ATLAS Upgrade

DESY activities

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DESY ATLAS Upgrade group

Introduction

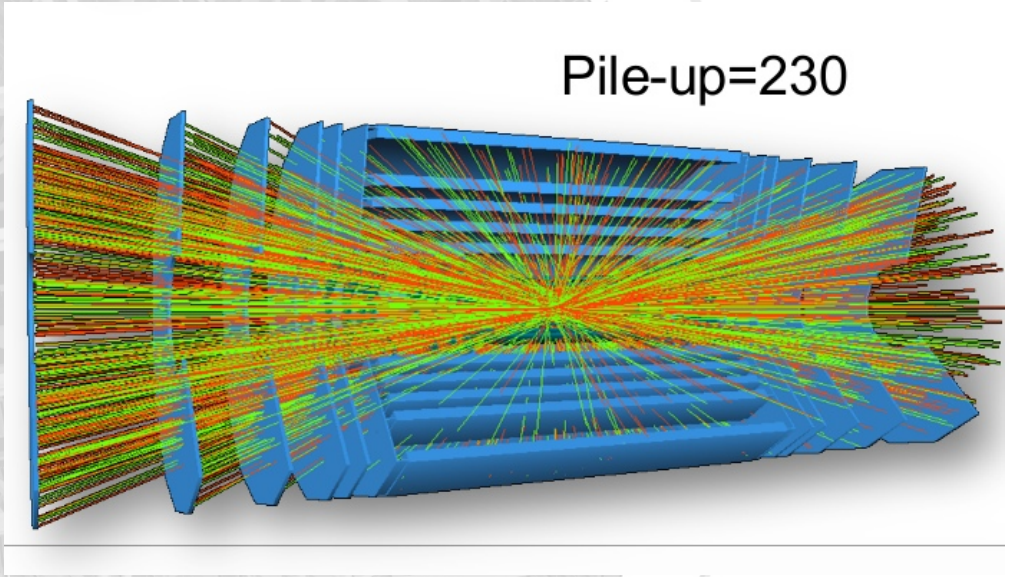
- DESY ATLAS Upgrade activities focus on silicon tracking
- Flagship project
  - Strip Endcap Upgrade (2022)
  - Petal 2014 R&D project as milestone
- Also some involvement in the IBL (2013)
- Building on infrastructure and expertise available at DESY
- Close collaboration with CMS Upgrade Projects at DESY

Current SCT activities

- DESY is member of the SCT collaboration
  - Since November 2011
- Working on
  - Offline Calibration
  - Long-Term Monitoring
  - Radiation Damage Studies
- Invaluable experience for the Upgrade project

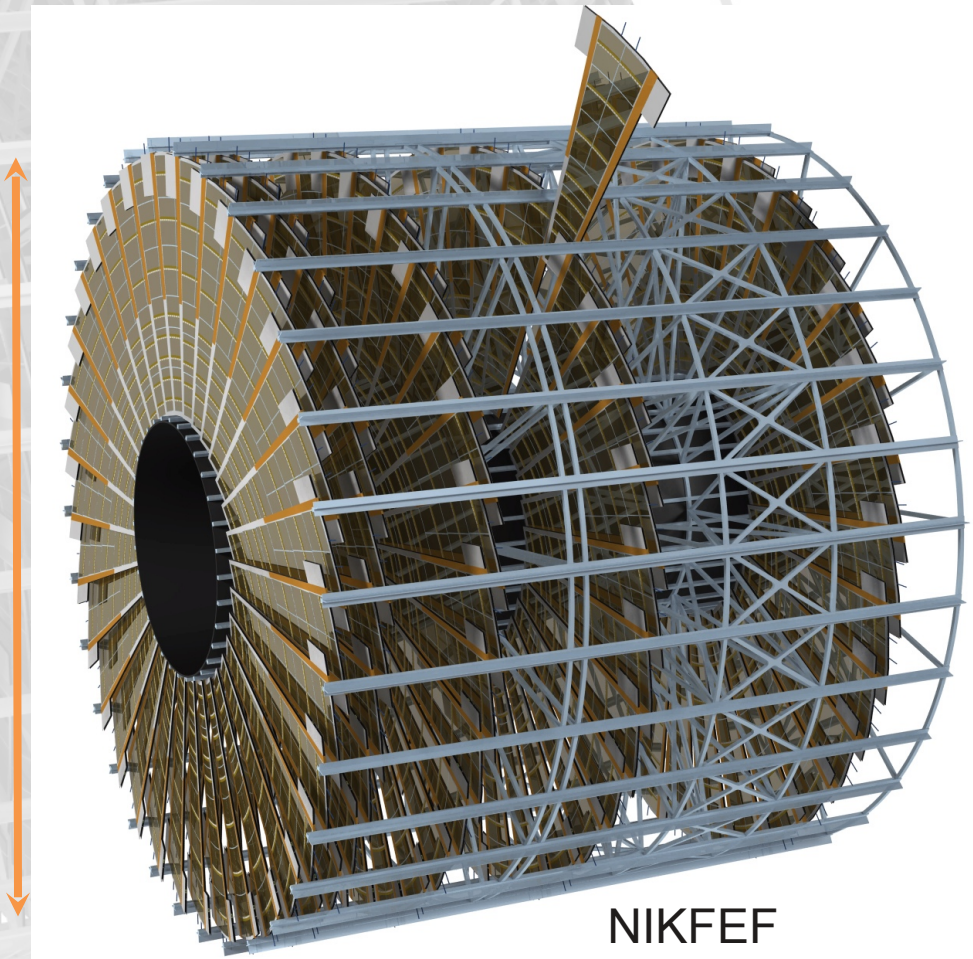
Challenges in the Upgrade

- HL-LHC machine challenges
  - Higher track density
  - Many more pile-up events
- This means for the ATLAS Inner Detector
  - Finer granularity
  - Less material
  - Even more rad-hard
- New design ideas



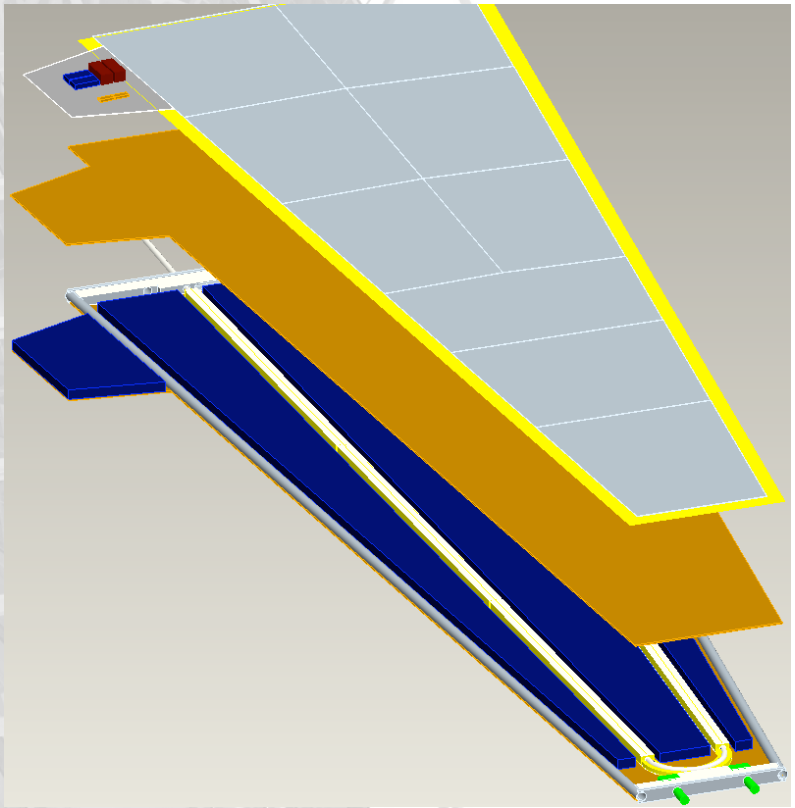
The Strip Endcap Upgrade

- Current SCT (Silicon Strip Tracker) will reach end-of-life in 2022
- Upgrade to handle higher event rates, pile-up and radiation levels from the High-Luminosity LHC
- Endcaps
  - 10 disks with 32 Petals each
  - 9 modules per Petal
  - 25 m² Silicon



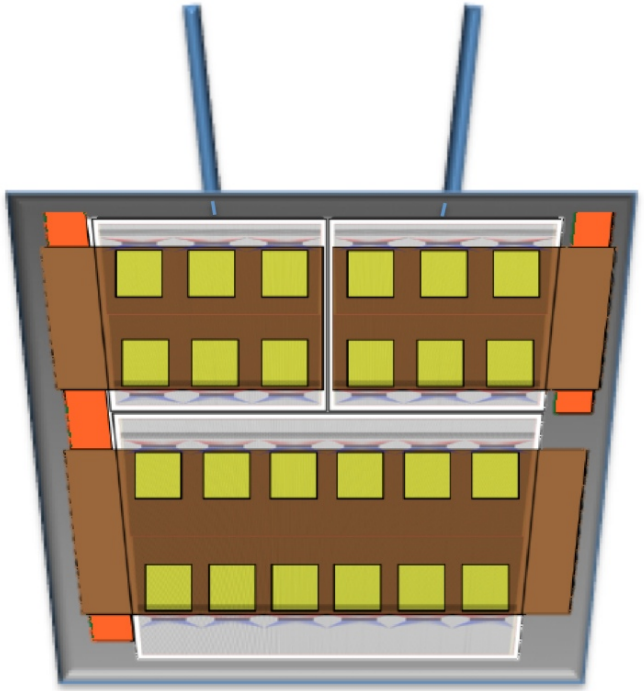
DESY Activities in the Strip Upgrade project

- Module Construction
  - Barrel & Endcap
- Endcap Mechanics
  - Study new materials, FEA studies, cooling, mechanical structures
- End-of-substructure electronics
  - Barrel & Endcap
- Testing & System integration
- Upgrade simulation
- Test beam



From Petalets to Petals to an Endcap

- Petalet 2012
  - Construction of Petalets
  - First step towards a full-size Petal
  - DESY is key player in this
- PETAL 2014
  - Build full-size prototypes
  - Complete with services, cooling …
- Silicon Strip Endcap
  - Installation in 2021/22



PETAL2014.

Module Construction

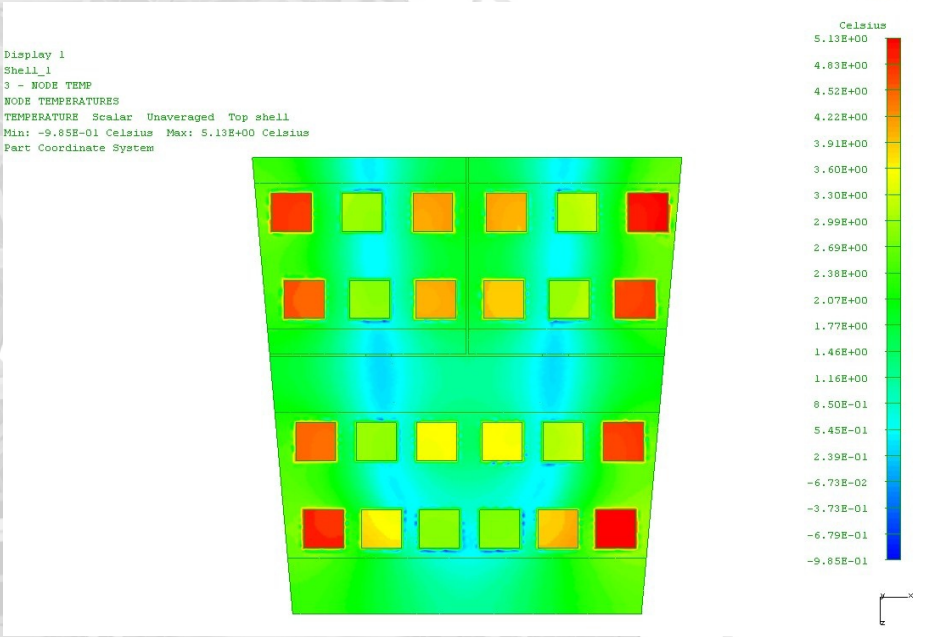
- Currently
  - Modules for Barrel Staves
  - Gluing, Bonding & Testing
  - Build up expertise
- From summer onwards
  - Making Petalet modules
  - Preparing for Petal production

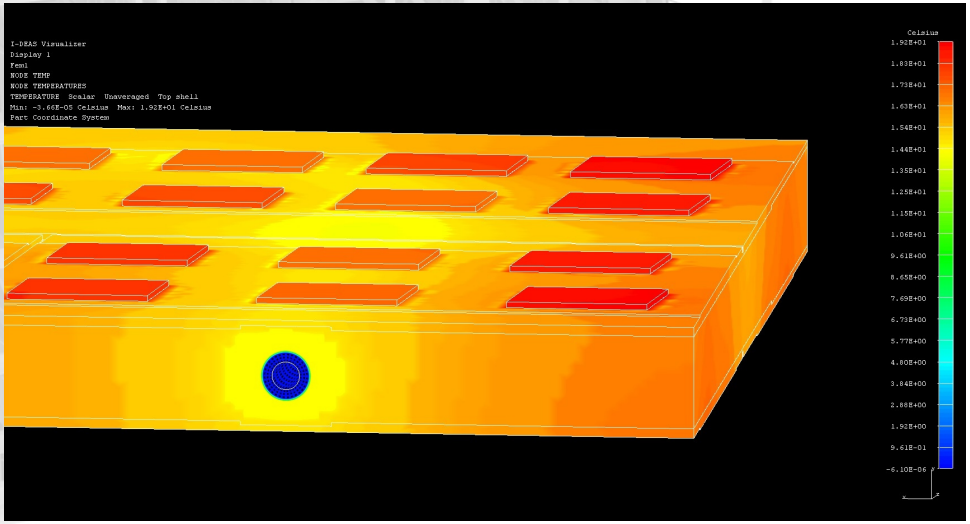
Mechanical studies

- DESY will assemble a full end-cap for Phase 2
  - Petal design and construction is the first milestone
  - New materials under investigation (cooperation with CMS)
  - Petalet as a first step
  - To be build in 2012
- Studies include
  - Finite Element Analysis (FEA)
    Thermal measurements of prototypes

FEA Simulations

- Using FEA to
  - Simulate heat load
  - Optimize cooling
  - Distribution of chips
  - Studying new materials
- Input to
  - Petalet design
  - Petal design

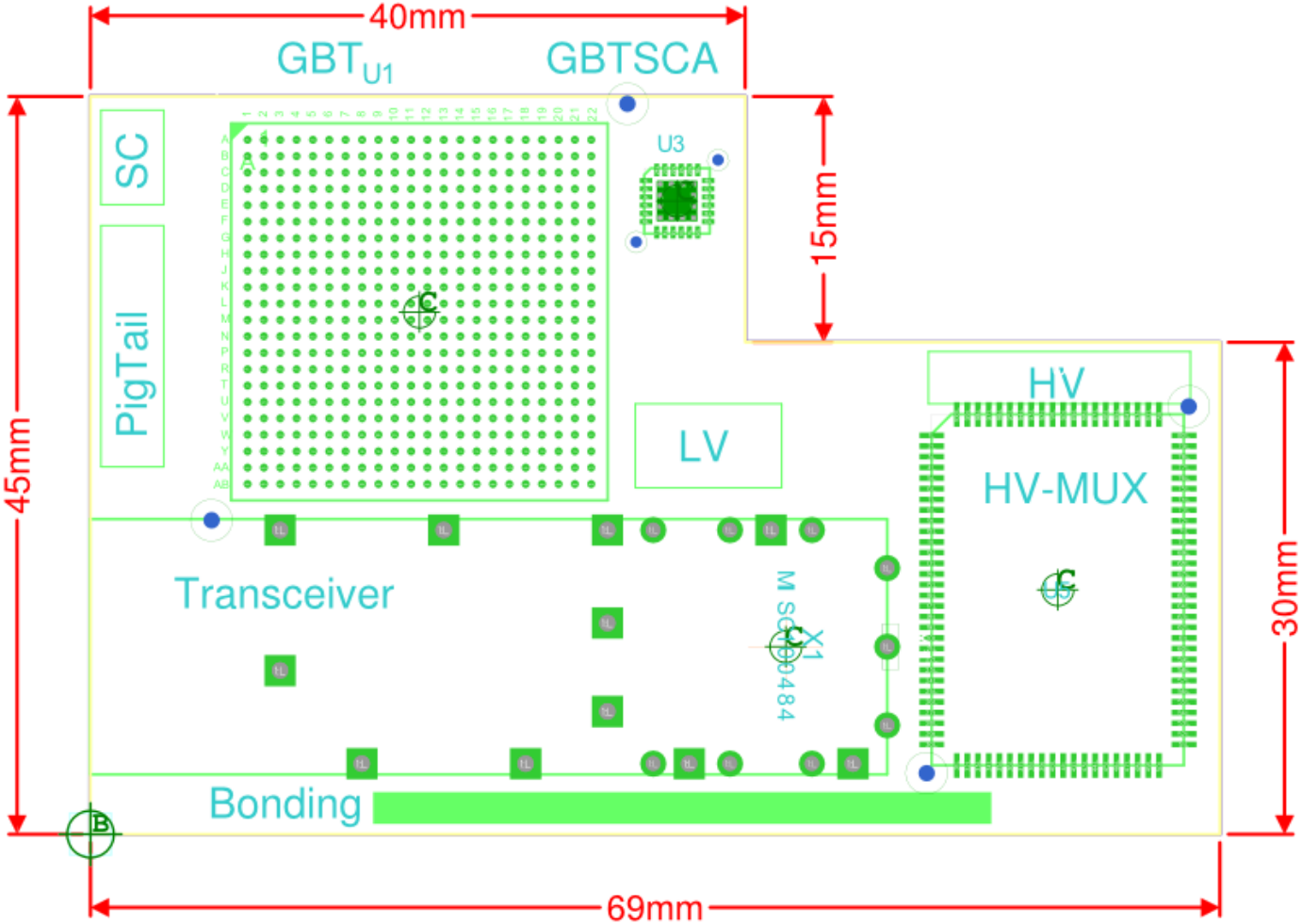




End-of-substructure electronics

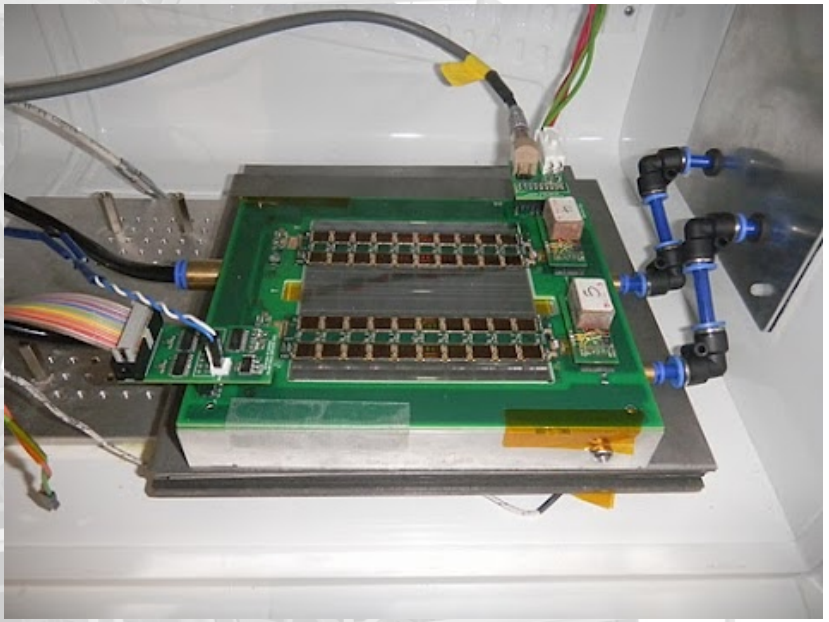
- Connects a strip detector unit to the outside world
  - High-speed optical data links
  - Power distribution
  - Slow controls
- Common schematics
  - Different layouts for Barrel and Endcap due to mechanical constraints
- DESY driven effort

First drawings



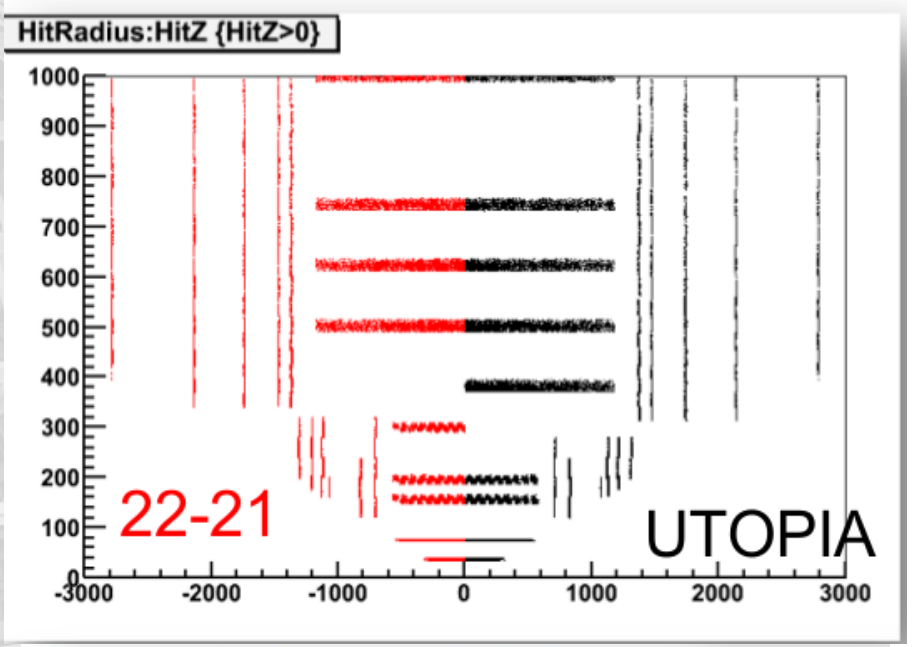
HSIO Teststands

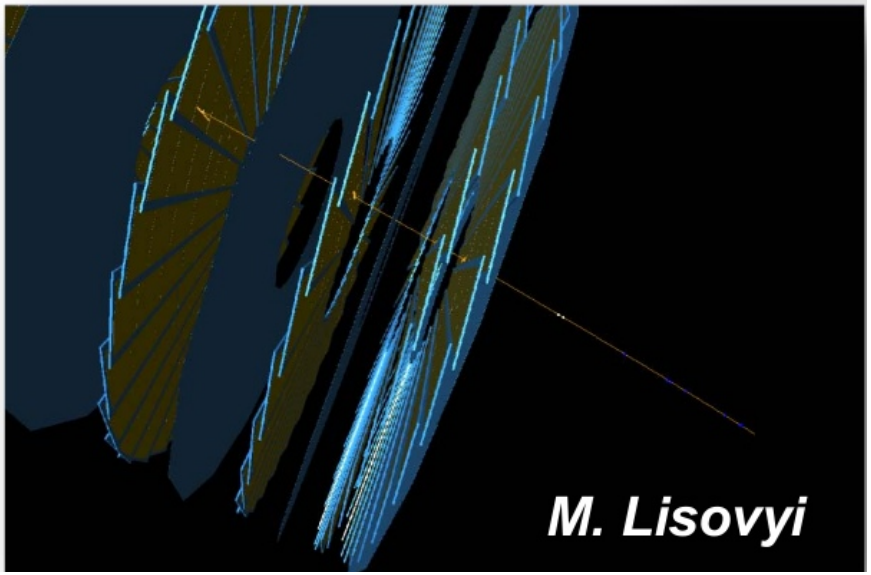
- HSIO = High-Speed IO board
- Currently testing
  - Individual hybrids
  - complete modules
- Moving to bigger units soon
  - Stavelets
  - Petalets
- Final goal
  - Testing entire Petalets



Upgrade Simulation

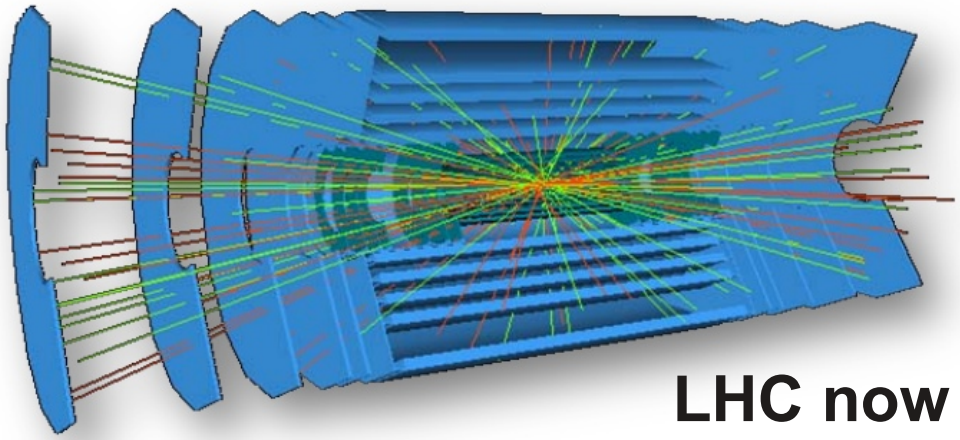
- DESY has leading role
- Study detector layouts
  - Tracking efficiencies
  - Material budgets
  - B-tagging
  - Pile-up
- Detailed Endcap Modelling
- Essential input to the detector design





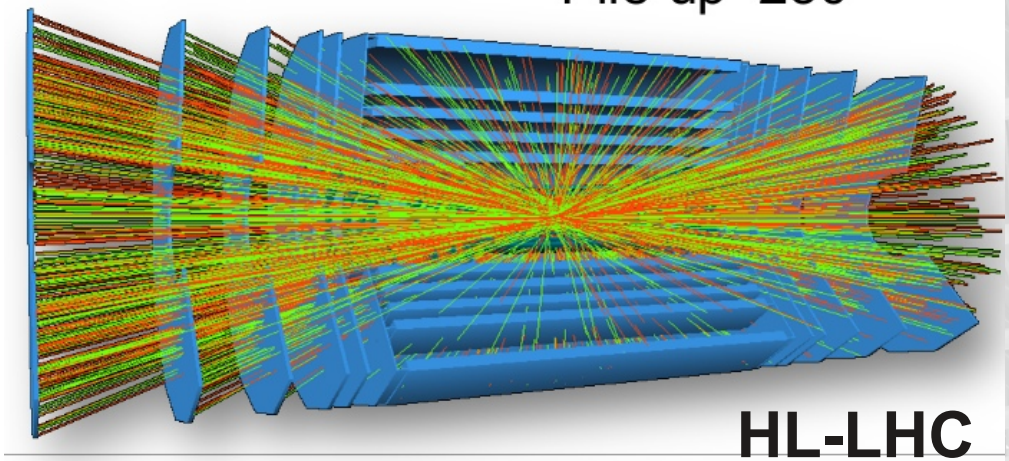
Studying pile-up, tracking, b-tagging

Pile-up=23

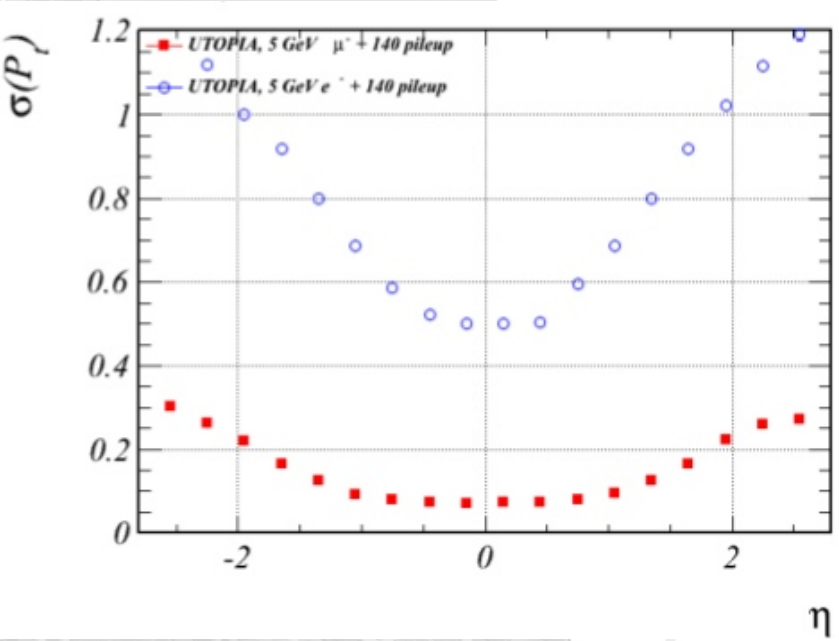


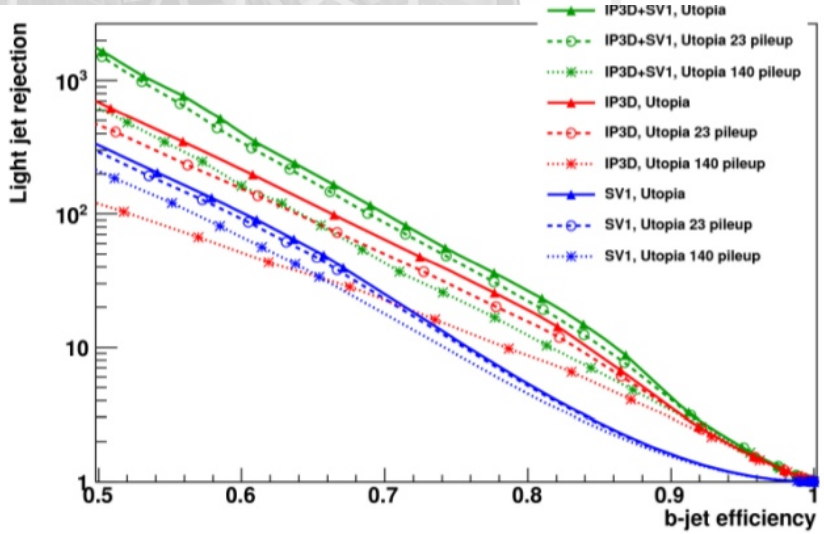
LHC now

Pile-up=230



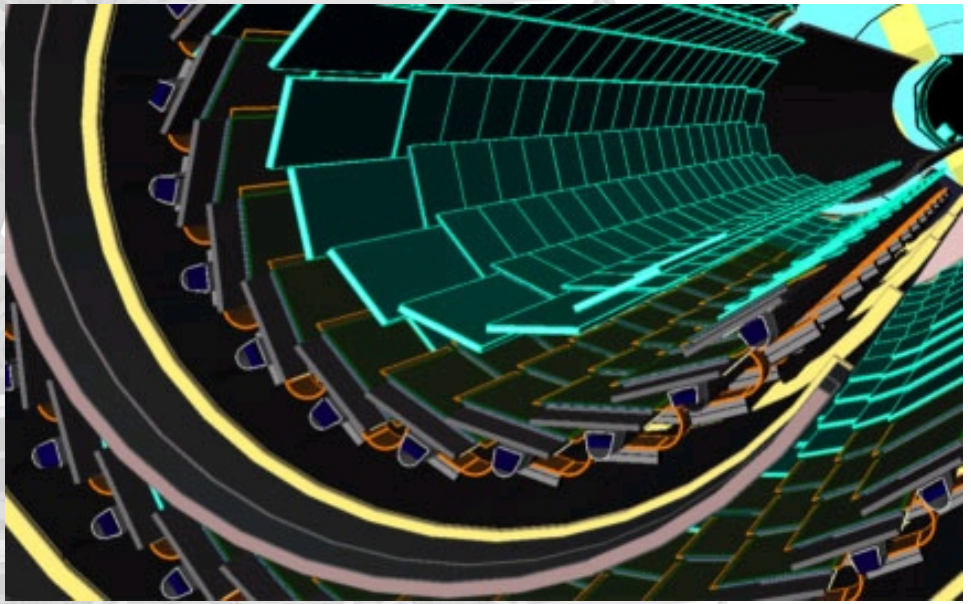
HL-LHC





Other Upgrade Activities

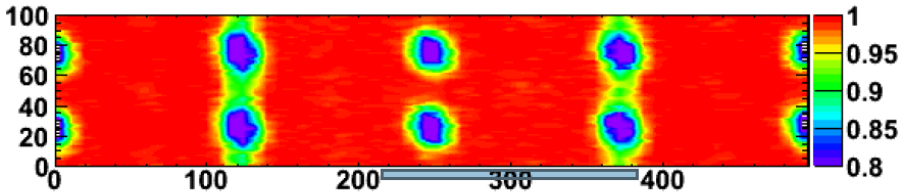
- DESY has small involvement in IBL
  - Mainly test beam support
  - Telescope, Reconstruction…
- Implementing Charge sharing models
- Optical fibers for the readout
  - Procurement and testing
- Test beam telescopes
  - Rates up to 4 kHz possible



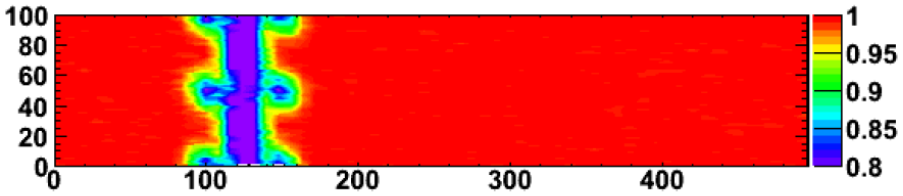
Test beam analysis

- Major player in the IBL test beam analysis
  - Making use of EUDET Software infrastructure
- Results from input to sensor decision for the IBL

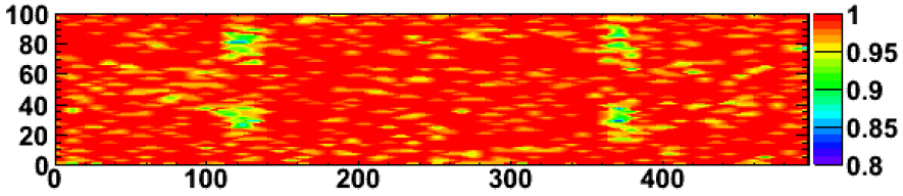
ATLAS IBL



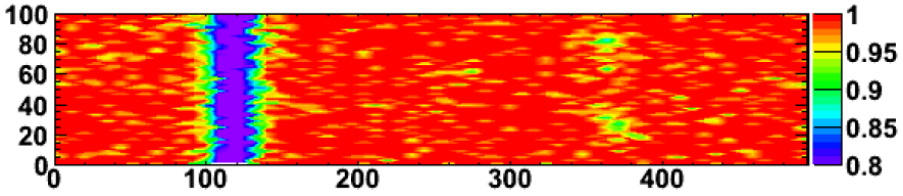
(a) CNM-3D, 0 degree, n-irrad HV=160V, Eff.=97.46%



(b) PPS, 0 degree, n-irrad, HV=1000V, Eff.=97.90%



(c) CNM-3D, 15 degree, p-irrad, HV=160V, Eff.=98.96%



(d) PPS, 15 degree, p-irrad, HV=940V, Eff.=97.65%

Areas of (potential) cooperation

- Sensor R&D, evaluation and procurement
  - Utilizing close KEK ties to Hamamatsu
- Test beams
  - DESY Test beam as a facility for Detector R&D
- Explore Novel materials
  - Needed for ultra-low mass structures
  - Sharing experiences, vendors ...
- Electronics design
  - Share designs and experience (e.g. EoS card)
- DAQ for generic sensor development
  - Using e.g. KEK's Universal DAQ module
- Many Points are generic and extend beyond the ATLAS upgrade scope

Already working together

Potential for cooperation

Summary

- DESY ATLAS group
  - Focus on silicon strip tracking
  - Endcap Upgrade is main project
- Some small involvements in other project
- Cooperation with KEK
  - Some activities already happening
  - Potential for more activities
  - Many aspects generic, beyond ATLAS, CMS ...