Status of On-Detector Opto-Links

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Outline

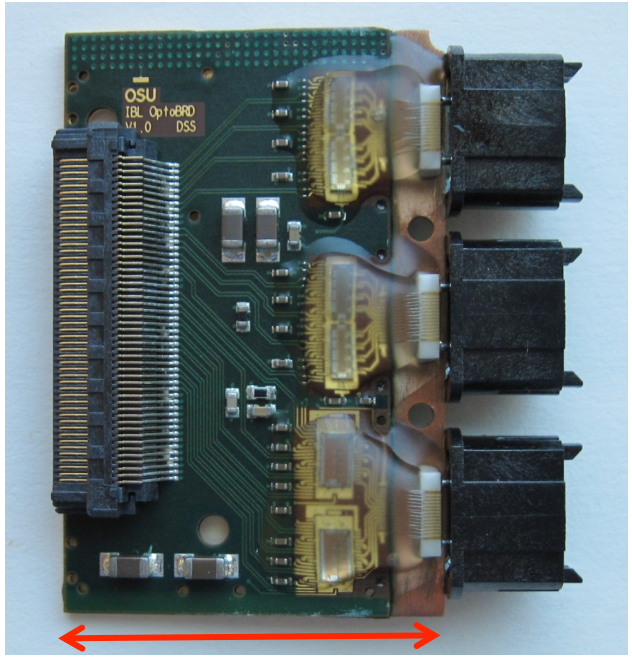
- Results on prototype opto-boards
- Status of accelerated lifetime test
- Plan/summary

Opto-Board Flavors

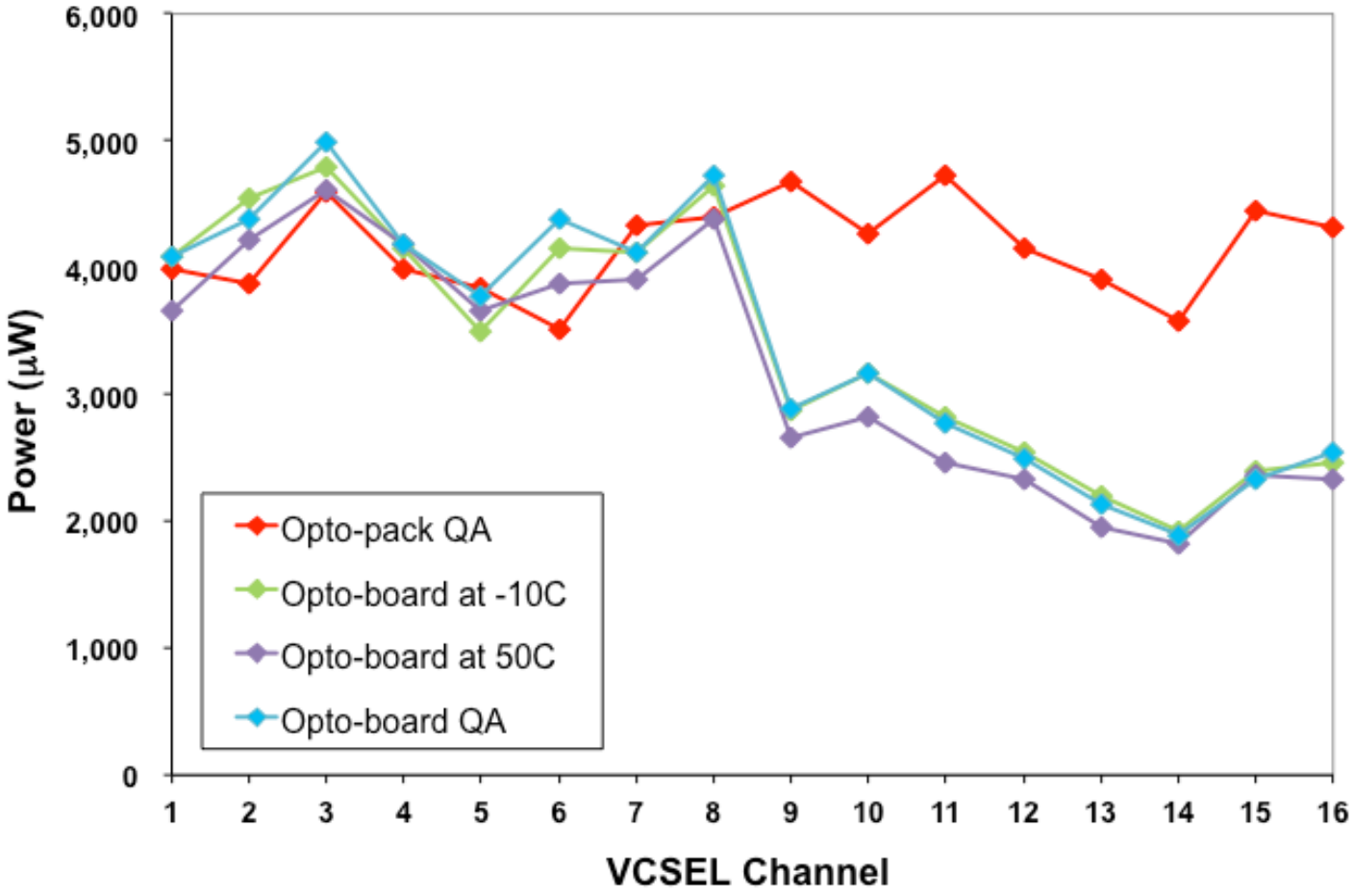
- 3 opto-board flavors
  - nSQP D opto-board (disk): 7 TTC + 14 data links
  - nSQP B opto-board (B-layer): 7 TTC + 14 data links
  - IBL opto-board: 8 TTC + 16 data links
- very similar design for IBL and nSQP opto-boards
  - ⇨ IBL opto-board R&D benefits greatly from that for nSQP

Status of IBL Opto-Board Prototyping

- One IBL opto-board fabricated
  - pass go/no go
  - pass QA after burn-in and thermal cycle
- Building 9 more for system test distribution



IBL Opto-Board Optical Power

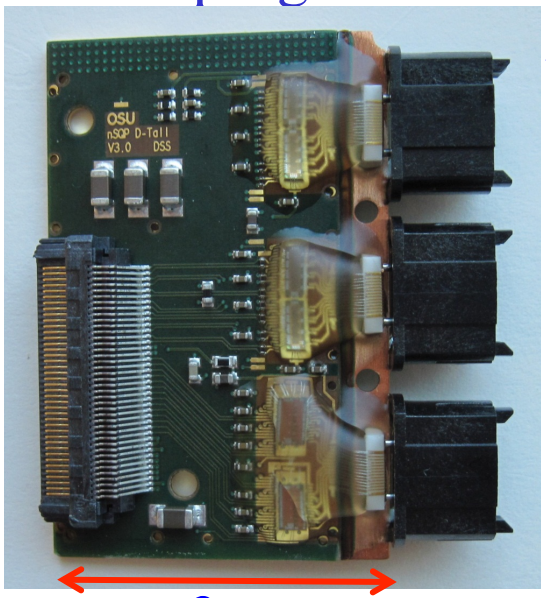


Need optical connector mounting jig

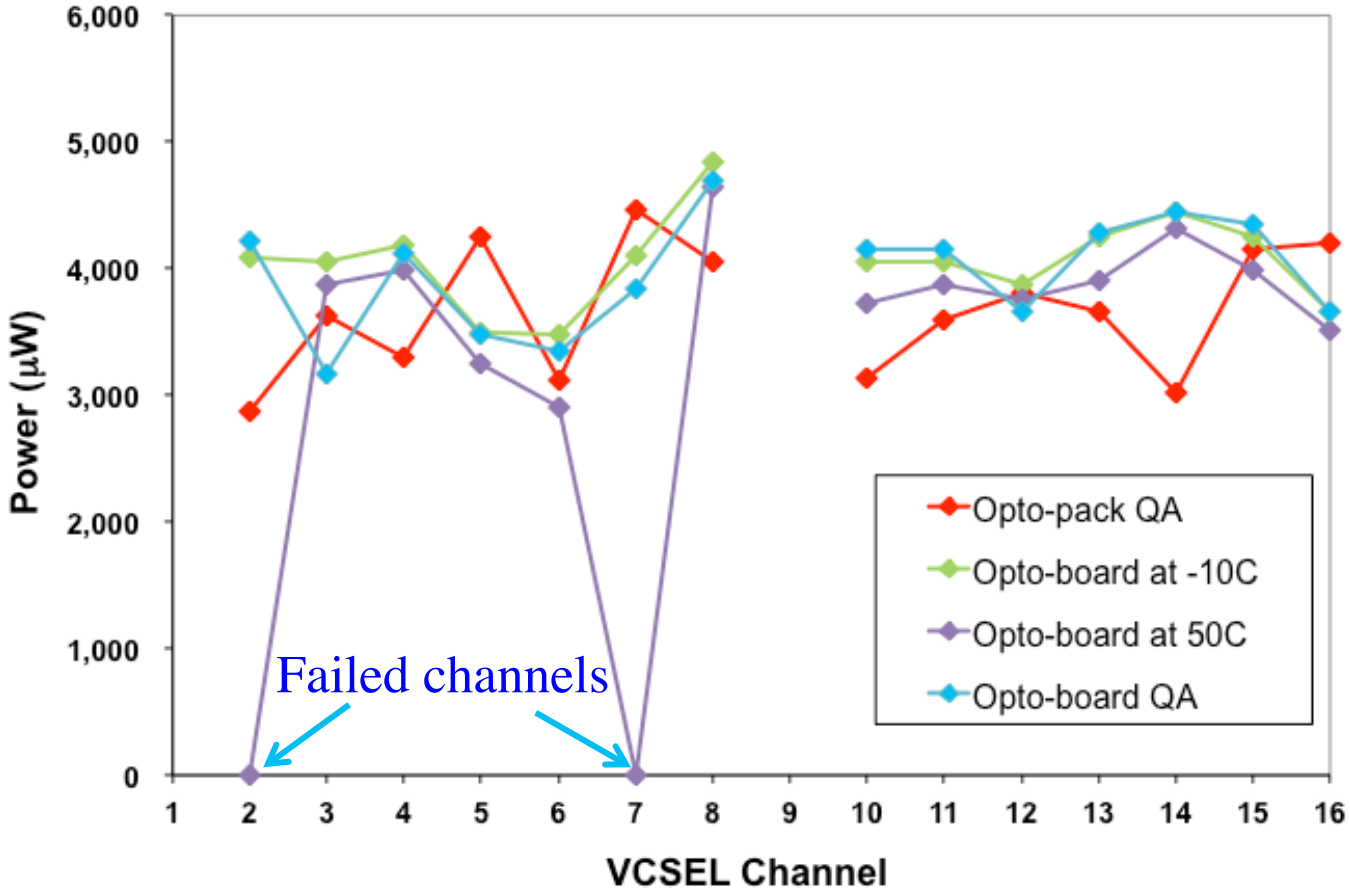
- Excellent optical power!!!

Status of nSQP Opto-Board Prototyping

- four nSQP B opto-boards distributed: CERN, SLAC, Wuppertal, Bern
- One nSQP D opto-board fabricated
  - pass go/no go
  - wirebond failures after thermal cycling on DTO2 VDC to opto-pack
    - ⇨ optimization of wire bond parameters in progress



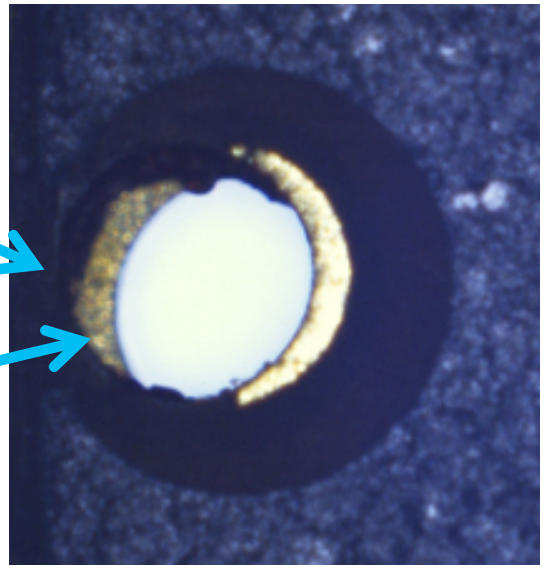
D Opto-Board Optical Power



- Excellent optical power but two channels failed

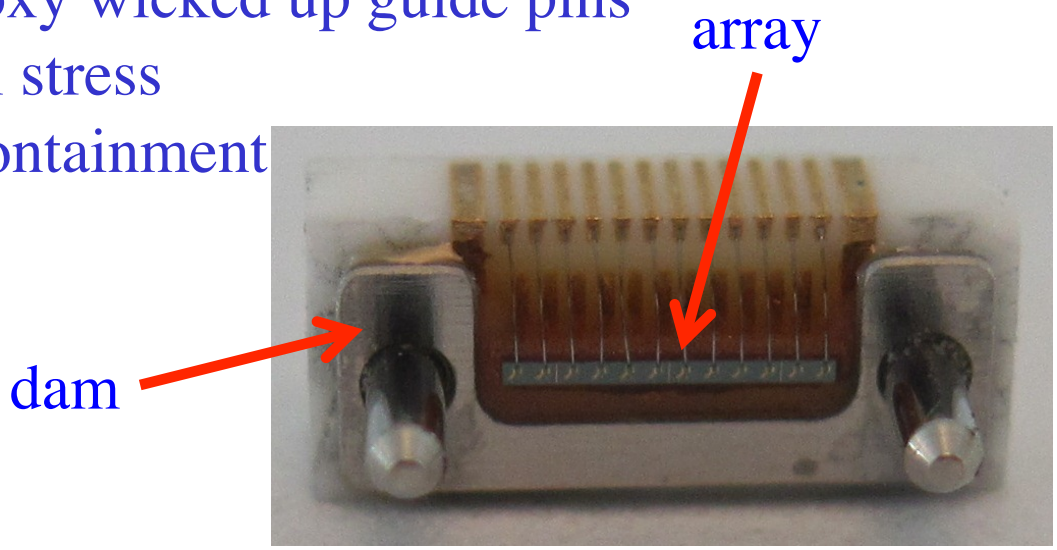
D Opto-Board Fabrication Problems

- VVDC/GND shorts on 6 of the 25 boards
  - shorts removable by high current/mechanical scraping
  - caused by problems with large hole drilling
- Problems at passive assembly house caused by misalignment between the copper plate holes and PCB holes
  - the connector would not sit flat
    - ⇨ should drill bigger holes on copper plate



Accelerated Lifetime Test

- VCSEL array mounted on opto-pack should survive at least 1,000 hours at 85 C and 85% humidity
  - to qualify two vendors: ULM and Finisar
- IBL GM, June 2012:
  - 20 ULM arrays survived to 1,000 hours
  - analysis of failed arrays after 1,000 hours
    - scrapping of optical epoxy wicked up guide pins might cause mechanical stress
      - ⇨ use dam for epoxy containment

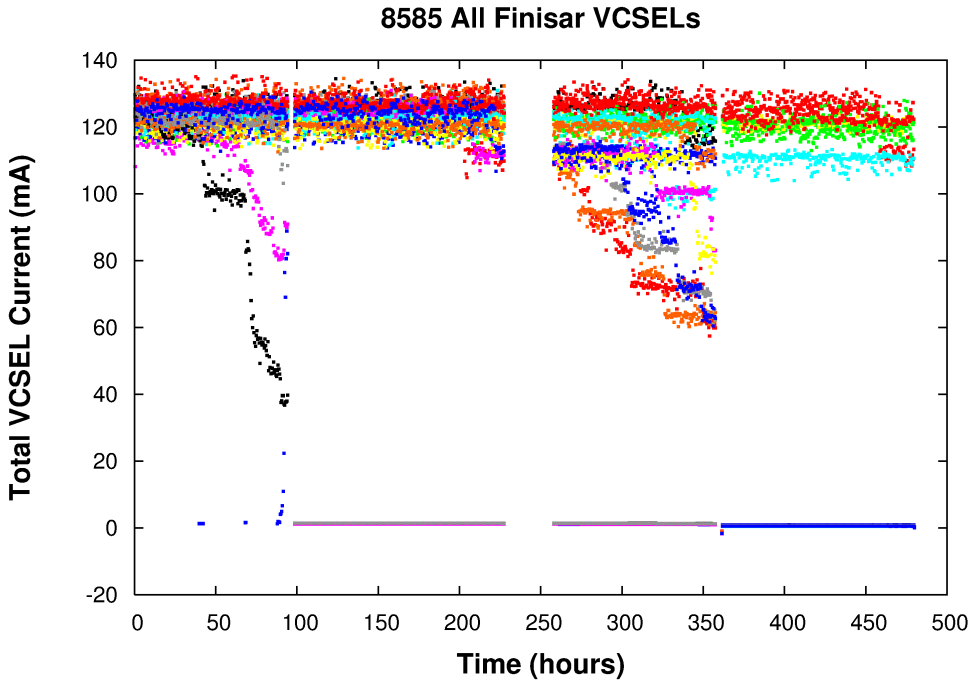


Finisar Accelerated Lifetime Test Fiasco

- Sept 2011:
  - loaded 20 VCSEL arrays
  - 16 exhibit high common serial resistance after a few hours
  - manufacture data on wafer shows a possible related problem
  - vendor replaced the arrays at no cost
- Feb 2012:
  - loaded 20 VCSEL arrays
  - expired wirebond encapsulant turns black and eats bonds
    - ⇨ all samples fail
- July 2012:
  - loaded 5 VCSEL arrays with dams for optical epoxy containment
  - environmental chamber breaks due to failed fan
    - ⇨ rain inside oven
    - ⇨ all samples ruined

More Accelerated Lifetime Test

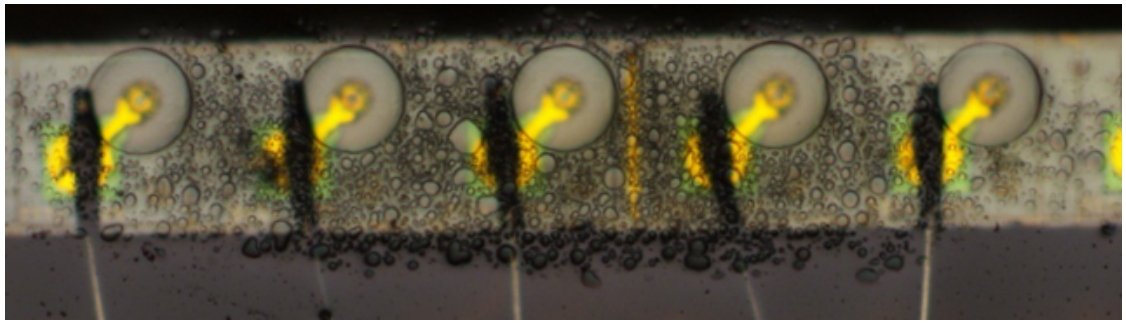
- Sept 2012:
  - loaded 20 VCSEL arrays
  - fibers inserted during test to exert connector spring force
  - after 50 hours: channels on 4 arrays failed
  - after 250 hours: channels on 10 additional arrays failed



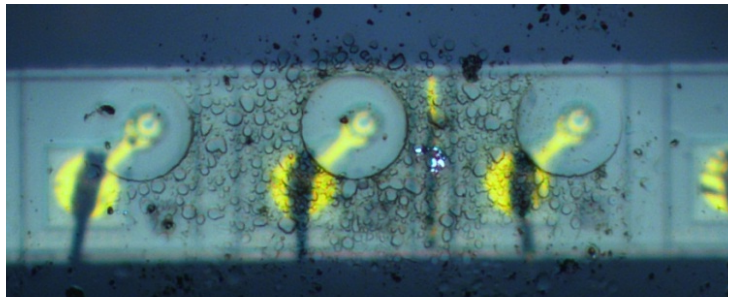
Postmortem

- Microscopic analysis shows 6 of the failed arrays have indentations in the optical epoxy
  - similar to those on several recently failed TX VCSELs
  - unfortunately no such indentations on other 8 failed arrays

Failed OSU opto-pack

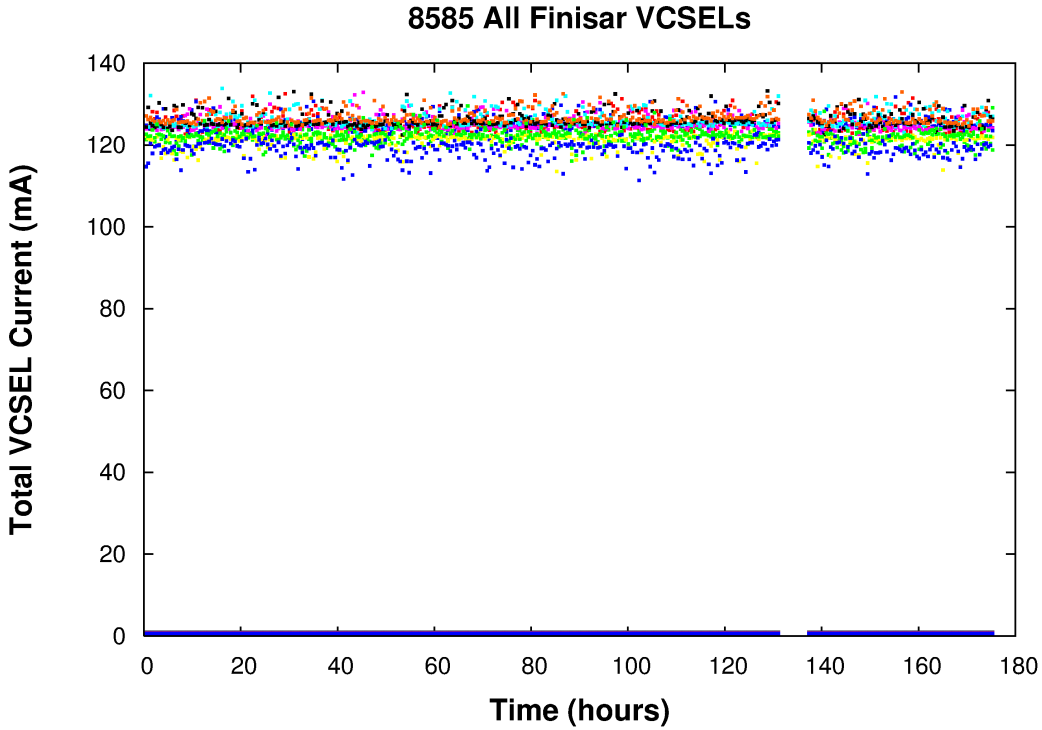


Failed TX



Latest Accelerated Lifetime Test

- switch from aluminum to gold wire bonds
- no optical epoxy
- began test on 10 arrays
  - no failures after 175 hours



Summary

- much learned from failed accelerated lifetime tests on VCSEL arrays
- started on latest accelerated lifetime test
- exercised burn-in/thermal cycle/QA system on opto-boards
- will build more nSQP B boards after successfully fabricated
  10 IBL and 10 nSQP D opto-boards