

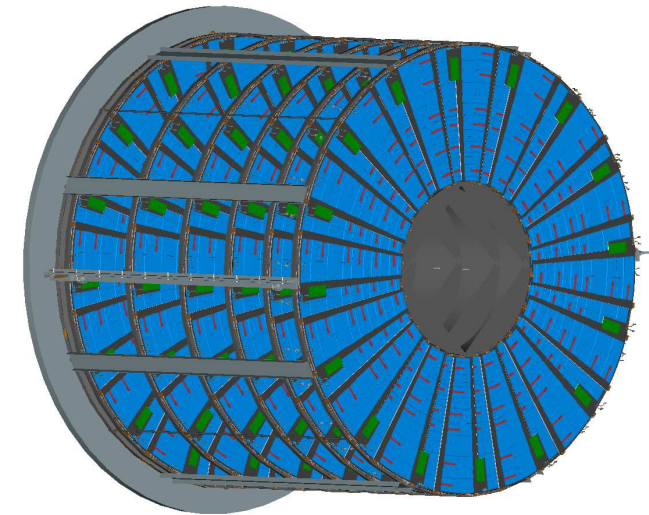
Detector Assembly Facility (DAF) and the LHC Upgrade Plans at DESY

The DESY LHC Upgrade Project



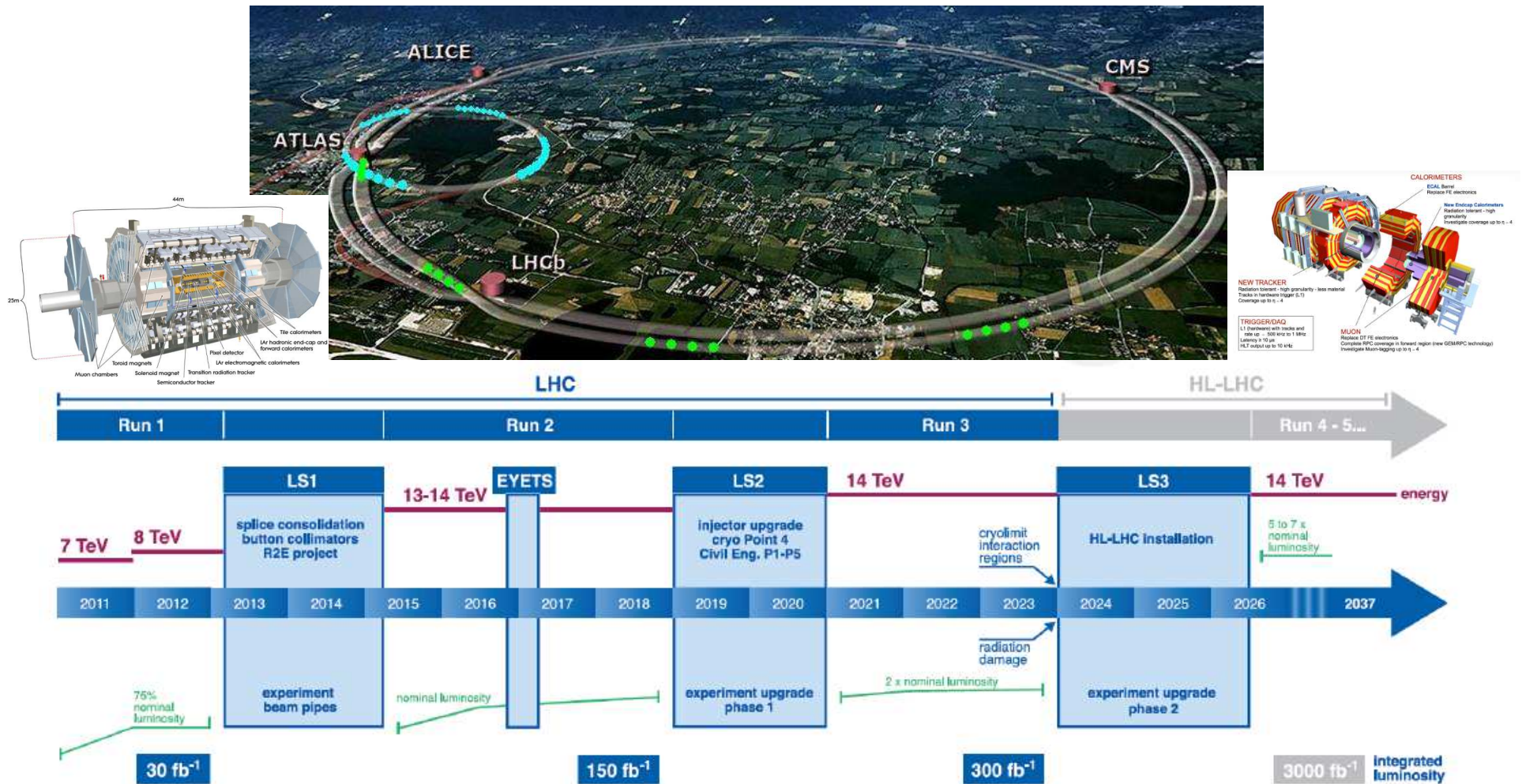
Current Endcap of the CMS tracking detector in the TIF at CERN

- HL-LHC & Upgrades
- Tracker Endcaps
- DAF
- R&D Activities
- Summary



Planned endcap of the ATLAS Silicon-Tracker

HL-LHC - Aiming for 3000 fb⁻¹

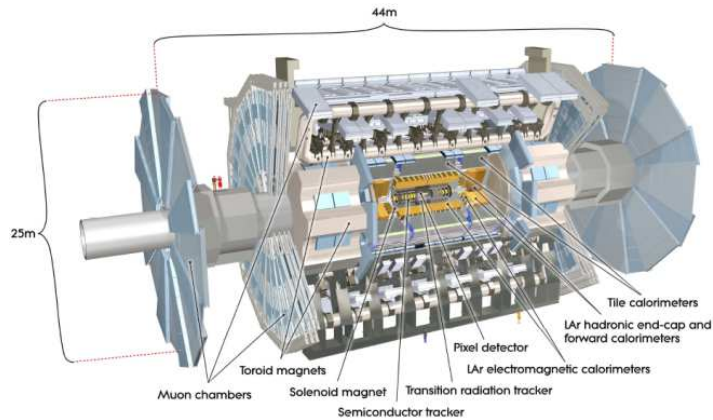


higher luminosity
higher sensitivity

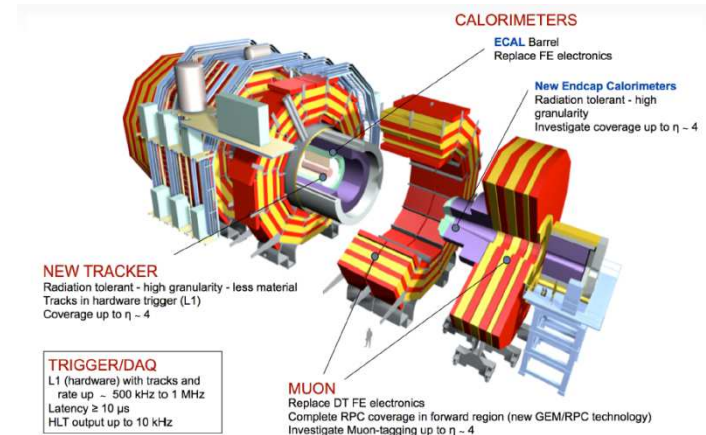
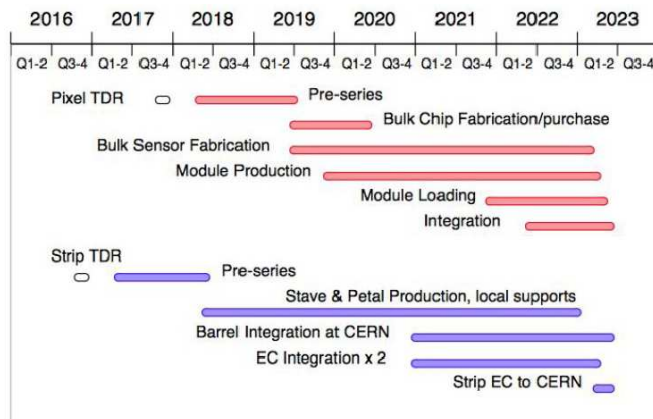


higher irradiation
higher trigger rates

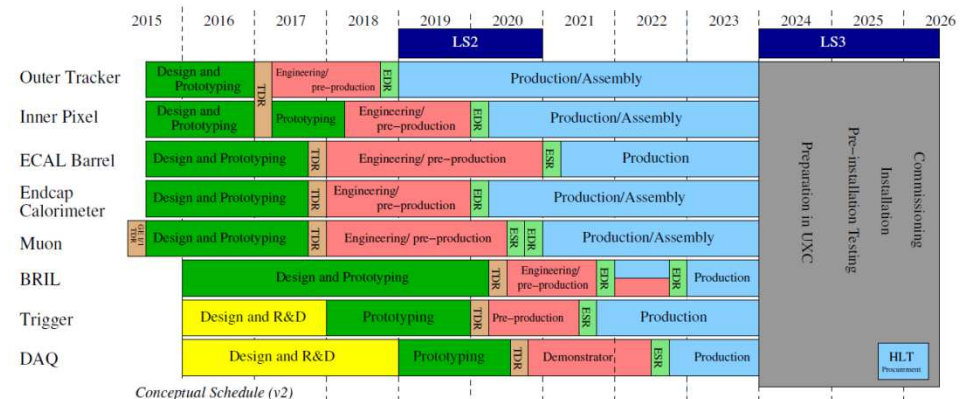
ATLAS and CMS Detector Upgrades



new tracker
new trigger & DAQ
improvements Calorimeters, Muons



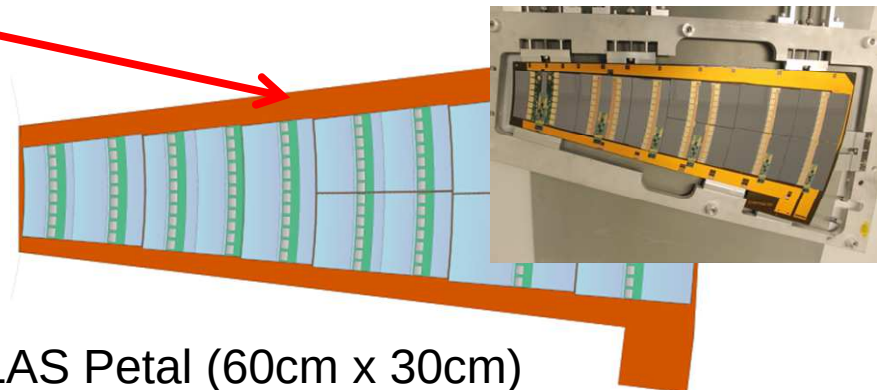
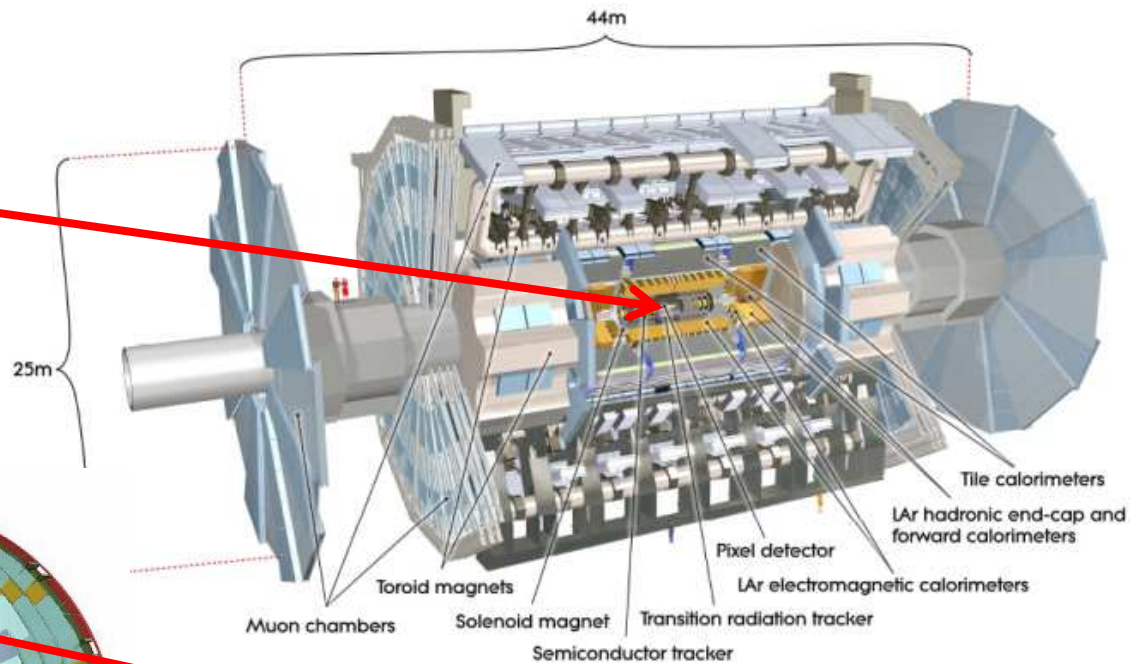
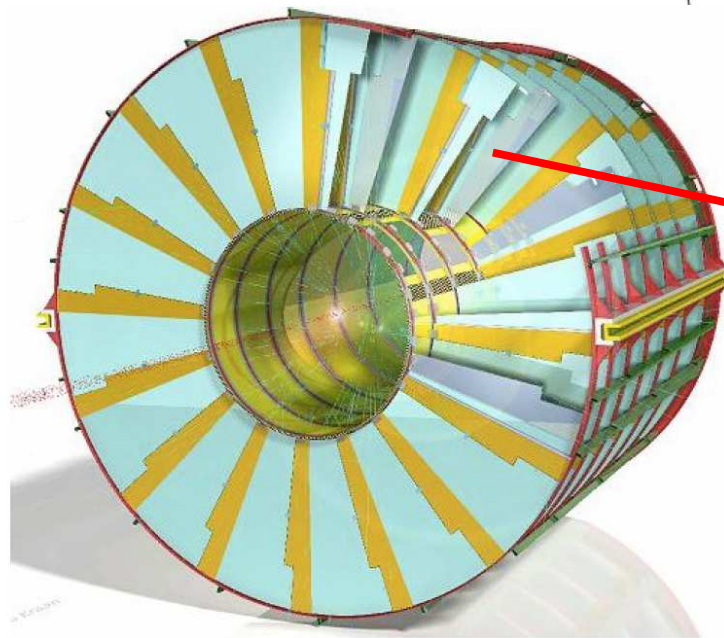
new tracker
new endcap calorimeter
new trigger & DAQ
improvements ECAL & Muons



ATLAS Detector: Phase 2 Outer Silicon Tracker

New ATLAS silicon tracker
~165 m²
~75M Channels

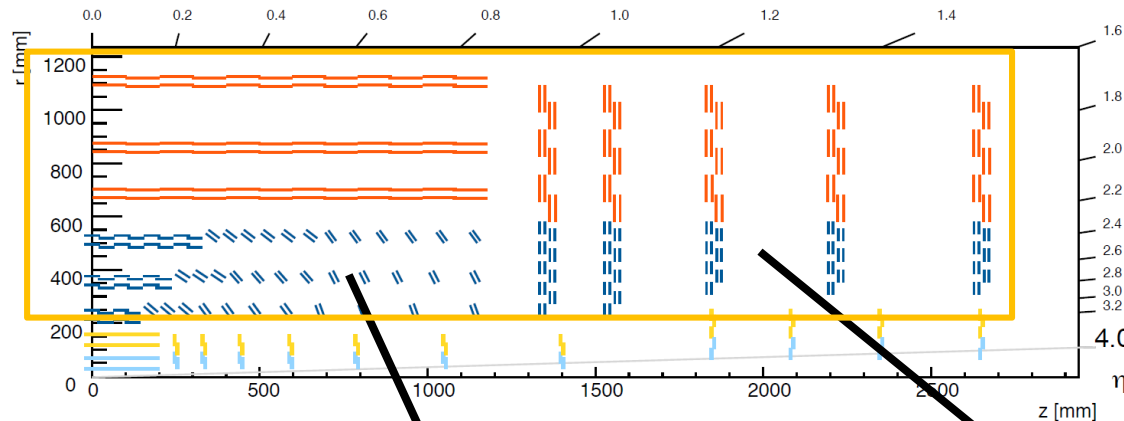
End cap : 6 disks
5000 silicon-sensor-modules



ATLAS Petal (60cm x 30cm)
9 sensor-modules per side

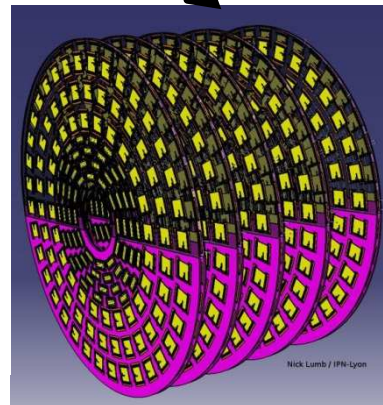
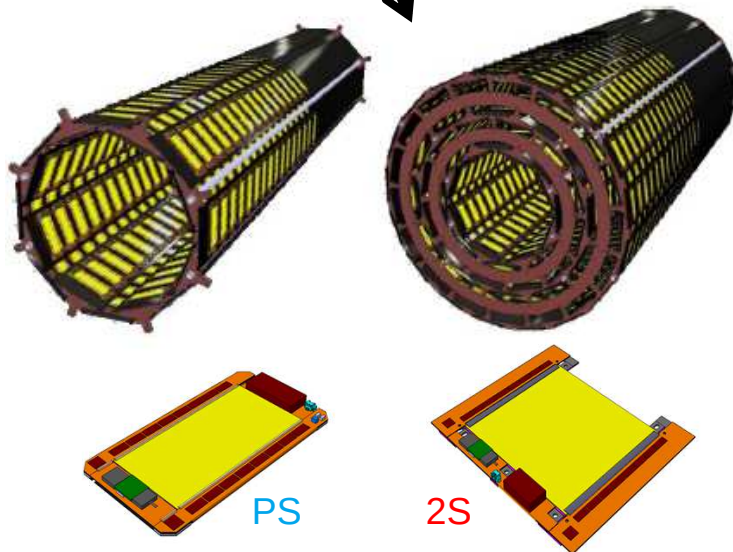
CMS Outer Tracker: Phase 2 Layout

Outer Tracker

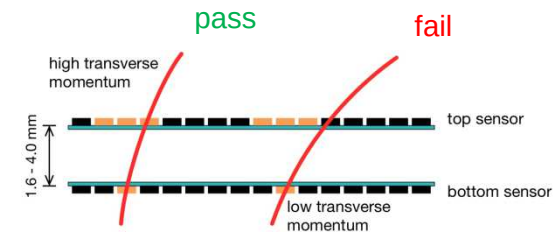


6 barrel layers
2x5 disks (Endcap)

2 Module types :
double layer of silicon sensors
 $r > 60$ cm: **2Strip (2S)**
 $r < 60$ cm: **Pixel-Strip (PS)**



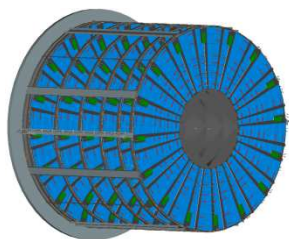
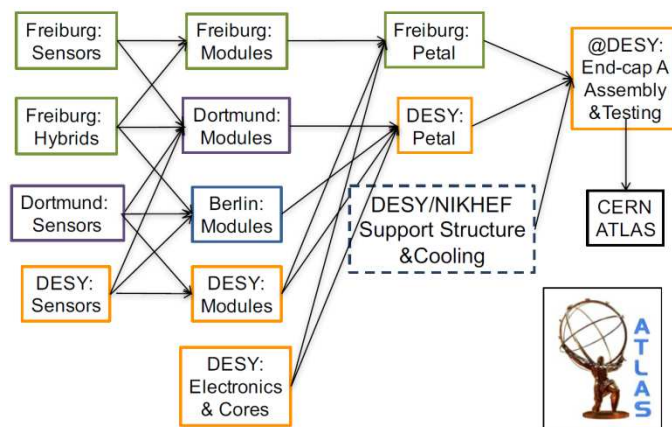
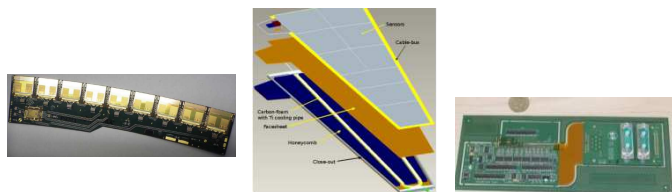
Radius ~ 110 cm
Length ~ 140 cm



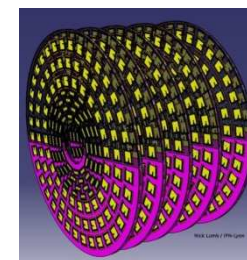
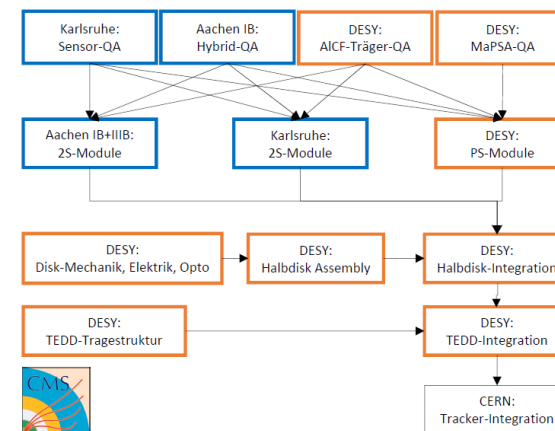
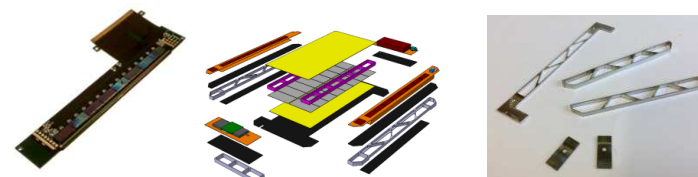
local p_t -discrimination
providing L1 trigger input

Building Silicon Tracker Endcaps in Germany

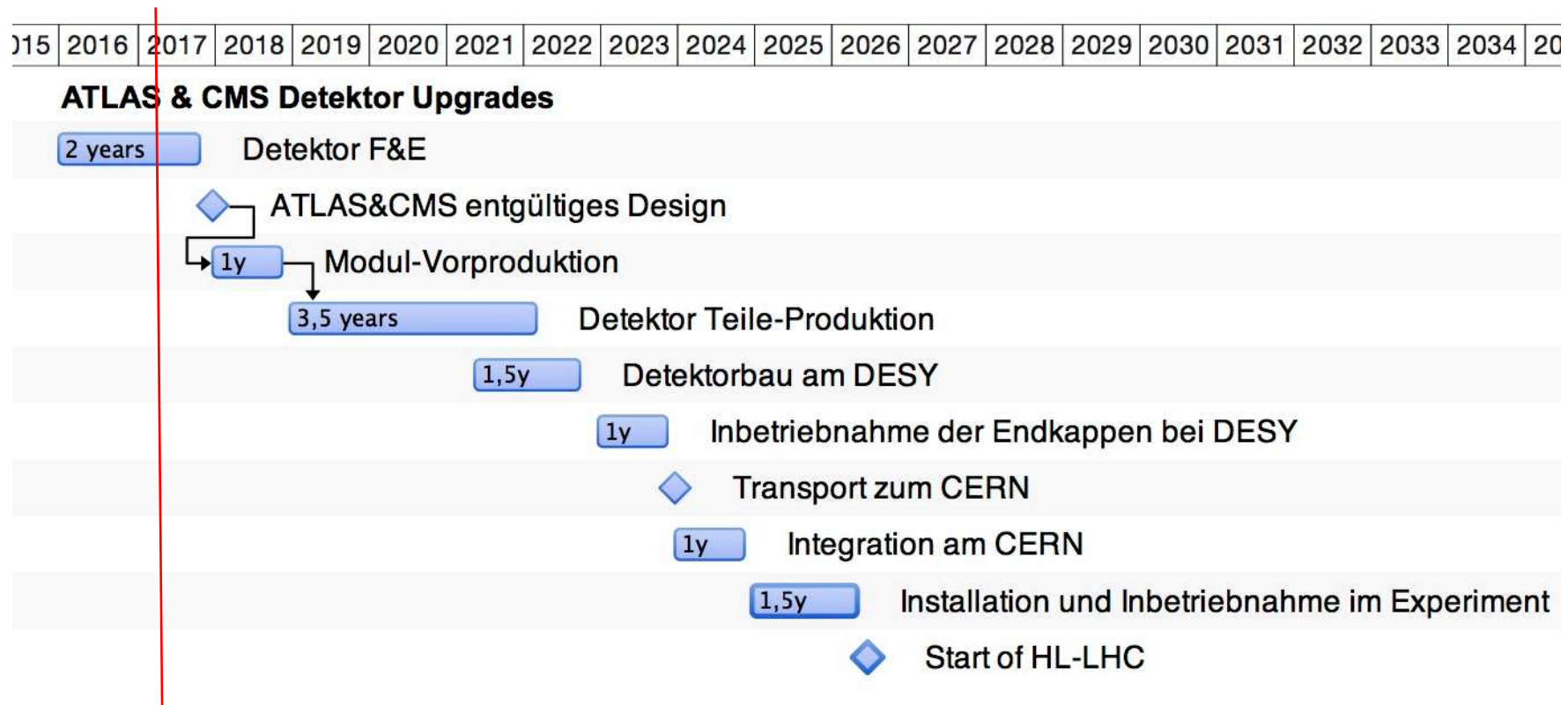
ATLAS



CMS

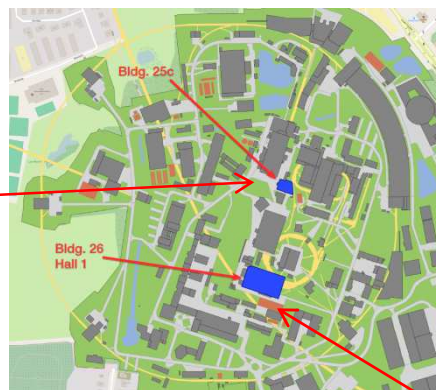


The LHC Detectors Upgrade Project at DESY



- currently in R&D phase
- TDRs will be submitted in 2017
- prototyping started
- pre-production will start 2018/19
- production and endcap integration until 2023
→ dedicated facility (DAF)

Infrastructure for Detector Upgrades at DESY



Detector Assembly Facility (DAF)
Buildings 25c and 26
250 m² ISO-6 (module production)
750 m² ISO-7 (assembly)
200 m² Lab and storage

shared by ATLAS and CMS

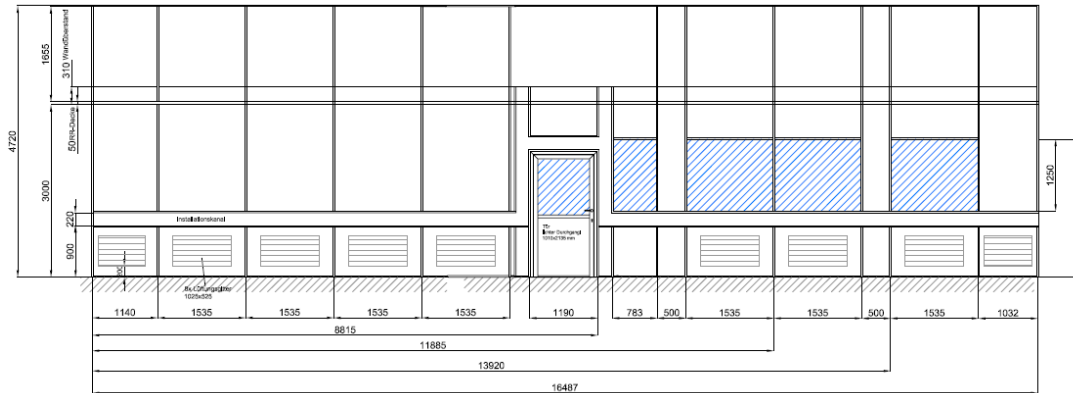
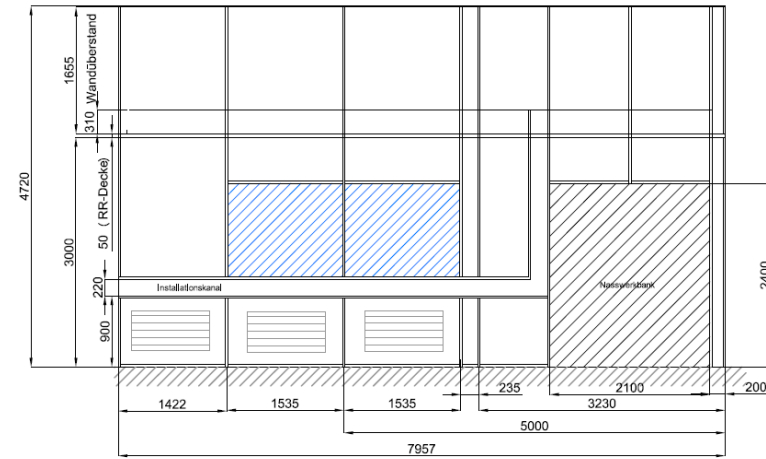
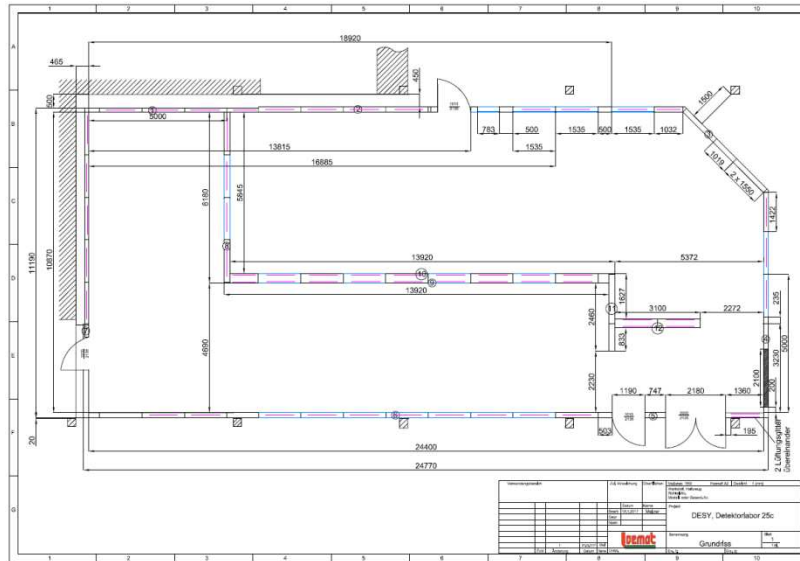


Bldg. 25c

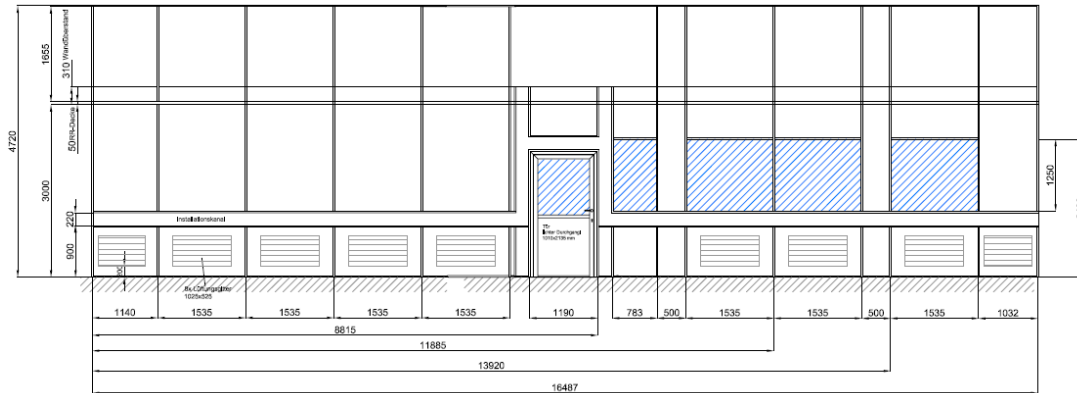
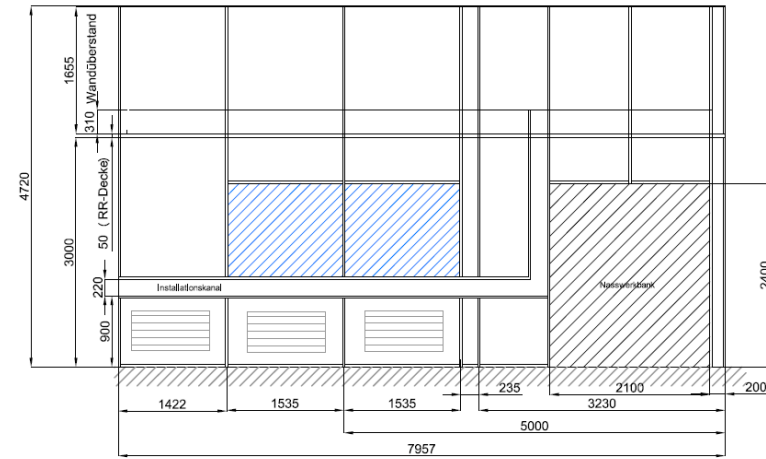
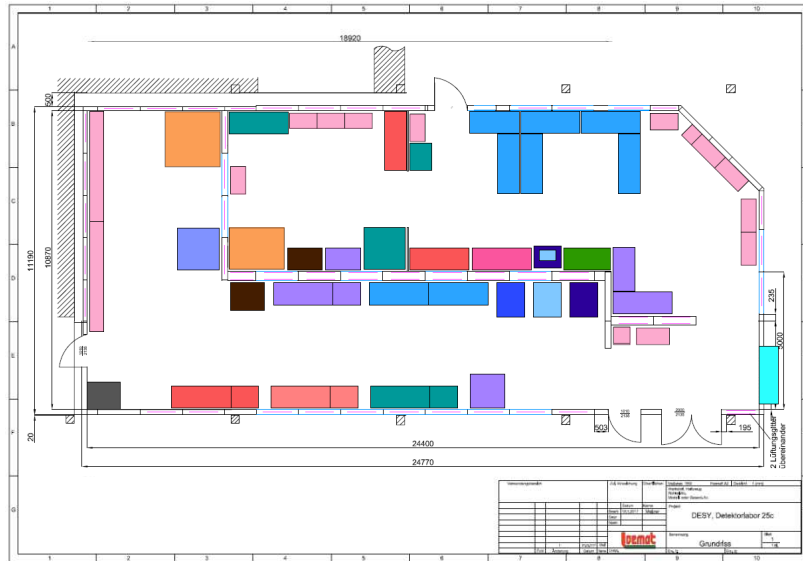


Bldg. 26 (Hall 1)

Building 25c - Cleanroom Planning



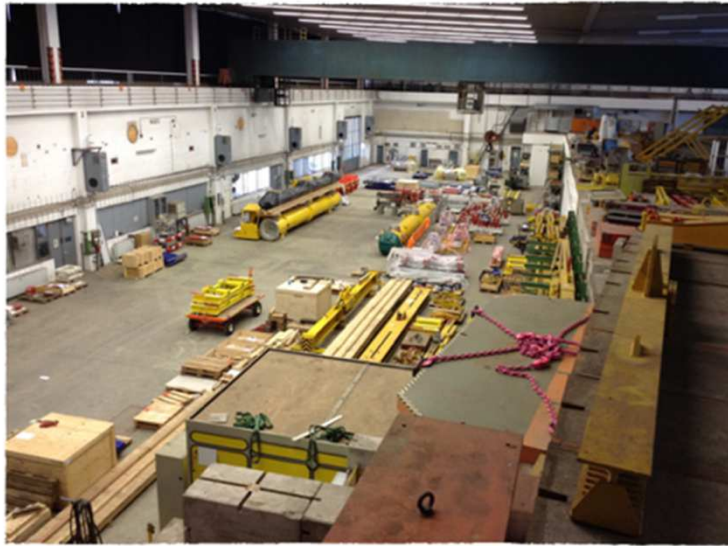
Building 25c - Cleanroom Planning



Building 25c - Current Status



Building 26 – Current Status



Current Status:

- available since Feb 2017
- hall is empty
- removing of old installations

Next steps:

- refurbishment
 - windows
 - doors
 - gates
- Installations
 - cleanroom ISO7
 - substructures assembly
 - end cap Integration
 - system tests
- Commissioning starting 2018

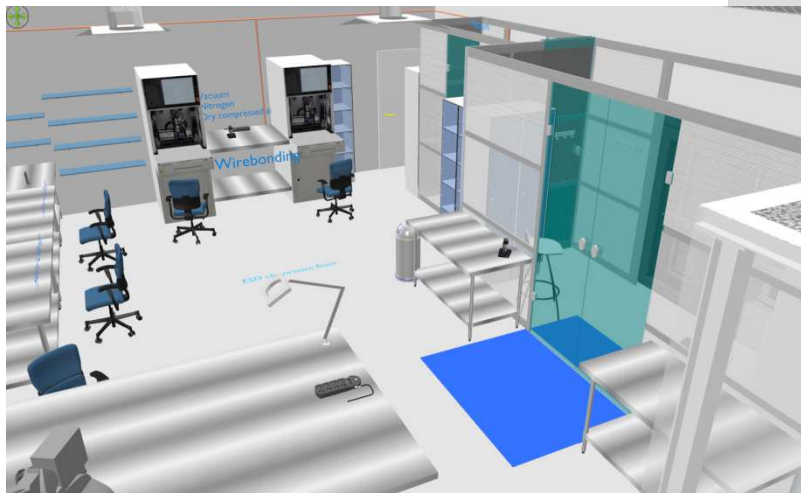


DAF Schedule

Year		2016												2017												2018												
Task\month	MS	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
Project start	✓																																					
Planning & Setup	✓																																					
Building 25c																																						
internal planning 25c	✓																																					
Building 25c available	✓																																					
removal of old infrastructure, renovation 25c	✓																																					
build new walls	✓																																					
planning and tender cleanroom 25c	✓																																					
planning and tender airconditioning/heating	✓																																					
planning/tender infrastructure (electricity)	✓																																					
contract cleanroom 25c	✓																																					
installation cleanroom 25c																																						
installation air conditioning/heating																																						
installation infrastructure (electricity)																																						
remaining work 25c																																						
commissioning 25c																																						
Building 26 (Hall 1)																																						
internal planning 26	✓																																					
Geb. 26 Übergabe	✓																																					
planning/tender technical infrastucture 26																																						
plannig/tender refurbishment work 26																																						
technical infrastucture work 26																																						
refurbishment 26																																						
planning and tender cleanroom 26																																						
installation cleanroom 26																																						
remaing work 26																																						
commissioning 26																																						

ATLAS Module Production Hall Zeuthen

- Location of new laboratory established
- Currently
 - Planning phase with engineering company
 - Basic work ongoing in room
- Next: get offers from companies
- Main work to begin in spring/summer



DAF Summary

- ✓ Preparation of proposal (partly together with LHC Upgrade) 2012 - 2015
- ✓ DAF funding approved by foundation council Dec 2015
- ✓ DAF locations decided by directorate Jan 2016
- ✓ DESY project “LHC Upgrade” launched Apr 2016
- ✓ Handover of building 25c Jun 2016
- ✓ Removal of old infrastructure and preparing building 25c since Jun 2016
- ✓ Handover of building 26 (after XFEL construction finished) Feb 2017
- ✓ Start installation of clean room in building 25c March 2017
 - o Start renovation of building 26 (windows, walls, gates, floor) March 2017
 - o Commissioning of module facility in building 25c Oct 2017
 - o Start installation clean room in building 26 Autumn 2017
 - o Commissioning of assembly facility in building 26 start 2018

→ DESY's LHC Upgrade Facility will be ready for the pre-production starting 2018

R&D Activities at DESY

Both groups at DESY are preparing for the end cap construction

R&D activities in key areas for module production and integration

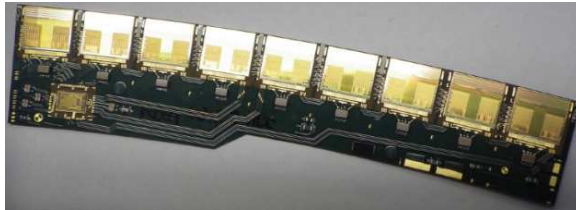
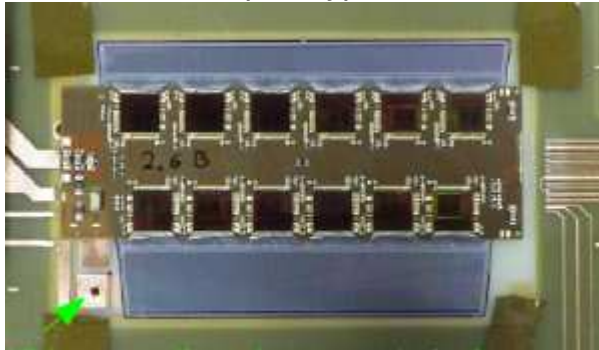
- Module design and production
- Mechanical structure
- Quality Control, classification
- Test-DAQ

→ A few examples shown in the next slides

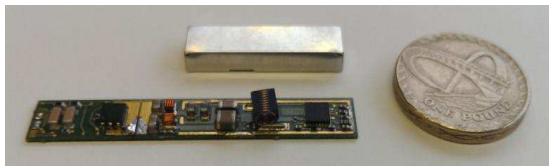
Towards Detector Construction – Module R&D

ATLAS

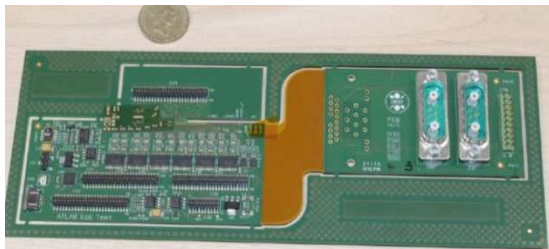
ATLAS module prototype



readout hybrid
for end cap module

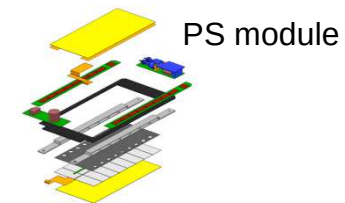


DC-DC power board

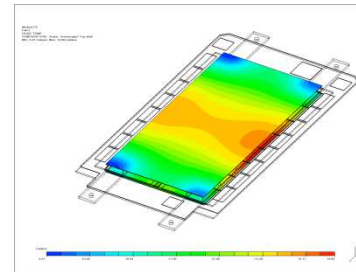


end of substructure board
with optical link

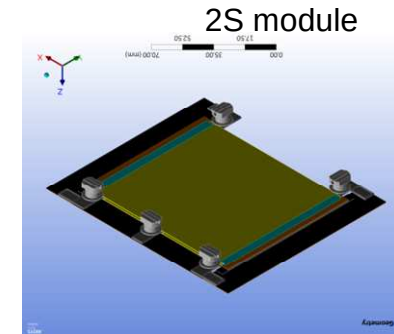
CMS



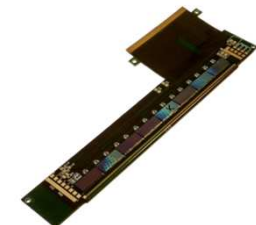
PS module



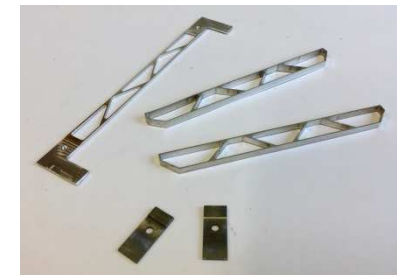
thermal FEA



2S module



readout Hybrid

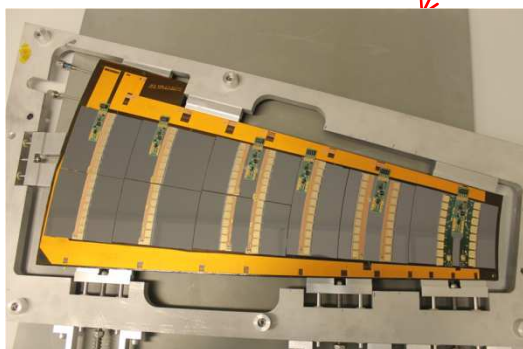
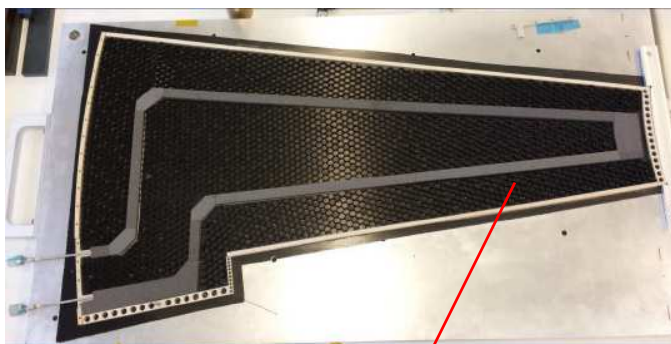


mechanical parts
(bridges)

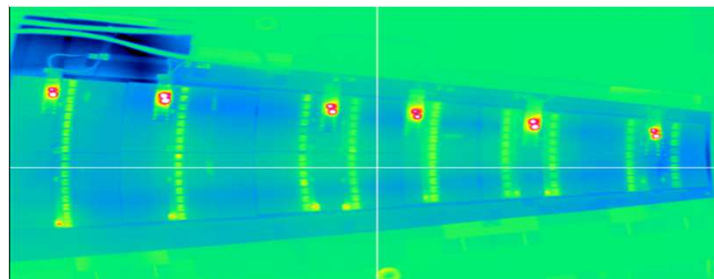
Towards Detector Construction – Mechanical Structures

ATLAS

PETAL core prototype



Thermo-mechanical prototype

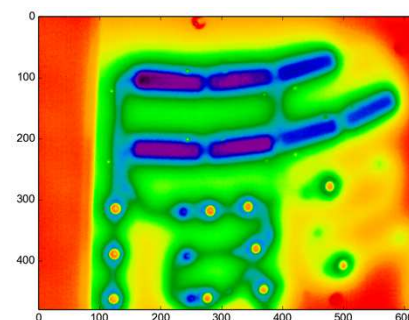
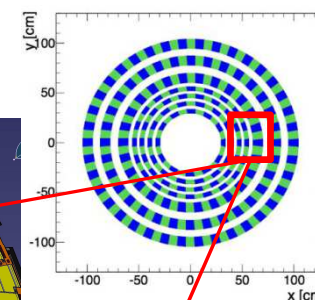
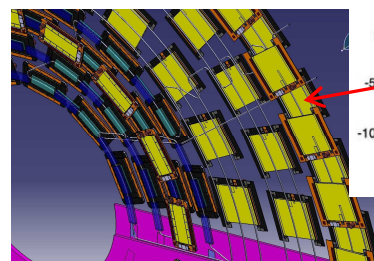


PETAL thermal image

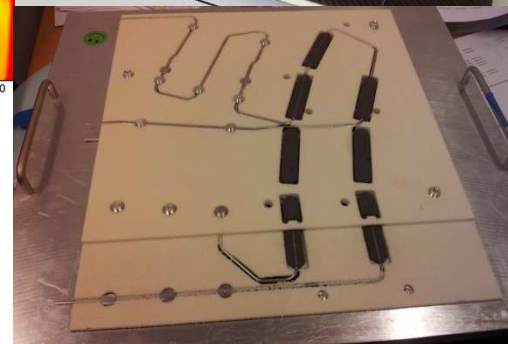
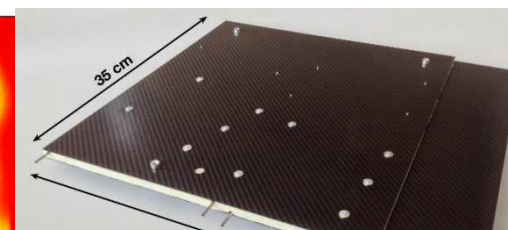
CMS

CMS Endcap Disk

Endcap cooling detail



Thermal image

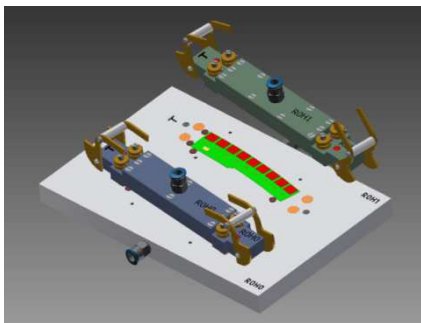


CMS DEE Prototypes 1 & 2

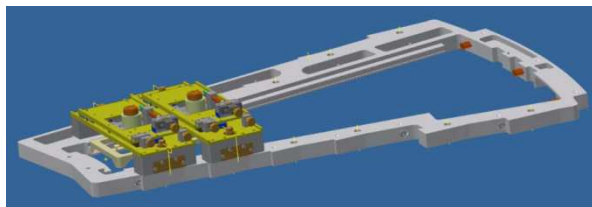
Towards Detector Construction – Preparing Tools

ATLAS

ATLAS gluing tool



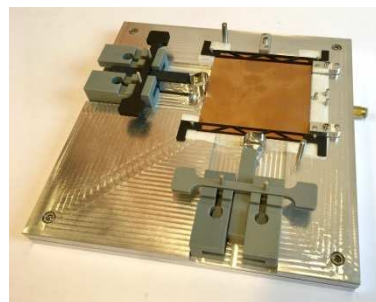
testing petal prototype



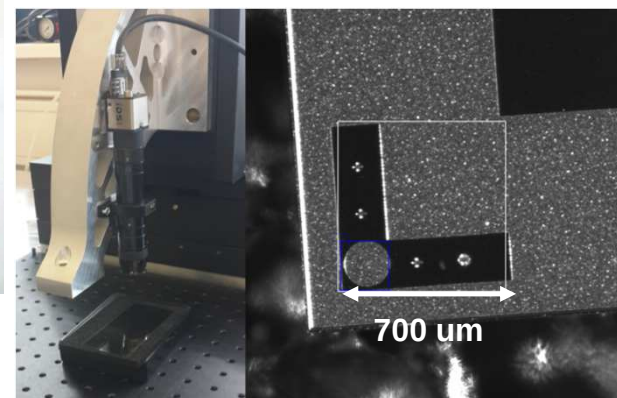
Endcap integration tool

CMS

uTCA test crate with FC7 readout board

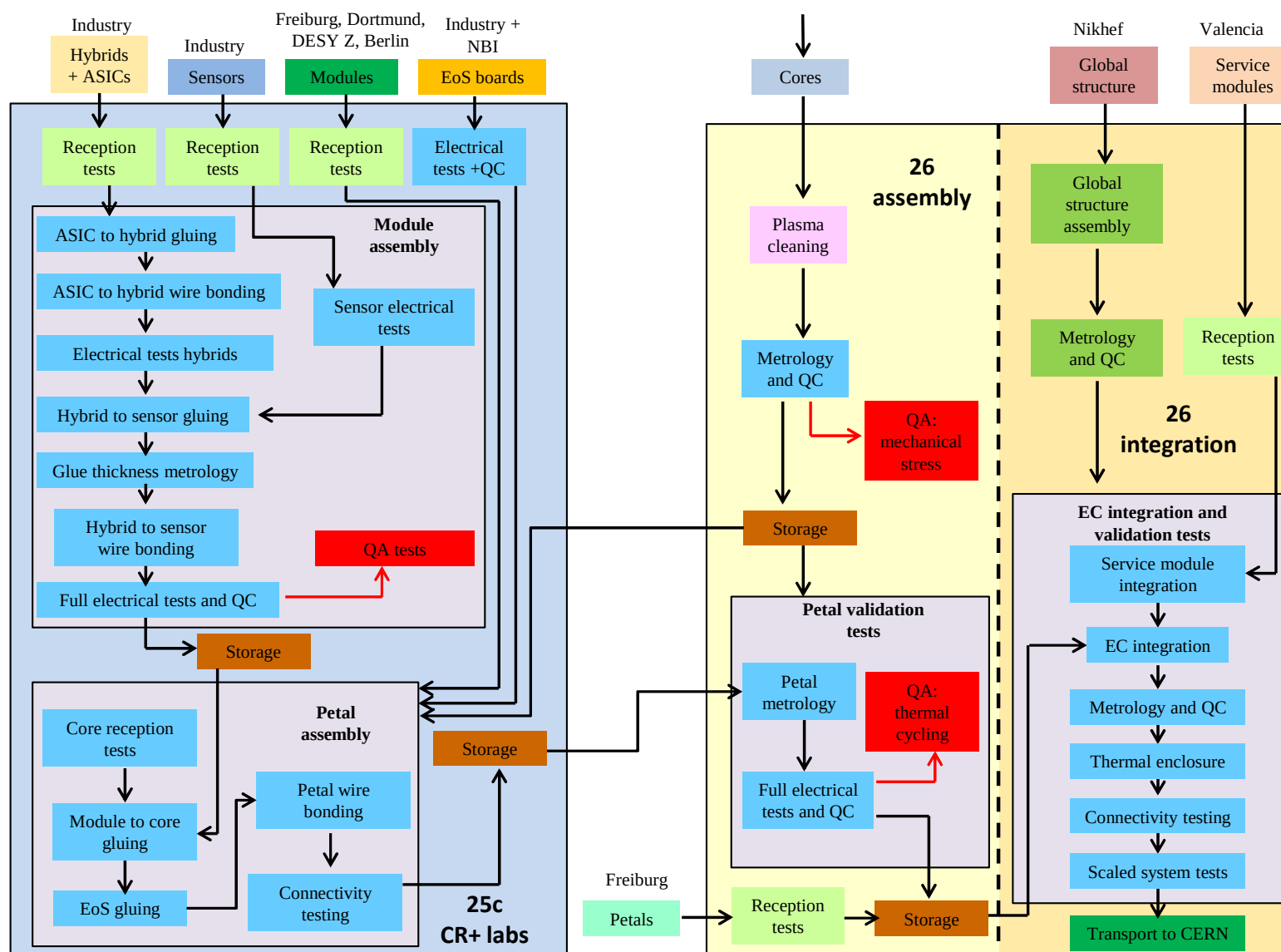


manual gluing tool



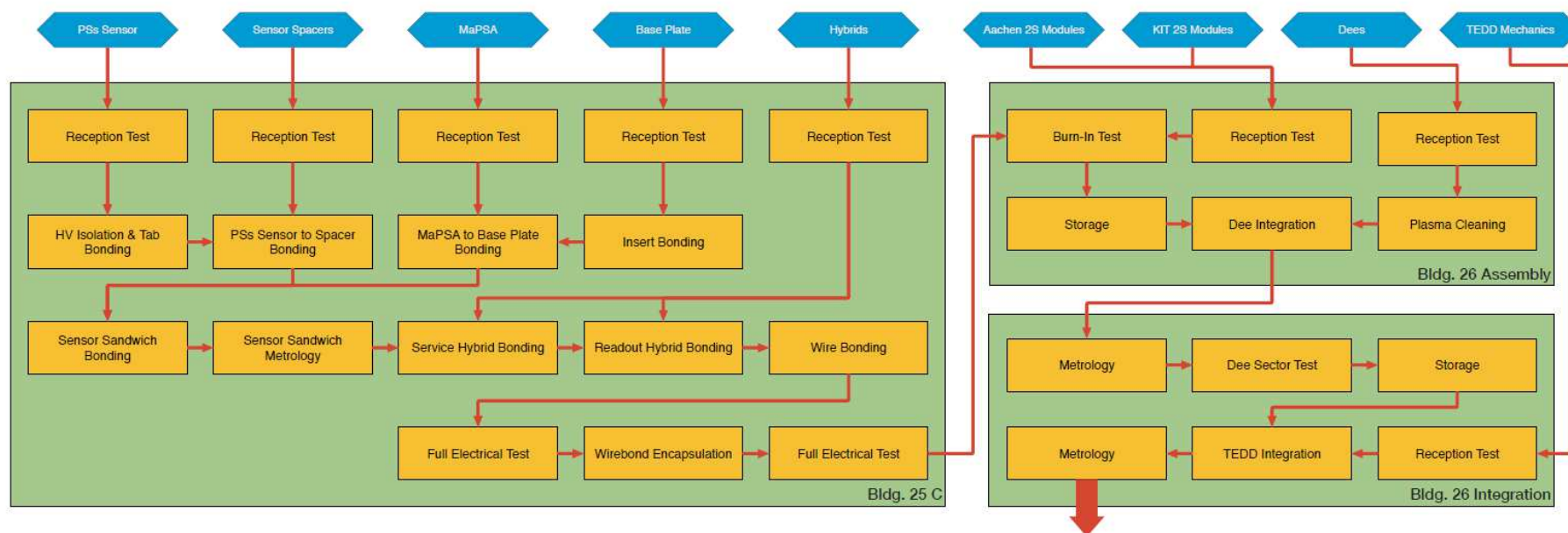
automated gluing tool

ATLAS Endcap Workflow at DESY



CMS Endcap Workflow at DESY

Components from industry and CMS institutes



Transport to CERN for integration and commissioning

Endcap Production - Timeline

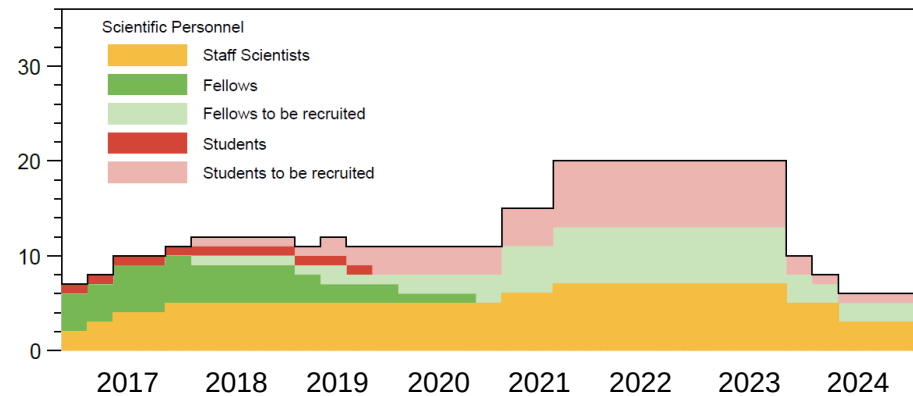
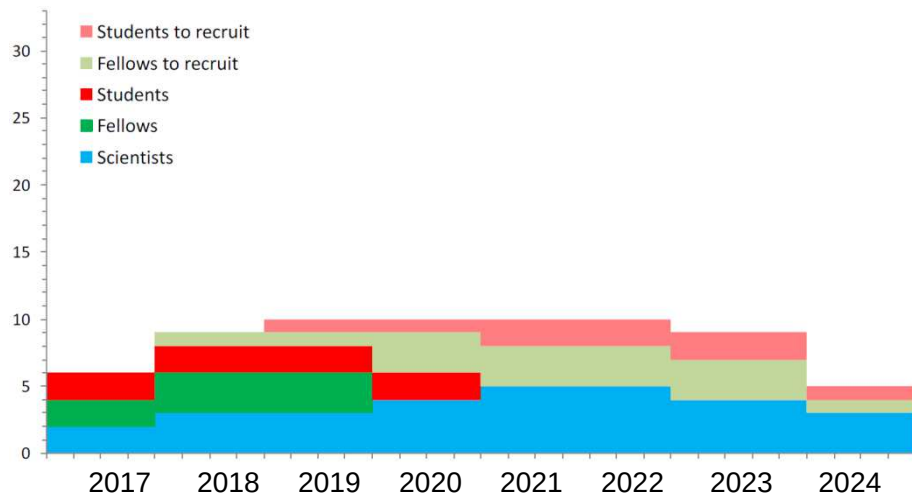
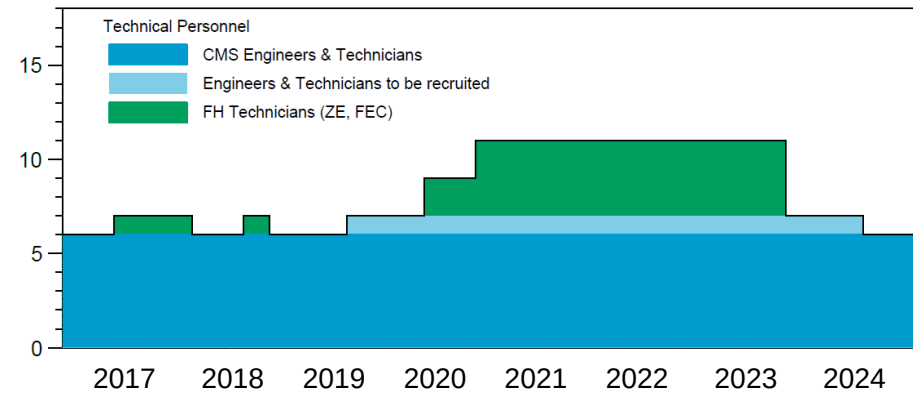
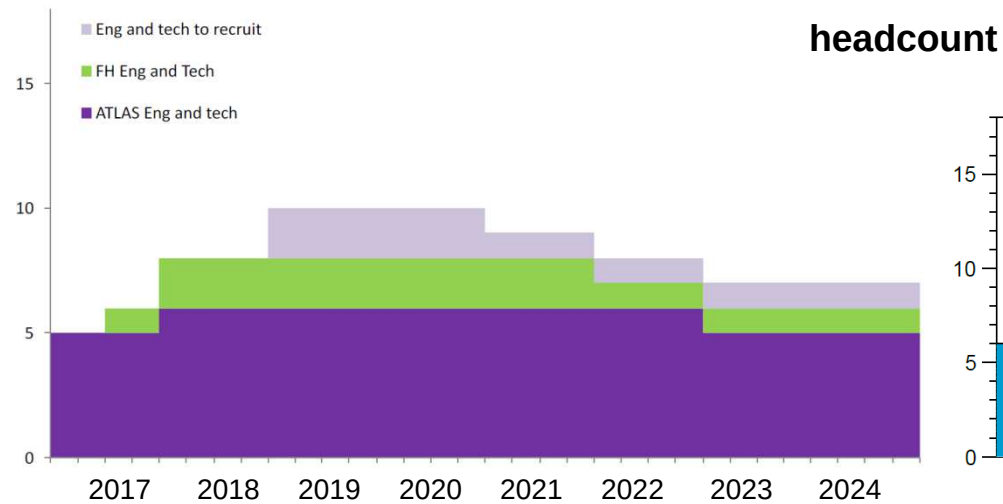
ATLAS

	2017	2018	2019	2020	2021	2022	2023	2024
Cores (400)								
Modules (500)								
EoS boards (1630)								
Petals (100)								
EC integration								
EC commissioning (DESY)								
EC transport, installation, and commissioning (CERN)								

CMS

Year		2016	2017	2018	2019	2020	2021	2022	2023	2024
Task\Quarter	MS	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4
TDR	X		X							
OT EDR	X				X					
Outer Tracker										
R&D and Prototyping										
MaPSA Reception Tests					Preproduction	Preproduction	Production			
Modules					Preproduction	Preproduction	Production			
DEE Structures					Preproduction	Preproduction	Production			
DEE								Integration & Sector Tests		
TEDD Structures								Reception		
TEDD								Integration		
TEDD Transport to CERN	X									X
Integration (at CERN)										Integration & Com

Detector Construction – Resources



ATLAS

Total of ~150 FTE for ATLAS & CMS

CMS

Summary

Detector Assembly Facility (DAF)

- DAF at DESY is key part of the LHC upgrade
- Module production facility is on schedule for prototype production
 - cleanroom installation in progress
 - expect to be ready by autumn 2017
- Hall 1 (Bld.26) is being prepared for assembly facility installation
- Planning for assembly facility on schedule
 - expect to be ready beginning 2018

Detector Upgrades (ATLAS & CMS)

- Funding has been approved, available on time (from 2018 onwards)
- Resource planning done
- R&D and preparatory work well under way
- Discussion on deliverables within collaboration is well advanced
 - ATLAS TDR currently reviewed by LHCC referees
 - CMS TDR in internal review, submission in June 2017.

→ DESY groups ATLAS and CMS are well positioned for the Phase 2 Upgrades