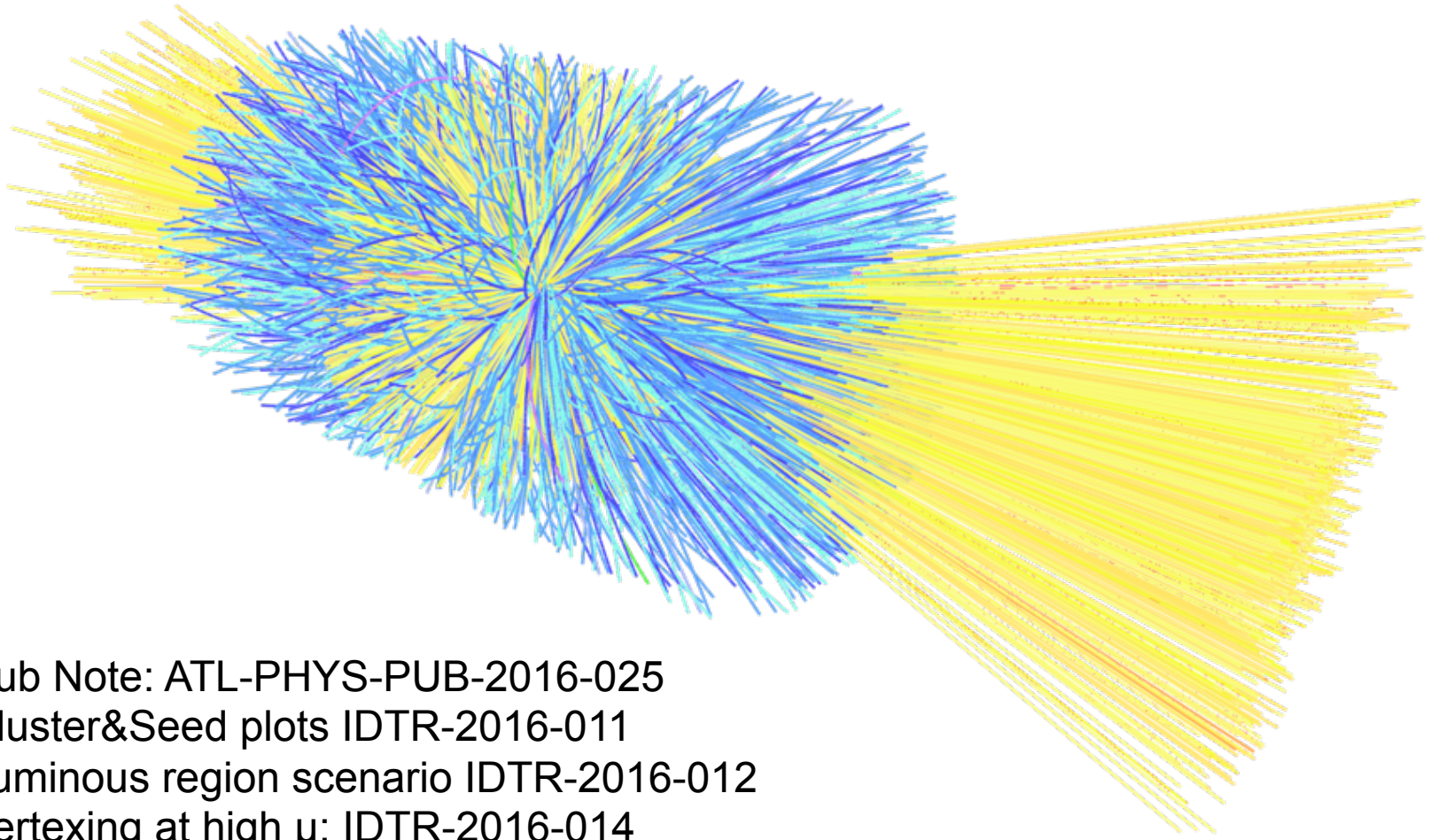
ATLAS ITk Pixel detector

C. Gemme, INFN Genova

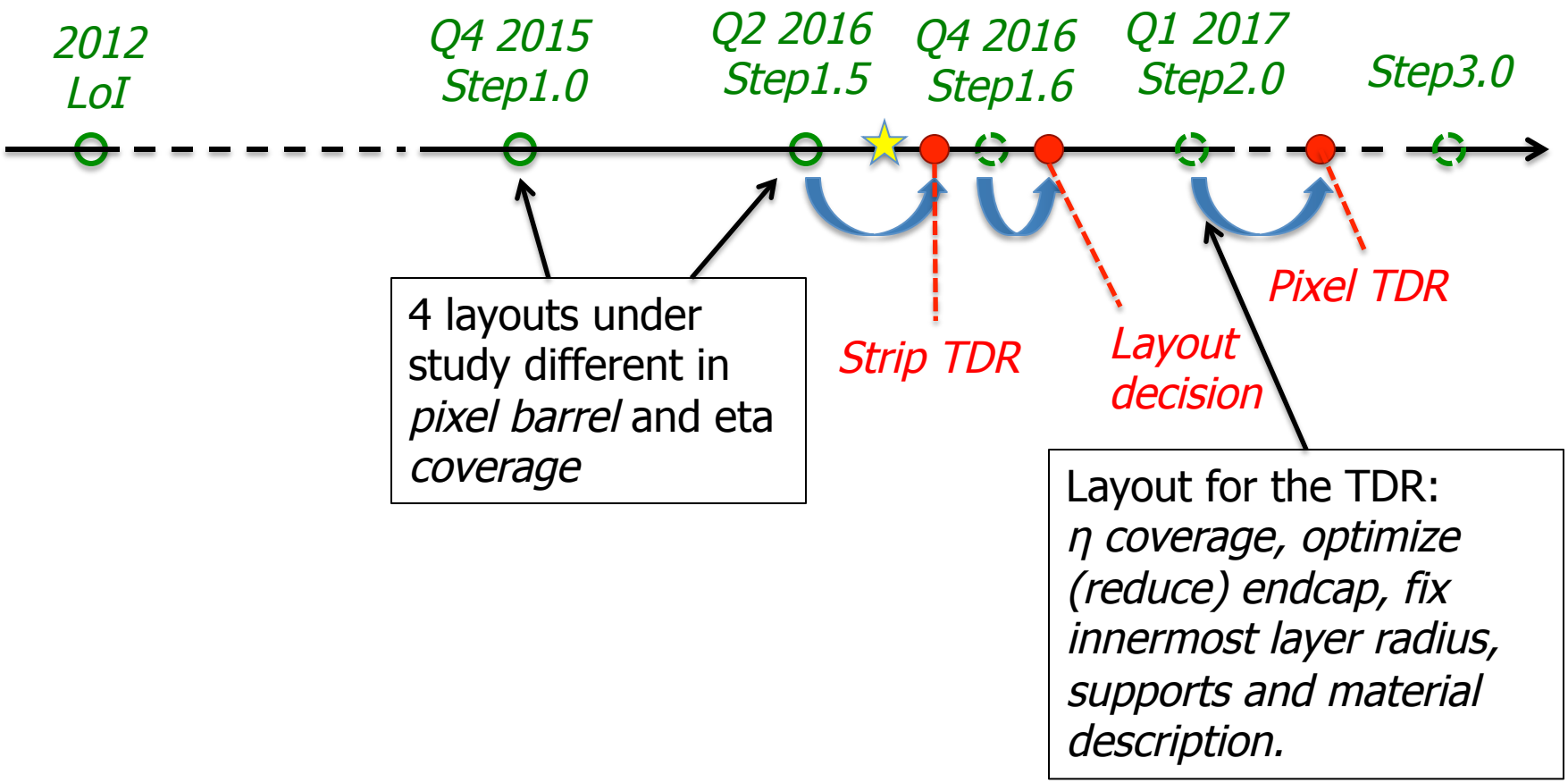
25 Ottobre 2016 – ATLAS ITK Italia



Pub Note: ATL-PHYS-PUB-2016-025
Cluster&Seed plots IDTR-2016-011
Luminous region scenario IDTR-2016-012
Vertexing at high μ: IDTR-2016-014

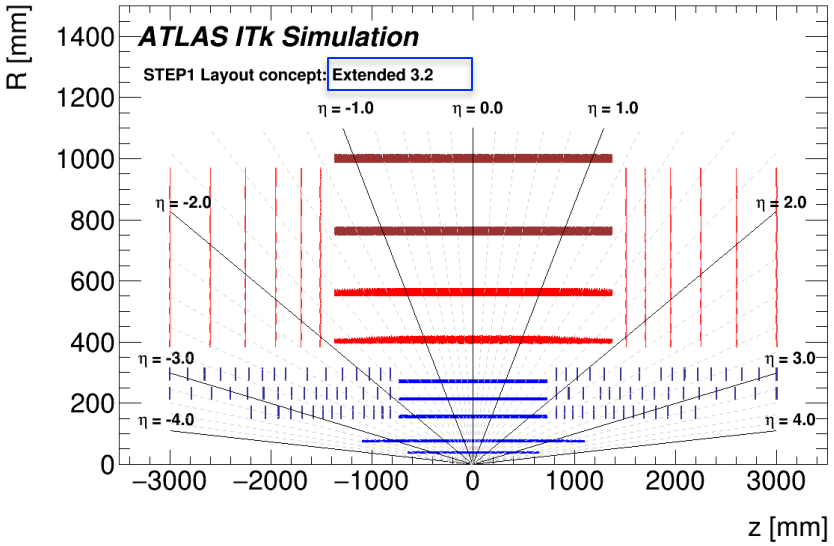
ITk Pixel timeline: close future

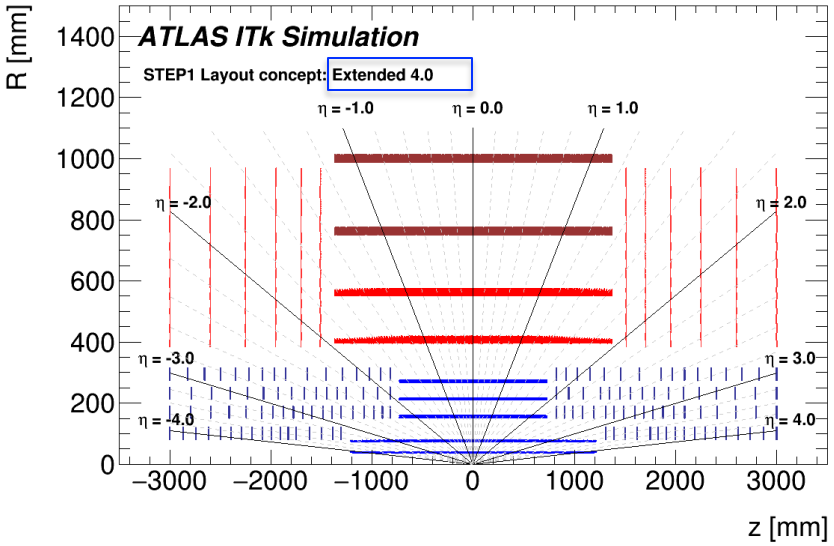
- ✓ In the last two years focus on finalizing the layout for the TDRs.
  - It is important also to have the community behind it.

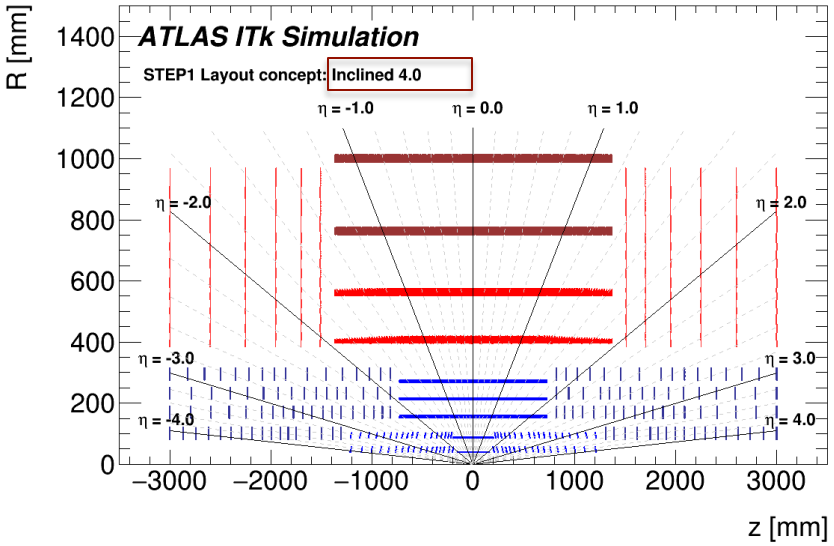


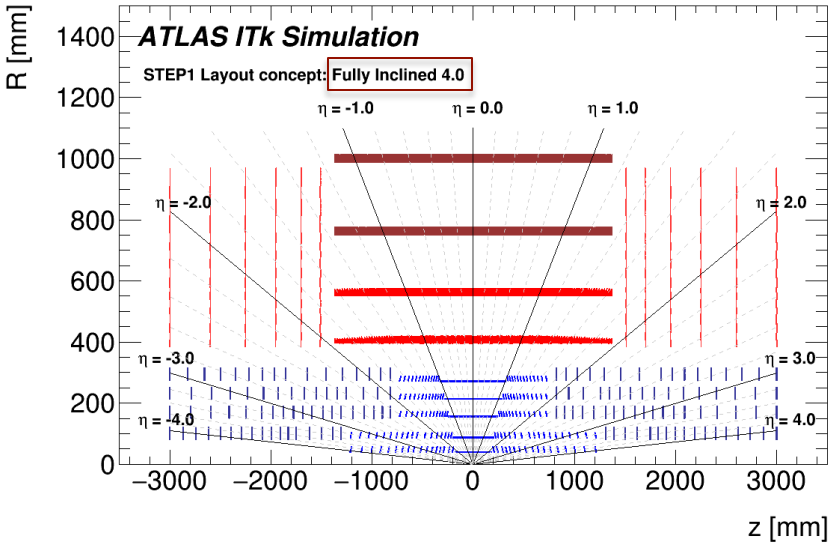
ITK Layouts under study

Strip layout and Pixel end-cap all the same. Changes only in the Pixel barrel.









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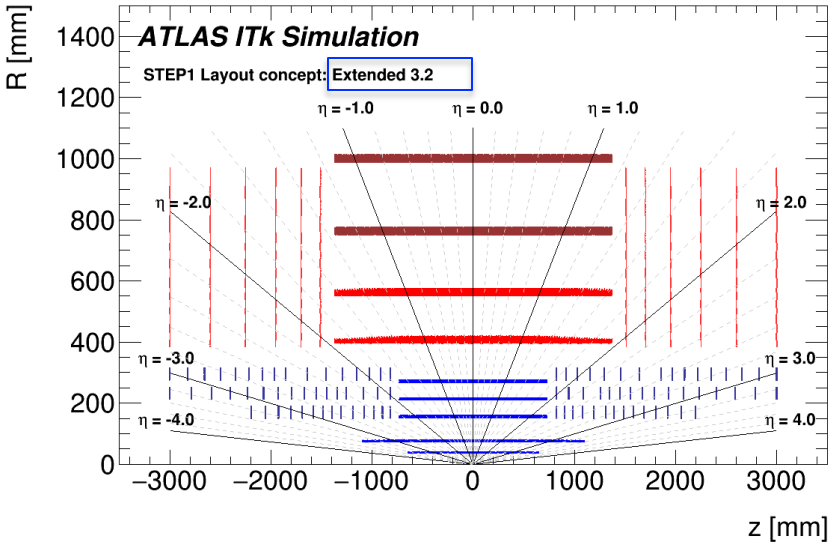
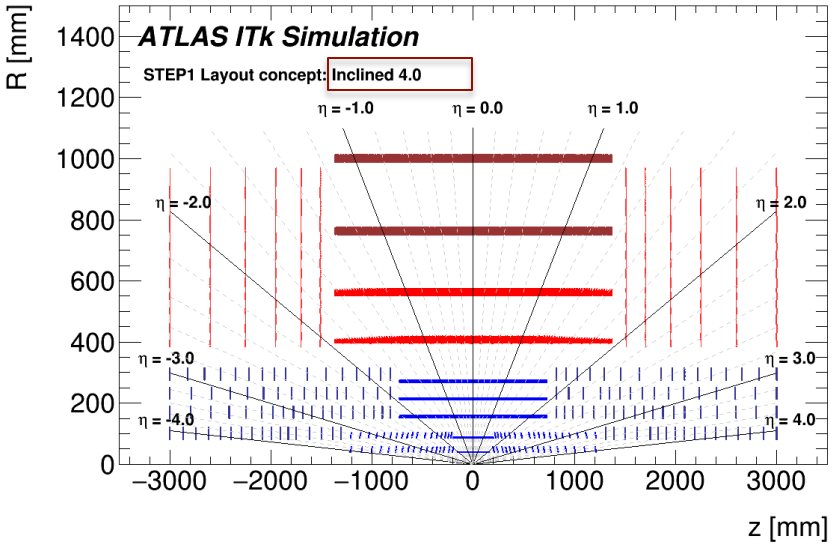
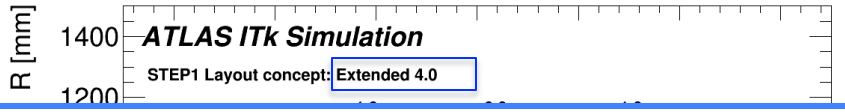






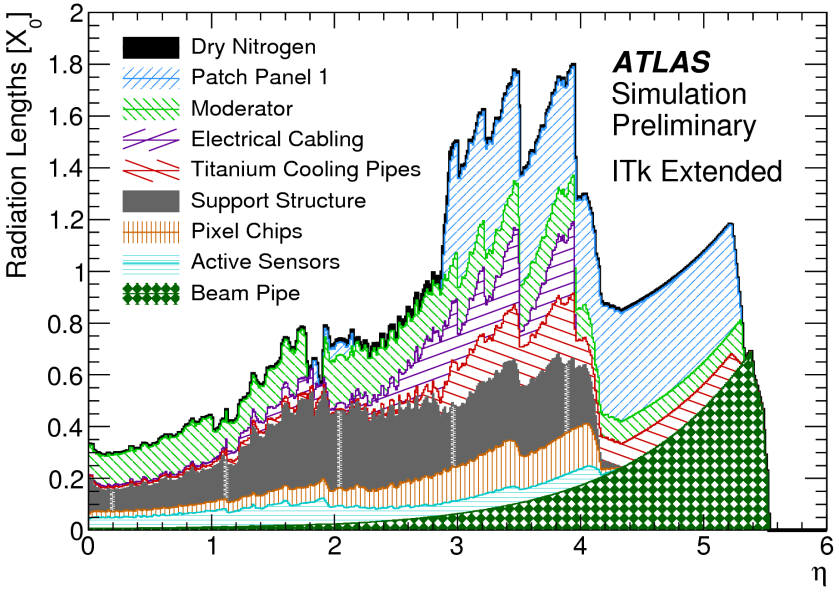
The layouts have:

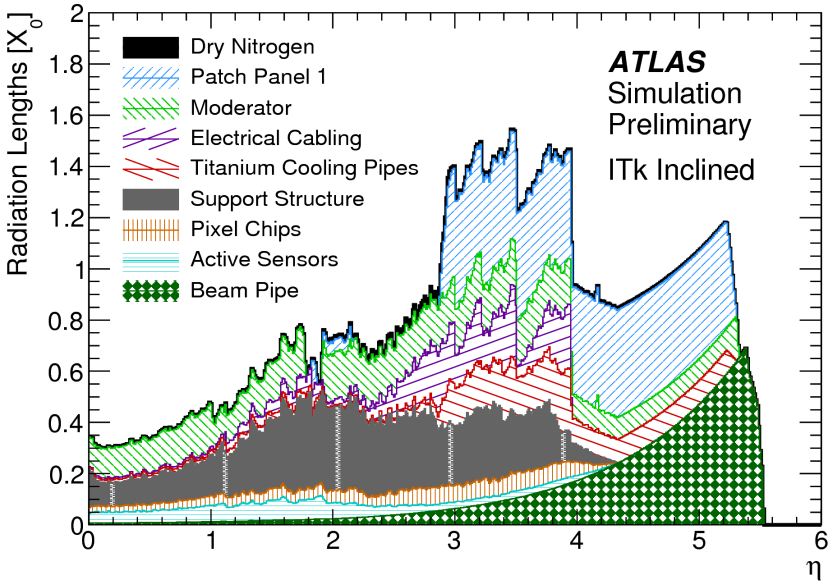
- ✓ Pixel volume up to 345 mm radius; then strip to the edge of the solenoid
- ✓ 4 Strip Barrel layers + 2x6 EC disks
- ✓ 5 Pixel Barrel and 4 (or 3) Rings layers, surface ~14 m^2

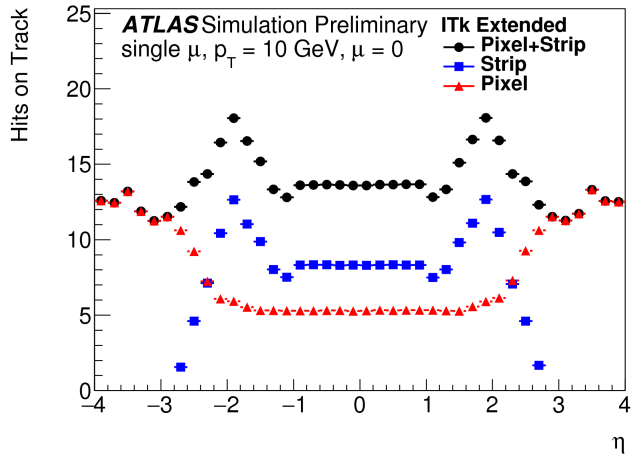
Layer	Radius ID [mm]	Radius ITk [mm]
0	33.5	39
1	50.5	75
2	88.5	155
3	122.5	213
4	–	271

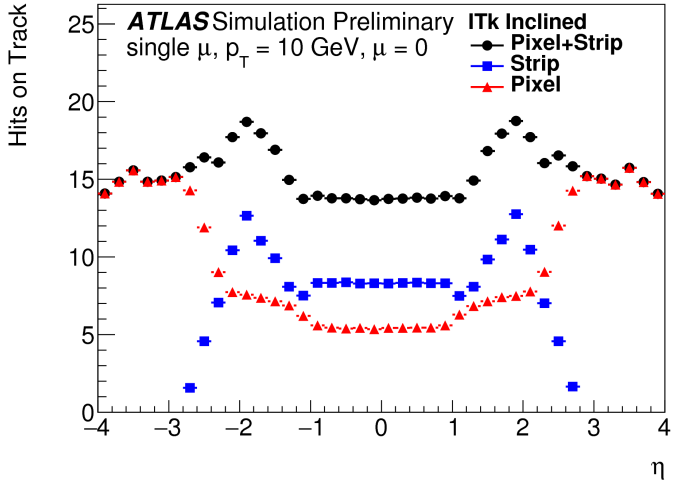
- ✓ η coverage up to 4.0 (or 3.2) with at least 9 space points
- ✓ Pixel innermost detector replaceable.

Step 1.5 : Material description

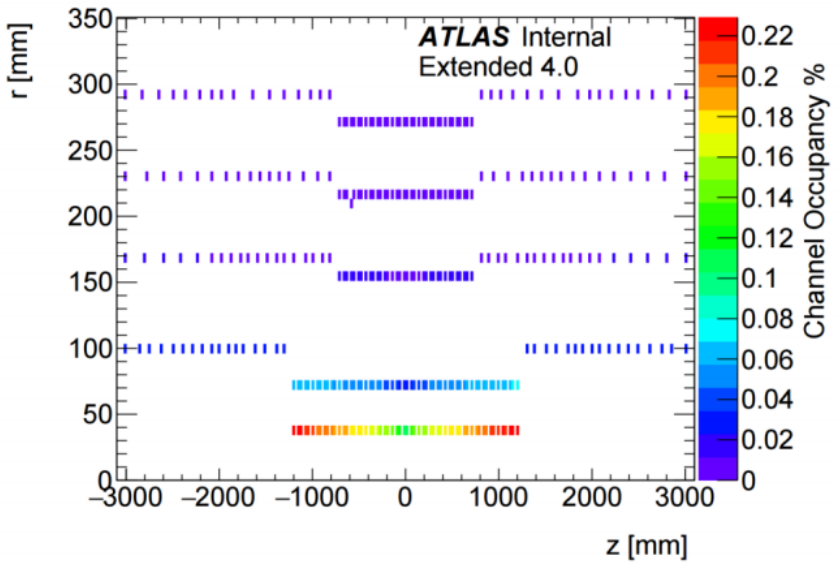


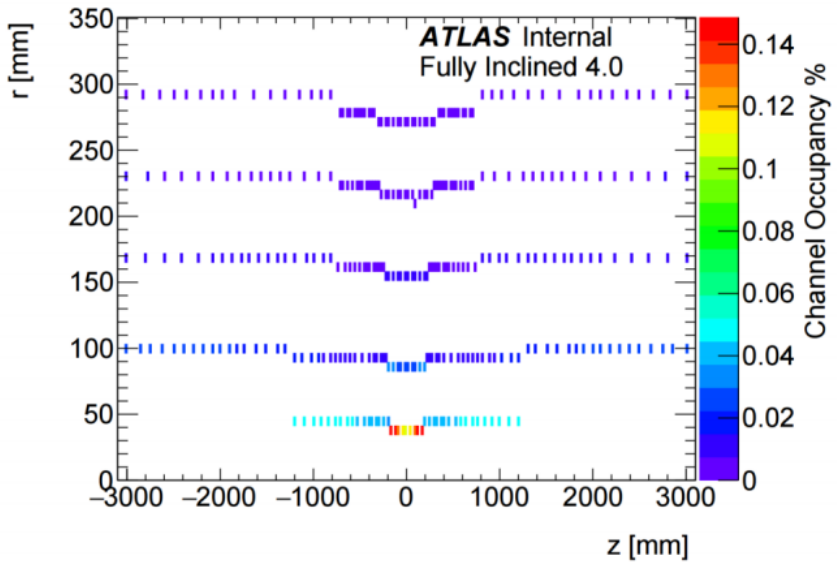






Step 1.5 : Pixel Occupancies





Pixel occupancies for a minimum bias event with a pile up of 200
Channel occupancy higher in extended (as expected)
Note the different scales on the two plots

Step 1.5 : Before we get to the results

- Intrinsic resolution
  - **pessimistic scenario**
    digital clustering: **done**
    (simplistic error assumption)
  - **optimistic scenario**
    idealistic clustering: **done**
    idealistic cluster-merging: **done**
    idealistic θ measurement: **implemented/used, needs to be checked by experts**
    include ϕ measurement: **implemented, but not used yet**
    (adapted errors)

In practice the results would not be realizable

- Material dependence
  - **extended:** **ok for next step**
  - **inclined:** **amount ok, local positioning needs to be checked**

The results presented here are indicative but not yet final. All of the tools are in

Step 1.5 : Preliminary results

- Impact parameter resolution

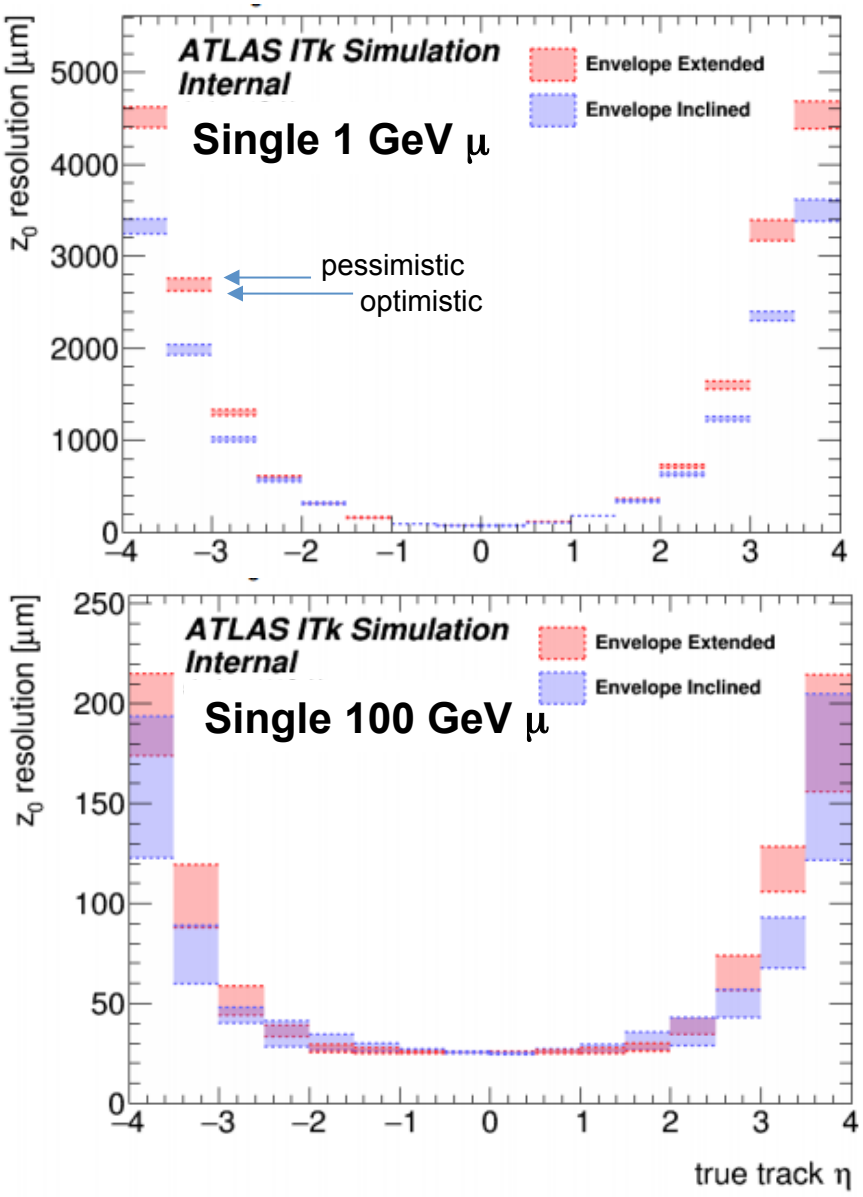
pessimistic scenario

digital clustering

-

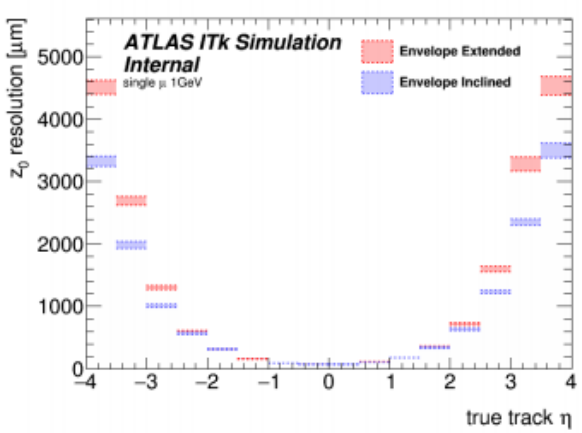
optimistic scenario

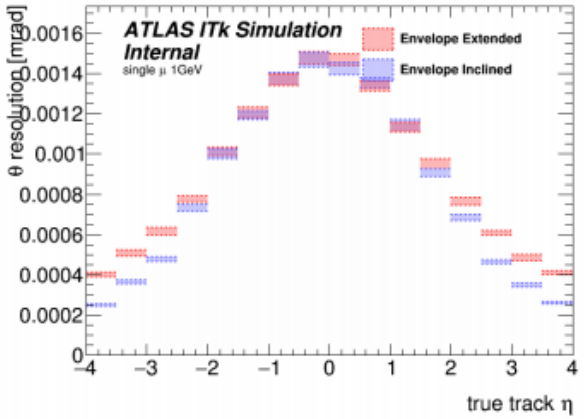
idealistic clustering
idealistic cluster-merging
idealistic θ measurement
(adapted errors)

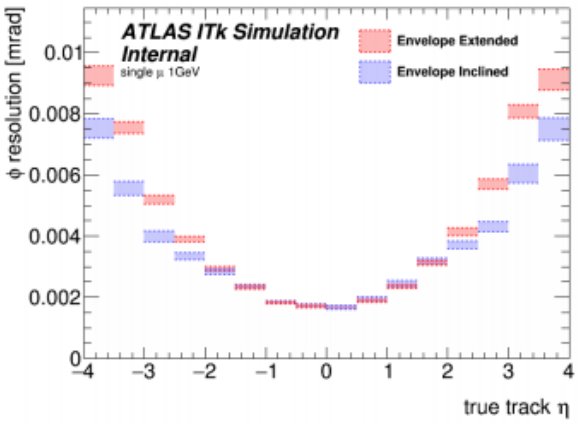


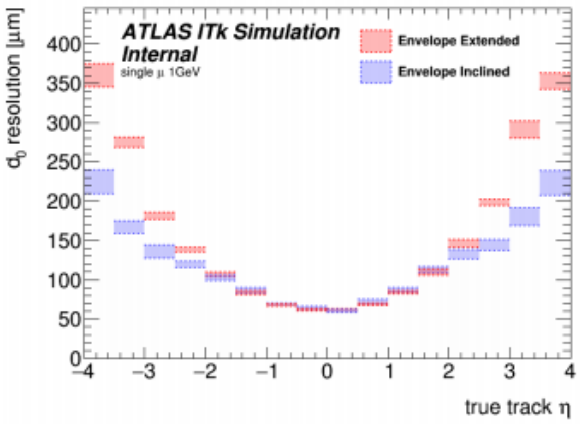
Step 1.5 : Preliminary results

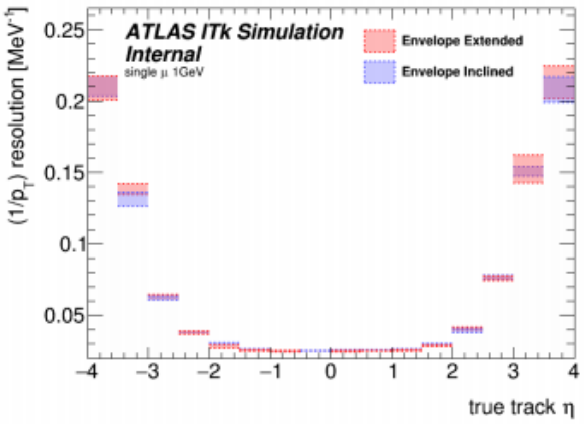
Comparison of performance results (extended vs inclined) for single 1GeV muons











See 3 very nice talks in ITk week (Plenary, Thursday am 11:30 – 13:15)
https://indico.cern.ch/event/562672/

Beyond the TF, towards the Pixel TDR (1)

✓ **Step 1.6**

- **Time**: weeks
- **Scope**: finalize the layout recommendation!
  - Extra material in the inclined modules
    - → Anything else???? We must to be sure everybody agrees on the input conditions!
  - One layout optimized in the barrel region for 28.5 cm BP envelope
    - Extended@4.0@33 → similar overlaps as in the Extended@4.0
- **Layouts**:
  - Extended@4.0@33 → BP studies
  - FullyInclined for better material comparison

Layout Task Force. What Happens Next? 3 Steps each with different "owners"

1. The ITk Layout Task Force will produce a set of recommendations in a written report [20-30 pages] by the end of November. This report will be circulated to the ITk through CDS who will then be invited to comment.
2. Those recommendations will be reviewed by a joint ITk/USC committee on 5th and 19th December. First meeting to review the document and its conclusions and a second meeting to clear up any outstanding issues that arise in the first meeting and cannot be resolved on the spot.
3. The findings of this committee will be presented to the USC/EB for approval.

Contents

Beyond the TF, towards the Pixel TDR (2)

✓ **Step 2.0**

- **Time**: end of year
- **Scope**: recommended layout so far
  - Input on the min radius if in time
  - Optimization of the EC
  - Optimization of extended and inclined layouts at to eta 4 in material description and realism
- **Layouts**:
  - Two flavors: Extended, Inclined

Beyond the TF, towards the Pixel TDR (3)

✓ **Step 3.0**

- **Time**: early-mid Q2, in time for the pixel TDR
- **Scope**: support the pixel TDR
  - Keep updating the material description and progress in realism.
  - The layout recommendation may bring the engineers in a further optimization or new ideas of the pixel local supports.
  - Pixel size, sensor/electronics thicknesses may change towards the TDR
  - Also for the strip, the recommendation may bring new effort in the barrel/end-cap transition.
- **Layouts**:
  - Hopefully ONE!