

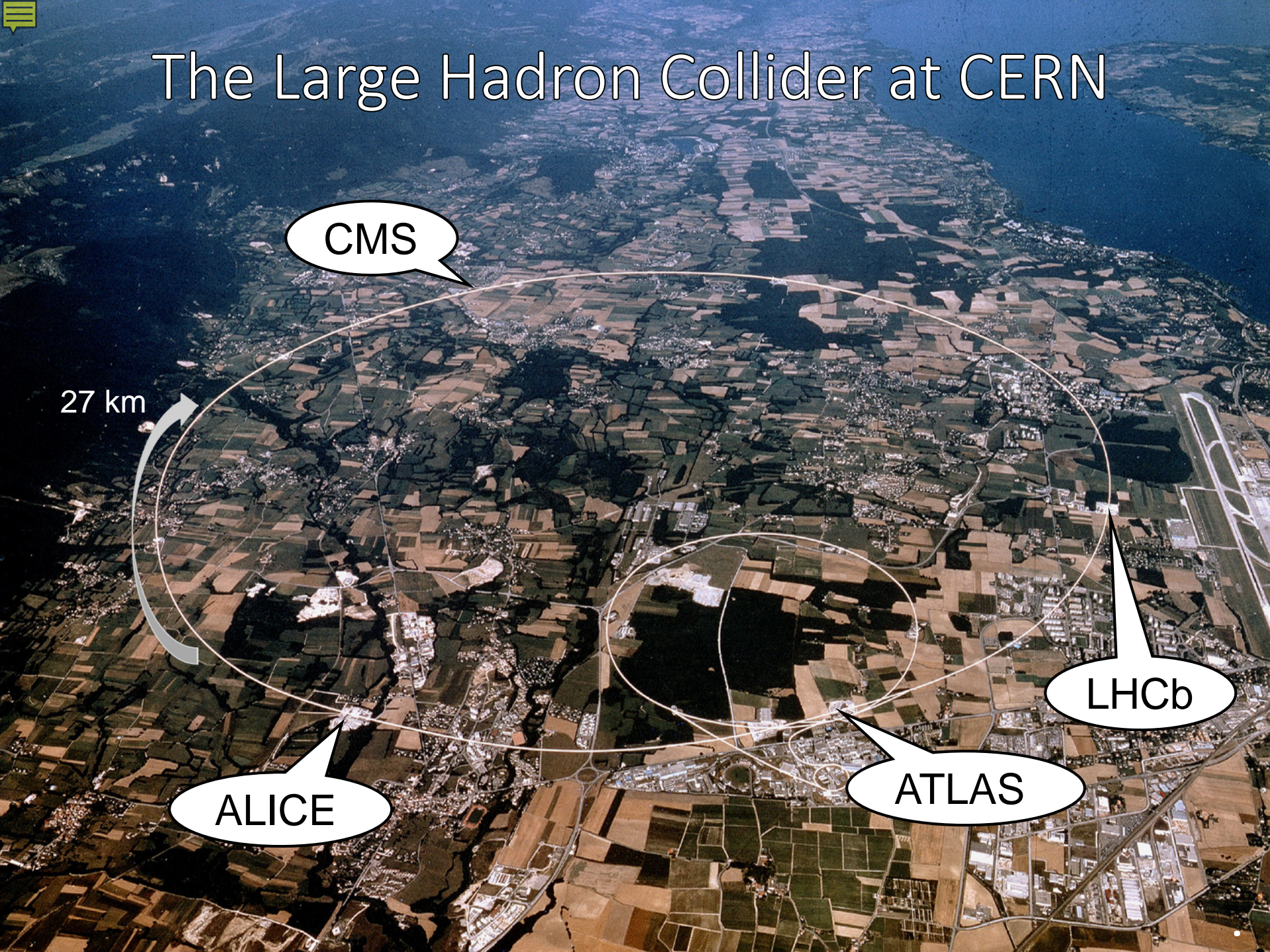
ATLAS ITk Strip Module Production

Xin SHI

On behalf of the IHEP/THU ATLAS ITk Group

23 December 2017

The Large Hadron Collider at CERN



CMS

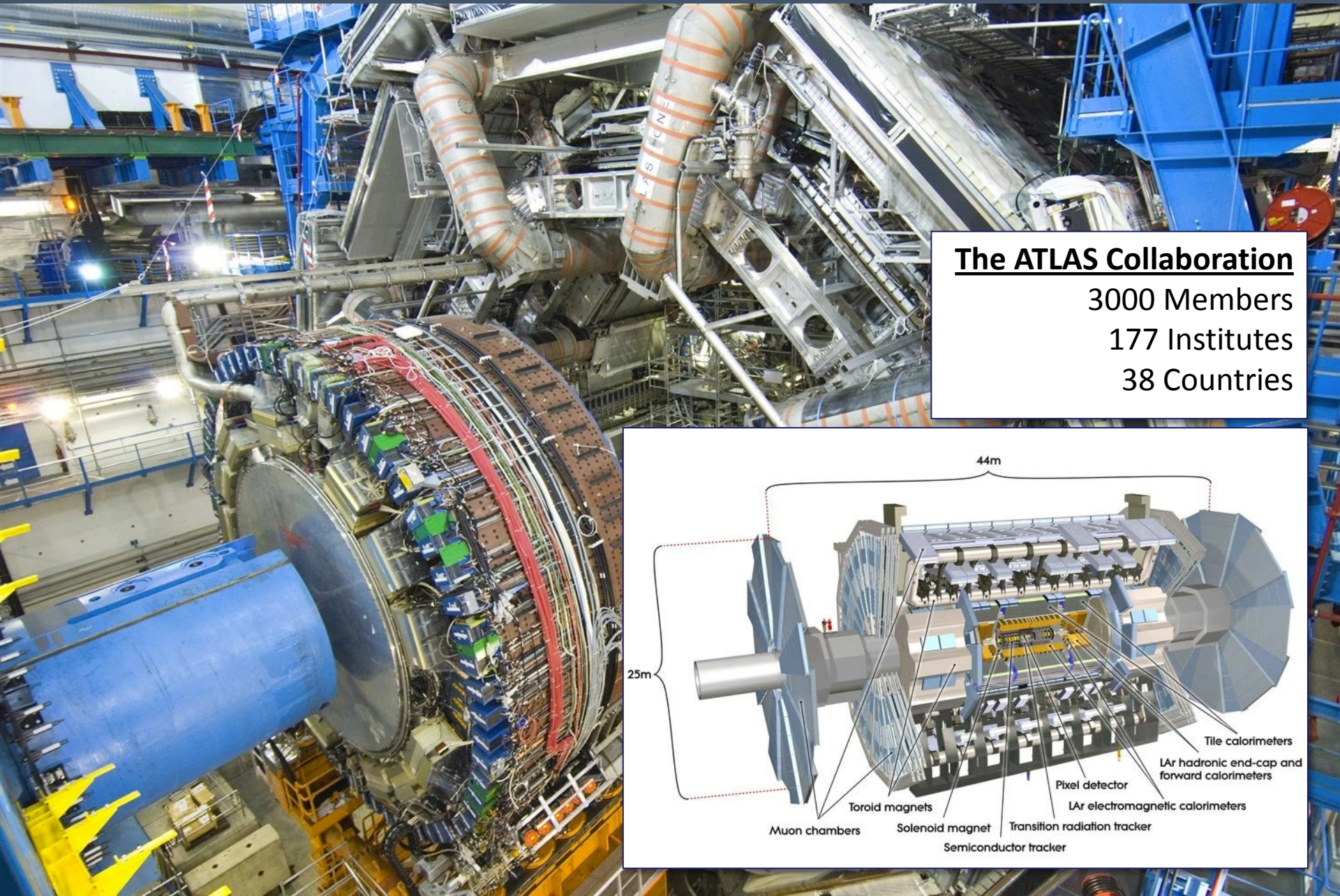
27 km

ALICE

ATLAS

LHCb

LHC Point 1: The ATLAS Experiment

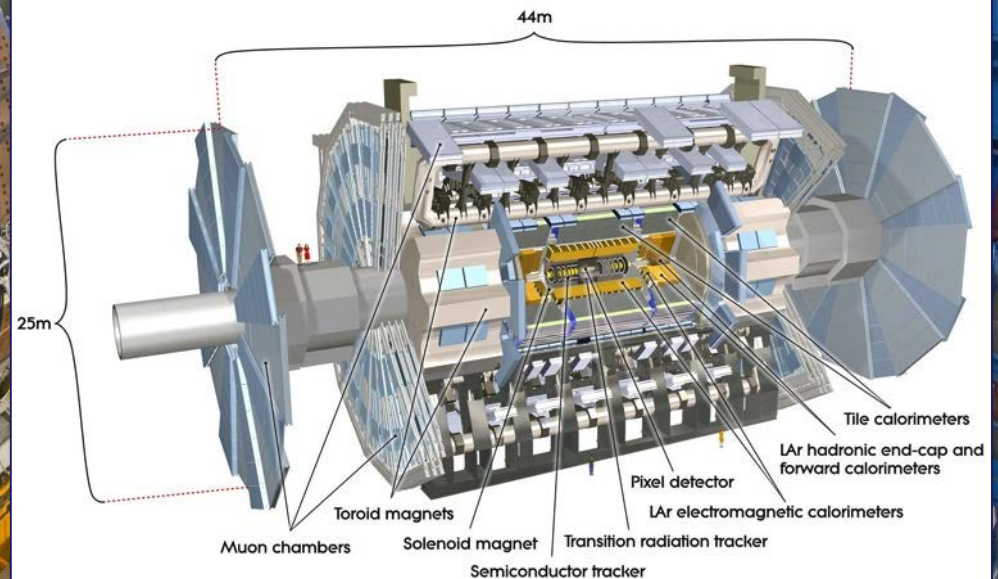


The ATLAS Collaboration

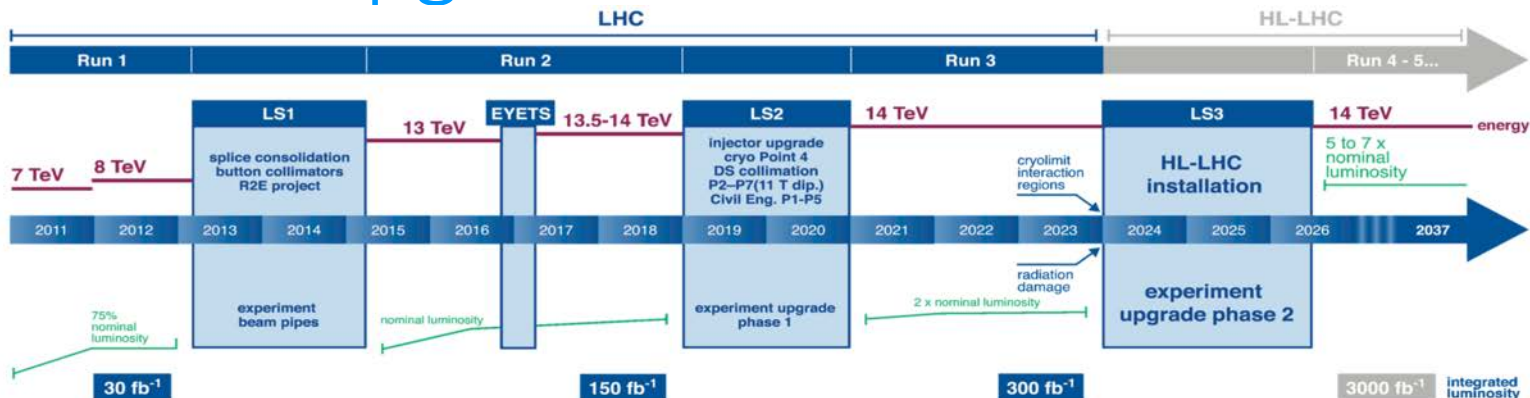
3000 Members

177 Institutes

38 Countries

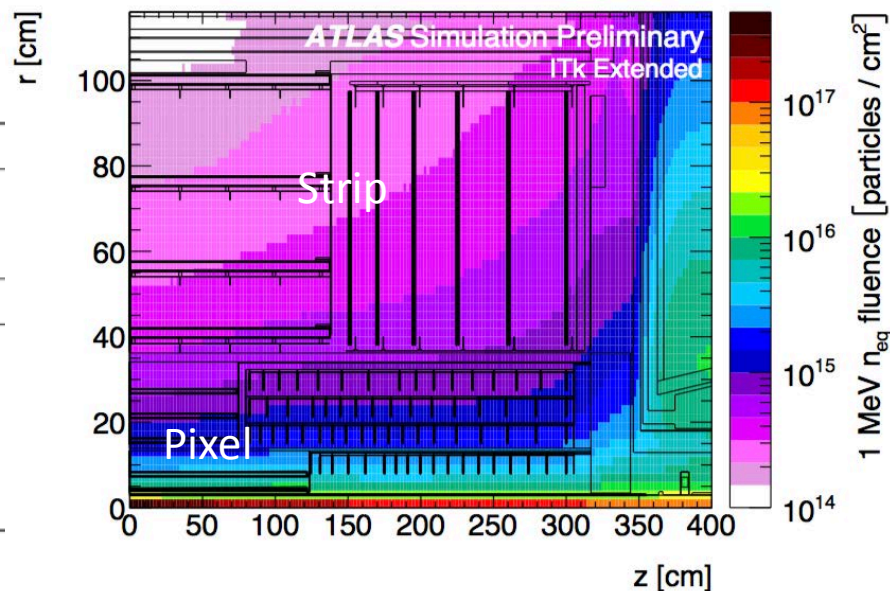


ATLAS ITk Upgrade



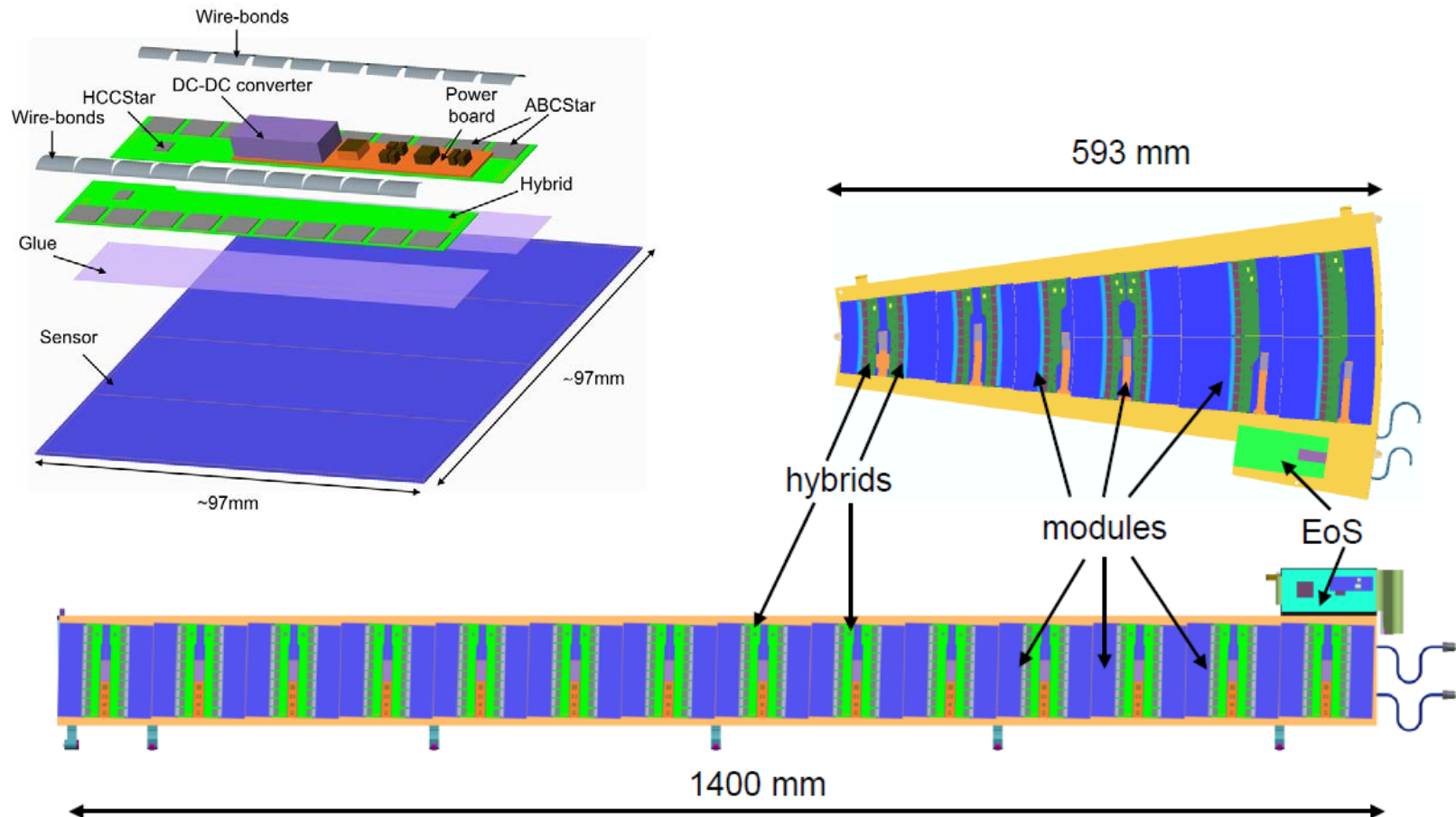
- ATLAS Detector upgrade for the LHC high luminosity upgrade, all silicon tracking device

Layer	Radius [mm]	Maximal Fluence [n_{eq}/cm^2]	Maximal Dose [MRad]
Strips			
Long Strips	762	4.2×10^{14}	10.7
Short Strips	405	8.1×10^{14}	35.7
End-cap	385	1.2×10^{15}	50.4
Pixels			
Layer 0	39	2.25×10^{16}	1710
Layer 1	75	0.82×10^{16}	715
Layer 2	155	0.25×10^{16}	148
Layer 3	213	0.12×10^{16}	96
Layer 4	271	0.12×10^{16}	61
End-cap	80	0.67×10^{16}	687

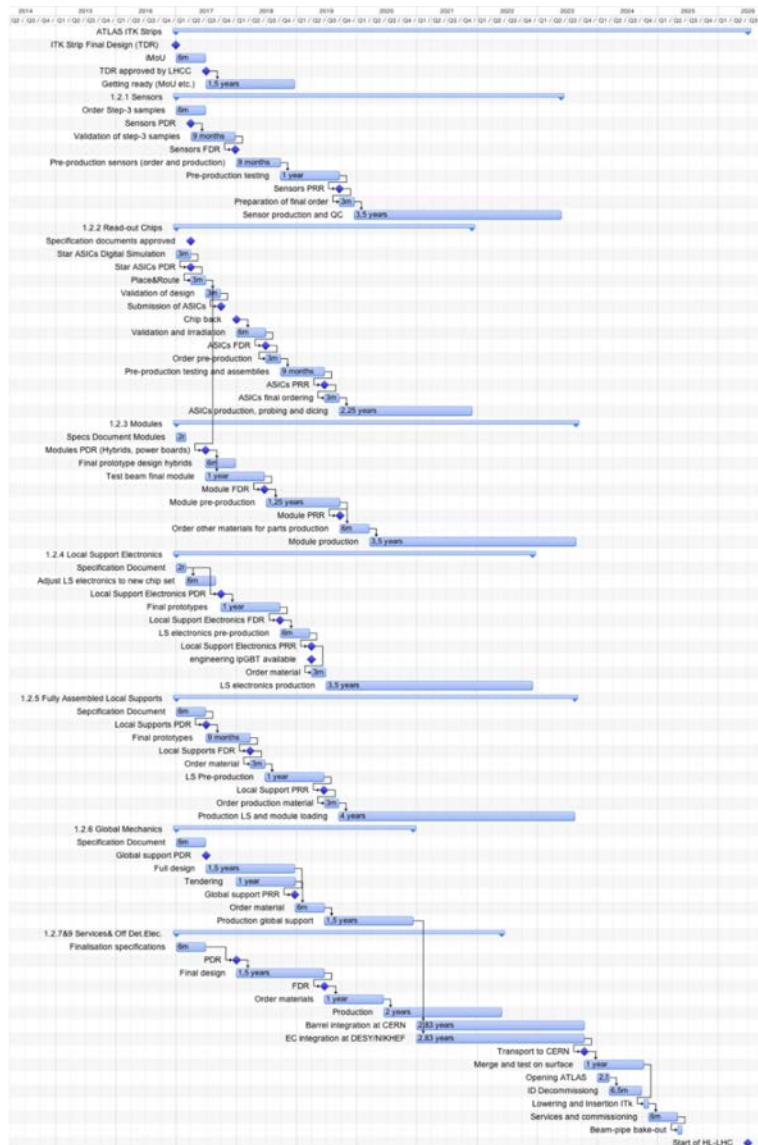


ITk Silicon Strip Detector Concept

- Stave/Petal + Mechanics Supported Silicon Modules



ITk Upgrade Project Timeline



2017: ITk-STRIP TDR

Mid-2018: Pre-Production

2019: Production Readiness Reviews

2024: Detector Install

The Team

8 Staff Members (7 IHEP + 1 THU)



Xinchou Lou



Joao da Costa



Hongbo Zhu



Weiguo Lu



Xin Shi



Zhijun Liang



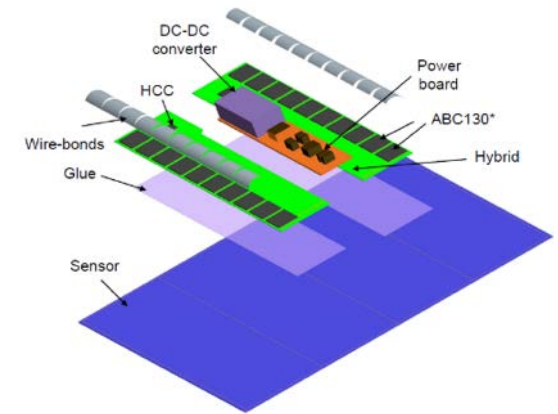
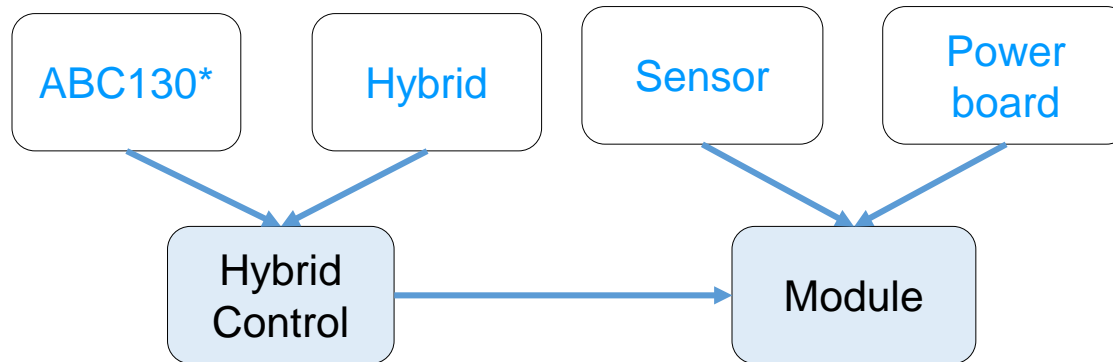
Yiming Li



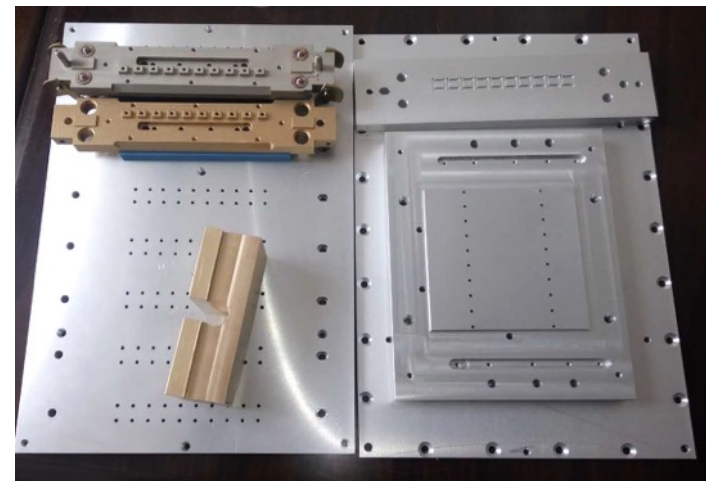
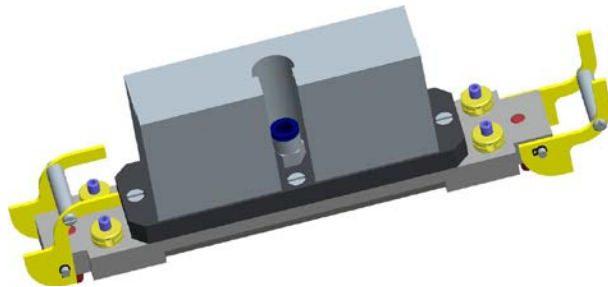
Xin Chen

Assembly and tests of barrel modules

- Produce 50 working modules during pre-production

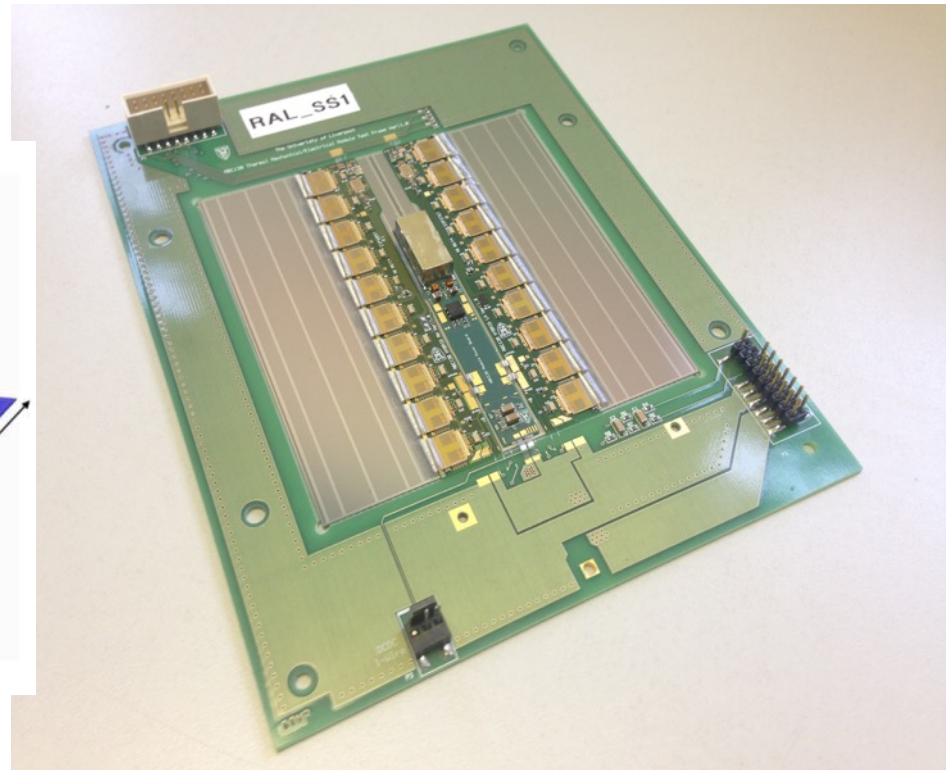
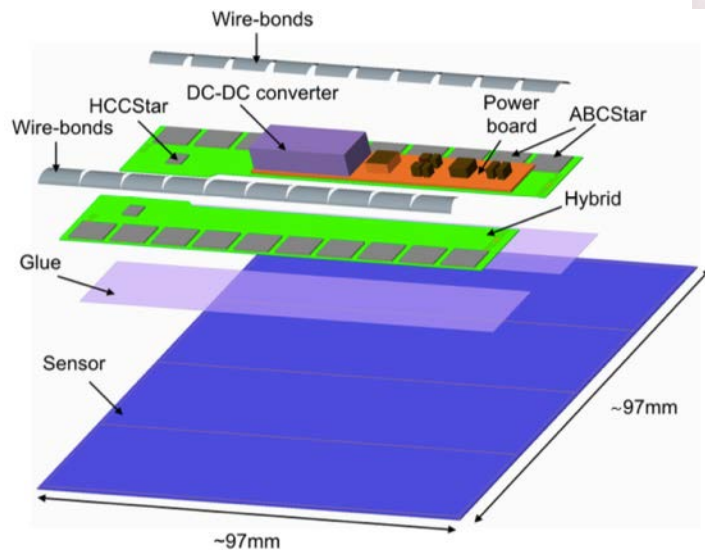


- Tooling for module handling



Silicon Strip Detector Module

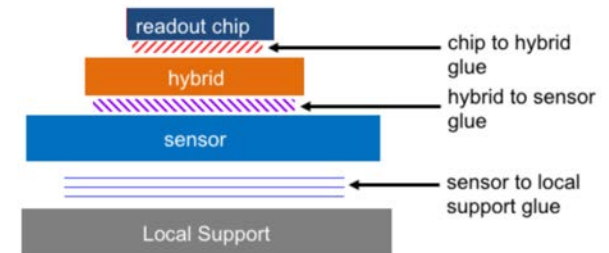
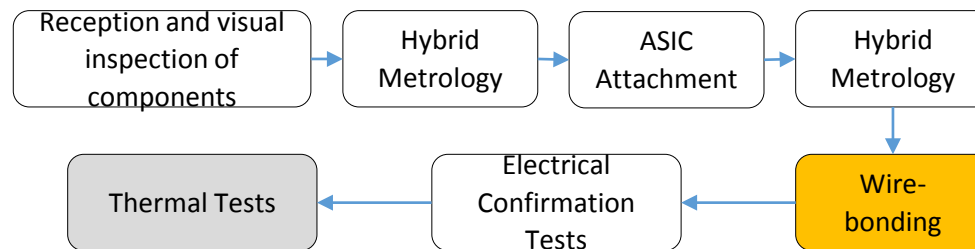
- Silicon Sensor + Hybrid PCB (with Readout ASICs and control chips) + Power board + Glue and Wire-bonds



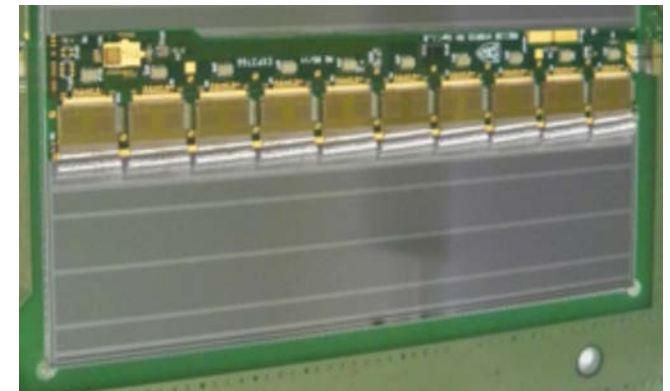
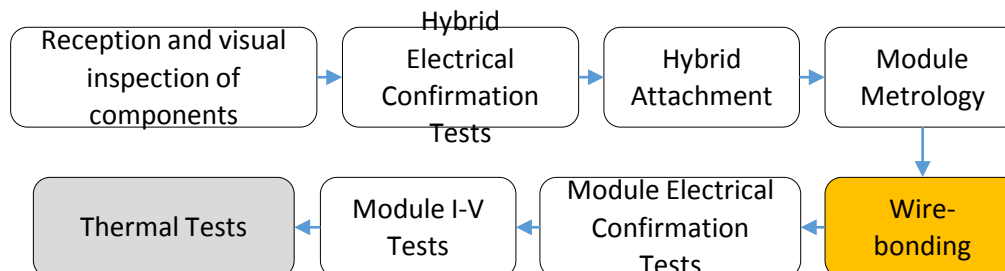
Quality Control

- Based on the prototype study, along with the current ATLAS SCT detector experience, improve the quality control (QC) of module production process

Control board QC

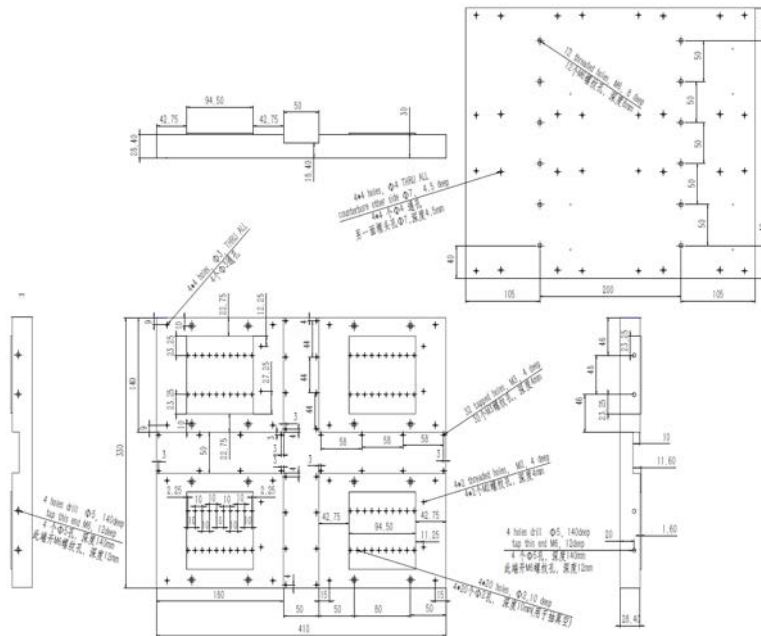


Detector Module QC

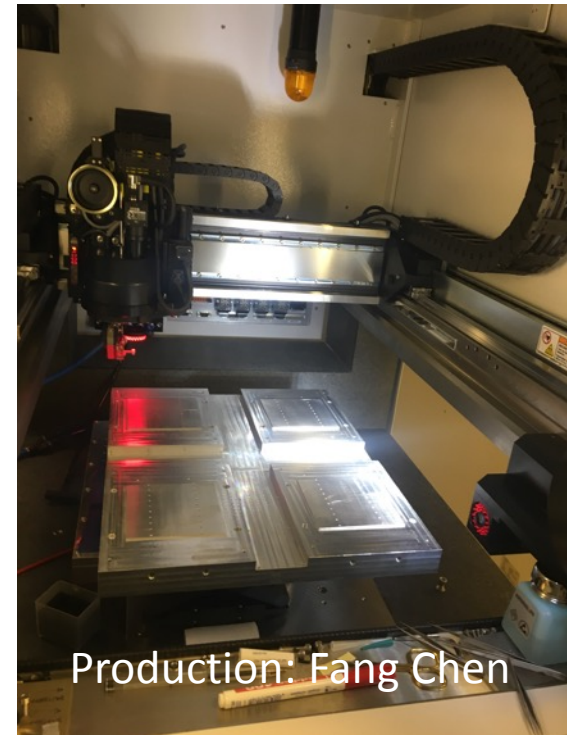


Module QC Task: Evaluate max no. of modules in a bonder – by IHEP

- Design and fabricated at IHEP, Polished at RAL
- Placed under BondJet820: dimensions fit, bonding head can reach to the four corners.
- Next: to evaluate with modules on jig



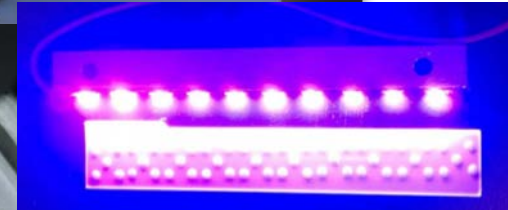
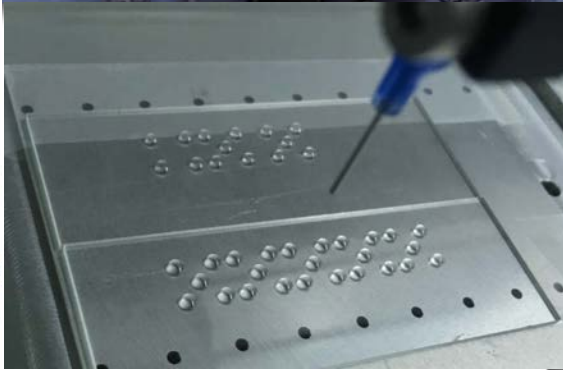
Drawing: Yuzhen Yang



Production: Fang Chen

IHEP Lab for ITk Upgrade

- An existing class 1000 Cleanroom with 150m²



- OGP Flash CNC 300 already purchased
- Hesse BondJet820 received

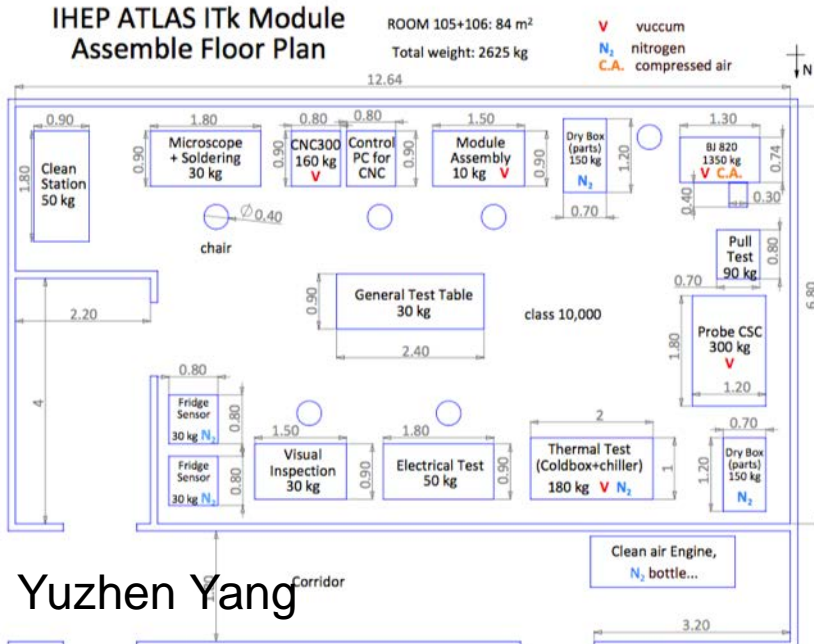


Flash CNC 300



HESSE BJ820

Cleanroom for mass production



A new cleanroom is proposed for the strip production



- Reinforcement of the floor has been completed

Radiation-hard ASICs Import Issue

- **Rad-hard ASICs under export control** → obstacle for our direct involvement in some high-tech detector projects
- **Main driving factors:** China's deeper involvements in detector operation , software development, and physics analyses, and continuous investment into various detector upgrade projects (Phase 0/I/II) → **increased contributions, higher visibility (across all LHC experiments!)**
- **Discussion over years and official requests** to the ATLAS upgrade management, which were escalated to the CERN management → started coordinating between ATLAS/CMS experiments and obtained **export license from US DoC**
 - **Overall package** (valid for process and ATLAS/CMS projects), valid for seven years
 - Much less difficult to apply for SECO (Swiss export license)
- Received the first **ABC130 (strip readout ASIC)** which allows setting up the local module test system

Milestone of the project



Collaboration with RAL

- RAL in UK is the leading institution on ATLAS ITk upgrade.

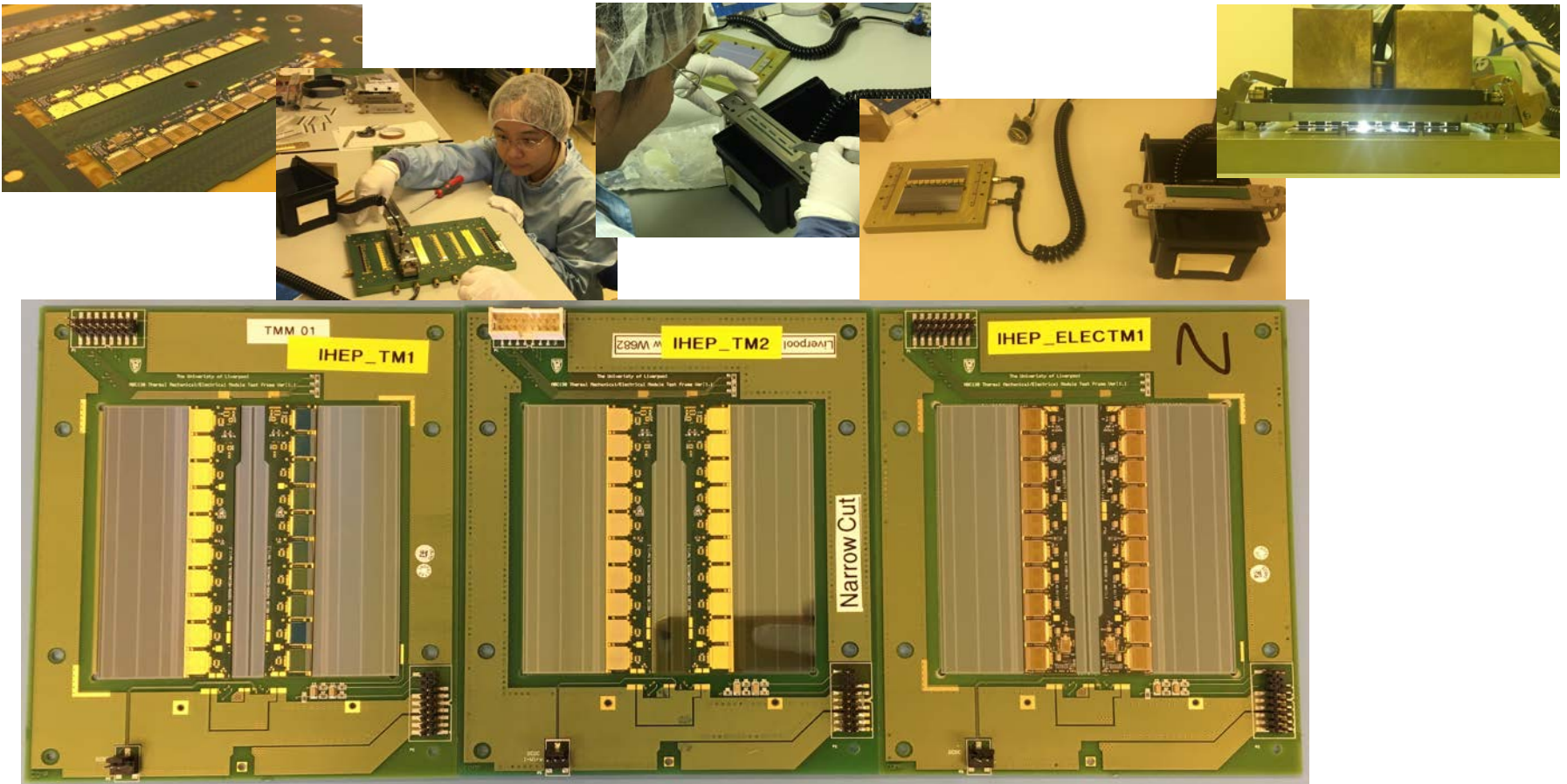


IHEP Team visited RAL on
September 19, 2016

- MoU to be signed with RAL
- Staff rotation plan to maintain 2 FTE's at RAL for the coming years.
- Invited RAL collaborators to China.
 - Giulio Villani visited IHEP in Dec 2017
 - Craig Sawyer will visit IHEP in Jan 2018

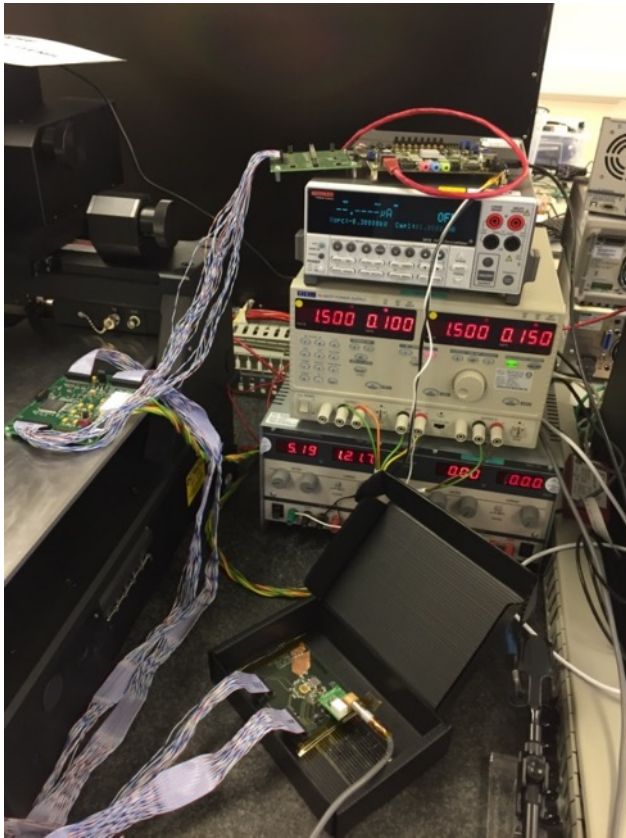
Module Production at RAL

- Glued three modules (two thermal mechanical and one electrical)
- Passed electrical test after wire bonding.

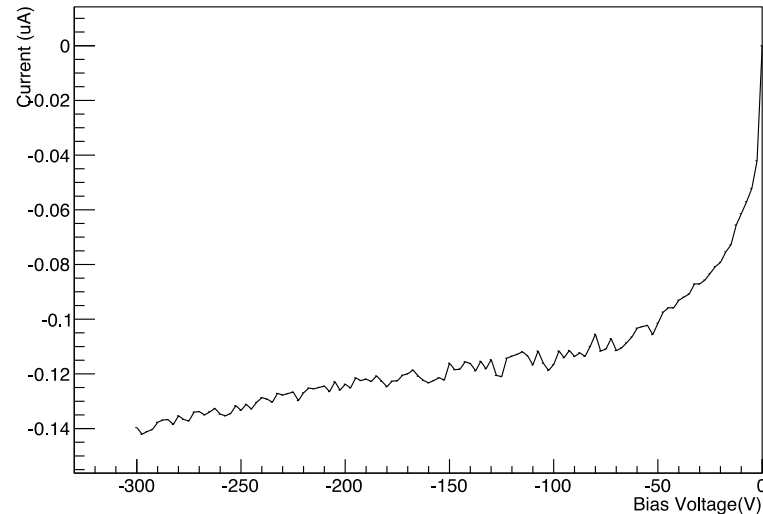


Sensor Electrical test at RAL

- ATLAS 07 Mini Sensor + ABC130 , Learn basic silicon strip sensor test, measure I-V and Equivalent Input Noise



IV Data from k2410 at resource ASRL12::INSTR



偏置电压	-10 V	-100 V	-300 V
Sensor + ASIC	597.9e	565.9e	563.5e
ASIC	450.5e	449.5e	448.4e

Participation of Module Testbeam at DESY

- ATLAS R0 module and SS module test at E-lab in DESY May 2017
- Xiaocong Ai, Liejian Chen and Yi Liu



Summary

- The HL-LHC upgrade requires ATLAS ITk upgrade to meet the challenge
- IHEP/THU ATLAS ITk team is making steady progress on barrel module assembly and tests
- More experience will be brought back to China