OAK RIDGE National Laboratory

Brainstorming on module integration for fTOF

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U.S. DEPARTMENT OF ENERGY

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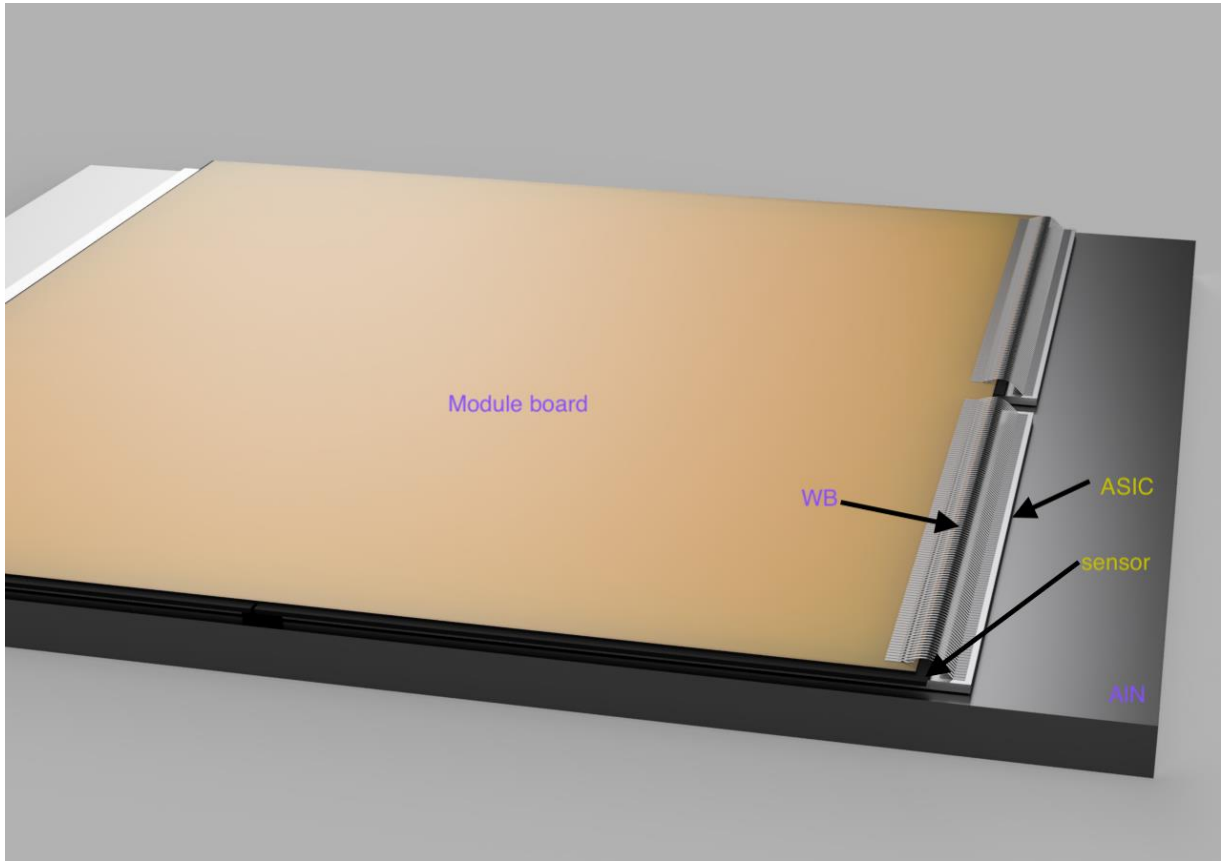
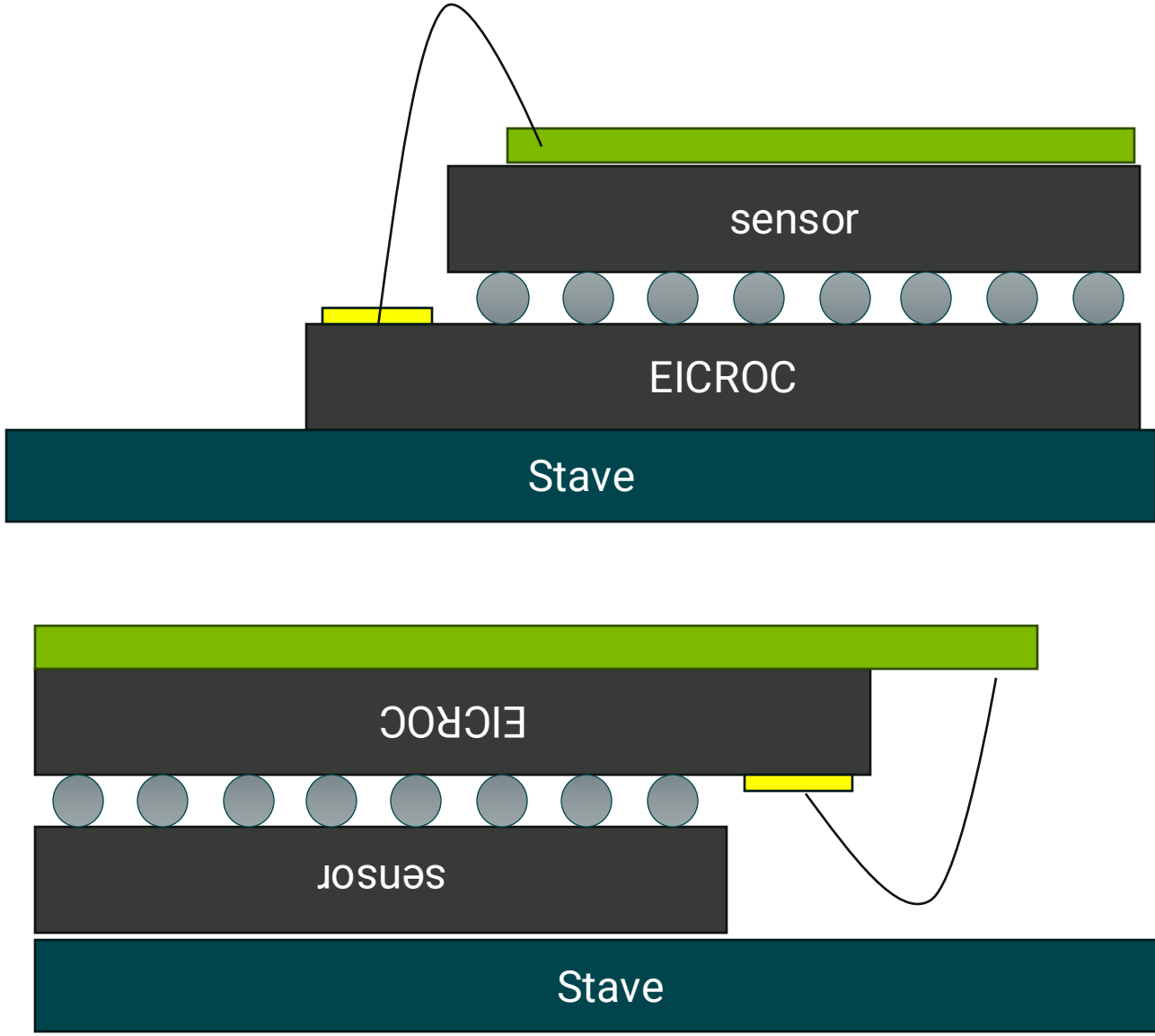
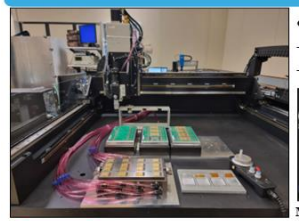
The Module stack problem



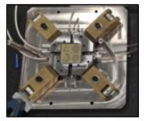


ETL Module Assembly Steps

ETL Module Assembly Device

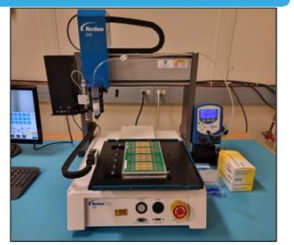


- **AEROTECH Robotic Gantry**
  - Precision placement at 10 μm level
  - **FNAL and BU**

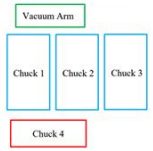


Mechanical Jig (INFN)

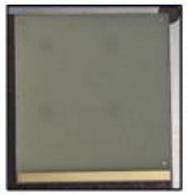
SCARA Robot (IFCA)



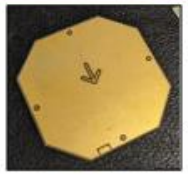
- **Nordson EFD Fluid Dispensing Robot**
  - Fully automated
  - 3-axis movement
- **Encapsulant**
  - Sylgard 186
  - 10.0 g of base & 1.0 g of hardener



- Vacuum Arm
  - Pick & place the subassembly and baseplate with vacuum
- Chuck 1 - 3
  - Position of module PCB carriers
- Chuck 4
  - Position of subassembly and baseplate



- **ETROC**
- Fiducial markers on each corner



- **LGAD**
- Fiducial markers on center of each side
- Chamfered corners (only for mockup)

- **Module PCB**
- Printed circuit board
  - Power and readout interface
- Plug into readout board

- **Baseplate**
- Ceramic plate
  - Thermal pathway (Cooling)
- Stainless steel (mechanical mockup)

- **Sensor Mount Film**
- Placed between module PCB and subassembly
- Fix the subassembly on module PCB

- **Baseplate Film**
- Fix the baseplate on subassembly
- Polyethylene terephthalate (PET)

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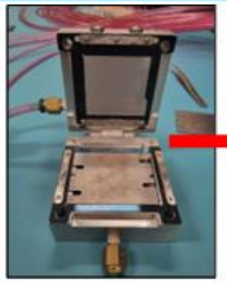
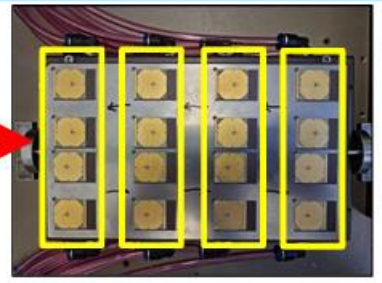
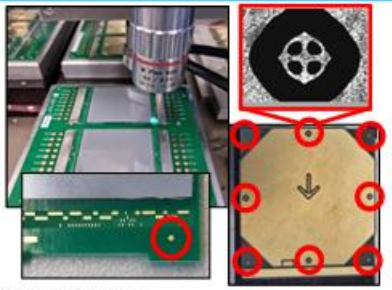
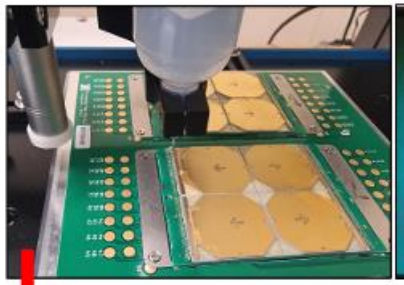


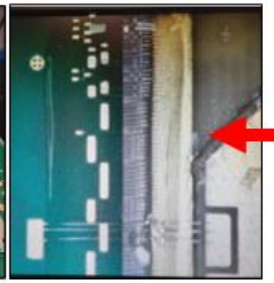
- **Step 1: Film Application**
  - Attach film on module PCB (baseplate) using clamshell jig
  - Film will fix the subassembly and PCB (baseplate)





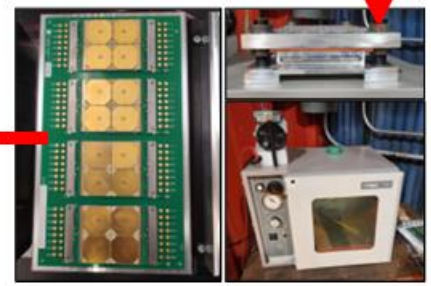
- **Step 2: Subassembly Pick and Place**
  - Connect module PCB and carrier then, place on Chuck 1 - 3
  - Place 16 subassemblies on Chuck 4 (Vertical box makes up one ETL module)
  - Scan the fiducial markers on each module PCB (4) and subassembly (8)
  - Pick the subassembly with vacuum arm and place it on the module PCB



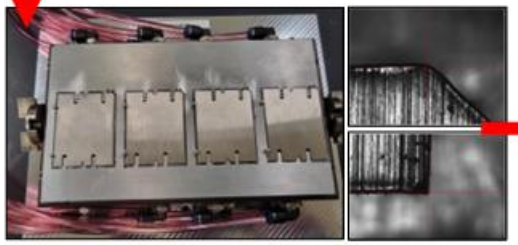


- **Step 5: Encapsulation (ETROC)**
  - Syringe spread encapsulant on signal wire-bonding with constant speed and amount
  - Draw 2 lines for each side to cover the entire area
  - Dispenser setting: [44.5 psi], [2.3 inH20]

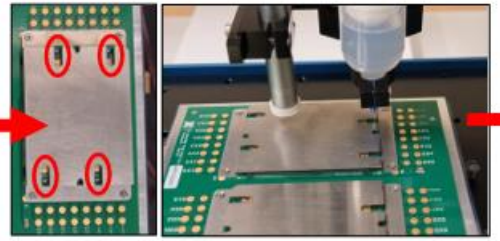
- **Step 4: Wire-bonding**
  - Signal: Between ETROC & PCB
  - Bias: Between LGAD & PCB
  - Wirebonder: Hesse BJ820
  - Line: Aluminum 1% Silicon Wire



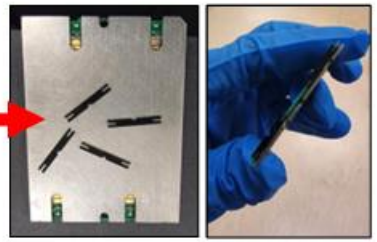
- **Step 3: First Film Curing**
  - Put carrier in WAM to provide proper pressure for curing
  - Vacuum oven setting: [60 °C], [~18 inHg], [30 minutes]



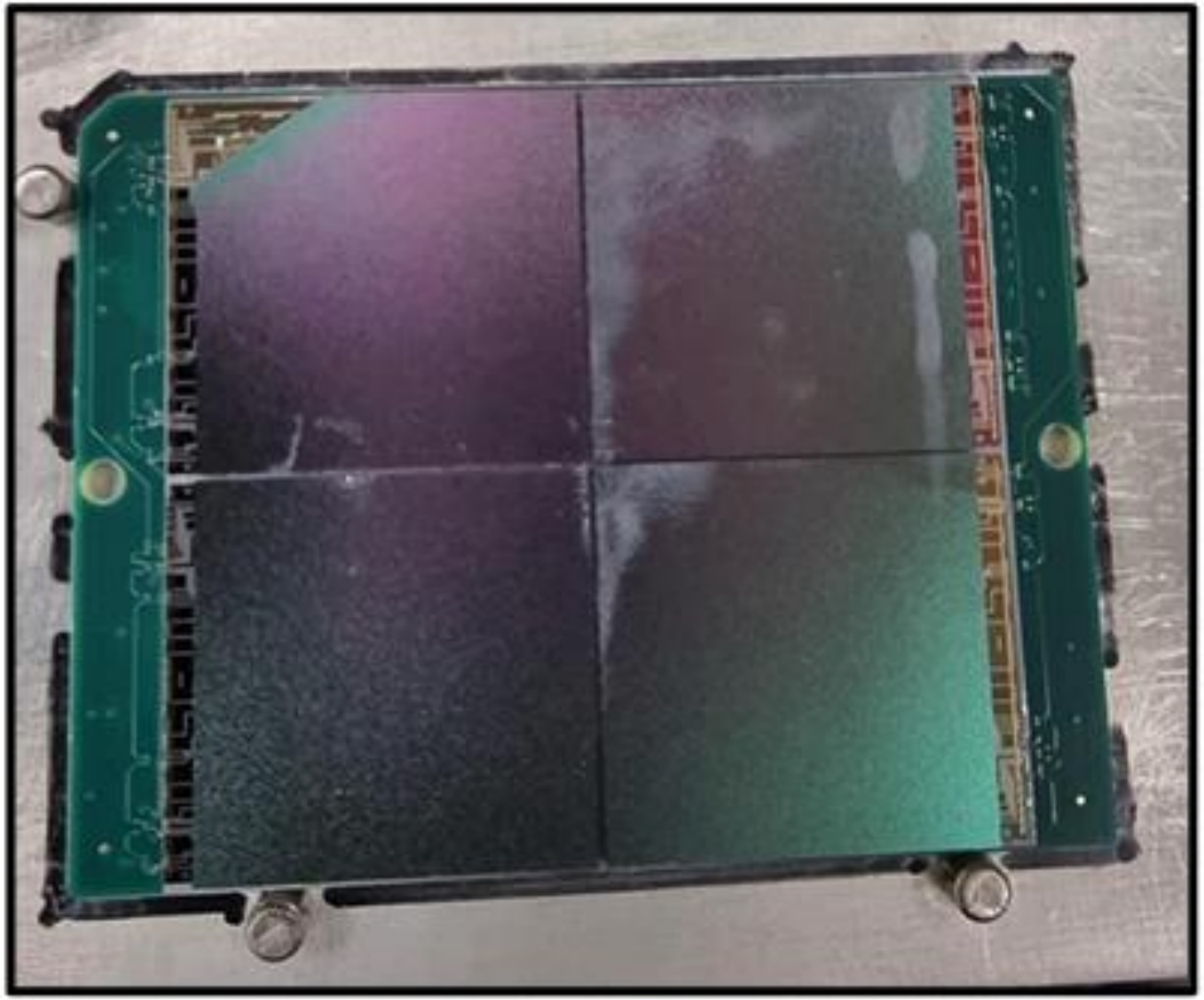
- **Step 6: Baseplate Pick and Place**
  - Scan 4 edge points to set center position
  - Pick and place the baseplate with vacuum arm
  - **Challenge:** partially automated

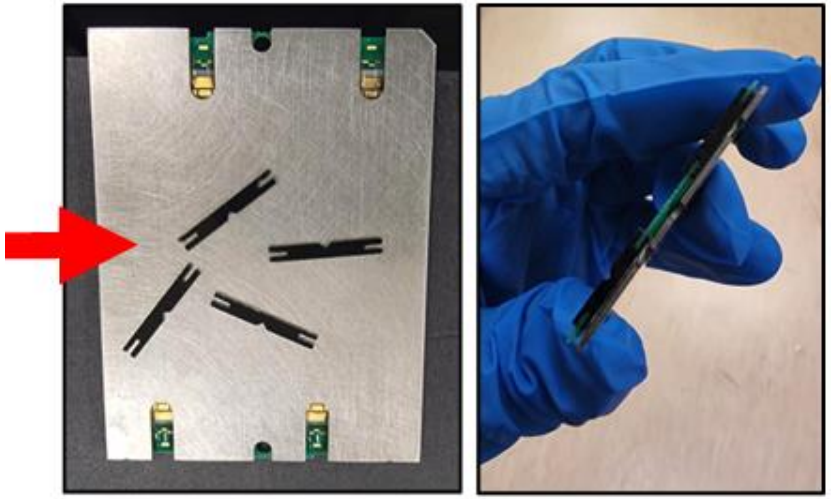


- **Step 7: Encapsulation (LGAD)**
  - Red circles must be aligned
  - Syringe spread encapsulant on bias wire-bonding (Same condition with step 5)



- **Step 8: Second Film Curing**
  - Cure again (Same process with step 3)
- **Step 9: Attach Spacer**
  - Mount 4 spacer → **Hooray!!!**





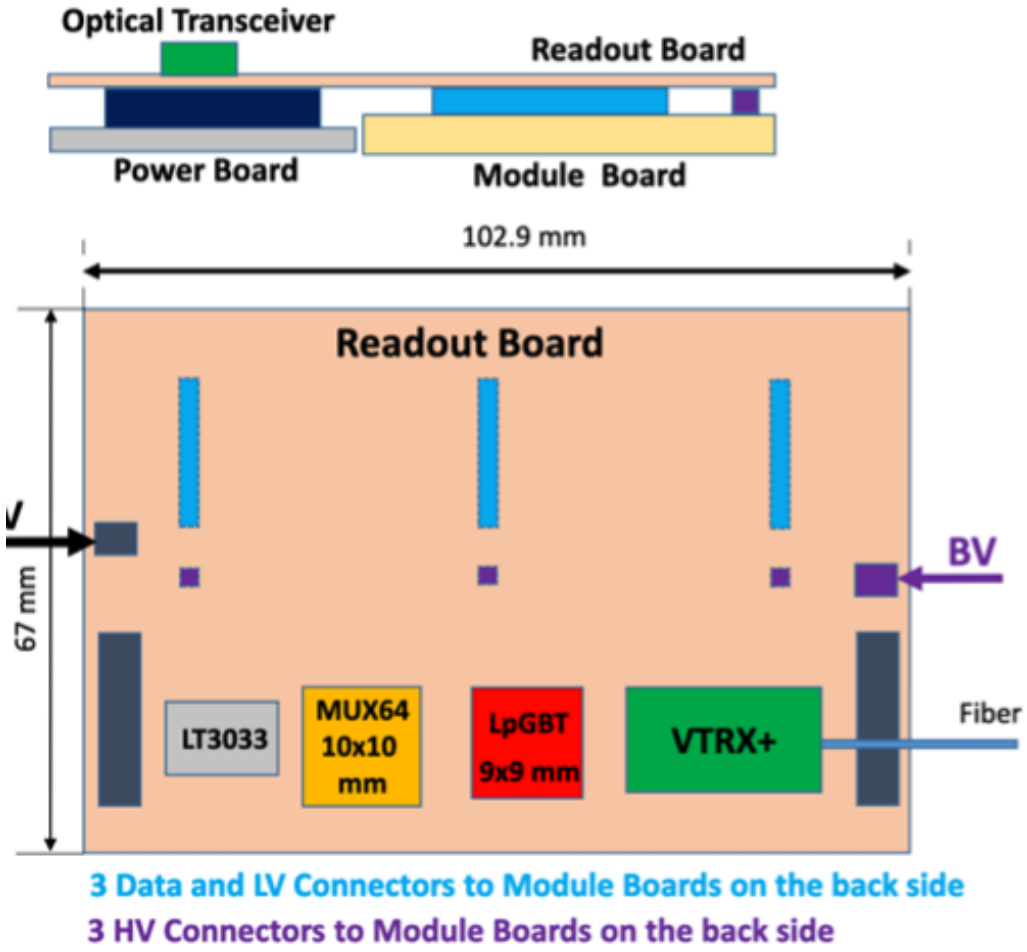
- **Step 8: Second Film Curing**

  Cure again (Same process with step 3)

- **Step 9: Attach Spacer**

  Mount 4 spacer → **Hooray!!!**

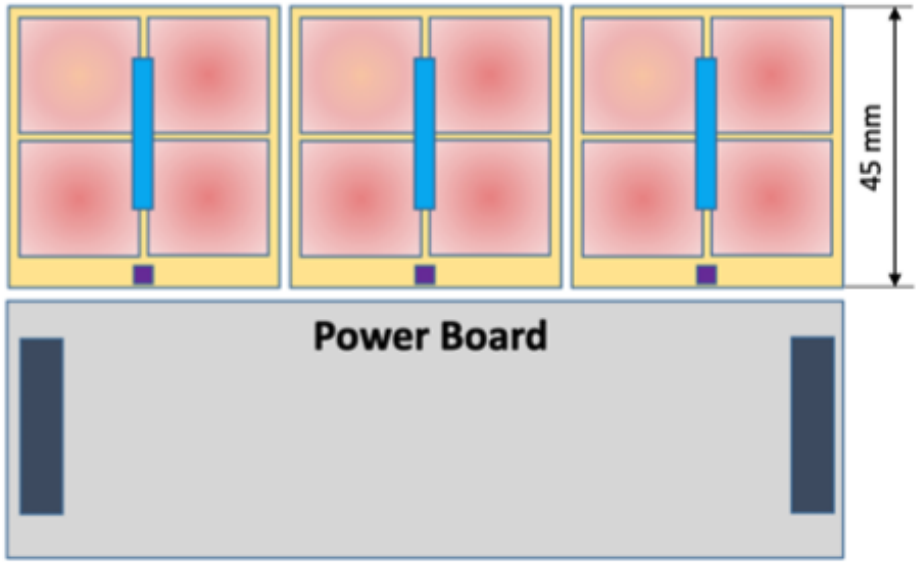
ePIC FTOF Readout Board v1 + Power board v0 prototypes



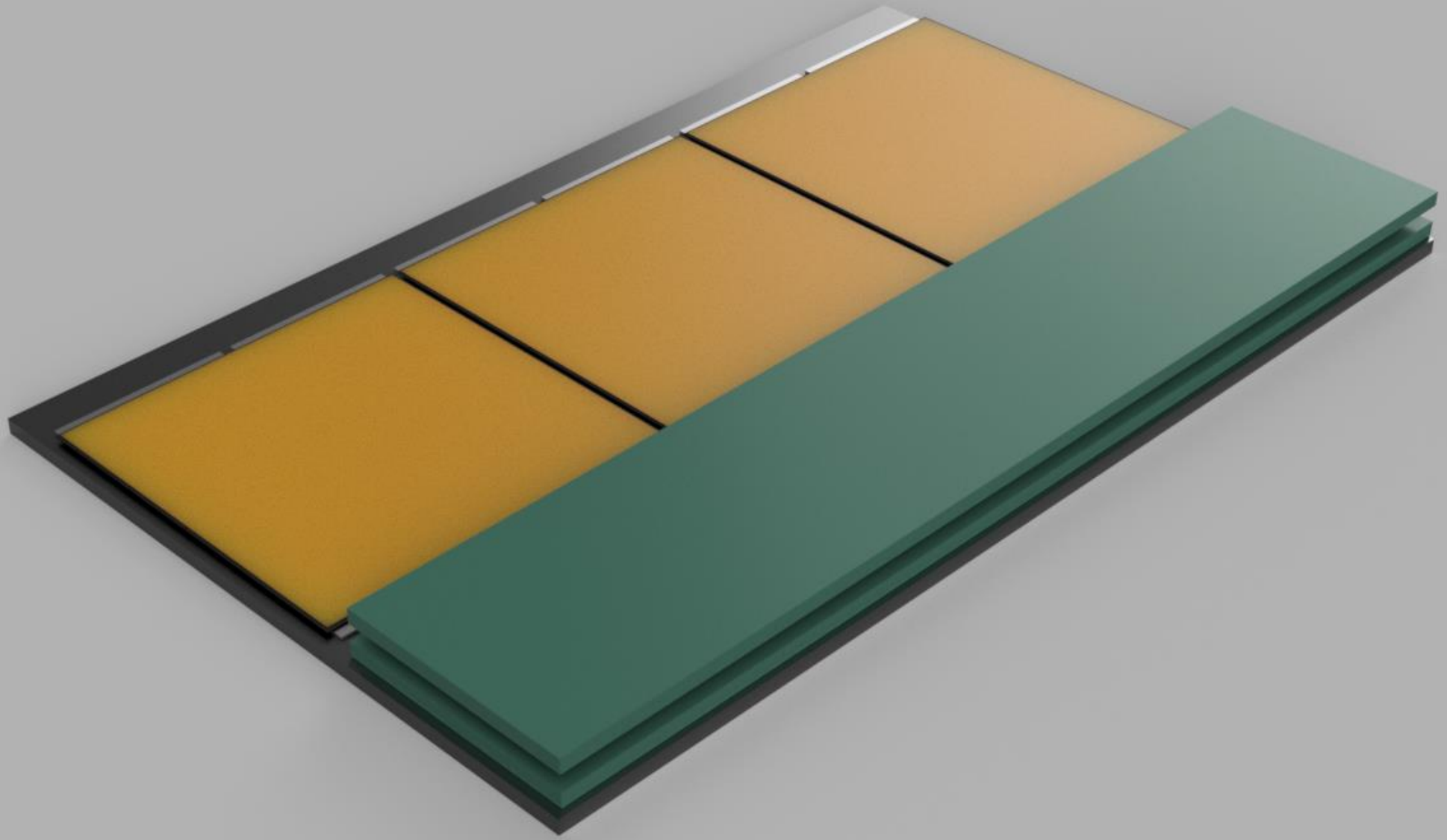
Proof of design:

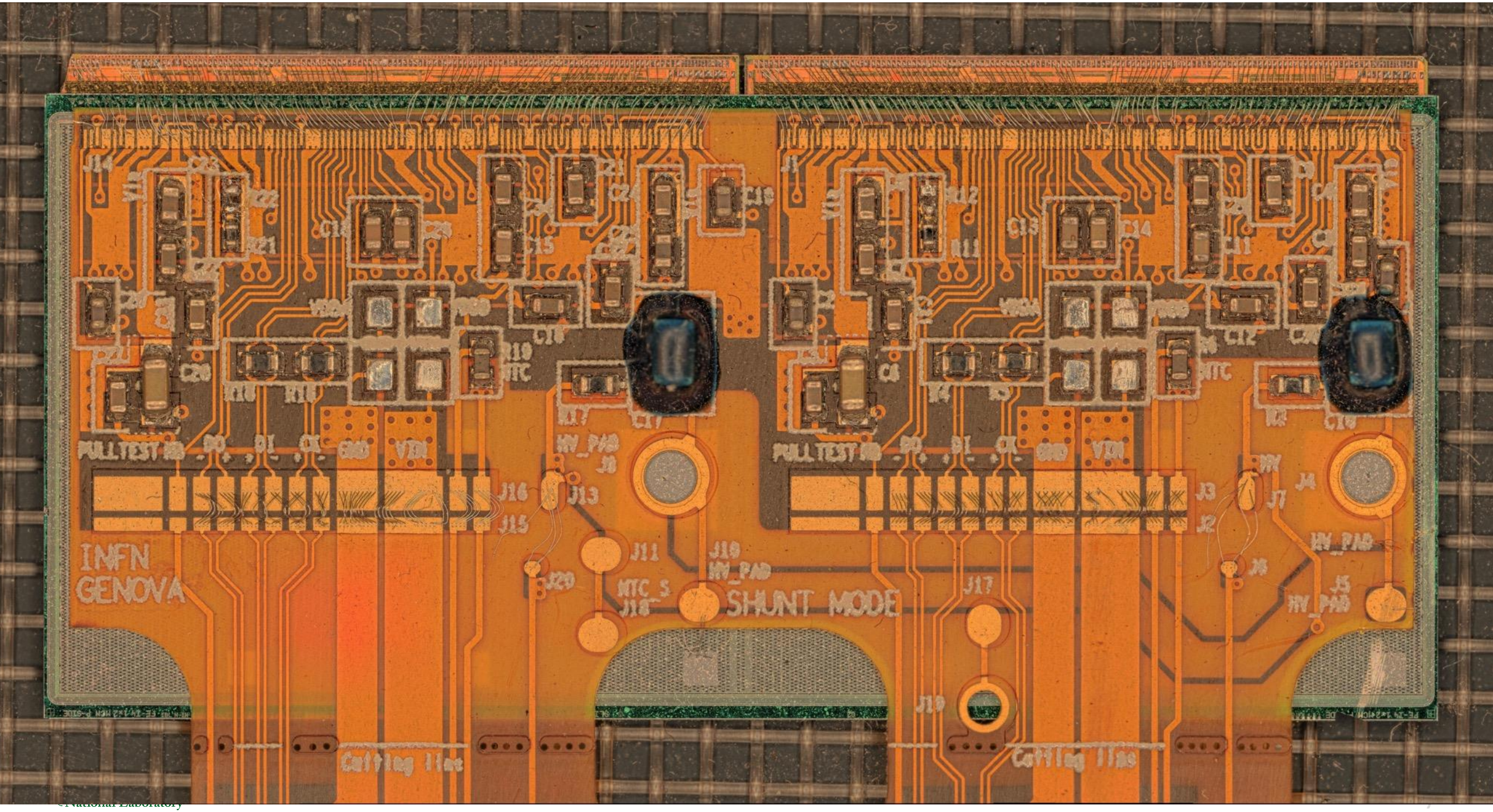
- All components can be accommodated
- RB-to-PB interface
- Power efficiency

PBv0 from Tim: link



https://indico.bnl.gov/event/25233/contributions/98158/attachments/58113/99847/ePICTOF_SHPrototypePlan_102524v2.pdf

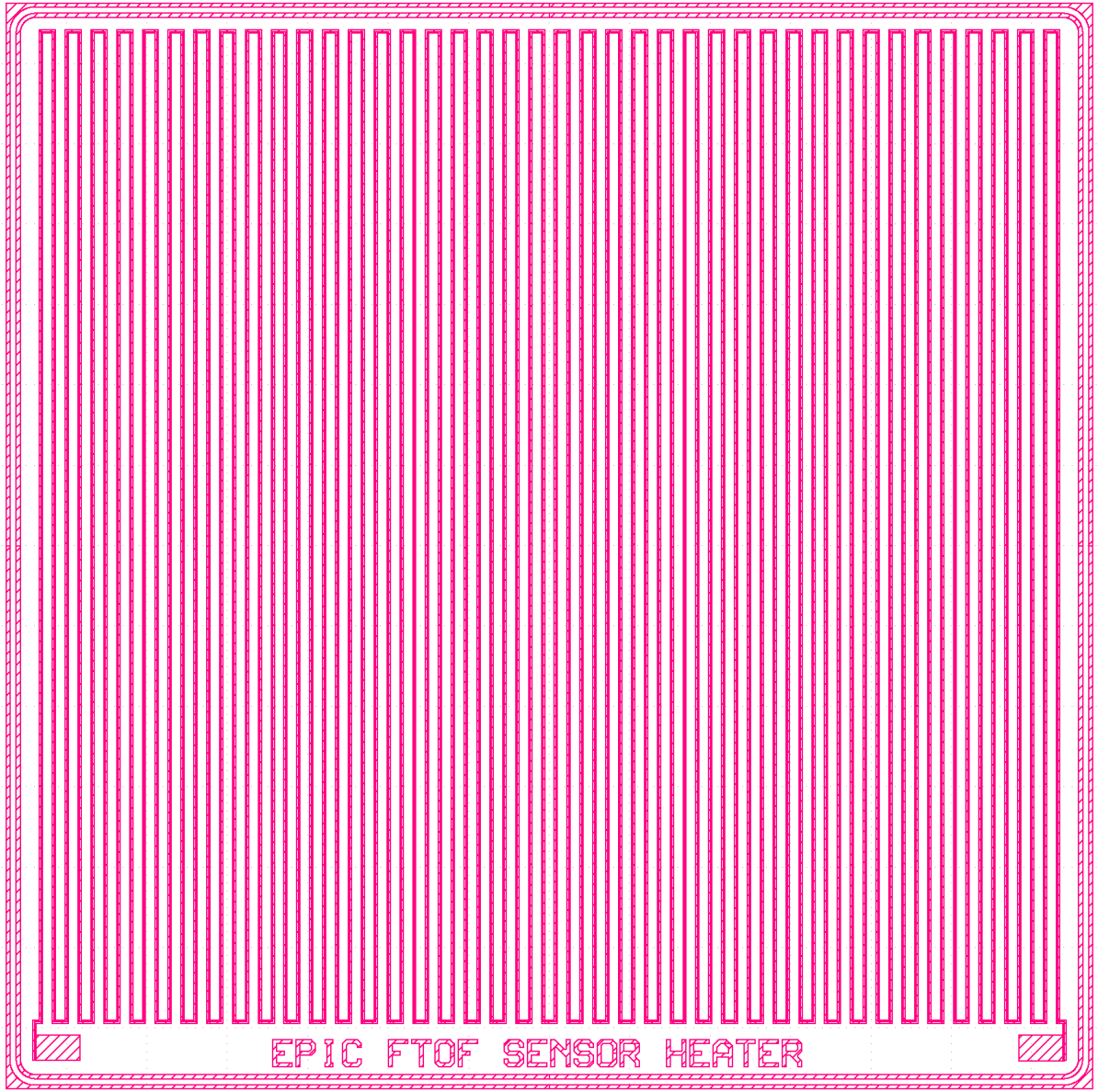



INFN
GENOVA
SHUNT MODE
HV_PWB
NTC_S
PULLTEST
GND
VIN

Plans for prototypes

- Prototype 0 (Show and tell)
  - We are assembling mechanical prototypes of assemblies at ORNL (1.6x1.6cm Sensor, 1.6x1.8cm ASIC)
  - Rather quick to make , can make enough of a few modules
  - Purchased AlN plates (0.3,0.5mm) that we will laser dice to hold assemblies
  - Could be mounted with dummy PB&RB?
- Prototype 1 (Thermo mecanical)
  - We plan on doing lithography in-house to make ASIC and Sensor heaters that can be WB to flex/PCB
  - Assemble following prototype 0 geometry for thermal testing on stave etc .
- Prototype 2 (Functional EICROC1 + Dummy LGAD)
  - Demonstrate power distribution, readout (even if not final scheme)
  - Can be used for more realistic thermal testing

Thermal mock up for integration tests



We have designed a heater structure than can be used for flip-chipping and thermo-mechanical test on stave while waiting for ASIC and sensors to come to maturity