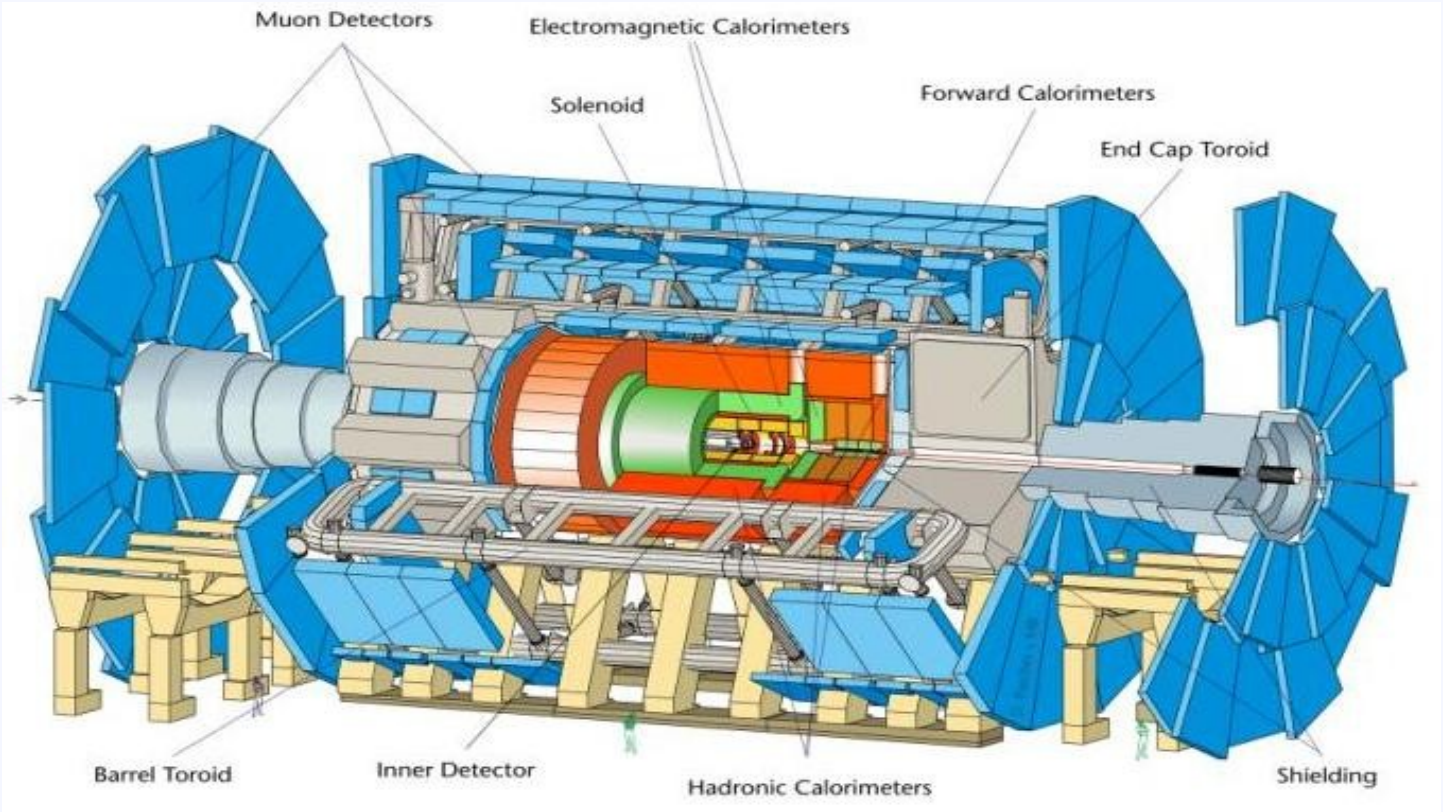
ATLAS/LHC Interface Status



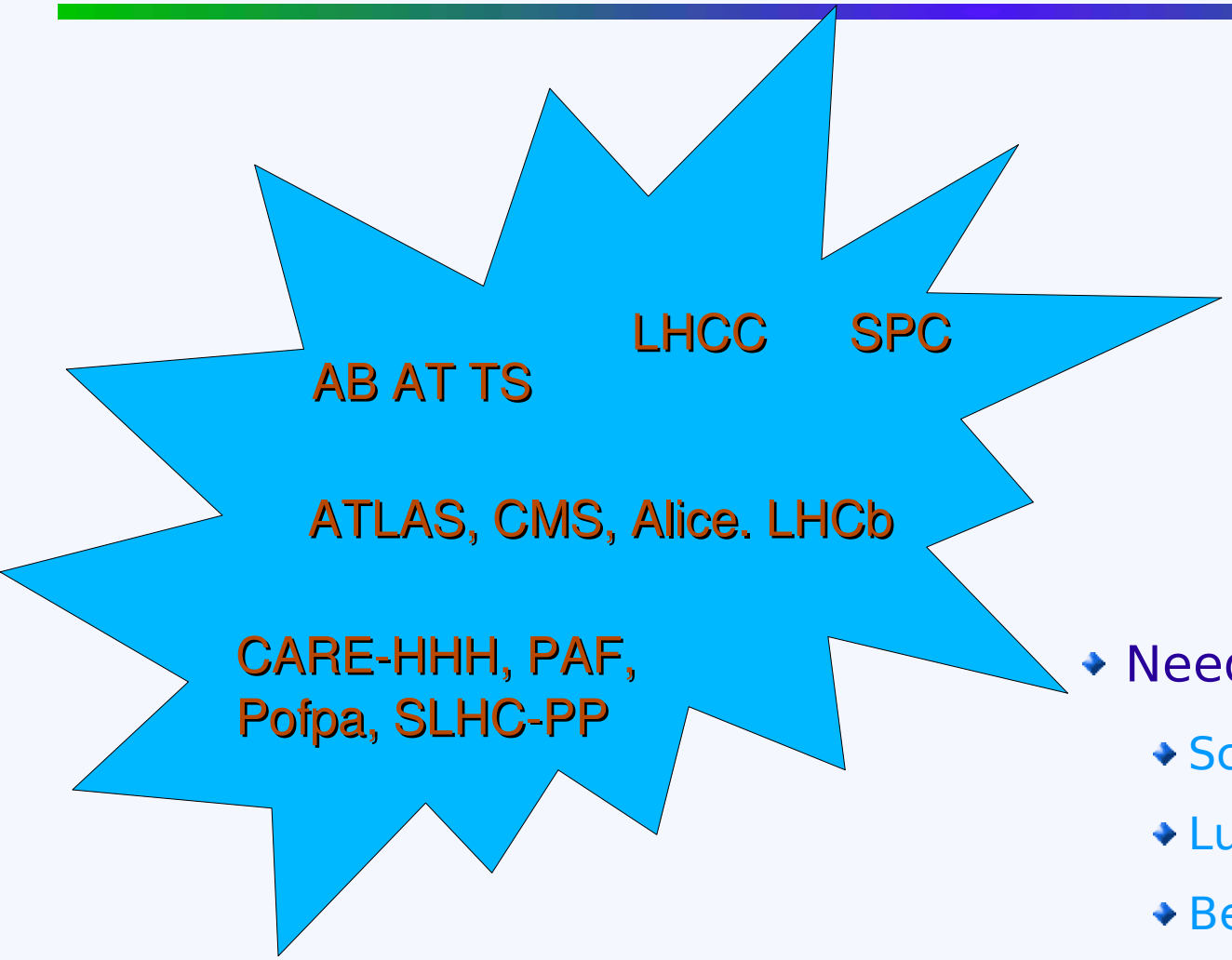
(Overview Upgrade talk given July 1st 2008 LHCC
Phase-I ATLAS Plans given Sep 23rd 2008)

Today: benefit from machine group presence
Communications, Beampipes, Machine conditions, Magnets in ATLAS

ATLAS Upgrade in a Nutshell

- Phase-I
  - 3 times nominal L, long shutdown 2012-13.
  - New B-layer “IBL”
- Phase-II
  - 10 times nominal, 3000 fb-1 data/radiation damage
  - Most of ATLAS remains, but:
    - New Inner tracker
    - (Probably) New forward calorimeter elements
    - New forward muon chambers, possibly more
    - New trigger elements
    - New readout electronics and power supplies in many areas
  - Approx. 40 % of original components cost

Comments on Organisation and Discussion



- Need to find optimum forums
- Particularly ATLAS+CMS with AB, AT, TS – for working meetings understanding the issues at interfaces

- Need to cover:
  - Schedule
  - Luminosity scenarios
  - Beam structure/conditions
  - Machine elements in the experiments
  - Beam pipes

Beam Pipes for ATLAS – 1,2,3 (and 4)

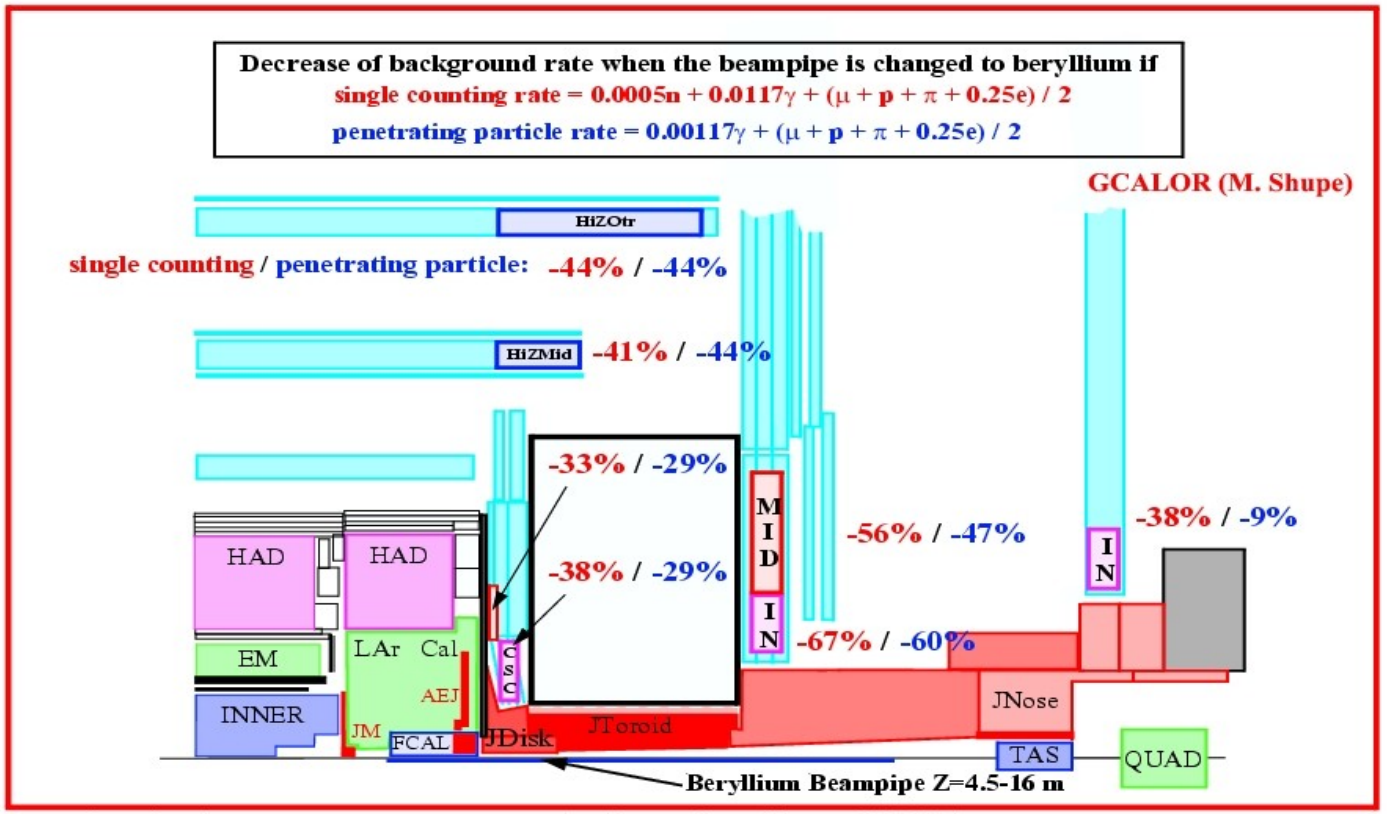
- Spare Beam-pipe
  - ATLAS B-Layer Task Force (BLTF) review realised we cannot replace the beam-pipe in a reasonable time (more than a winter SD)
    - e.g. in event of an accident spoiling LHC vacuum
    - Propose to make a new spare which can be inserted without removing the pixel detector
    - Needs a scenario for removal of the current pipe, insertion of the new, with pixel in place, with LHC up and running in a reasonable time
    - Thinking in terms of Be in central part, SS elsewhere, plus heaters etc.
    - Hope it is never used!

Upgrade Beampipes

- Change SS first to Al then to all-Be for 2017
- Reduced radiation during intervention
- Reduced radiation to muon detectors
  - Factor 2 – 3
  - Very much cheaper than large areas of muon chambers

A beryllium beampipe

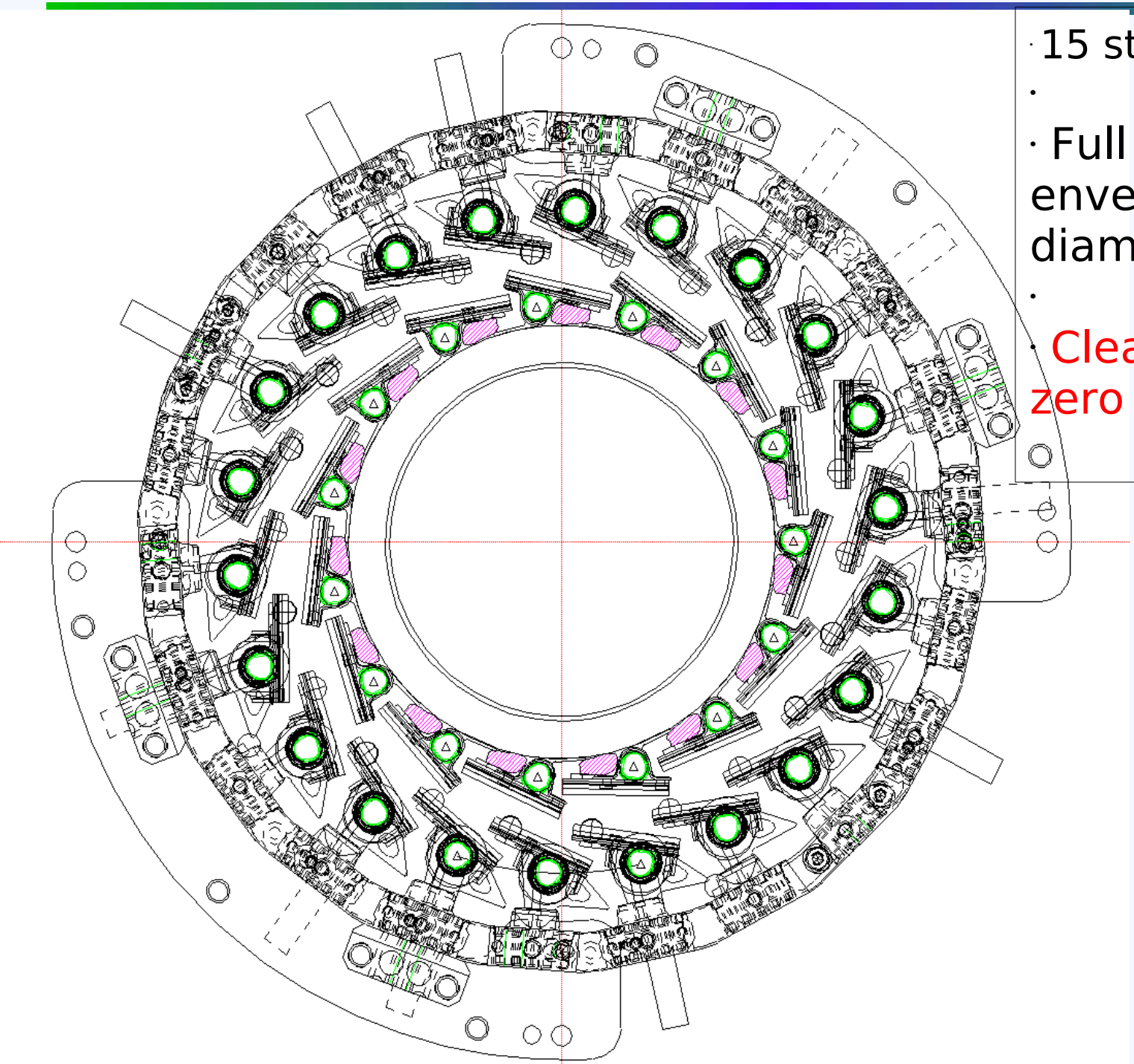
A beryllium beampipe is also the only way of significantly reducing the background in the muon spectrometer.



Phase-I IBL Beam-pipe

- Schedule is to insert a new B-layer (IBL), leaving the current pixel detector in place, in 2012/13 shutdown
  - (Drawn up before 9/19; need to assess if this shifts when more is known about LHC startup)
- This is not a lot of time to prepare new technologies necessary for the very harsh environment
- IBL was the main recommendation of the BLTF – the only game in town
- Very motivated Pixel and PO group, fully behind it
- Main issues for today are space, space and space.
- The engineers have to start now with making real designs – and the beam-pipe diameter is one of the most important inputs
- Clearly machine would like experience of running LHC, collimation etc. before coming up with an optimised minimum radius

IBL Clearance



- 15 staves - tiled
- Full beampipe envelope (72mm diameter)
- Clearance essentially zero

IBL Issues

- We need to understand how alignment issues – how much adjustment is needed?
- We need several mm extra for IBL
- We need a safe value fixed very soon – more important than a minimum target value

Sizes (radius in mm):

Current beam pipe i.r.	29
Heaters etc.	36
Liverpool “theoretical min”	17
BLTF assumed	25
Pixel ID	45.4

- Many other issues, e.g. services passage through supports, extraction/installation, ...

Machine Conditions

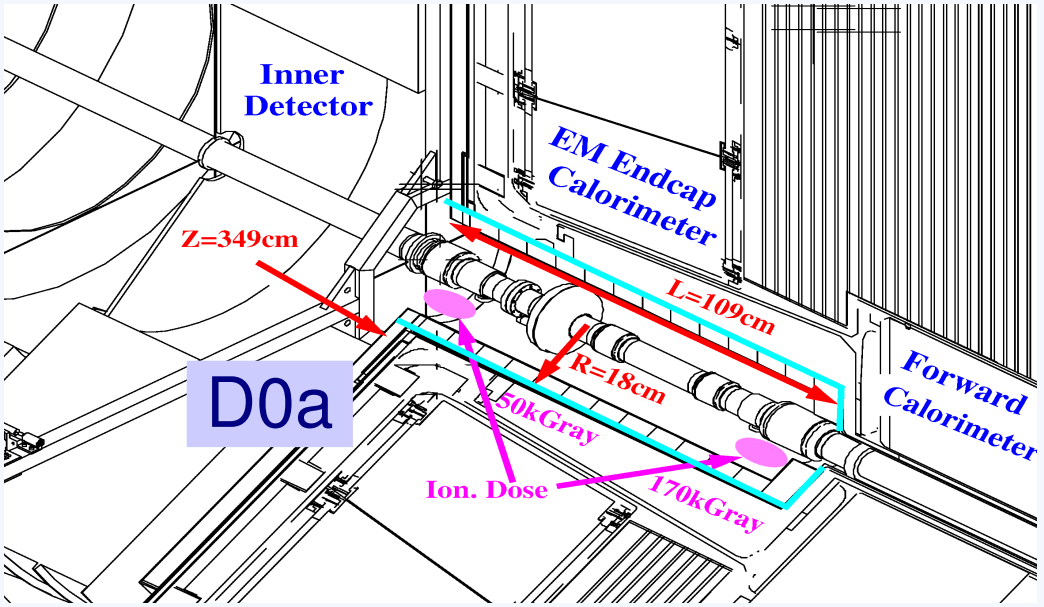
- We understand the necessity of following many roads to sLHC
- Keeping many options open has a cost:
  - We design for worst case in every aspect, even if the combination is not possible
    - E.g. 25 ns is worst case for many electronics aspects (L1 latency buffers, shaping)
    - 400 ev/BC is worst for many others
    - We have to design for both even though the combination is not proposed
- The 400 ev/BC is very challenging
  - Luminosity levelling remains very attractive
    - Even more so if we can count on it in time to relax some criteria
  - 400 ev/BC means more granularity - $ and X0; extra pixel layer and SS further out in place of LS

Machine elements in ATLAS - Update

- Machine magnets close to the IP can help achieve high luminosity at 25 ns bunch crossing – lower pile-up, clearly an advantage, and may turn out to be the only solution
- However, many difficulties as discussed in the past:
  - Degrade detector performance, especially forward calorimetry
  - Increased back-grounds from interactions
  - Less shielding --> more backgrounds
  - On top of these, not yet looked at: stability of supports, space for services, scenarios for ATLAS access and maintenance…; and CMS is different.
- Ian Dawson and Mike Shupe have studied the possibilities
  - https://edms.cern.ch/document/932316

Magnet Options in ATLAS

- D0a near ID, inside calorimeter
- D0b just behind calorimeter
  - Best performance with both, but D0b alone is significant help
- Q0 and TAS in JT/JF



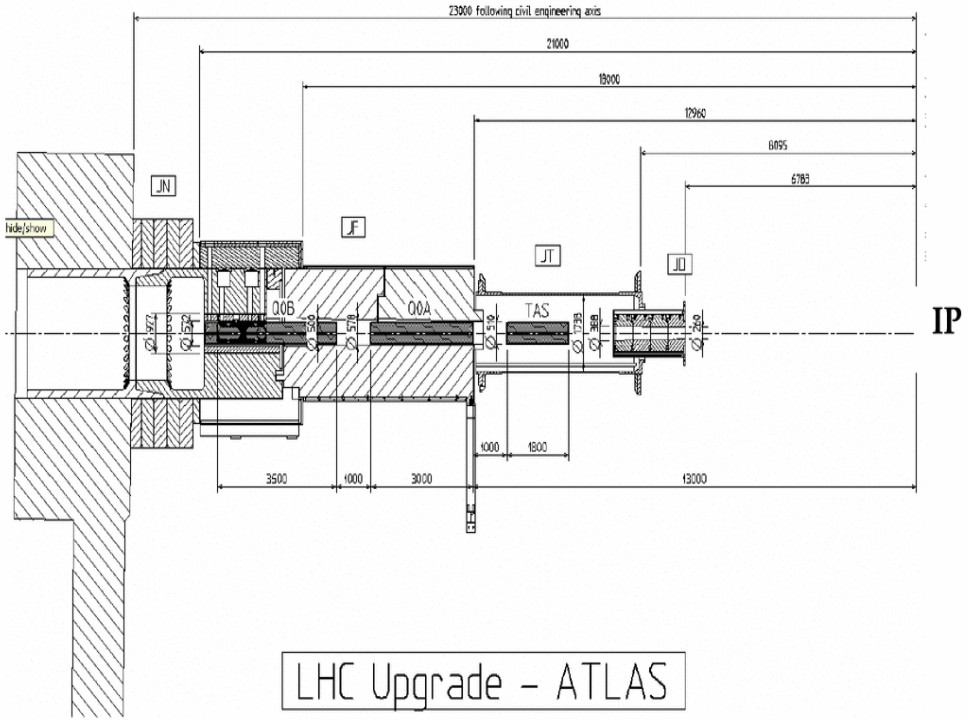
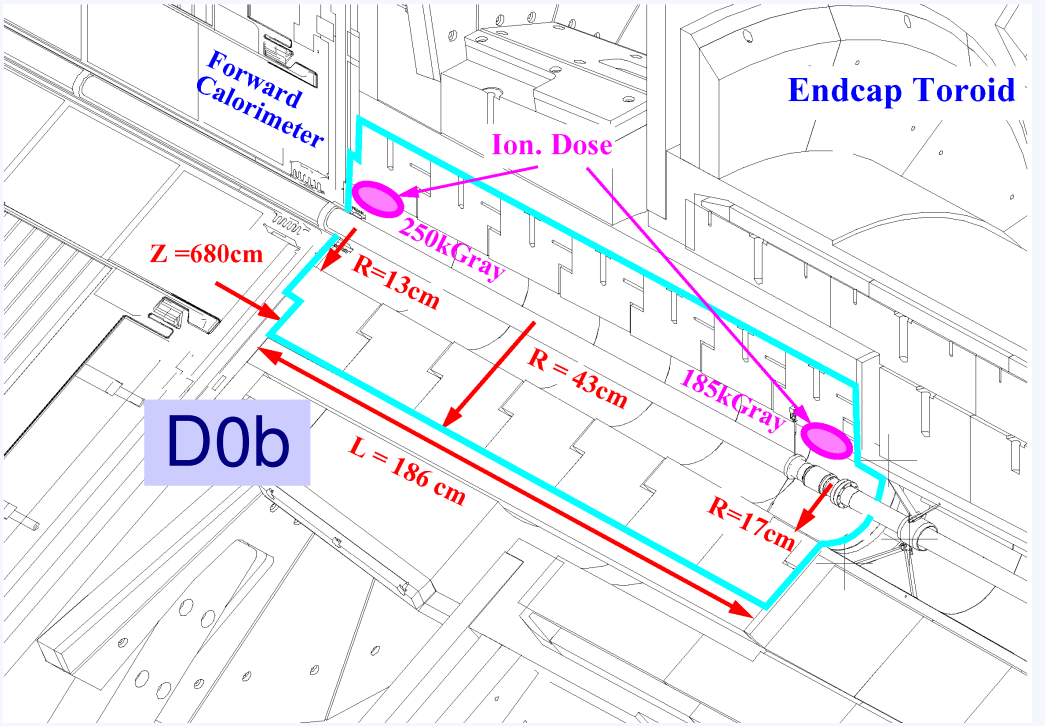


Figure 2: Integration of slim quadrupoles and TAS in the ATLAS insertion region.



Results

- D0a - Dipole in ID area:
  - 50 % background increase in the ID; and more importantly destroys forward calorimetry --> don't go there
- Q0 and TAS:
  - Gives a very significant increase to backgrounds in the muon system
    - Not just forward region, would need to replace a very large area with more expensive technology
  - Trouble is the TAS moved forwards outside the heavy JF shielding into the toroid shielding JT
  - We will study whether a new TAS moved forwards but still inside the JF is OK
    - Don't know if this makes any sense for the Q0 idea, just for understanding
- D0b – dipole after ECAL:
  - Raises muon system background by ~30 %. This is in the 300 ev/BC scenario, so equivalent to 400 ev/BC case without D0b
  - Seems acceptable from ATLAS physics performance point of view
  - (But still many engineering difficulties!)

Summary

- Many issues to keep discussing between many groups
- Most urgent topic is beam-pipe radius for IBL – can we count on 25 mm? When will we know?
- D0a and Q0/forward TAS do not look feasible
  - D0b needs more work, but looks possible

FP420

- Forward Physics with detectors at +-420 and +- 220 m from ATLAS IP
- Letter of Intent being reviewed internally in ATLAS
- Clearly needs close liason with machine
- Just flagged for completeness here