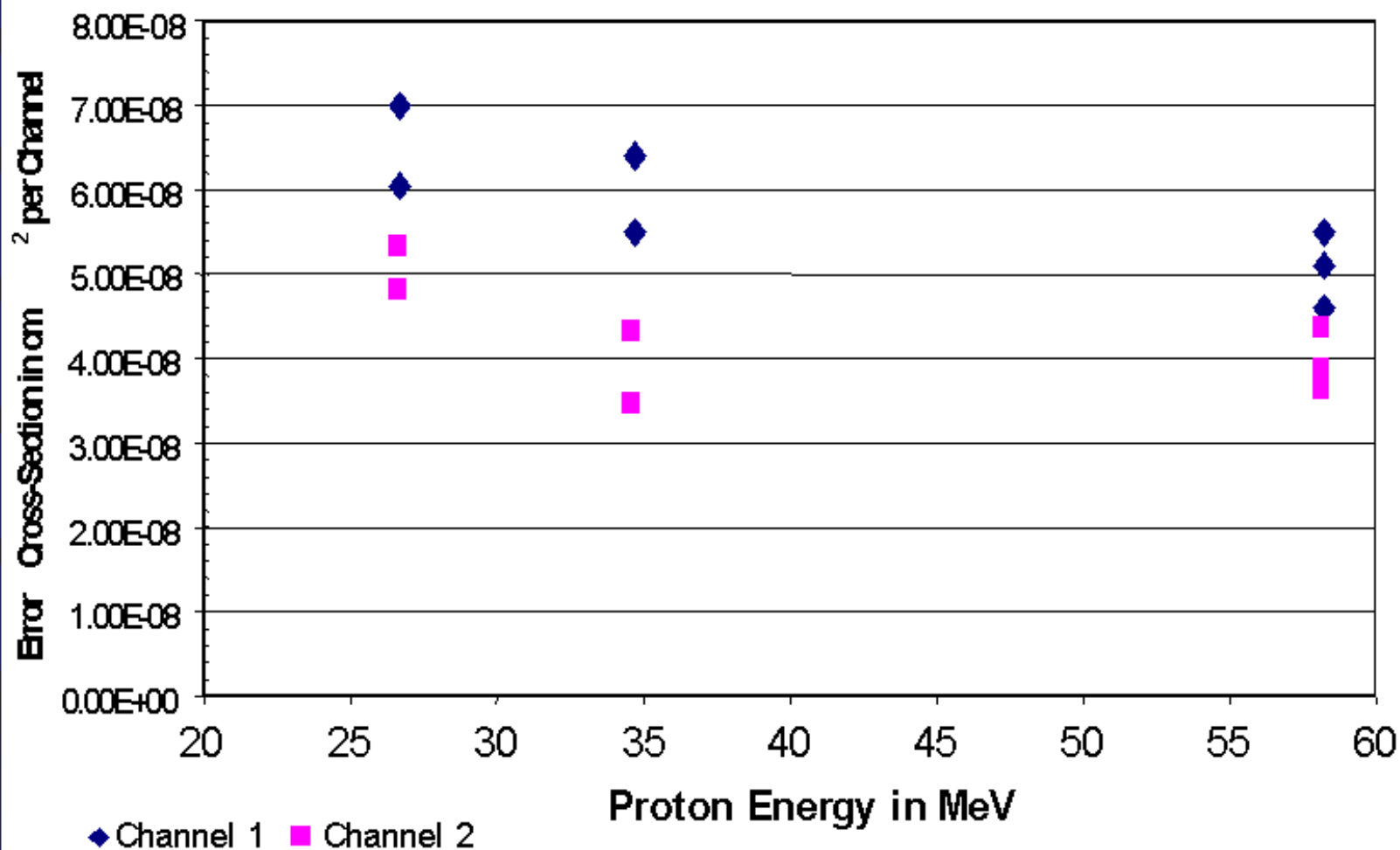


Figure 2 illustrates the error cross-section for the MP 66123 device. Again, all transients measured were in the <50 and 50-100 nsec bins.

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CONCLUSIONS

- COTS3 board built and delivered Dec. 1997 will provide in-flight data on optocouplers after launch in 1999.
- Optocouplers on COTS3 tested at TRIUMF: monitored for transients.
- SETs observed only on high-speed optocouplers Micropac 66123 and Hewlett Packard HCPL 6651.
- Transients detected on high-speed optocouplers were in <50 ns and 50 - 100 ns range bins.
- No transients detected on device that had filtering added.
- COTS3 experiment validated for gathering SETs data on STRV-1d in space.
- Data from COTS3 will be presented upon retrieval and analysis during STRV-1d flight mission.

