

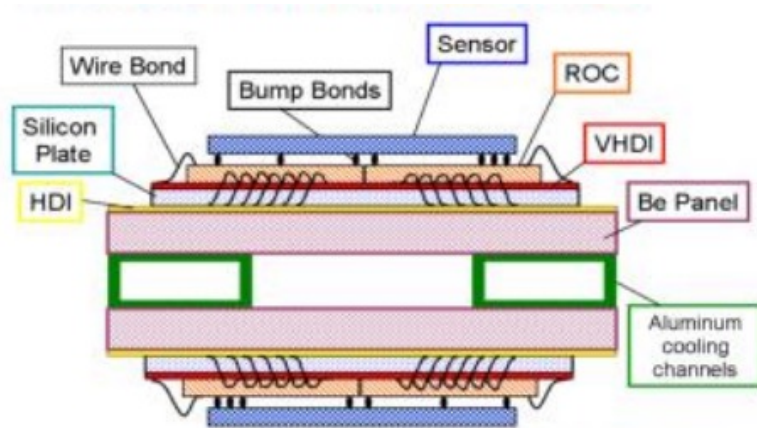


Module Assembly at Purdue

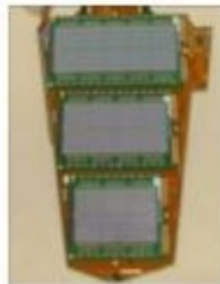
- Past projects:
 - CMS forward pixel detector (Phase 0)
 - CMS forward pixel detector upgrade (Phase 1)
 - Strip sensor telescope for Fermilab Test Beam Facility
- Current activities:
 - CMS forward pixel detector HL-LHC upgrade (Phase 2)
 - Mu2e extinction monitor (pixel telescope)
- Main capabilities:
 - Robotic assembly with $\sim 1 \mu\text{m}$ intrinsic precision
 - Automatic wire bonding (Hesse BJ855 aluminum wedge bonder)
 - Semiconductor characterization (probe station, instrumentation)
 - Encapsulation (Sylgard 186 elastomer/Parylene-N)
 - Mechanical design (Autodesk/SolidWorks)
 - Rapid CNC prototyping or small-scale production of tooling
 - High-speed PCB design and simulation (Cadence)
 - Firmware development and simulation (mostly Xilinx/AMD)

Ancient History: Phase 0 and Phase 1

Phase 0



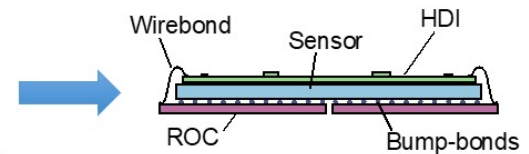
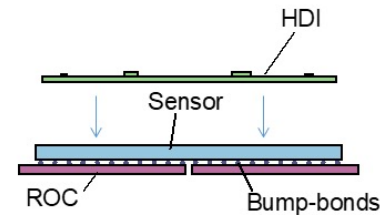
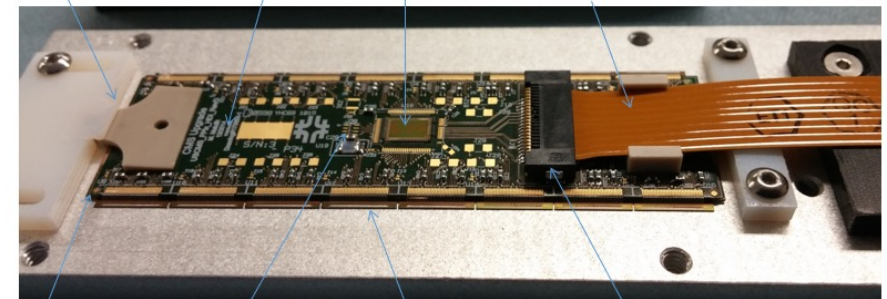
FPix blades have 7 different modules
(we assembled ~1000 modules to yield 672 for installation + spares)



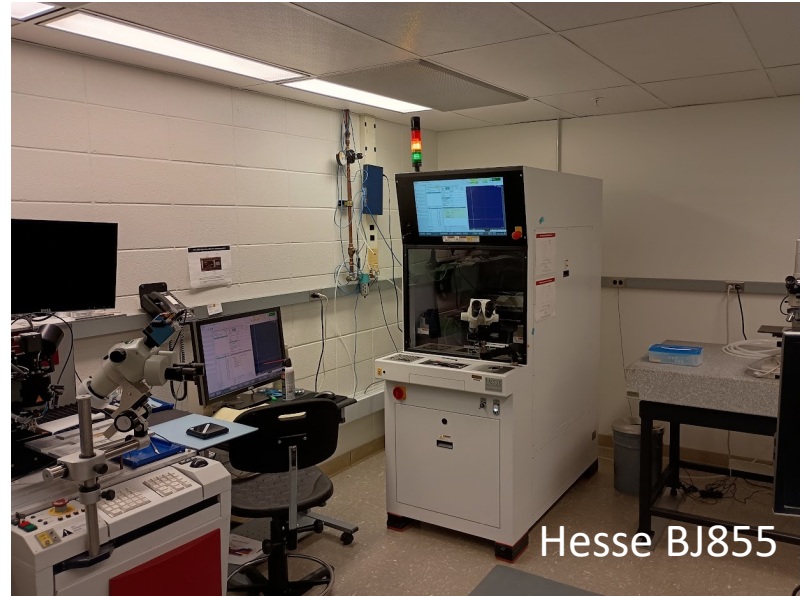
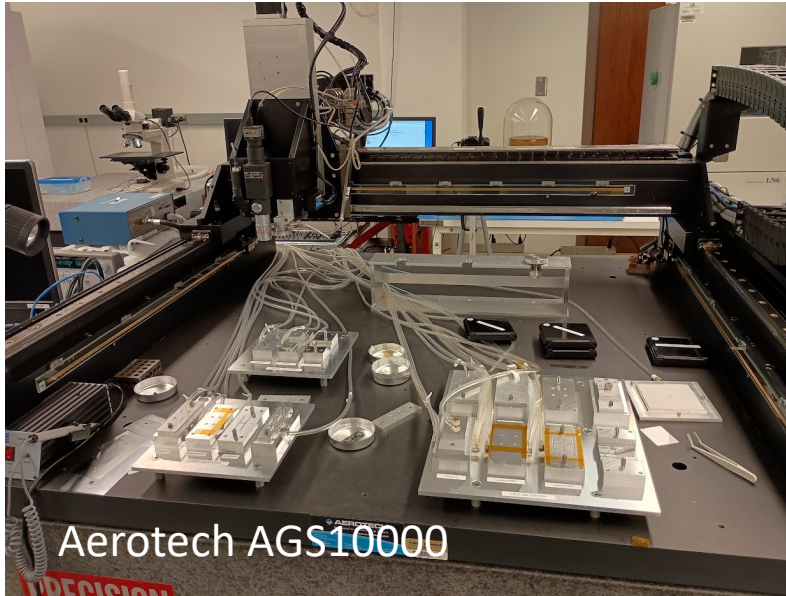
Phase 1

Module end holder
(with thru hole for #00 or M1.2 screw)

Flat flex cable, 75 cm length
(short "connector saver" pigtail flex will be used for testing during assembly)



Robotic Module Assembly

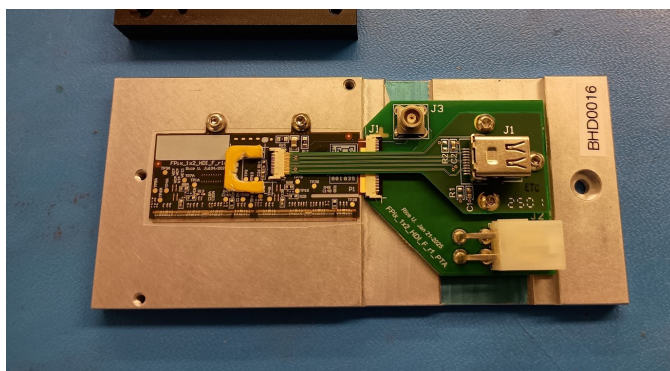
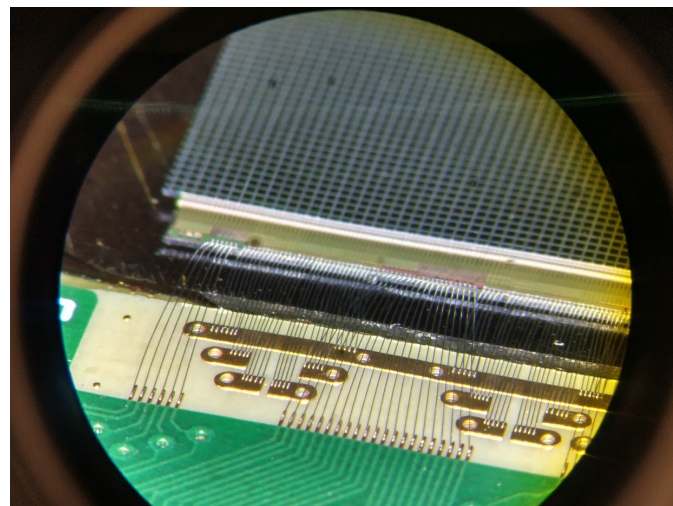
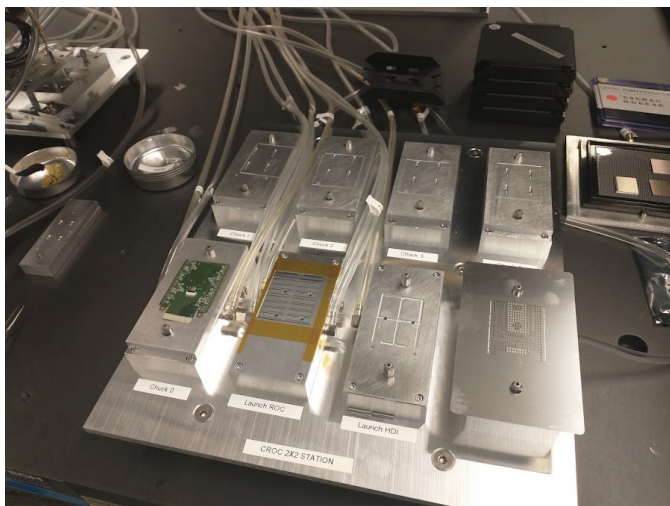


Electrical test equipment:

- Royce wire bond pull tester
- High speed digital oscilloscopes
- Keithely source meters
- Programmable DC power supplies
- MicroTCA racks and modules
- Prototype PCB assembly/rework

TFPX Module Assembly Tooling

- Custom tooling for various types of module assembly and wire bonding



Well understood systematics:

- Placement precision is routinely better than about $5\ \mu\text{m}$
- Epoxy mass controlled to 5%
- Wire bond pull tests typically 10 g (0.2 g RMS)

Birck Nanotechnology Center Clean Room

- Located across campus, we routinely use the BNC clean room facilities for
 - Lithography on 100 mm substrates
 - Wet etching
 - Surface characterization
 - Parylene coating
 - Dicing
 - Plasma cleaning

