ATLAS Upgrade

Liebenberg Retreat 2022

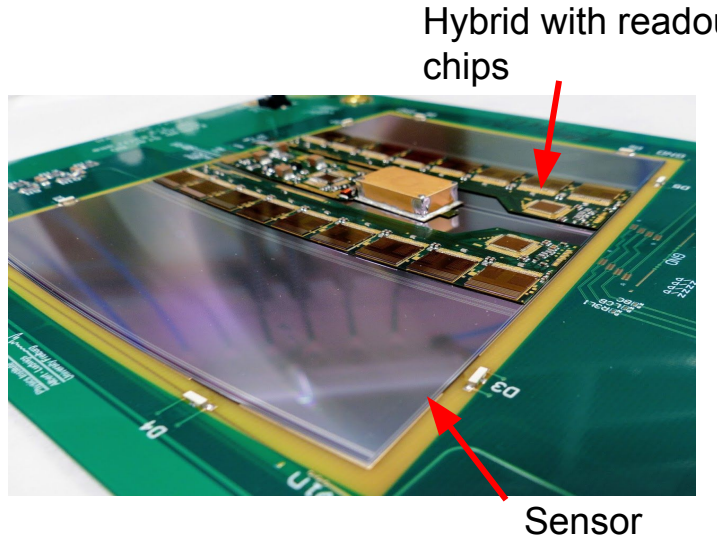
ATLAS ITk Strip Tracker Upgrade

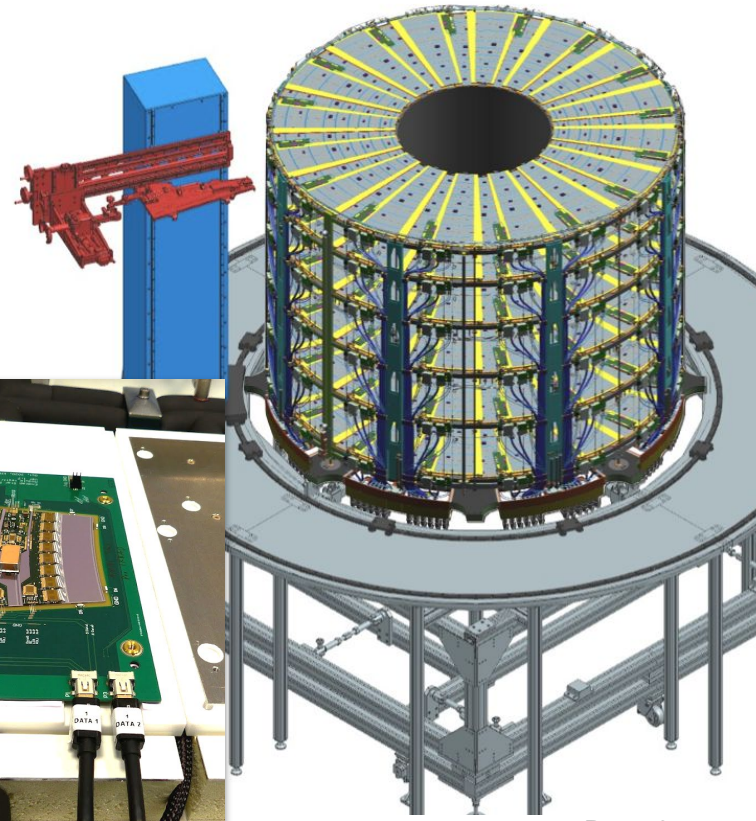
at DESY - Zeuthen Campus

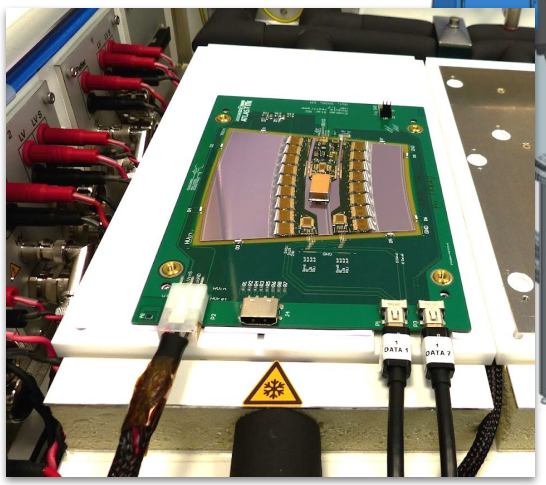
- **Micro-Intro: why ATLAS upgrade @ DESY**
  - LHC: higher luminosity with “HL-LHC” Upgrade
  - at HL-LHC, current ATLAS tracking detector will not
    - withstand radiation nor
    - be able to separate dense tracks in time and space
  - ATLAS needs new tracker
    - higher radiation hardness and
    - higher granularity and
    - faster readout (and new trigger) capabilities

  - DESY joined ATLAS late, without contributing to ATLAS dev and construction
    - required that large labs do this, to be accepted into collaboration
    - we fulfill this “dept” retroactively with contribution to tracker upgrade (aka *obligation to international collab*)

  - DESY-Z contributed significantly to dev of new tracking detector
  - DESY-Z will build large fraction of new tracker
    - entered pre-production
    - production scheduled Q1-2023







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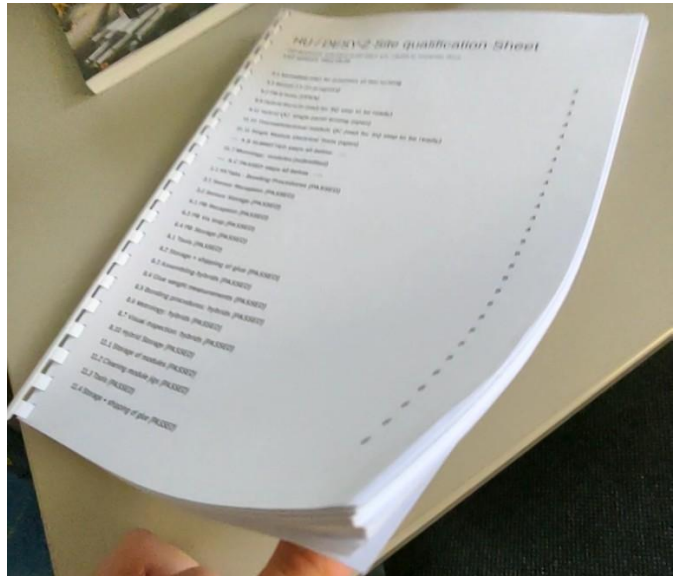
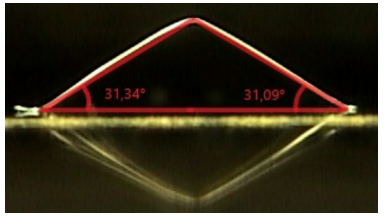
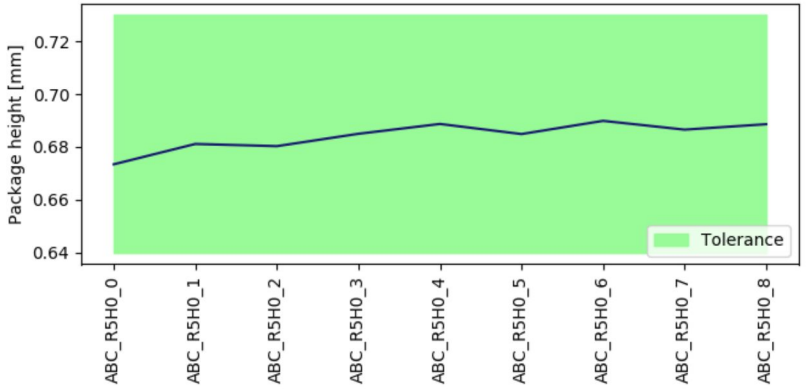
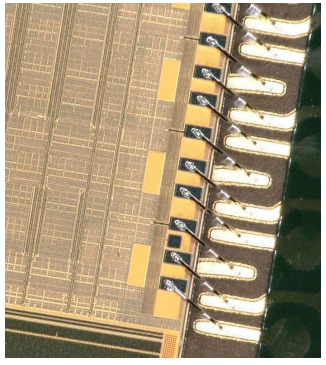
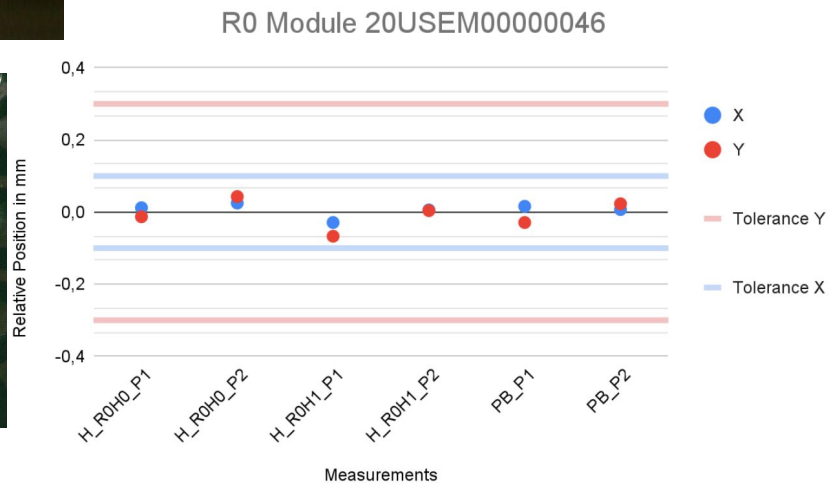
- **Status - gearing up for production**
  - Well advanced in “qualification” for production
  - Covid: qualify >20 labs worldwide in “remote” way
    - had planned site visits, spend few days at each lab
    - now record data, shoot videos, … and put into documents
      - Zeuthen alone: wrote 145 pages (85% done)
    - significant time and work investment
      - worth it, play through every step in production and document, finding “bugs” in the process and learning in detail requirements to ensure coherent required quality at all labs

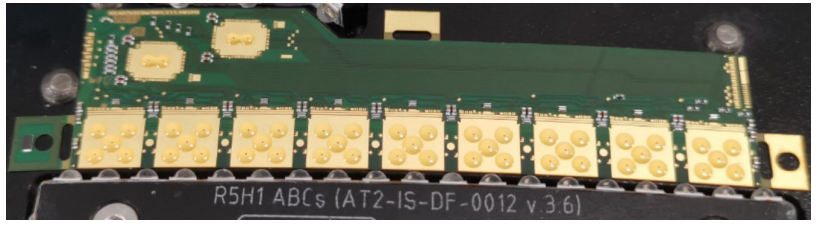


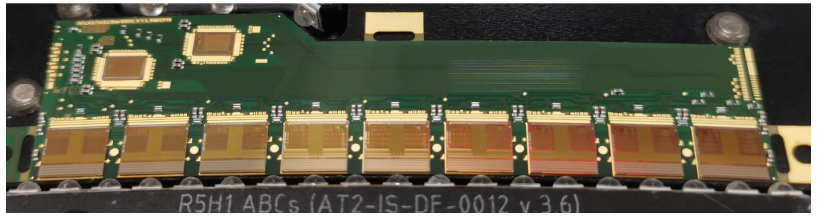










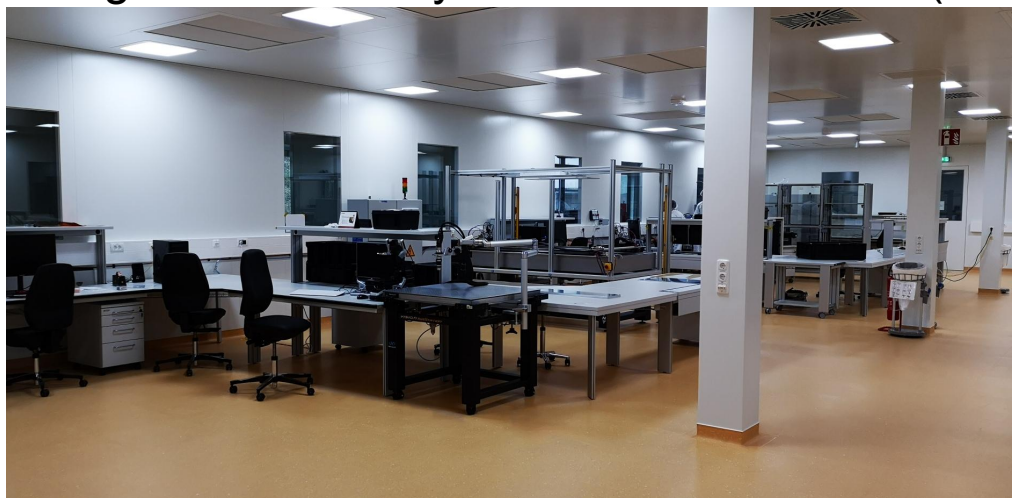


ATLAS ITk Strip Tracker Upgrade

DESY wide laboratories and clean rooms operational, undergoing site qualification

Zeuthen ATLAS upgrade production lab (ISO-6)

Hamburg DAF assembly and QC Clean Room (ISO-7)



Hamburg DAF module/petal building Clean Room (ISO-6)

Hamburg DAF Integration Clean Room (ISO-7)

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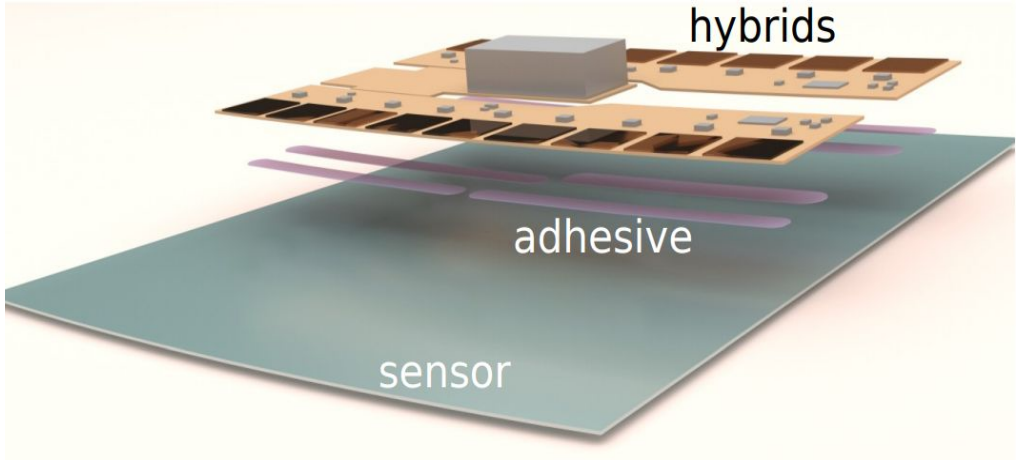

- **1. Where are our scientific and technological gold mines?**
  - The real gold mine is 4000fb^{-1} HL-LHC data that we work towards
  - Challenge to operate detectors at huge radiation levels at HL-LHC led to technological advancements, e.g.:
    - radiation hard components
      - silicon detectors
      - electronics (analogue and digital readout, powering (DCDC converters), environmental monitoring, flex circuits …)
      - construction components (composites (e.g. carbon), adhesives, …)
    - efficient powering schemes (e.g. DCDC conversion or serial powering)
    - CO2 cooling
- **2. What are our future applications fields?**
  - upgrade technology has many direct applications (e.g. in medical imaging, nuclear safety, satellites near the sun, …)
    - wherever high radiation fields and/or large temperature changes are expected and high detection sensitivity at low noise is required
  - future detectors will build upon what we developed for the HL-LHC (as we have build upon previous detectors)
  - data reduction techniques, online reconstruction and high throughput methods have a WIDE field of application (incl Astronomy)
  - efficient powering methods as well
- **3. What are our (== ATLAS Upgrade @ Zeuthen) mission-critical research infrastructures?**
  - short term the cleanroom and the cleanroom requirements
    - electricity, cooling, heating, air filters
  - long term mostly office space, fast network and local computing infrastructure for data analysis

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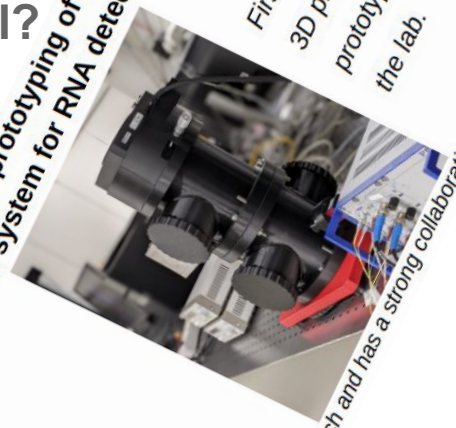
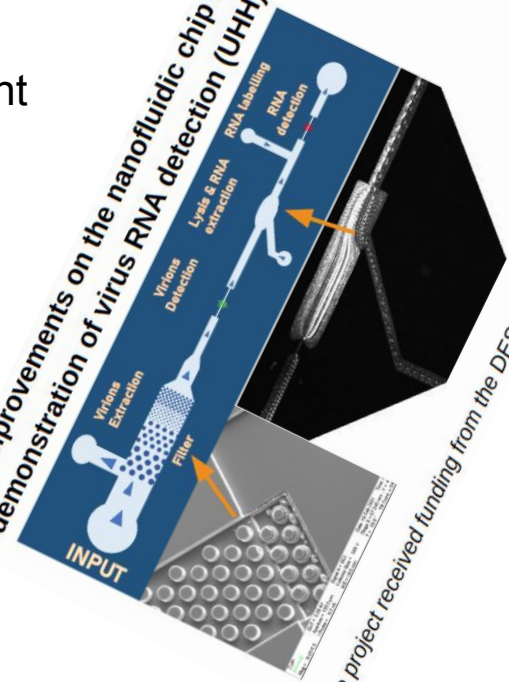
- **4. What are further RIS (research infrastructure) with high discovery potential?**
  - ideally a plasma accelerator driven collider @ DESY :)
  - next higher energy collider - succeeding LHC
- **5. What are DESY obligations in international collaborations?**
  - in the context here, clearly
    - construct ~2000 modules and
    - deliver one of two endcaps CERN by Q2-2026
- **6. How can we increase the societal impact of the lab?**
  - ATLAS group (HH) develops cheap “DNA analysis tool” (nanoflu)
    e.g. as reliable detector for viruses (e.g. covid)
  - mind set: decisions checked for alternatives with smaller CO2 footprint
  - more remote collaboration (zoom, remote det ops, …)
- **7. How do we set up our service groups, deal with lab space?**
  - the “engineering matrix” appears a good start to me
    - think about ways to “automate” “booking” process
      - an online version of the matrix with immediate feedback to the person who adds a request?
  - as for lab space - we need more land!
    - if need to share, important to have protected zones, ensured that individual setups are protected against involuntary modifications

WP2: design & prototyping of a portable laser readout system for RNA detection (DESY)



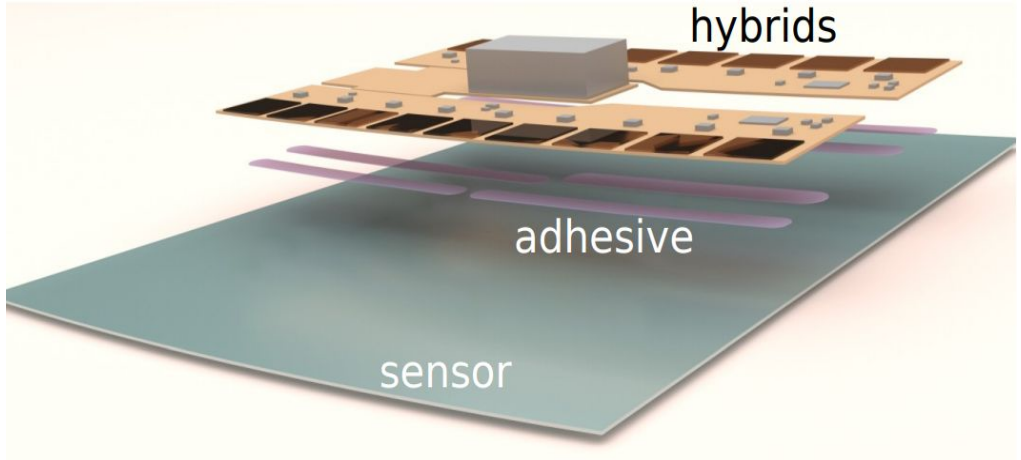
First test of 3D printed prototype in the lab.

WP1: improvements on the nanofluidic chip and demonstration of virus RNA detection (UHH)



The project received funding from the DESY Strategy Fund for COVID-19 research and has a strong collaboration with the DESY technology transfer

Backup slides…



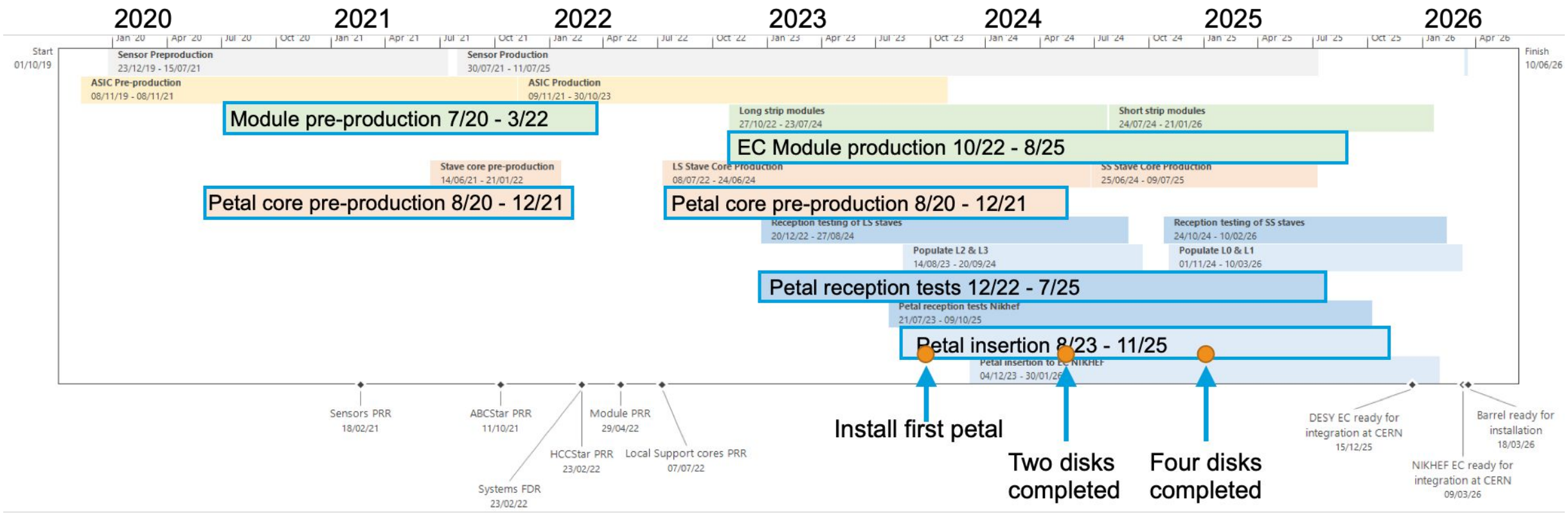
DESY Deliverables

Need to deliver more than 4600 parts ….

- **Petal cores (400)**
  - Planning based on delivering parts for all cores for BOTH end-caps
    - Co-cured facings, Titanium pipes with welded insulating breaks, smaller parts
  - Main process of building the petals taken over by company AVS (Spain)
- **Endcap modules (2000 +500)**
  - Split into 3/4 in Zeuthen and 1/4 in Hamburg
  - 500 modules for the HU delivery
  - Backup for each other
- **End of Substructure (EoS) cards (1630)**
  - Custom board to be produced in industry
  - Test of every single EoS board for both end-caps and the barrel
  - FE group strongly involved
- **Fully instrumented petals (100-125)**
  - ~ 50% of an end-cap
- **End-cap integration structure (1)**
  - Structure will be built at NIKHEF
    - DESY involved in overall design and producing some of the carbon fiber components (service trays)
- **Fully instrumented end-cap (1)**
  - In close collaboration with Berlin, Dortmund and Freiburg

ATLAS ITk Schedule

Highlighted on DESY Deliverables (Status: PRC - May 2022)



- Overall - strong impact due to Covid-19 - many delays in all areas
- Hard to disentangle “normal” delays and Covid-delays, but estimates assume at least 70% of delays due to lockdowns etc.
- Running with 50% top speed compared to “normal” times
- Many reviews ongoing