



Opto-Packs for On-Detector Pixel Opto-Links

K.K. Gan, H. Kagan, R.D. Kass,
J. Moore, D. Pignotti, S. Smith, Y. Yang
The Ohio State University

P. Buchholz, M. Ziolkowski
Universität Siegen

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Outline

- Opto-pack design
- Production experience
- Status of accelerated lifetime tests
- Summary



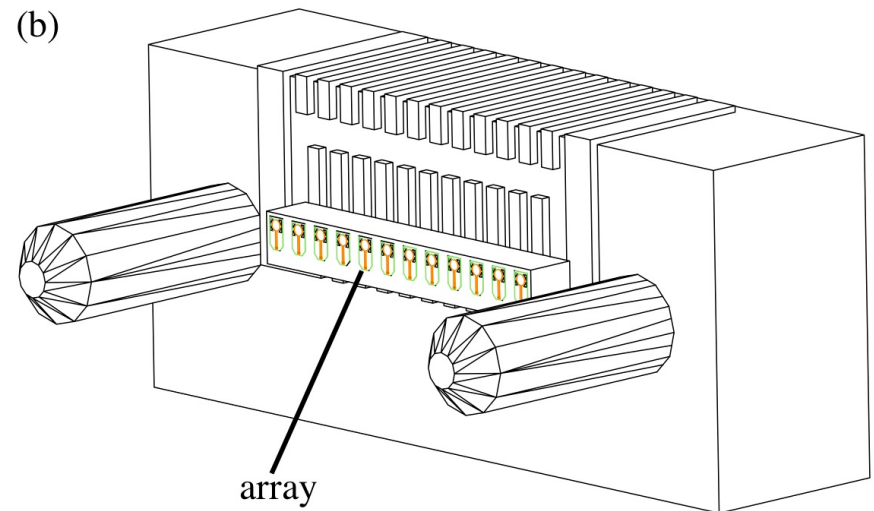
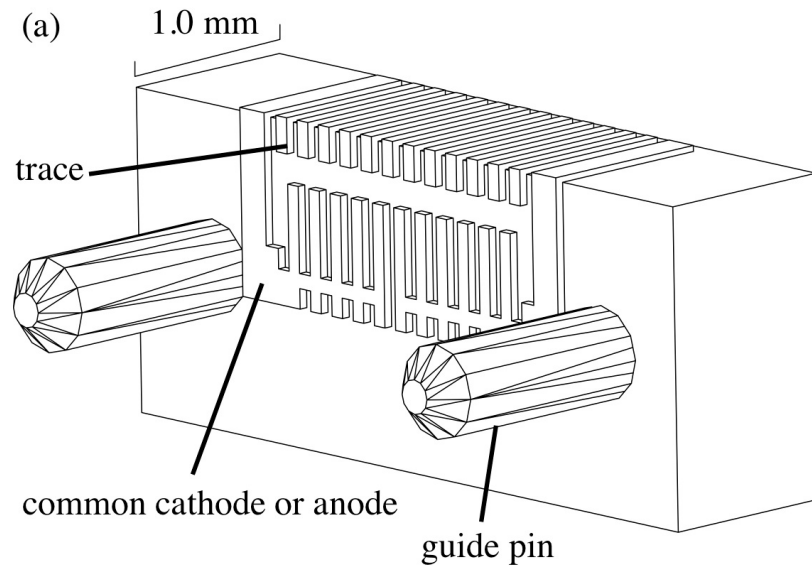
Experience with Taiwan Opto-Packs

- 588 opto-packs were installed in current pixel detector
 - ◆ a clever design but with limitations
 - ◆ VCSEL array is mounted on a poor heat conductor (FR-4)
 - ◆ difficult to solder tiny leads to BeO opto-board
 - too little heat will produce cold solder joints
 - too much heat will produce lead detachments inside opto-packs
 - ⇒ major contributor to failures in installed opto-links
 - ⇒ new opto-pack design



Design of New Opto-Packs

- Use BeO as substrate for heat management
- Use wire bonds to connect to opto-board
- Final system needs 600 VCSEL and 300 PIN opto-packs





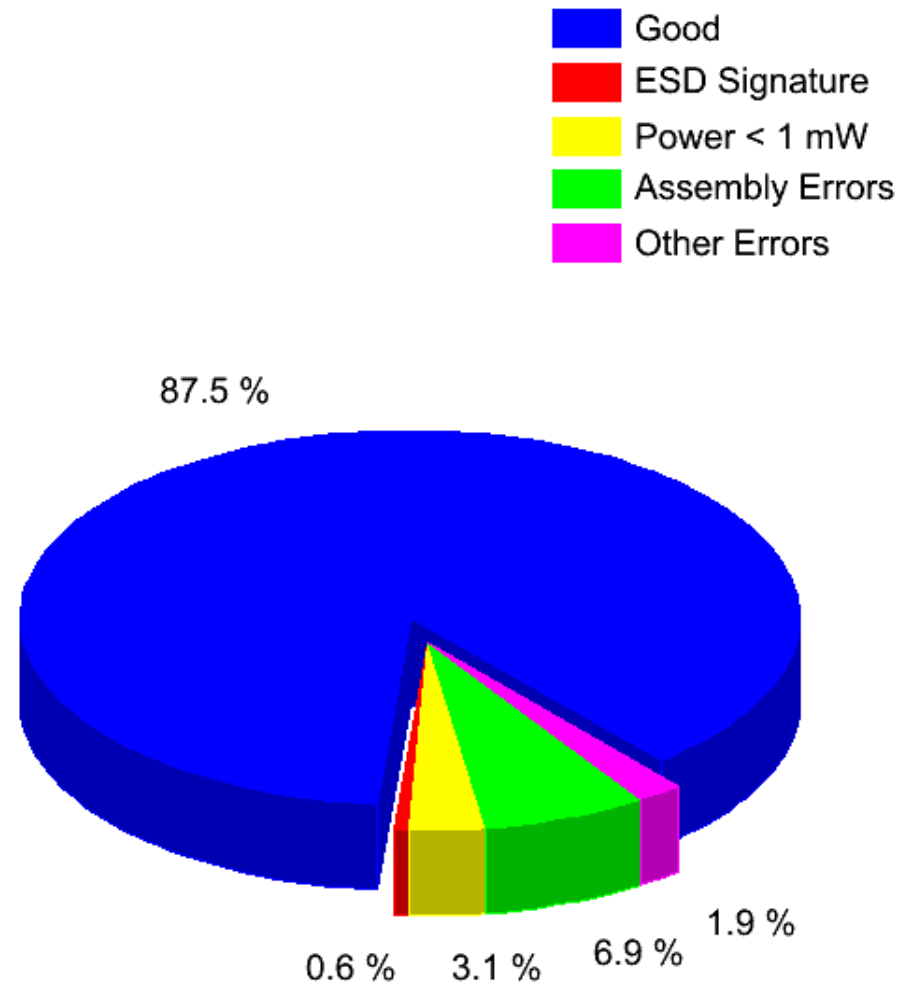
Production Procedure

- Glue guide pins to BeO with precise location defined by MT ferrule
 - Cure the epoxy
 - Deposit conducting epoxy on BeO
 - Place VCSEL or PIN array on BeO
 - Align the array
 - Cure the epoxy
 - Wire bond the array
 - Cover PIN array with optical epoxy
- ⇒ all steps (exclude epoxy curing) is ~2 hours



VCSEL Opto-pack Production Experience

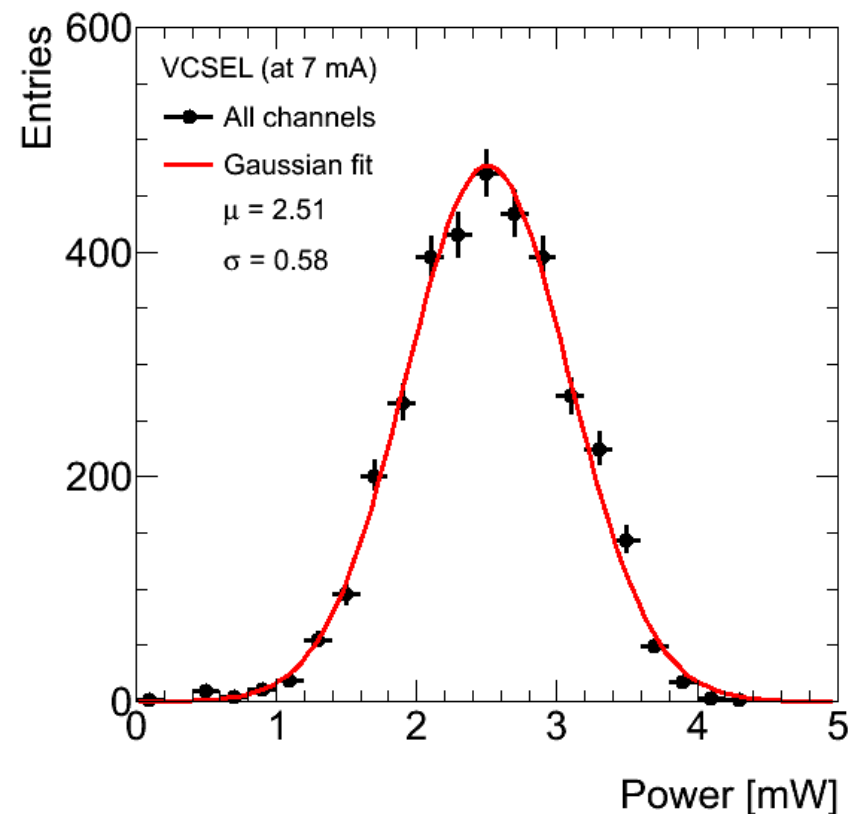
Total	321
Good	281
ESD	2
Power	10
Assembly	22
Other	6





VCSEL Optical Power

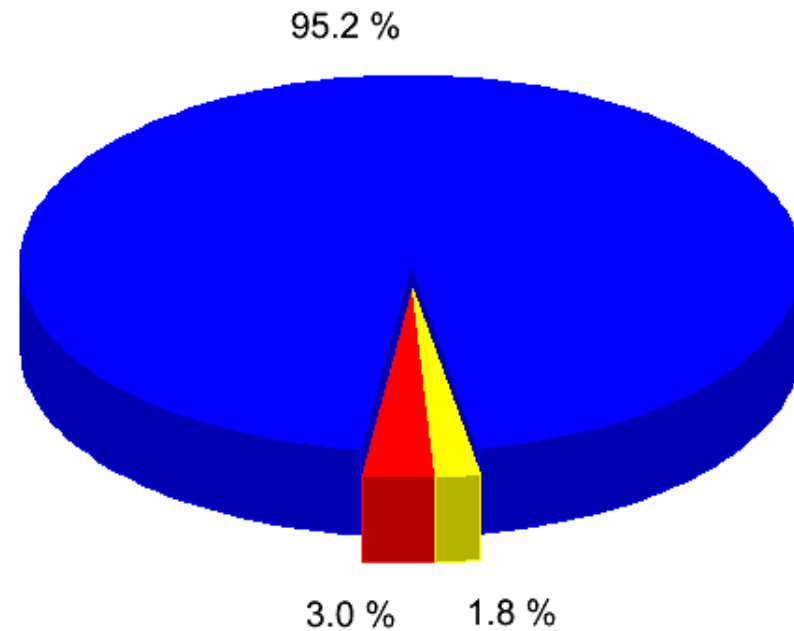
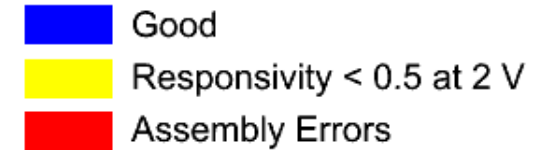
- average optical power ~ 2.5 mW
- require 1 mW @ 7 mA in QA (max current 11 mA)
- propose to use 5 Gb/s arrays from Finisar as the off-detector TXs





PIN Opto-pack Production Experience

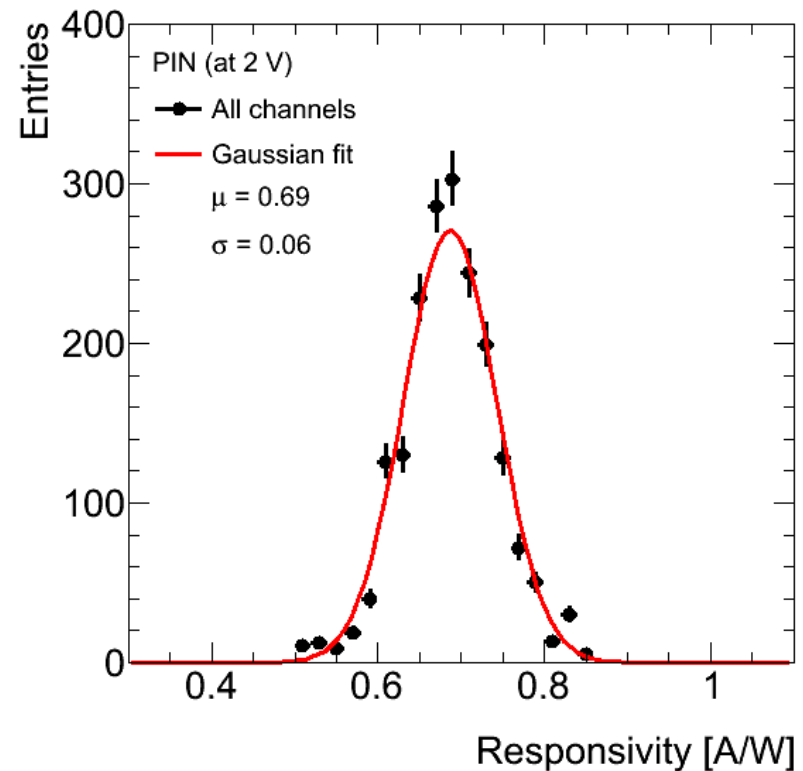
Total	161
Good	153
Responsivity	3
Assembly	5





PIN Responsivity

- average PIN responsivity ~ 0.69 A/W
- require 0.5 A/W @ 2 V in QA
- propose to use 4.25 Gb/s arrays from ULM

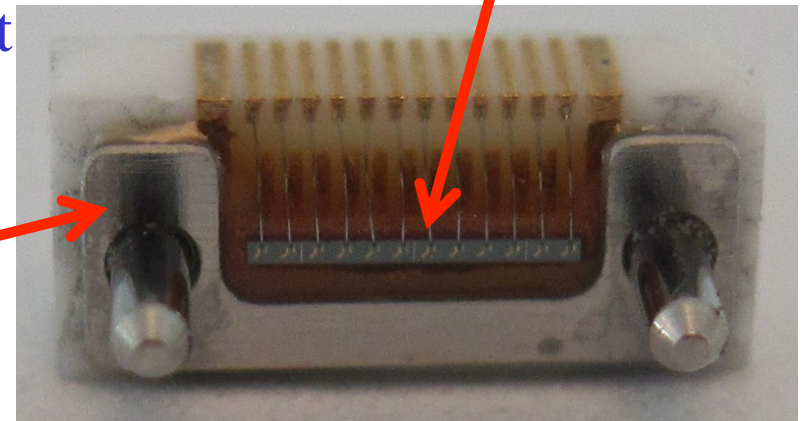




Accelerated Lifetime Test

- VCSEL array mounted on opto-pack should survive at least 1,000 hours at 85 C and 85% humidity
 - two vendors investigated: ULM and Finisar
- ULM (December 2011):
 - 20 arrays survived to 1,000 hours
 - analysis of failed arrays after 1,000 hours
 - ◆ scrapping of wicked up optical epoxy from guide pins array might cause mechanical stress
 - ⇒ use dam for epoxy containment

dam





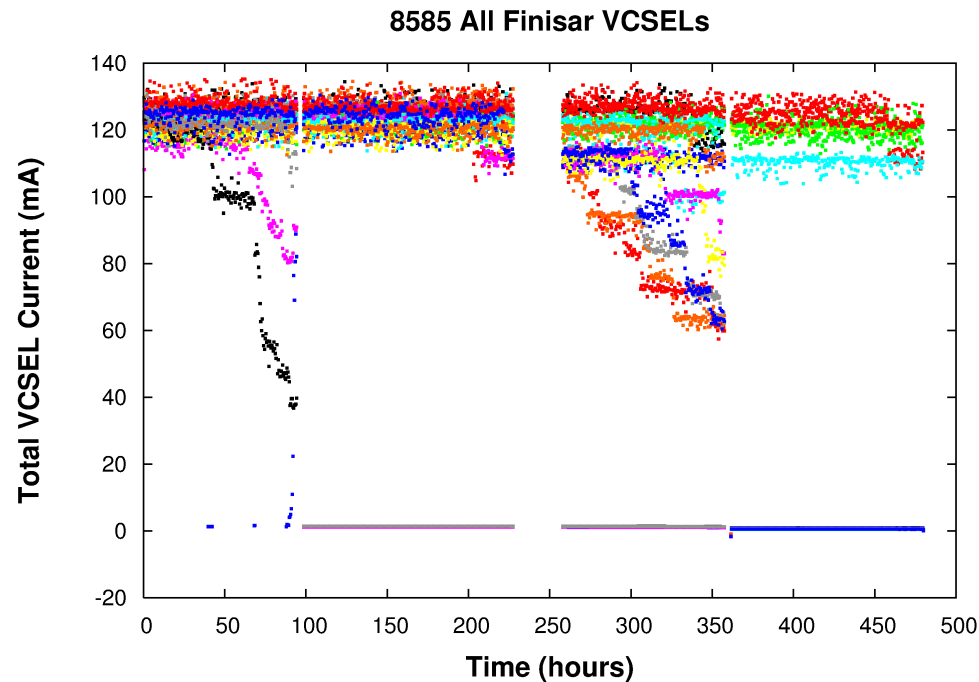
Finisar Accelerated Lifetime Test Fiasco

- Sept 2011:
 - loaded 20 VCSEL arrays
 - 16 exhibit high common serial resistance after a few hours
 - manufacturer 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 broke due to failed fan
 - ⇒ rain inside oven
 - ⇒ all samples ruined



More Accelerated Lifetime Test

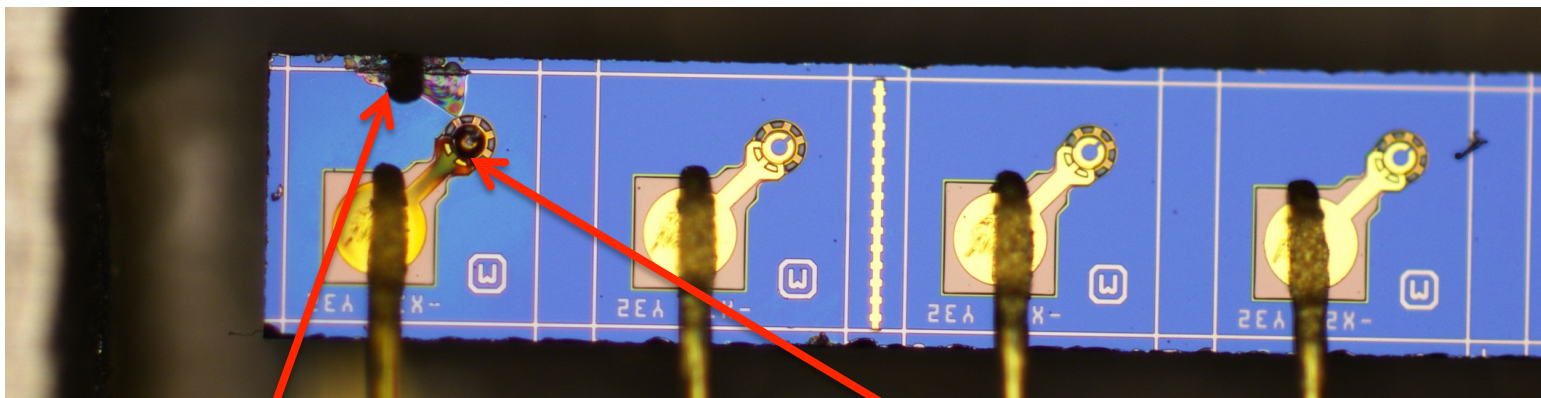
- Sept 2012:
 - loaded 20 VCSEL arrays
 - fibers inserted during test to exert connector spring force
 - after 50 hours: channels on 4 arrays failed
 - after 250 hours: channels on 10 additional arrays failed





Latest Accelerated Lifetime Test

- switch from aluminum to gold wire bonds
 - no optical epoxy
 - 20 arrays are currently being tested:
 - 10 arrays have run for 1,611 hours
 - 9 arrays have run for 686 hours
 - 1 VCSEL array has run for 549 hours
 - one infant mortality after 4 hours
- ⇒ results so far very encouraging



K.K. Gan **Mechanical
damage?**

Pixel Opto Review

“Burned” laser aperture



Plan for Accelerated Lifetime Test

- Will continue the test to 2,000 hours
 - if no failure by 1,000 hours and no significant number of failures by 2,000 hours
 - ⇒ Finisar is then qualified for the opto-board production
- 16 opto-boards of various flavors will be tested for 2,000 hours after the completion of the above program
- Tony Weidberg suggests longer term test at less stressful condition: 50 C and 50% humidity



Summary

- Improved opto-pack design with better reliability and connection
- Large sample of opto-packs have been produced
- Latest sample of opto-packs survived 85/85 test well
- Ready to start opto-board production in January