



Status of On-Detector Opto-Links

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Outline

- Results on prototype opto-boards
- Results on prototype opto-board irradiation
- Results on iFlame optical packages
- Status of stress test
- Summary



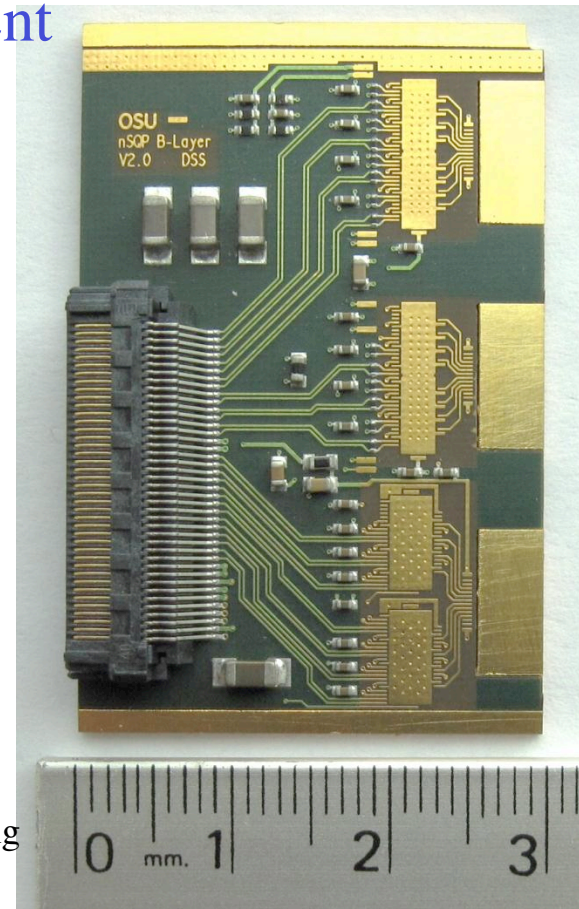
Summary of Opto-Board Flavors

- 4 opto-board flavors
 - ◆ D opto-board (disk): 7 TTC + 7 data links (2 flavors)
 - ◆ B opto-board (B-layer): 7 TTC + 14 data links
 - ◆ IBL opto-board: 8 TTC + 16 data links



nSQP B Opto-Board

- In spring, decided to produce copper backed PCB over thick film BeO for cost saving
- CERN PCB shop fabricated 25 B-layer opto-boards
- PCB design/fabrication quality excellent
 - ✓ good passive/connector soldering
 - ✓ sharp etch patterns
 - ⇒ easy wire-bond
 - ✓ no error found in schematic/layout
- Problems with copper backing plate



VCSEL



VCSEL



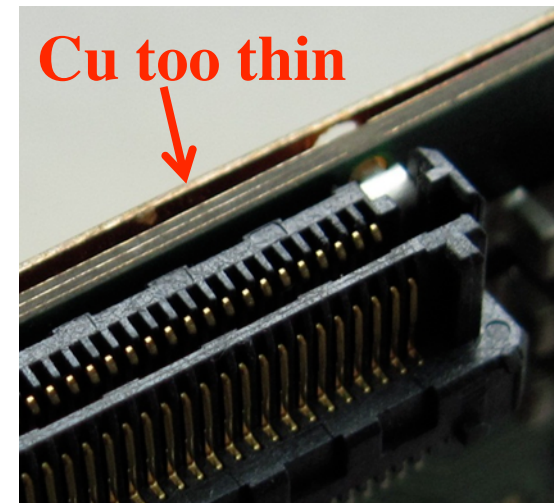
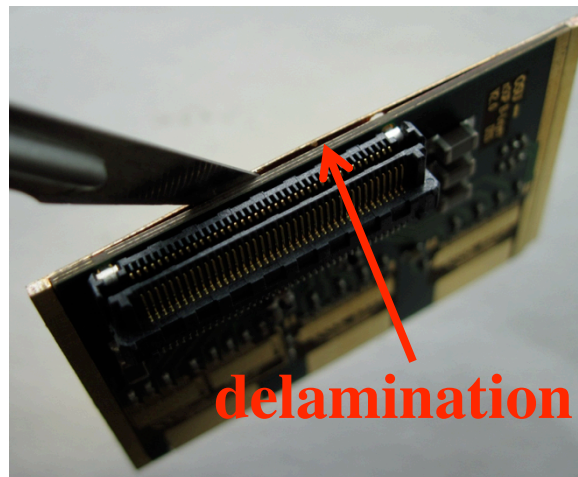
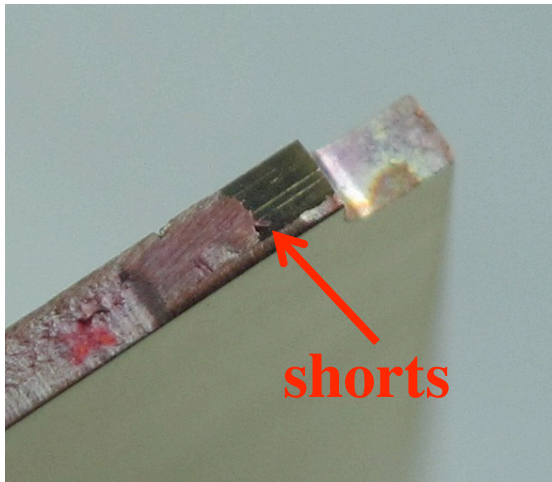
PIN





Fabrication Problems

- Shorts between VVDC, GND, and Cu plates
 - ◆ planes 125 μm from edge exposed after cut out
- Several boards were delaminated from Cu plate
- Cu plate too thin ($< 200 \mu\text{m}$) for good heat conduction





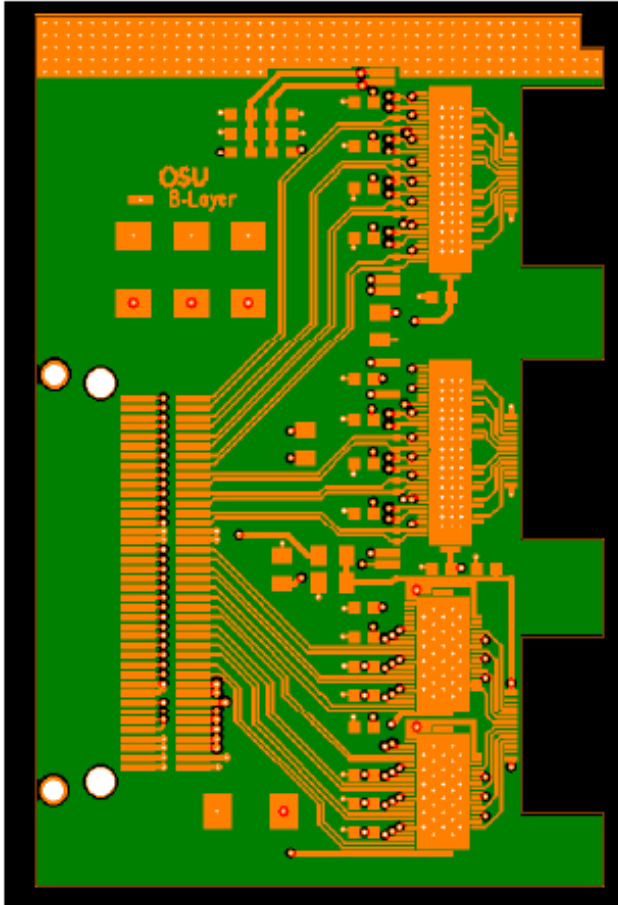
Design Changes

- Design modified to ease fabrication:
 - ◆ all artwork 250 μm from PCB edge
 - ◆ notches for opto-packs removed
 - ◆ PCB outline identical to Cu plate
- Mechanical/thermal improvements:
 - ◆ increase Cu plate thickness to 1 mm
 - ◆ add holes for extraction tool
 - ◆ exposed Cu on top layer for cooling of iFlame opto-pack (if used)
- Submitting to CERN PCB house this week for fabrication
 - ◆ also asking a US vendor to quote/fabricate PCB

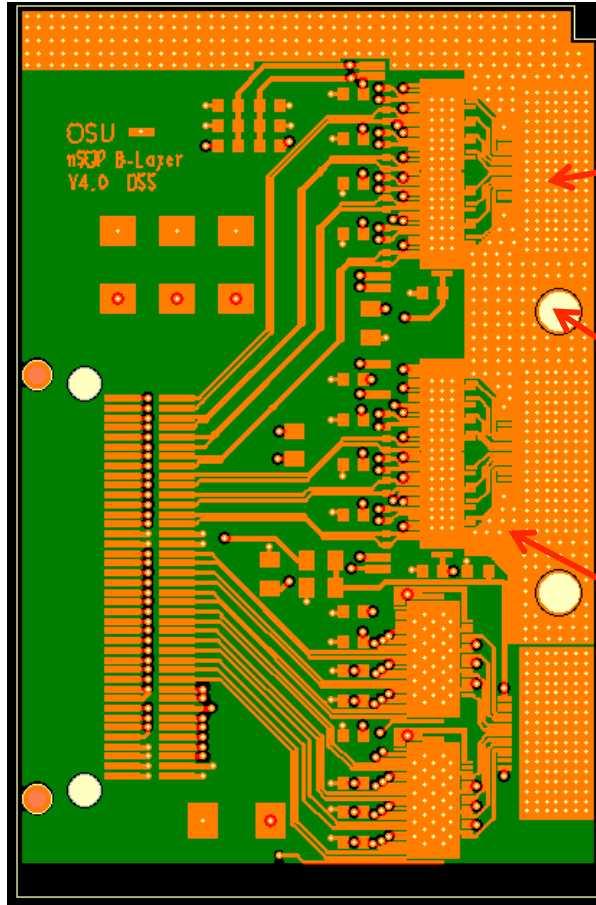


Design Changes

First Prototype



V4.0 (new)



No cutouts for opto-packs, board is exact size as Cu plate

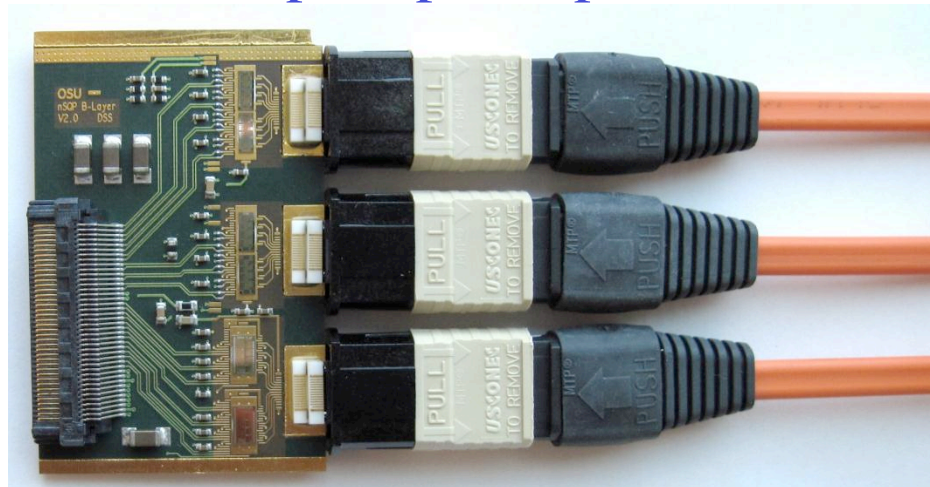
Added 2 mm extraction holes

Added exposed Cu on top layer



Prototype Opto-Board Irradiation

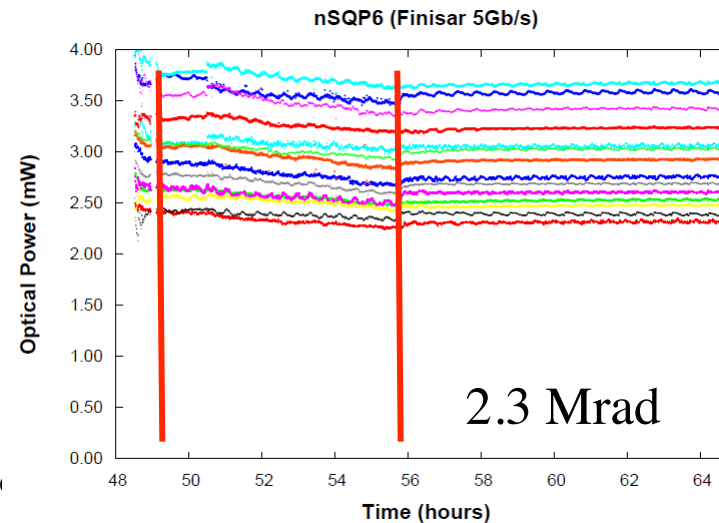
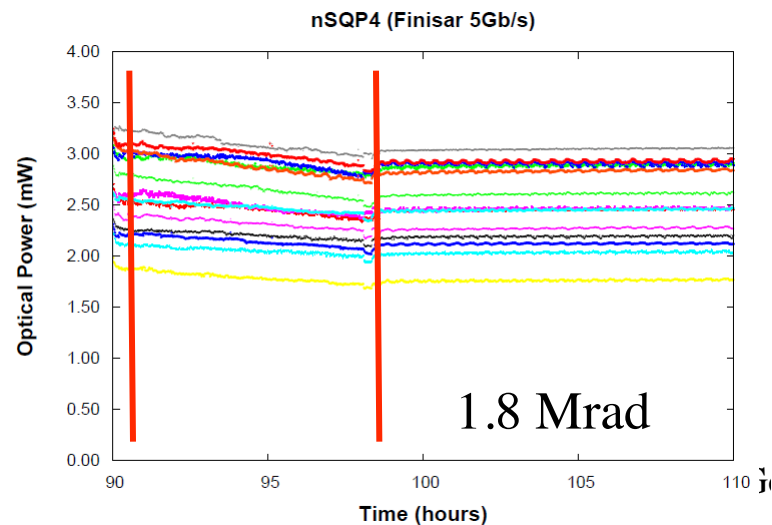
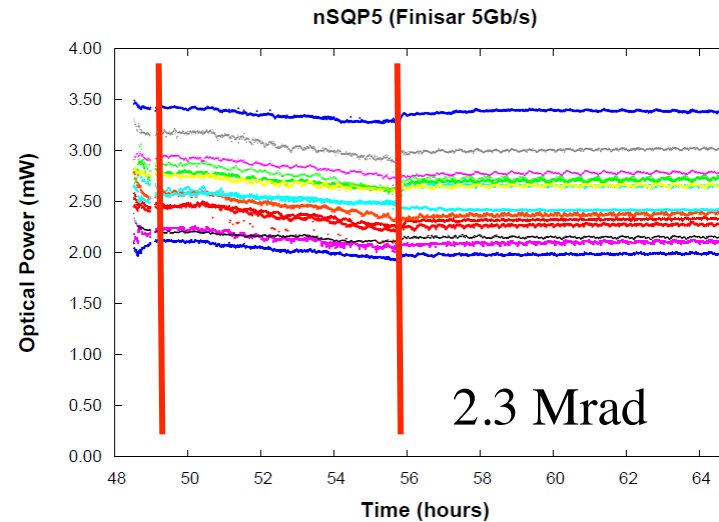
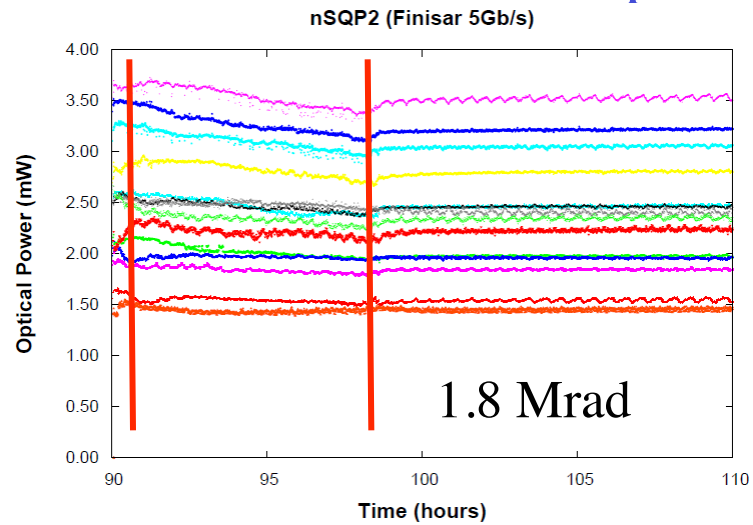
- Populated 6 prototype opto-boards:
 - ◆ used Finisar 5 Gb/s VCSELs and ULM PINs with OSU opto-packs
 - ◆ assembly was straightforward
 - ◆ wire-bonding went well
- Irradiated 4 opto-boards with 24 GeV protons at CERN:
 - ◆ 2 boards to 8×10^{13} p/cm² or 1.8 Mrad (18 kGy)
 - ◆ 2 boards to 10×10^{13} p/cm² or 2.3 Mrad (23 kGy)
 - ◆ no increase in PIN current thresholds for no bit errors
 - ◆ modest decrease in output optical power





Prototype Opto-Board Irradiation

- modest decrease in output optical power



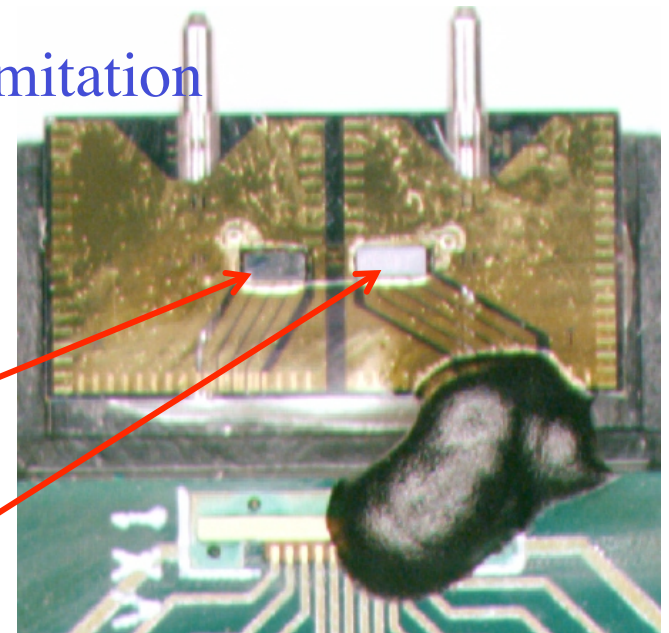


iFlame Opto-packs

- Fabricated by Xloom
- Received 11 opto-packs with 4-channel VCSEL and PIN arrays
- Semi-hermetic sealed using optical epoxy similar to OSU/Taiwan opto-packs
- Optical power is somewhat low:
 - ◆ significant reflection loss due to design limitation

PIN array

VCSEL array

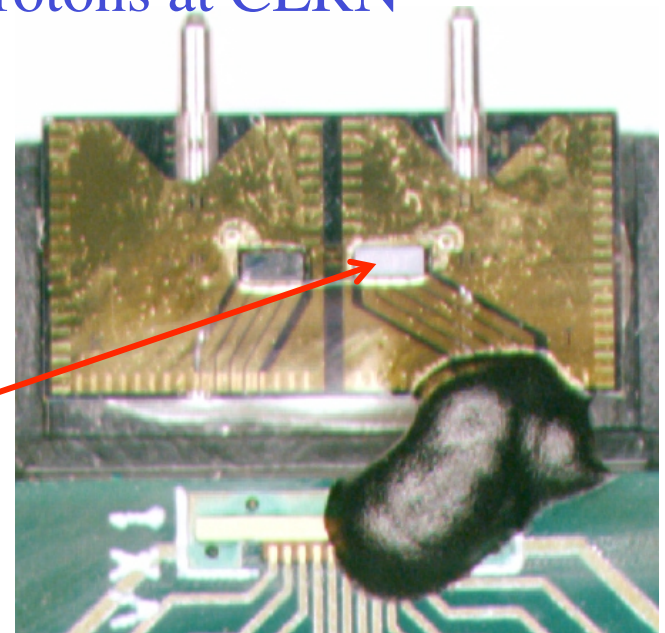




iFlame Opto-packs

- Channels on 3 opto-packs died during burn-in
- Xloom blamed the death on thermal stress
 - ◆ no heat sink attached during test
 - ◆ no heat sink required in OSU or Taiwan opto-packs
- 6 opto-packs were irradiated with 24 GeV protons at CERN
 - ◆ degradation is modest
- Learning to fabricate 12-channel opto-packs
 - ◆ encountered technical difficulties
 - ◆ expect delivery soon

Require heat sink attached
to back of VCSEL array





85/85 Test

- Started stress test with 85% relative humidity @ 85°C
 - ◆ operate all 12 VCSEL channels with 10 mA DC
 - ◆ continuously monitor optical power and current consumption
 - ◆ good devices expected to survive at least 2,000 hours



K.K. Gan



IBL General Meeting



85/85 Test

- 20 ULM VCSEL arrays:
 - ◆ no significant degradation after 500 hours
- 20 Finisar VCSEL arrays:
 - ◆ 15 arrays exhibited high common series resistance
 - ◆ problem worsen at 85°C
 - ◆ working with Finisar to find the cause
- Will test 20 iFlame opto-packs when available
- Will test 20 opto-boards once design settled



Summary

- Experience from nSQP prototype B opto-board has lead to improved design
 - ◆ new design submitted for fabrication
- Successful irradiation of 4 nSQP prototype B opto-boards
- 85/58 stress test started
- Will work on nSQP D board and IBL board once B boards validated