

BNL Institutional Capabilities and Interests

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LBNL

BNL Facilities (Physics)

1 Two class 10,000 clean rooms

- Air kept to at most 10,000 dust particles per cubic foot
- Now building and testing silicon strip modules for ATLAS ITk
- ATLAS ITk production planned through 2028
- Large enough to be shared among projects afterwards

2 Fully equipped for assembly and tests

- Wire bonding machines
- Dry storage cabinets
- Metrology stations, microscopes for visual inspection
- Stress testing: hot and cold enclosure, plus long-running burn-in

3 One class 1,000 clean room

4 Laboratory space



Assembly clean room (class 10,000)



Dry storage cabinets



Wire bonding machine

2 class 10,000 rooms

1 class 1,000 room

Assembly and test labs

Potentially shared across projects

BNL Facilities (Instrumentation)

12-inch Wafer Testing and Assembly stations at BNL

A complete in-house facility that can test and build components for the ePIC Silicon Vertex Tracker

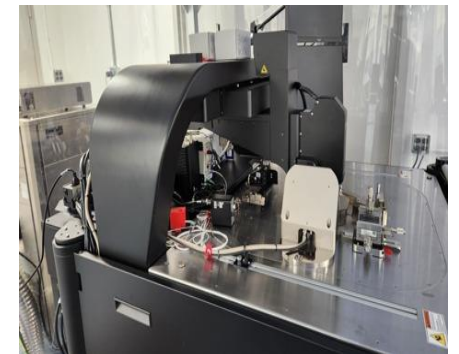
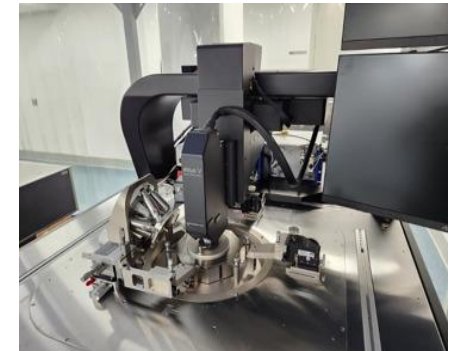
1 Capability for testing full wafers

- Tests every chip across a full 300 mm wafer, automatically
- Runs from -60 °C to +300 °C to test chips at the extremes
- Shielded from electrical noise for very sensitive measurements
- Spots bad chips before the wafer is cut apart

2 Capability for stave tests and assembly

- **Wire bonding:** thin aluminum or gold wires link chips to boards
- **Flip-chip bonding:** combine sensors with PCBs or readout ASICs
- **Quality checks:** x-ray imaging, bond-strength tests, 3-D scans

3 Full chain production capability



FormFactor CM300xi probe station in BNL's new shielded test lab

Test wafers



Select good chips



Bond and connect



Build staves

BNL expertise

1 Monolithic pixel sensors (MAPS)

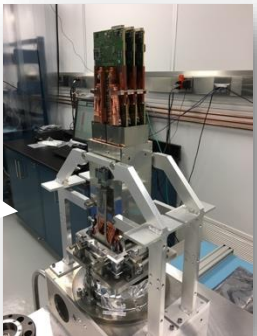
- Sensor electronics co-design, AncASIC, MOSAIX
- sPHENIX MVTX MAPS integration

2 Silicon strip detectors

- PHENIX VTX and FVTX
- sPHENIX INTT silicon strip detector
 - RIKEN project built and assembled at BNL
- ATLAS HL-LHC ITk silicon strip detector

3 Other sensor technologies

- R&D on LGADs and AC-LGADs
- LSST CCD focal plane construction



BNL Summary

Facilities, people and a proven track record in silicon detectors

1 Facilities ready

- Two class 10,000 clean rooms equipped for module and stave production, one class 1,000
- Wire bonding, pull testing, metrology, inspection, thermal and burn-in tests
- 300 mm wafer probe station for MAPS testing

2 Proven track record

- Silicon detectors built and tested: PHENIX VTX & FVTX, sPHENIX INTT, ATLAS HL-LHC ITk strips
- Large-area stave assembly: sPHENIX INTT, ATLAS ITk
- LSST CCD focal plane construction

3 MAPS/AC-LGADs

- EIC-LAS AncASIC, MOSAIX
- R&D LGADs and AC-LGAD

**BNL has capabilities and strong interest to contribute to the
ePIC SVT outer barrel**

From the design and production to assembly, integration and operation