Welcome to PIXEL 2018

Sponsors

MOST 科技部
Ministry of Science and Technology

Previous symposia and publications:
PIXEL2016, Sestri Levante, Italy
PIXEL2014, Niagara Falls, Canada
PIXEL2012, Inawashiro, Japan
PIXEL2010, Grindelwald, Switzerland
PIXEL2008, Batavia, U.S.A.
PIXEL2005, Bonn, Germany
PIXEL2002, Carmel, U.S.A.
PIXEL2000, Genoa, Italy

Stathes Paganis (NTU), Suen Hou (AS)
on behalf of the Organizers

PIXEL Proceedings, Topics, IAC

- Nearly 100 participants from EU, America, Japan, China, India…
- **56 ORAL** reports, **24 POSTERs**, a total of 80 papers
- Papers will be published on the IOPscience "**Journal of Instrumentation**"

TOPICS:

Pixel detectors in Particle and Nuclear Physics, Astrophysics, Bioscience, X-ray science …

with emphasis on:

- pixel sensor technology and device design
- front-end readout electronics
- radiation effects on devices
- mechanics and integration
- calibration and data processing

International Advisory Committee

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Papers and programs supervised by the

PIXEL International Advisory Committee

Senior members of GE, SW, IT, US, JP research labs and industry

Scientific topics of the PIXEL workshop

R&D on Pixel detector technology for

- charged particle tracking in High Energy Physics, Nuclear Physics
- Astrophysics, and X-ray imaging in Astronomy, Biology, Medicine and Material Science

R&D on Pixel detector applications associated with

- front and back end electronics,
- radiation effects,
- low mass mechanics and construction techniques,

R&D on new technologies

- monolithic
- 3D integrated detectors

Silicon programs in Taiwan

High Energy programs

- CERN-LHC ATLAS HGTD (High Granularity Timing Detector) using fast (thin) silicon pad detector (Academia Sinica, Nat'l Tsing Hua Univ.)
- CERN-LHC CMS HGCAL (High Granularity Calorimeter) Fast timing silicon pads (Nat'l Taiwan U., Nat'l Central U.)
- Beijing e^+e^- collider CEPC LumiCal (Si-Tungsten Luminosity Calorimeter) position precision to 1 μm Si-strip and pads (Academia Sinica, Nat'l Taiwan U., Nat'l Central U.)

Instrumentation for Synchrotron radiation (NSRRC)

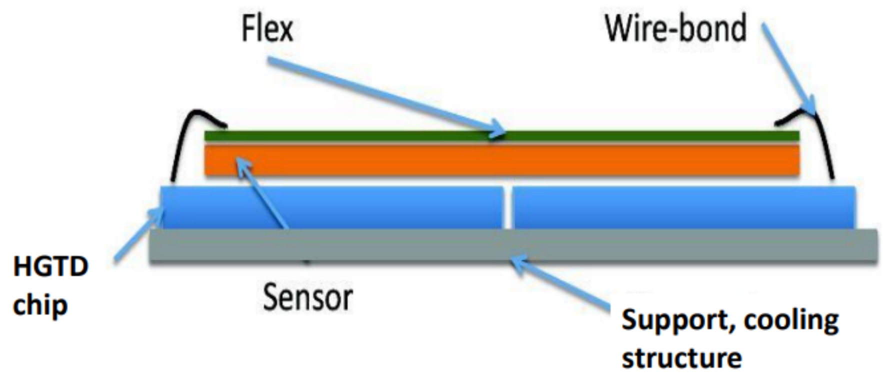
- X-ray pixel camera
- Radiology, X-ray imaging

Silicon readout electronics (Academia Sinica)

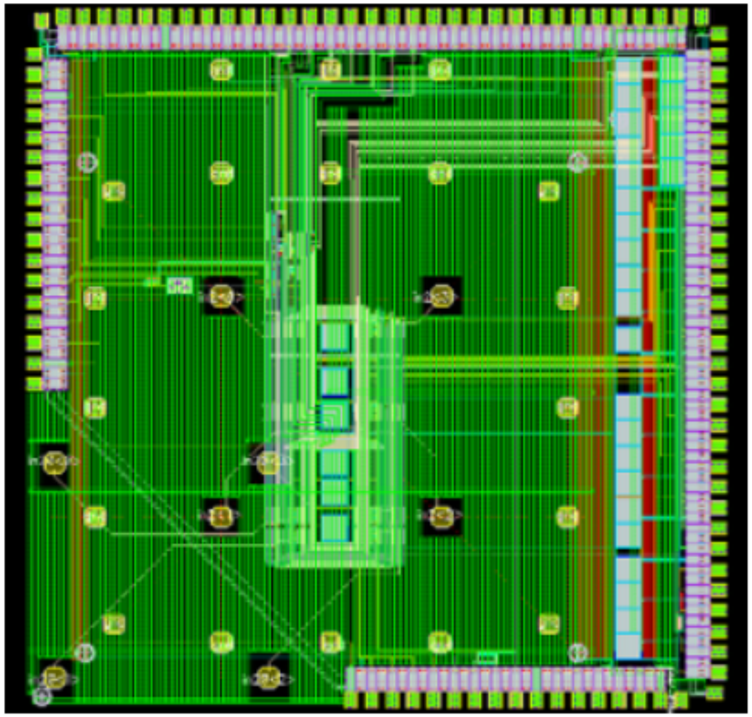
- Front-end for HGTD
- 25 Gbps/ch readout optical transceiver

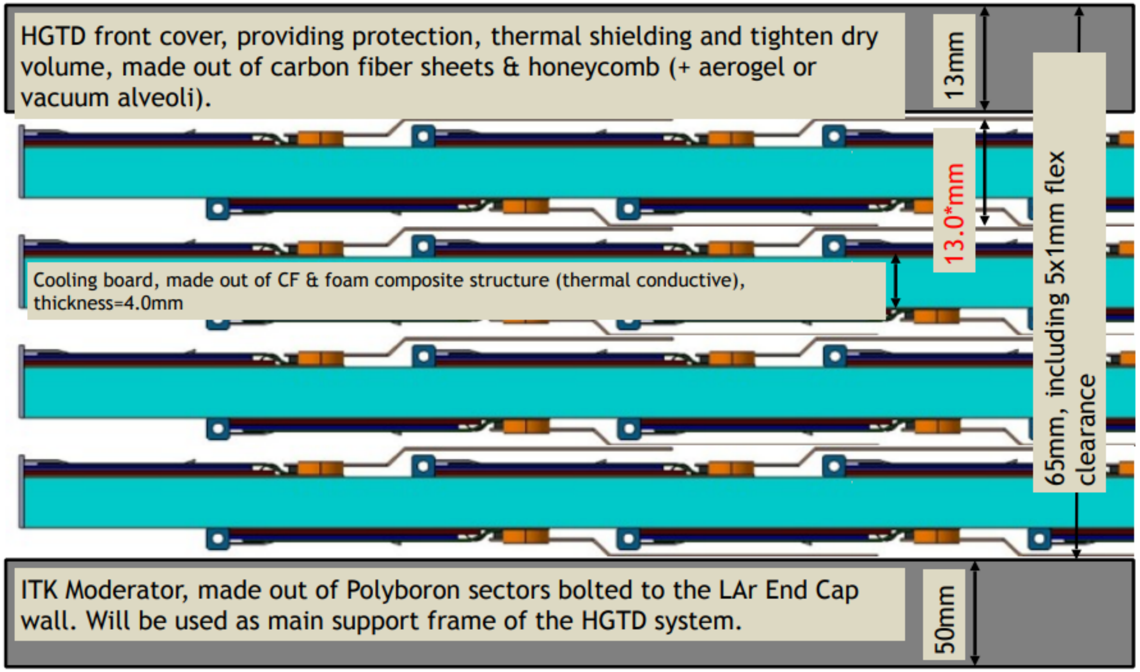
HGTD program at Academia Sinica

2x2 array of sensors
bump-bonded to ASICs
TSMC 130nm CMOS Technology



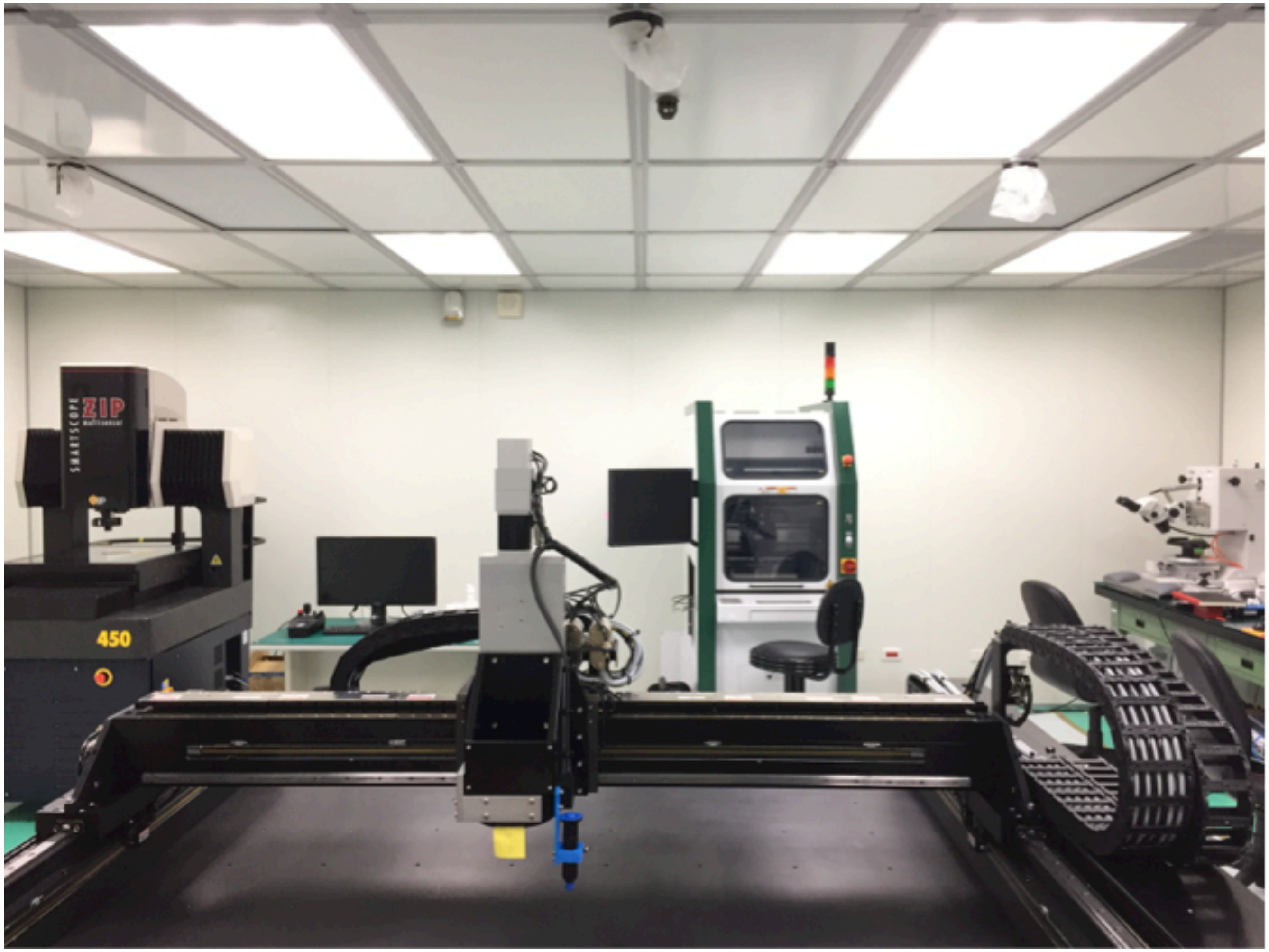
Chip layout with wire bonds in the periphery

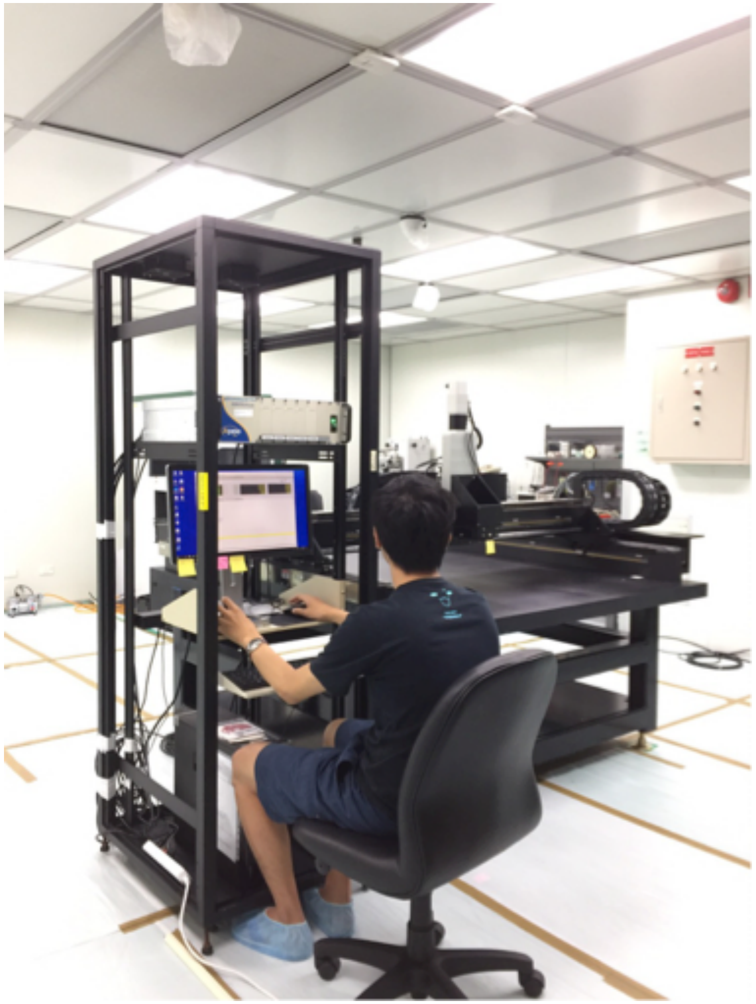




* Full layer thickness, CF cooling panels limited to 4.0mm & Stave flex maxi stack up 4.5mm.

Si Sensor Assembly Facility

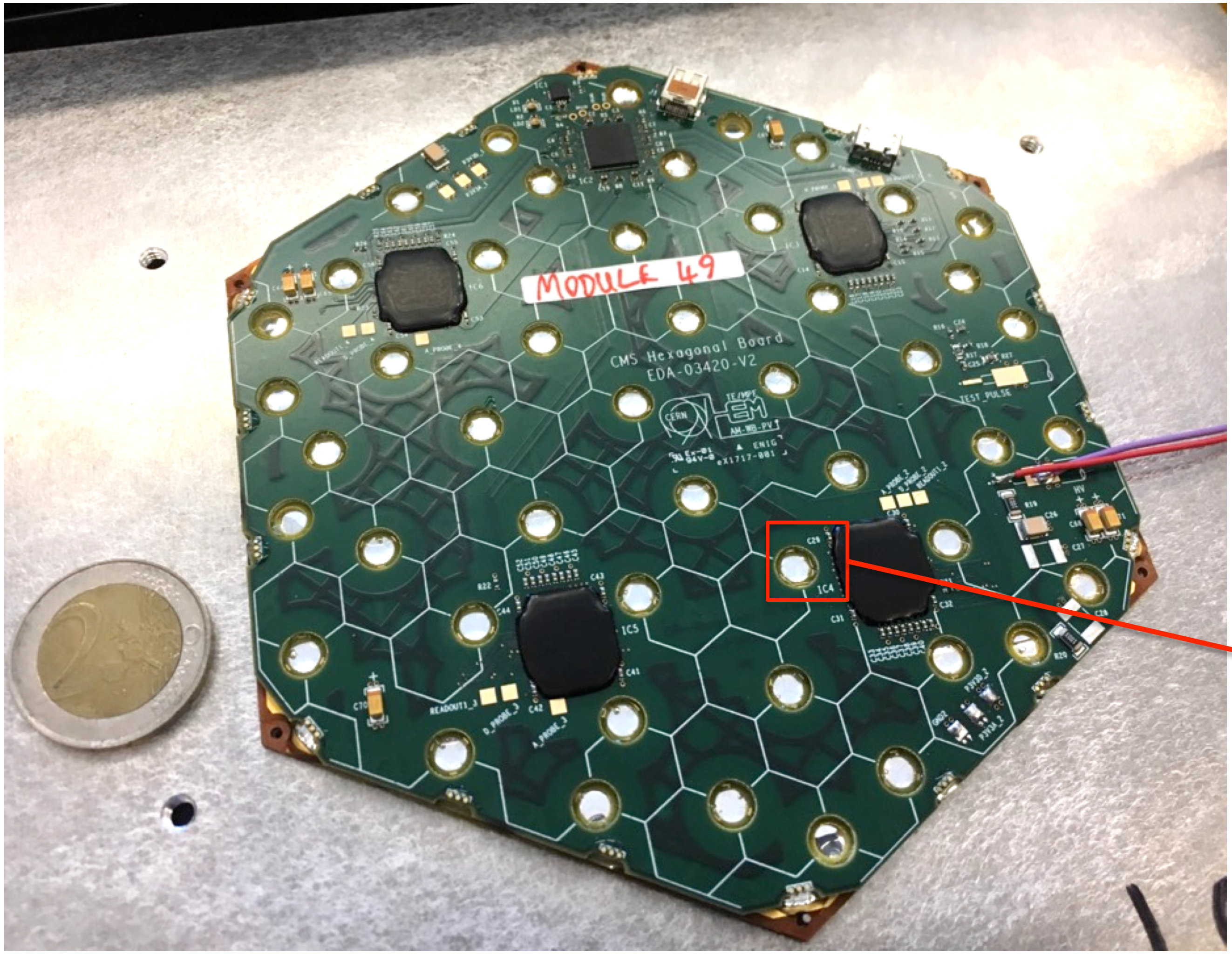




Academia Sinica, NCU, NTU, NTHU, collaboration.
Charged to: Produce 5000 HGCAL modules, do CEPC and other R&D

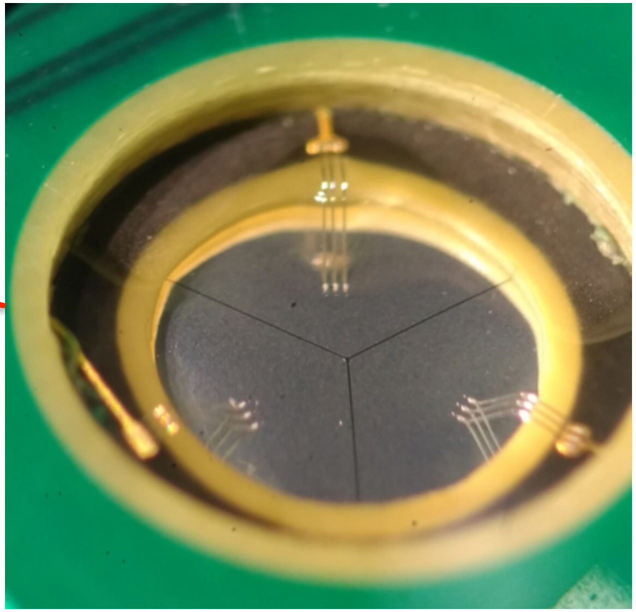
5000 modules to be built in Taiwan

Silicon sensor glued to baseplate and PCB containing FEE



Taiwan is one of few HGCAL MAC centers (in Asia, also China and India)

Wire bonding from PCB to silicon through holes



Packaging of optical transceivers

Suen Hou

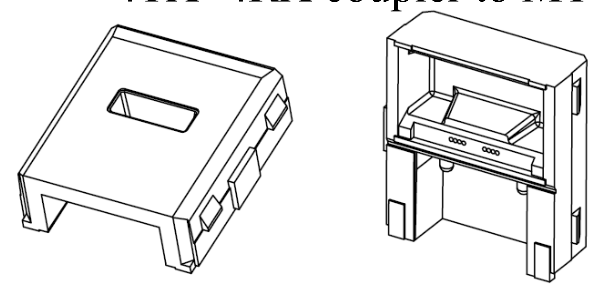
– Chip-on-board assembly

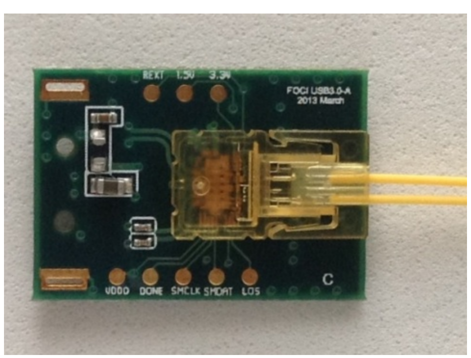
- Commercial products are in miniature form-factor
- Available for Intel Light-peak, SFP+ (TX+RX), QSFP+ (4TX+4RX)
- Height ~ 2mm e.g. muRata, matched connector
  ~5 mm match to MT e.g. Forward Optics

– Assembly solution for HEP application

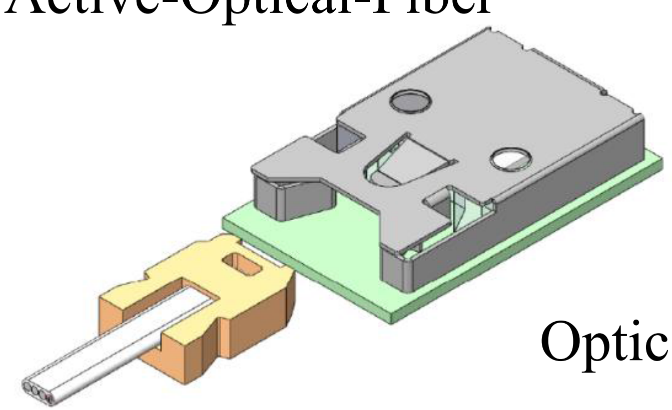
- Rad-hard Multi-Mode GaAs 850 nm VCSEL/PD
  most of the commercial GaAs products perform well
- Rad-hard Laser Driver, TIA
  no commercial candidates!
- Light coupling Prism/Lenses
  industrial assembly are automatic on die/wire bonding
  with alignment precision ≤ 5 μm

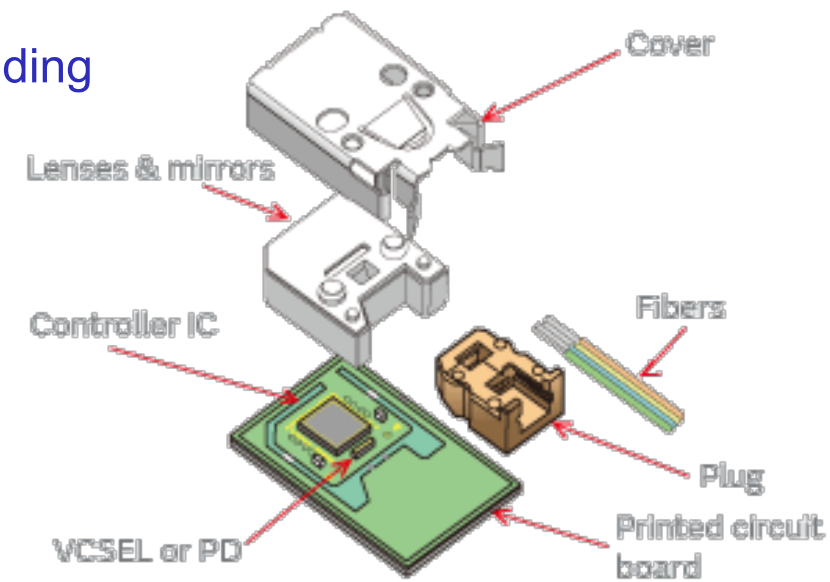
Forward Optics
4TX+4RX coupler to MT





FOCI light-peak engine
Active-Optical-Fiber



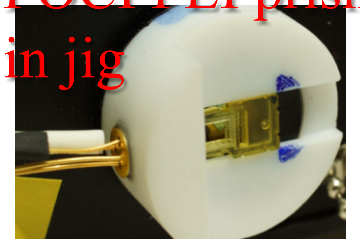


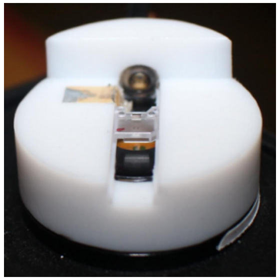
muRata Fiber
Optical Transceiver

Durability of Transceiver assembly

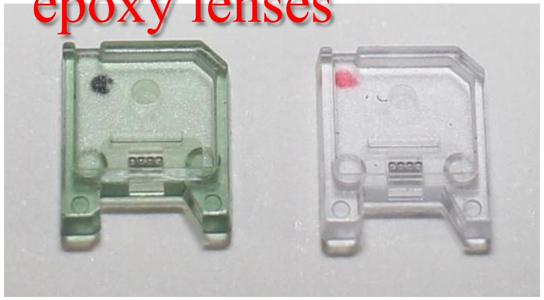
- **Commercial → customized Rad-hard transceiver**
  - Replace ASICs to Rad-hard types, e.g. VLAD of SMU
  - Choice of light-coupling Prism/Lenses to Multi-Mode fibers
- **Durability of assembly**
  - Rad-hard of Lens material: Co^{60} TID PEI to 117 kGy, Epoxy to 370 kGy light attenuation negligible
  - Assembly are fixed by Epoxy, UV-glue $85^{o}C$/85%RH ~4000 hr, ***sustained !***

FOCI PEI prism in jig



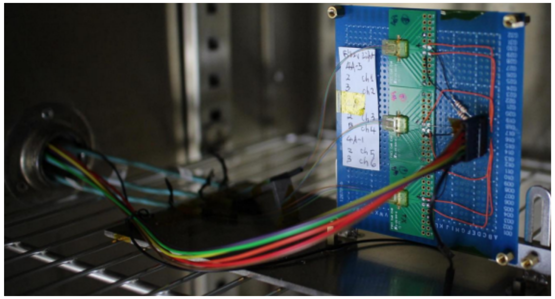


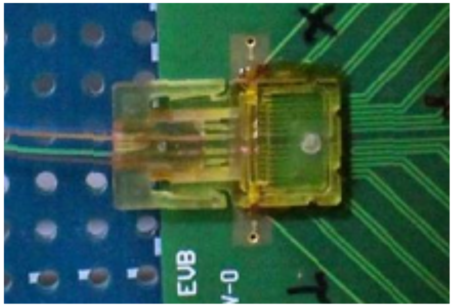
muRata epoxy lenses

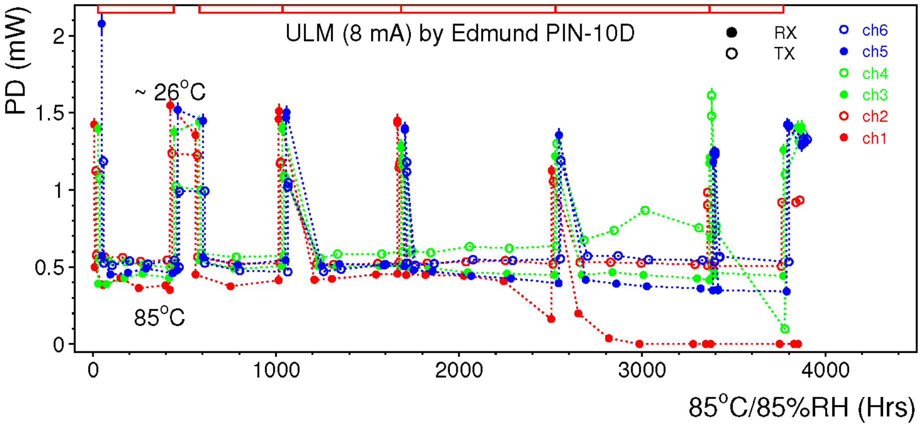


Test assembly (industrial prepared by FOCI)

VCSELs in DC, monitored in 85/85 & when cooled (3x light power)



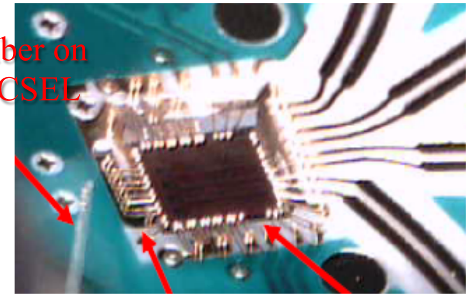


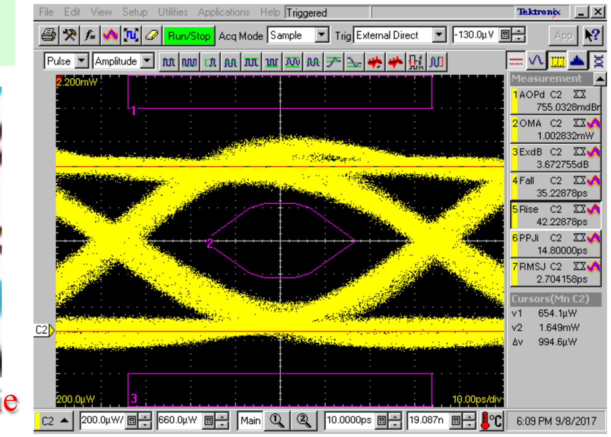


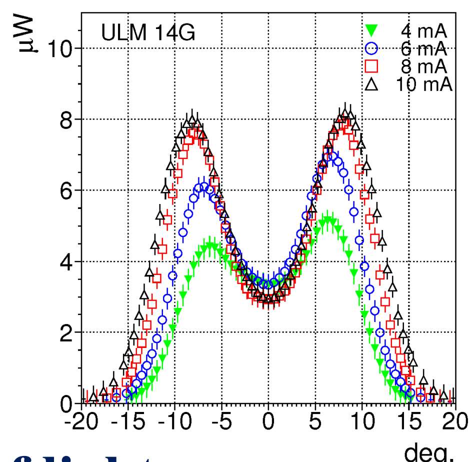
Sample in Chamber

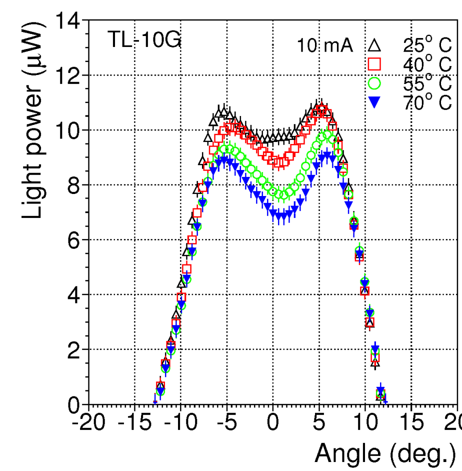
Rad-Hard Transceiver options

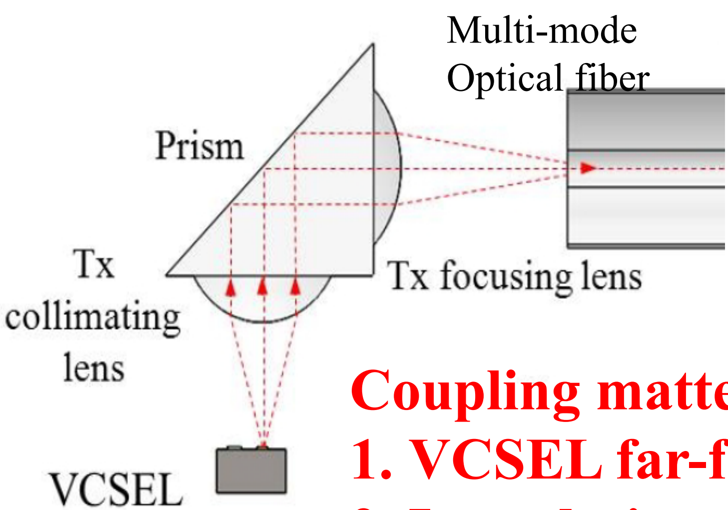
- **VLAD driver + VCSEL**
  - 4-ch array, tested to 14 Gbps,
  - 2-7 mA to VCSEL, ~50 mW/ch
- **Light coupling is delicate**
  - higher mode 5 ~ 8 deg.
    wider far-field angle (donut-shape)
    loss matching to fiber
  - Flexibility to be examined
    for L-I at high current



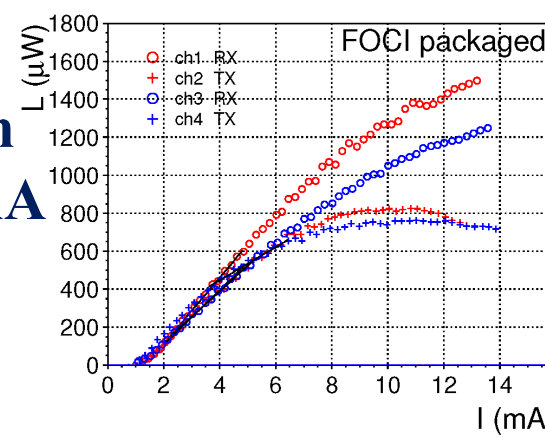








Far-field of light power
1. Varies by types/maker
2. Coupling loss tested with
FOCI lens, linear to 8 mA



Coupling matters for
1. VCSEL far-field, distance to Lens
2. Lens design

Extra Slides