

ATLAS ITk Module Construction at DESY

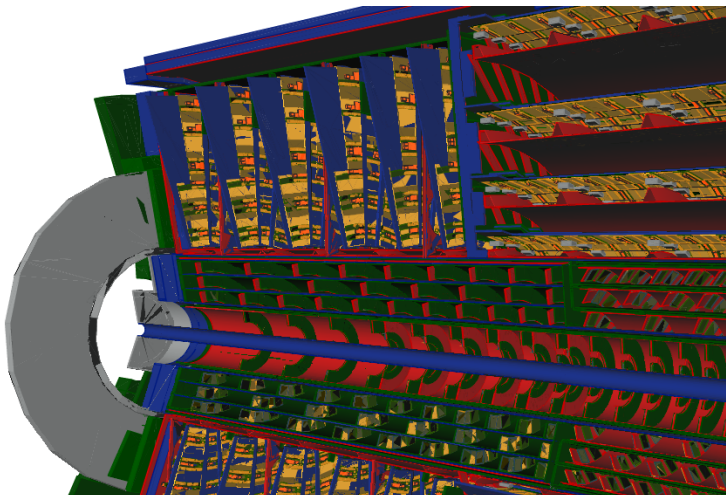
Petar Bokan on behalf of the DESY

ATLAS ITk modules building team

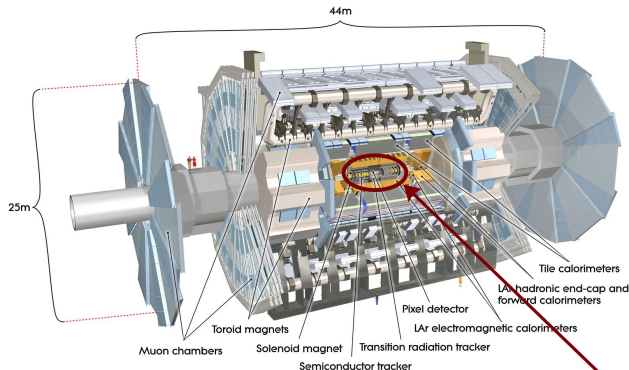
Fortnightly SiDet R&D Meeting; March 16, 2022



ATLAS
EXPERIMENT

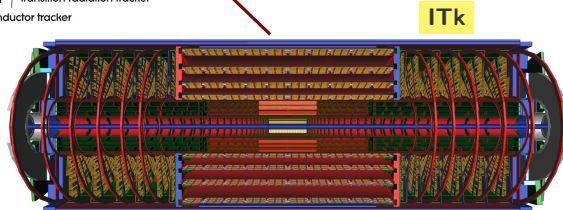


Inner Tracker (ITk)

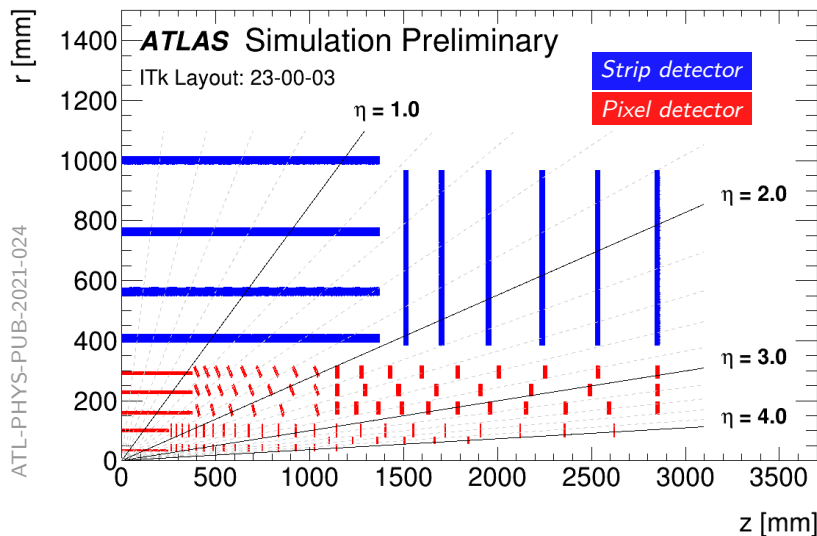


Current ATLAS detector not designed for the harsh radiation environment of the High-Luminosity LHC

Replacing the current Inner Detector with a new all-silicon Inner Tracker (ITk)

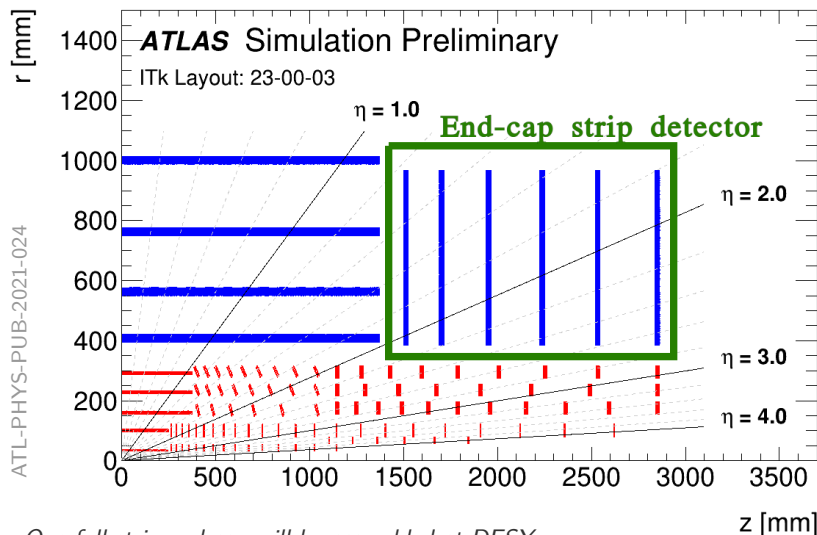


ITk Layout

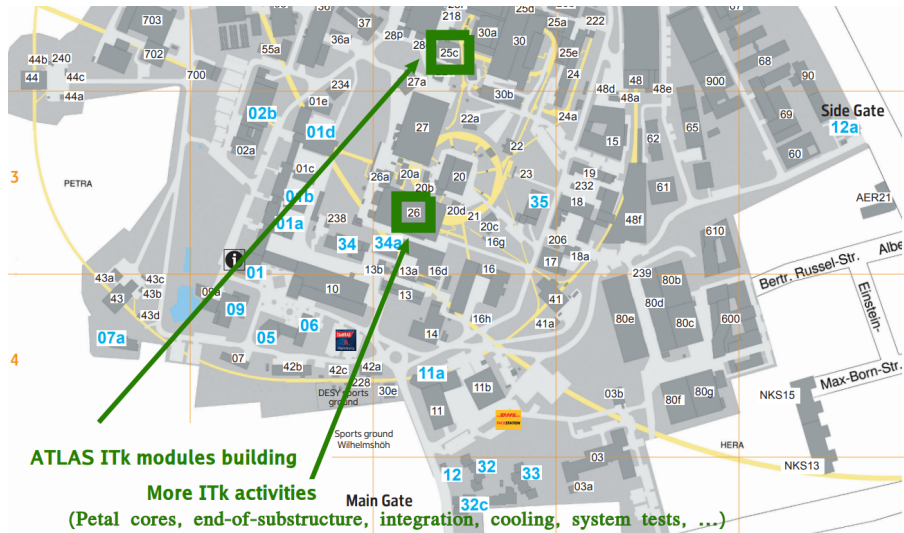


ATL-PHYS-PUB-2021-024

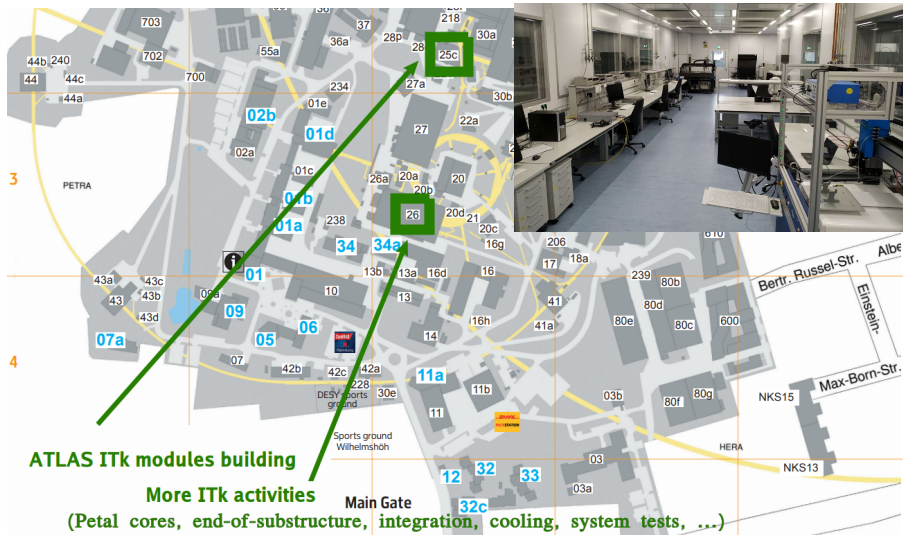
ITk Layout



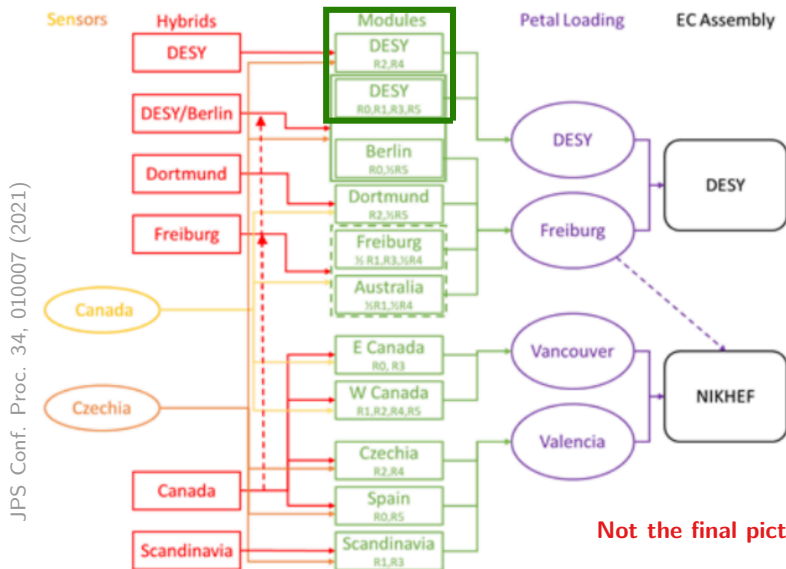
DESY ITk production facilities



DESY ITk production facilities

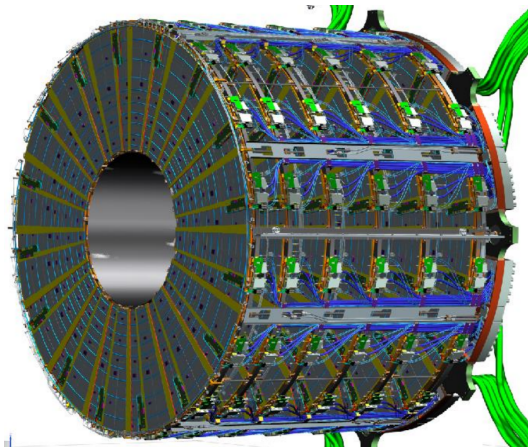


ITk strip end-cap production workflow

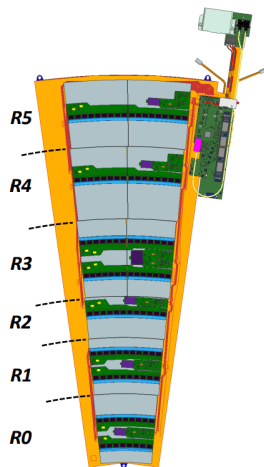


Not the final picture!

ITk strip end-cap

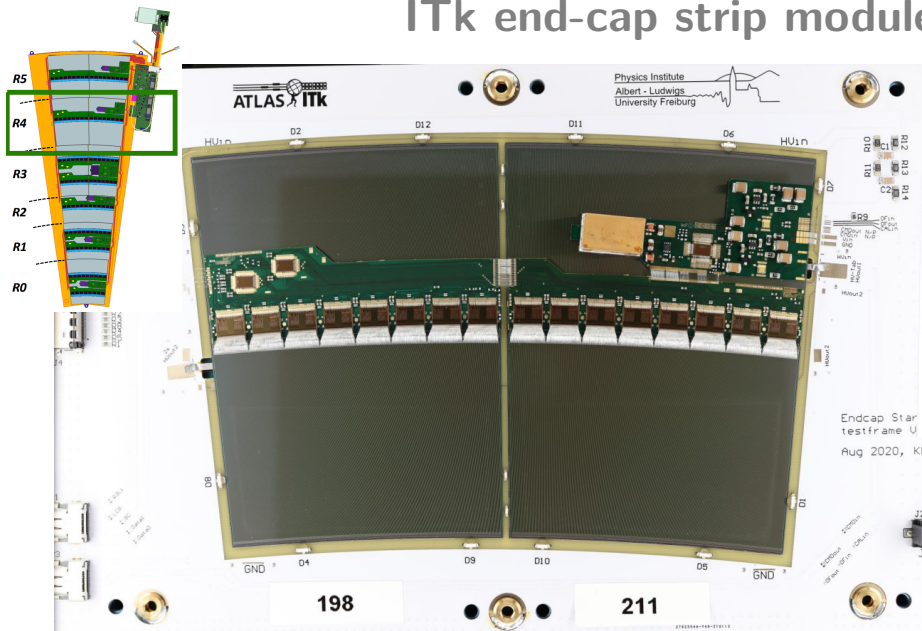


End-cap (6 discs, 192 petals)

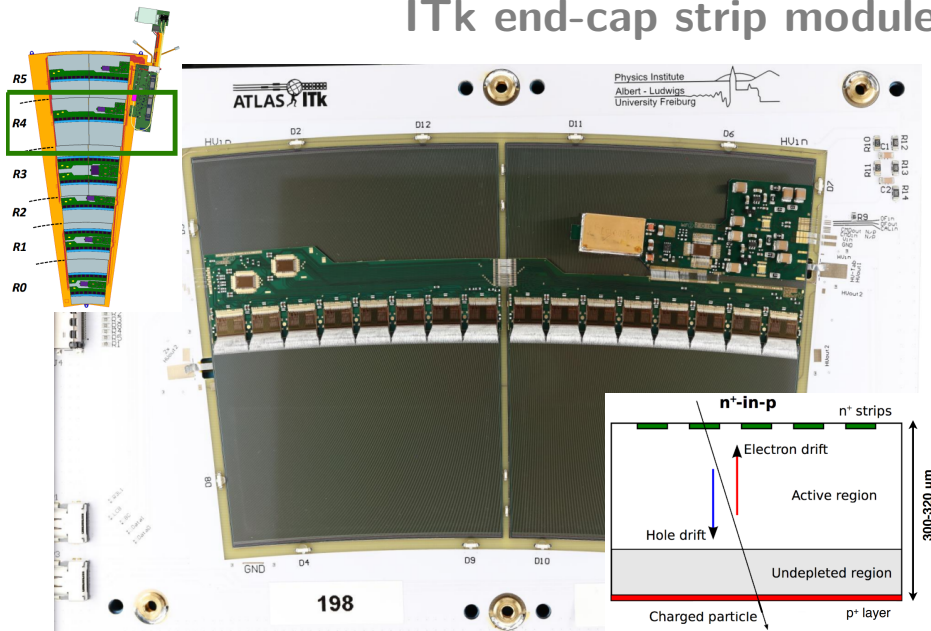


Petal (6 modules on each side)

ITk end-cap strip module

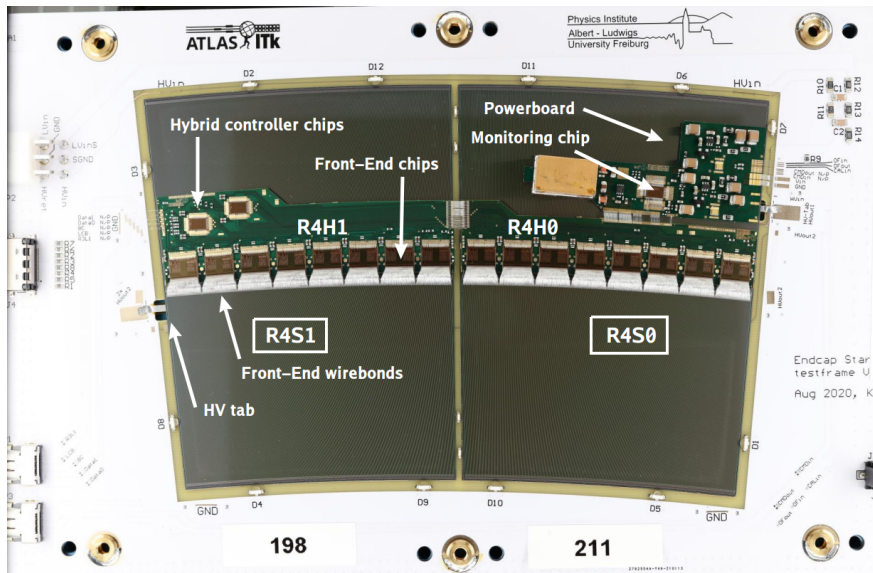


ITk end-cap strip module



Picture from Sergio Díez Cornell's slides (14th Terascale Detector Workshop)

ITk end-cap strip module



Picture from Sergio Díez Cornell's slides (14th Terascale Detector Workshop)

Reception of components

Sensors

- Visual inspection
- IV curve
- Bond-pull tests

HV tabs

- Visual inspection
- Bond-pull tests

Powerboards

- Visual inspection
- Electrical tests
- Bond-pull tests

Hybrids

- (Assembled)
- Visual inspection
- Electrical tests
- Bond-pull tests

Testframes

- Reception tests

Visual inspection

Sensors

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- IV curve
- Bond-pull tests

HV tabs

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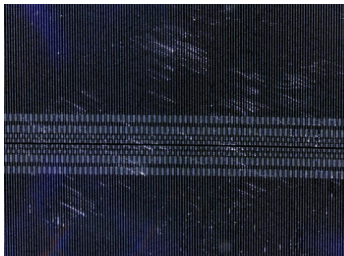
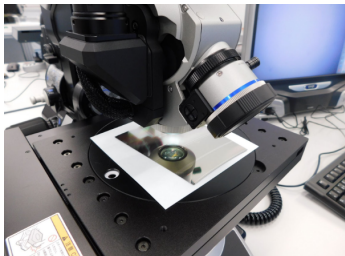
Hybrids

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Testframes

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Visual inspection mostly done using a microscope
An example of a scratched sensor



Sensor IV curve

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HV tabs

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Powerboards

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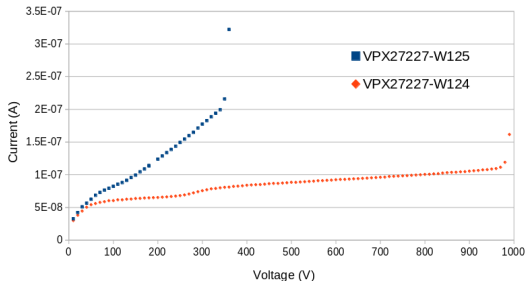
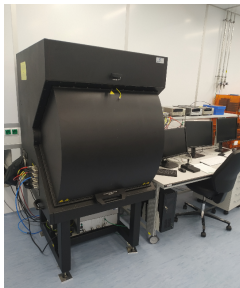
Hybrids

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- Visual inspection
- Electrical tests
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Testframes

- Reception tests

*Sensor **IV** curves measured using a probe station*



Bond-pull testing

Sensors

- Visual inspection
- IV curve
- Bond-pull tests

HV tabs

- Visual inspection
- Bond-pull tests

Powerboards

- Visual inspection
- Electrical tests
- Bond-pull tests

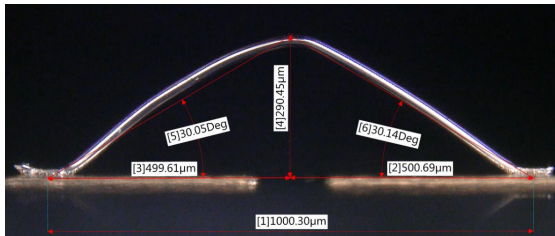
Hybrids

- (Assembled)
- Visual inspection
- Electrical tests
- Bond-pull tests

Testframes

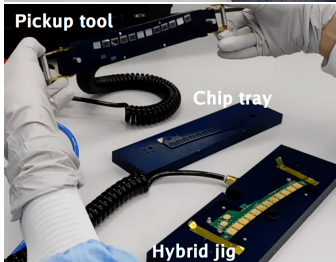
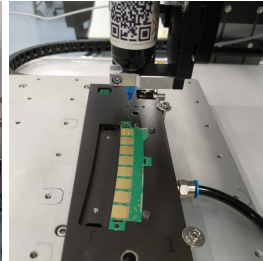
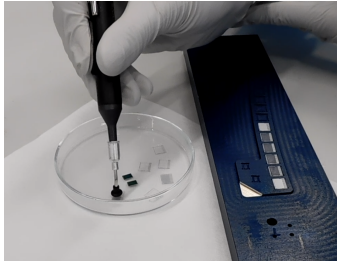
- Reception tests

Bond-pull tester and an example of a measured pull-test angle



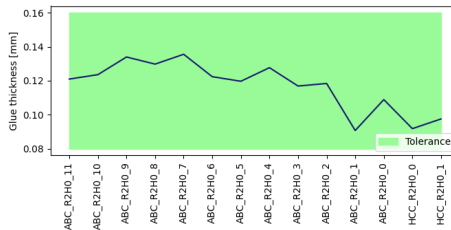
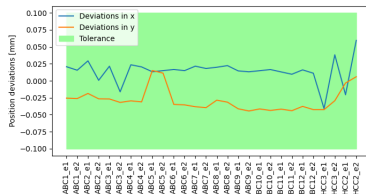
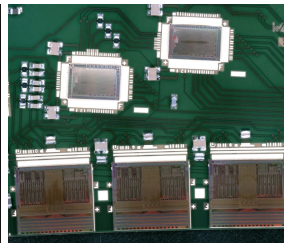
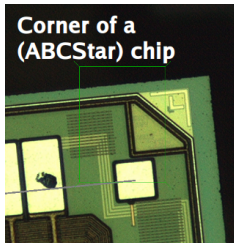
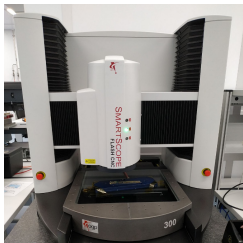
Hybrid assembly

DESY-HH is a backup site for the R2 and R4 *hybrid assembly*

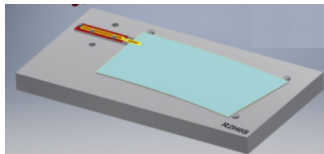
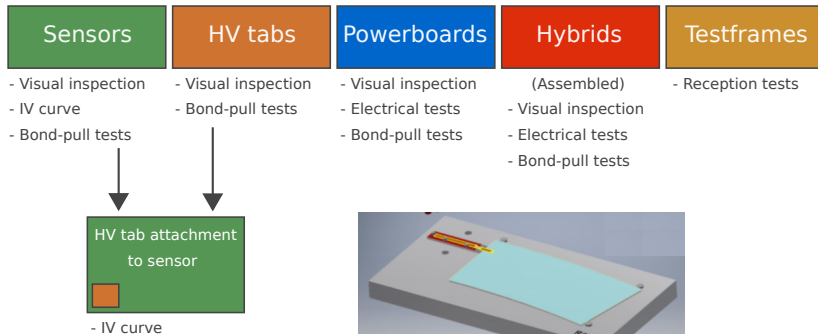


Hybrid metrology

Metrology performed using pattern recognition features of a Smartscope

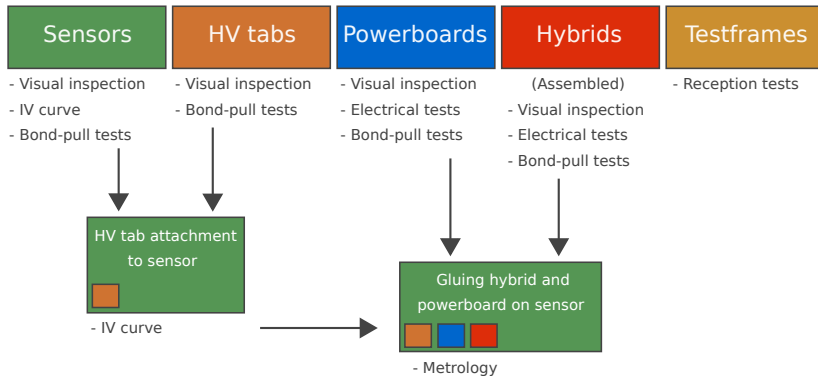


HV tab attachment

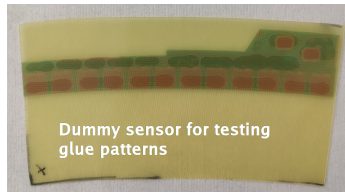
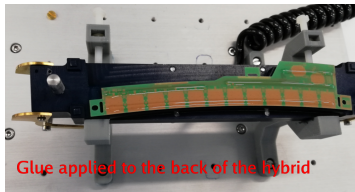
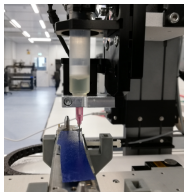


For allowing to bias the sensors with high voltage

Module assembly

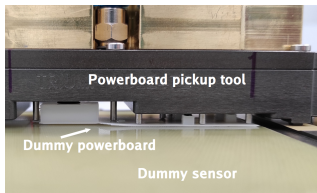
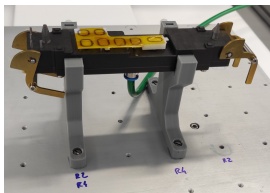


Hybrid- and powerboard-to-sensor gluing

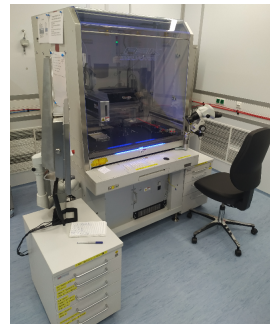
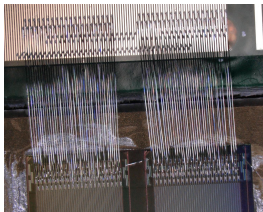
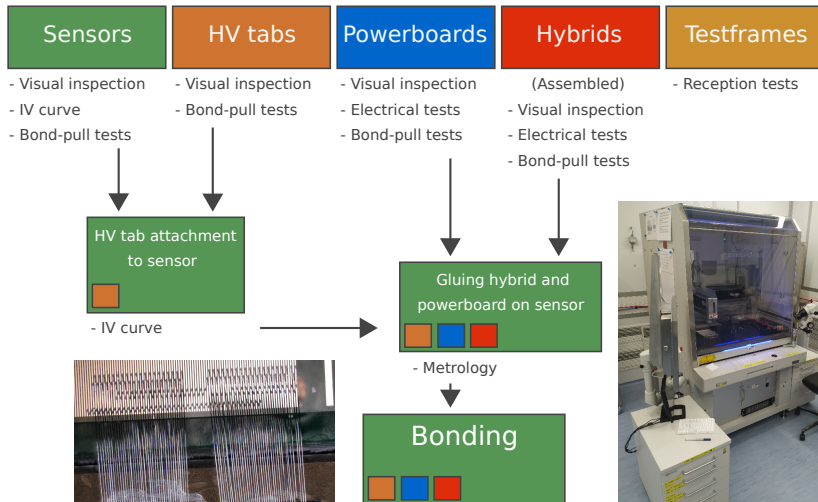


*Thinky mixer used for mixing and degassing the Polaris glue
(rasin:hardener = 100:9)*

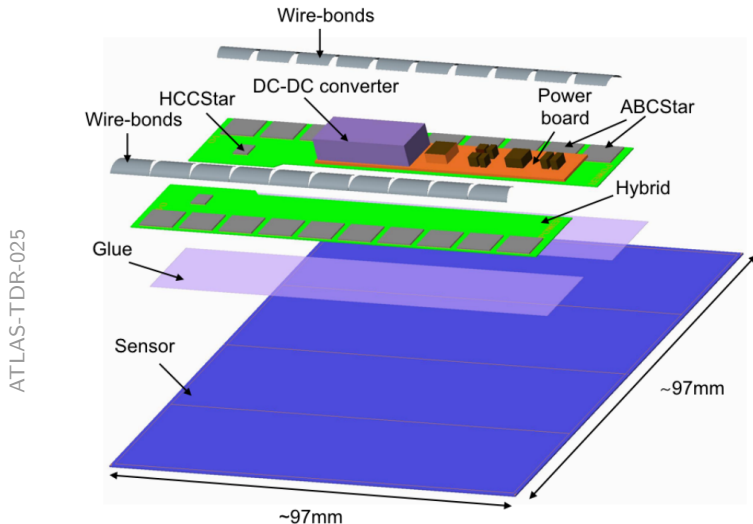
Curing of the glue takes 8 hours



Bonding

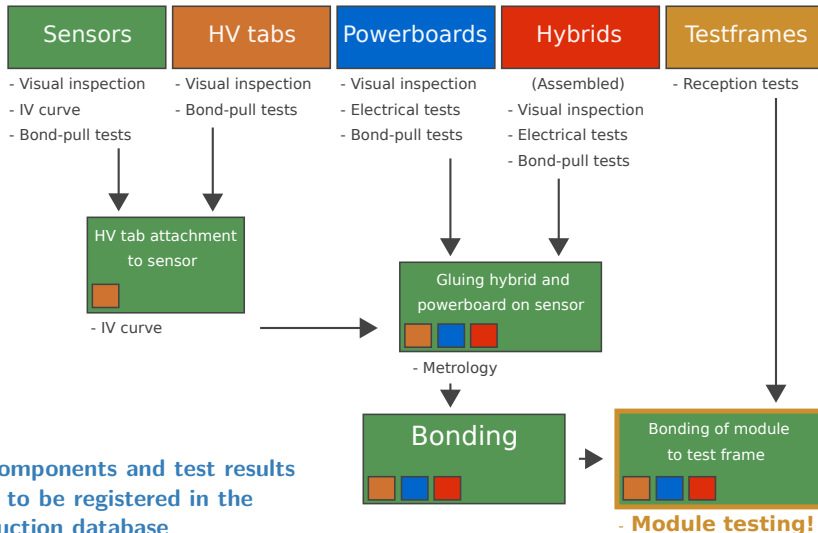


Exploded view of a module



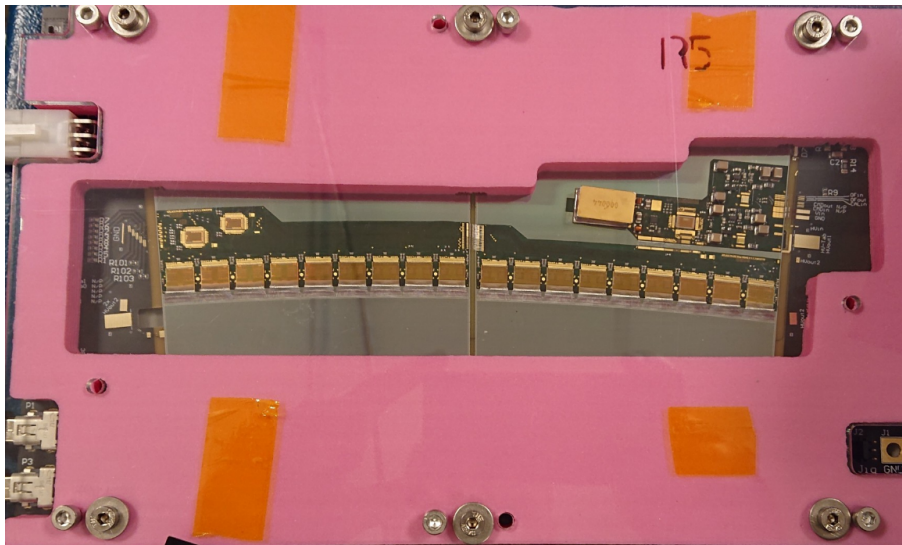
Short-strip barrel module
(for illustration)

Module production flow at DESY



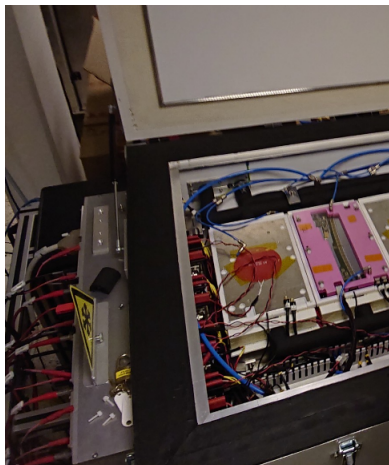
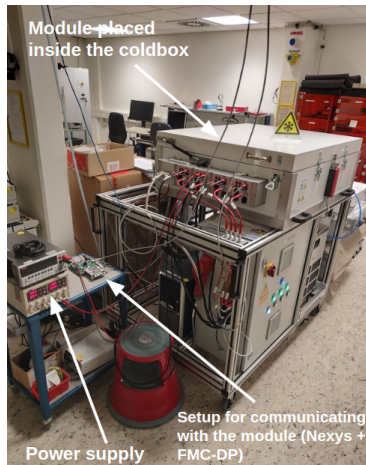
All components and test results need to be registered in the production database

Module in the test frame



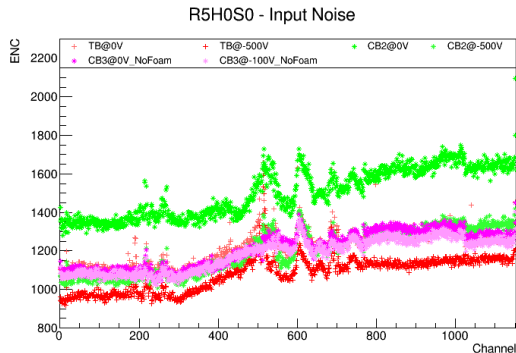
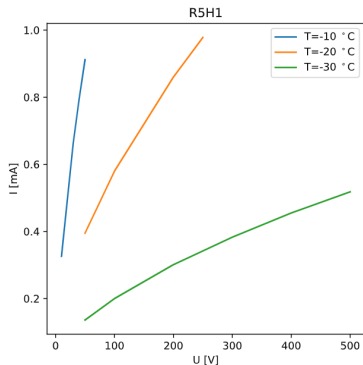
Module testing

*Setup in the clean room, but also working with the prototype **cold box** in the Elab (B1, built by DESY)*



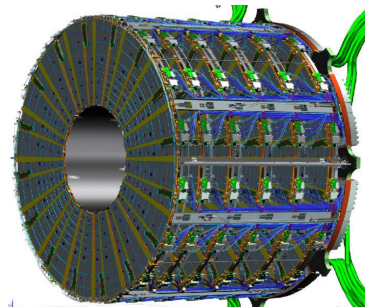
Module testing

An example: trying to solve high-noise levels in an irradiated R5 module

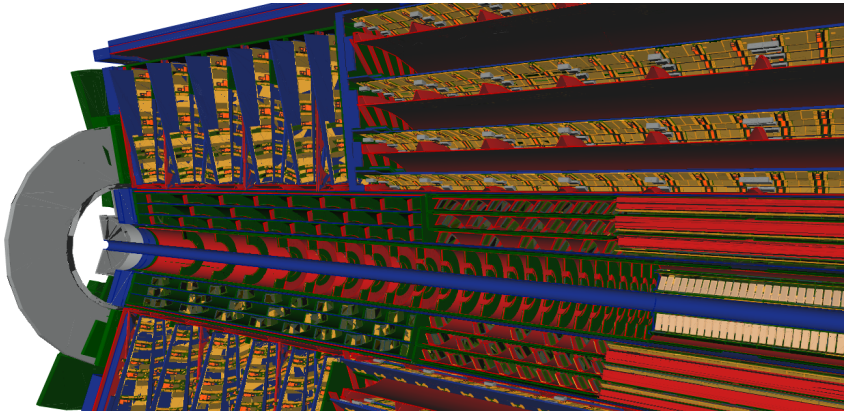


Conclusion & Outlook

- DESY is heavily involved in the ITk production and instrumentation
(Sensor testing, module production, loading and testing, petal cores, end-of-substructure cards, integration, cooling, system tests, ...)
- A lot of progress made towards the full qualification of DESY-HH as one of the ITk modules building production sites
- Different module assembly steps studied extensively – procedures mostly established
- Pre-production campaigns ongoing to test procedures with real parts
- Next steps are to finalize the site qualification procedures and further optimize our production workflow



Thank you for your attention



Backup