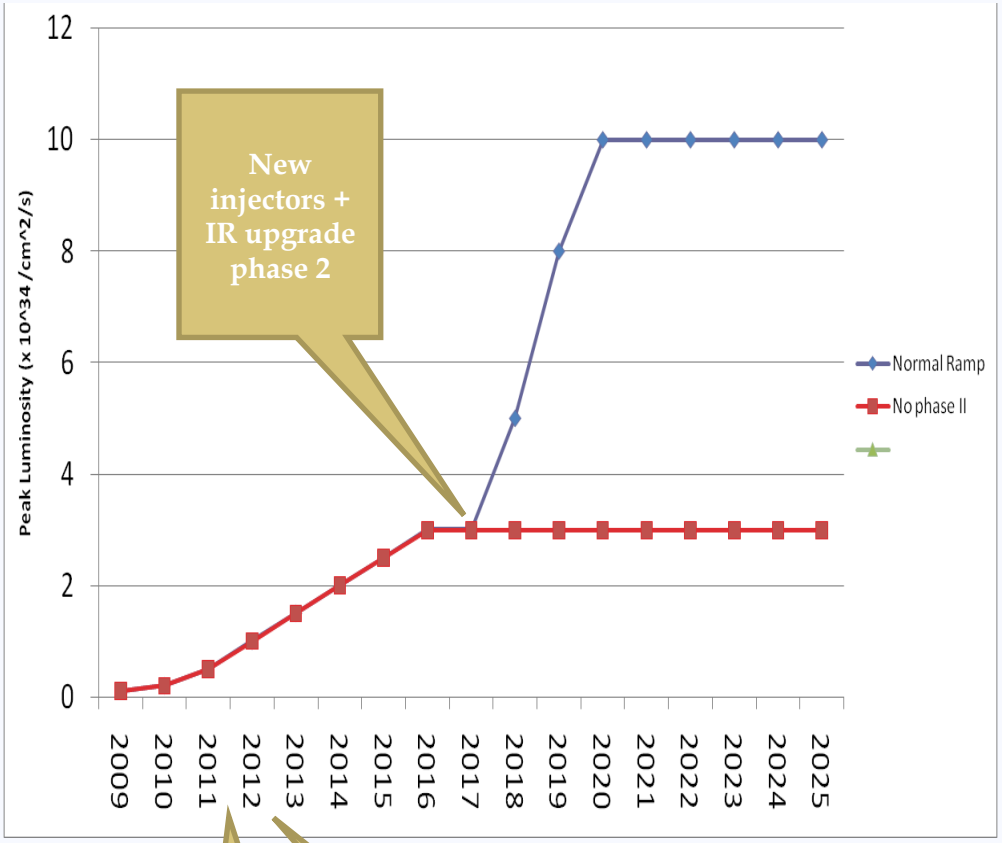
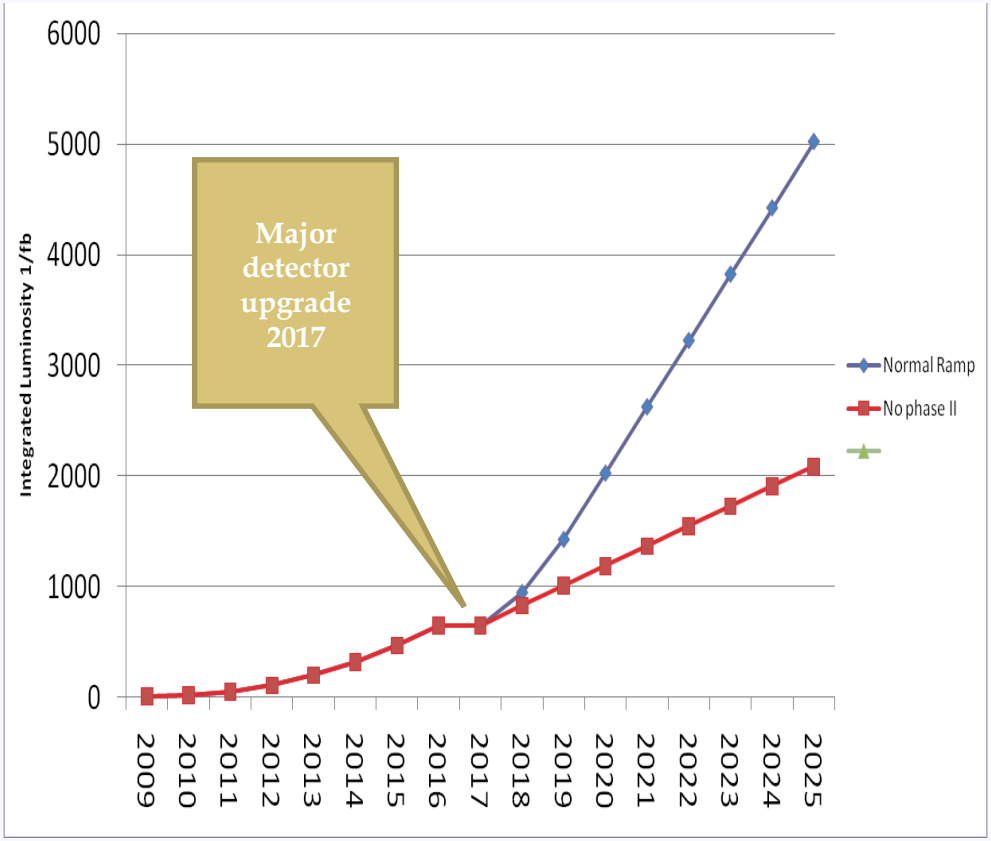
ATLAS Upgrade Plans 2009

TDR for B-layer
Phase-II – towards a LoI
Layout
Trigger
Schedule

LHC expectations (pre-Chamonix): Peak and Integrated Luminosity





Goal for ATLAS Upgrade:
3000 fb^{-1} recorded
cope with ~400 pile-up events each BC

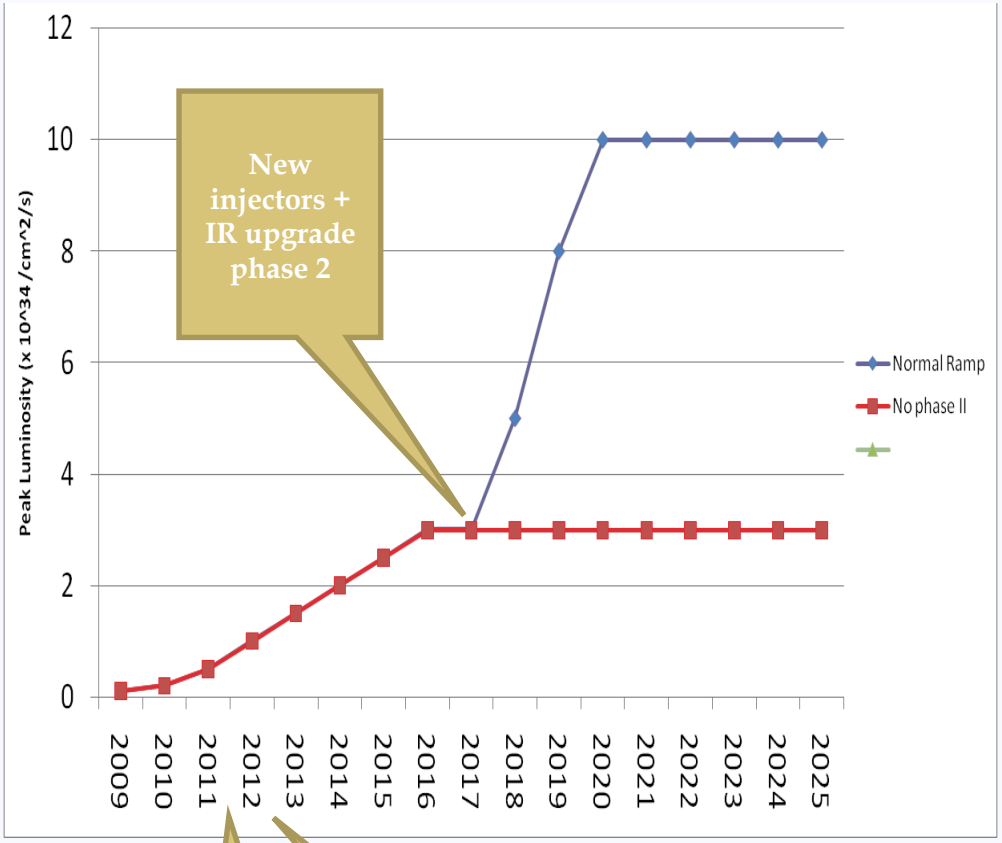
Phase-I – TDR for IBL (see next talk)

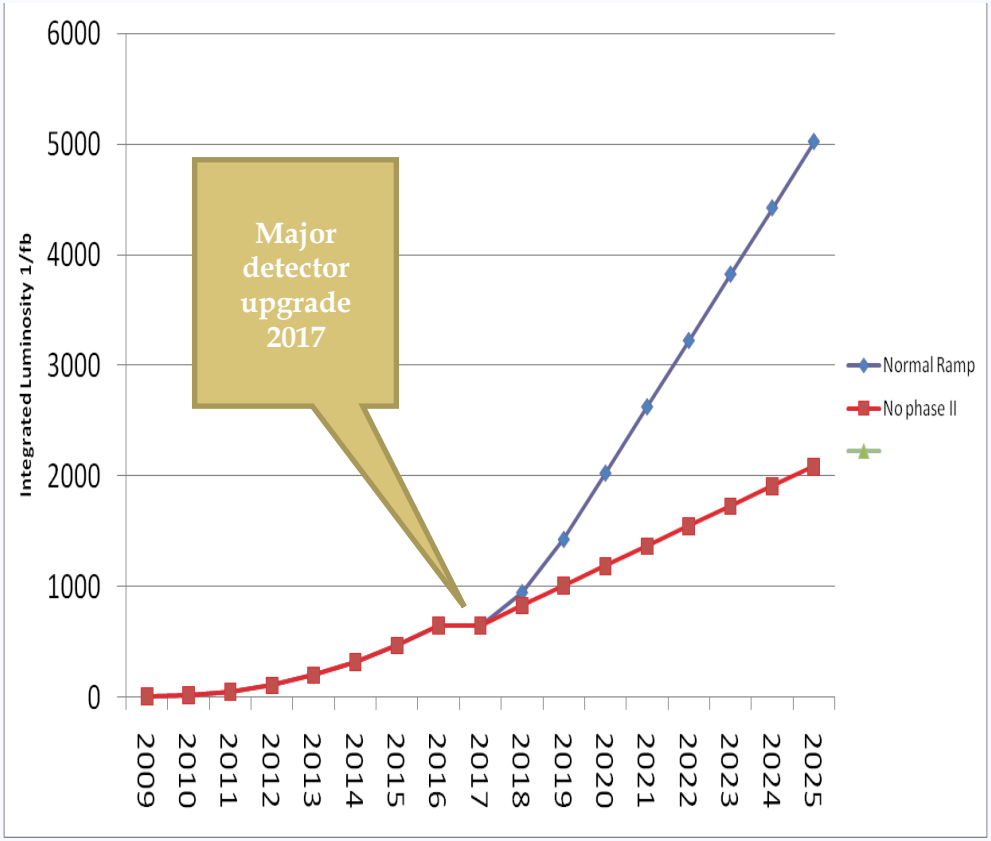
- Background:
  - ATLAS B-layer will not survive until the end of Phase-I running, and will be inefficient at 3.10^{34} cm^{-2} s^{-1}
  - Cannot replace it in a long shutdown – needs > 1 year to remove to surface, open up, replace b-layer, reassemble, and reinstall
  - Hence B-layer Task Force decided to insert a new B-layer, inside the current pixel detector - “Insertable B-layer”, IBL
  - Limited space – discussion with LEB ongoing to minimise beam-pipe diameter
- TDR:
  - Write over the next year
  - Bring together effort to make timely decisions (cooling, materials, ...)
  - Some choices can be made later – need to follow Phase-I schedule carefully in view the new LHC schedule (would expect naively a year - or two - impact).
  - WBS more or less completed; costing based on this also being prepared
  - Preparing TDR will help set up organisation, task sharing => MoU

IBL Management

- Management structure being set up:
  - Expect to approve Project Leader Friday CB meeting
  - Discussion started of management structure: Project Office effort, engineering, Technical Coordinator...
- Internal Reviews (Review Office as part of Project Office) to help with choices, e.g. choice of coolant wanted soon to avoid parallel developments

LHC expectations (pre-Chamonix): Peak and Integrated Luminosity





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Overview of Phase II Upgrade

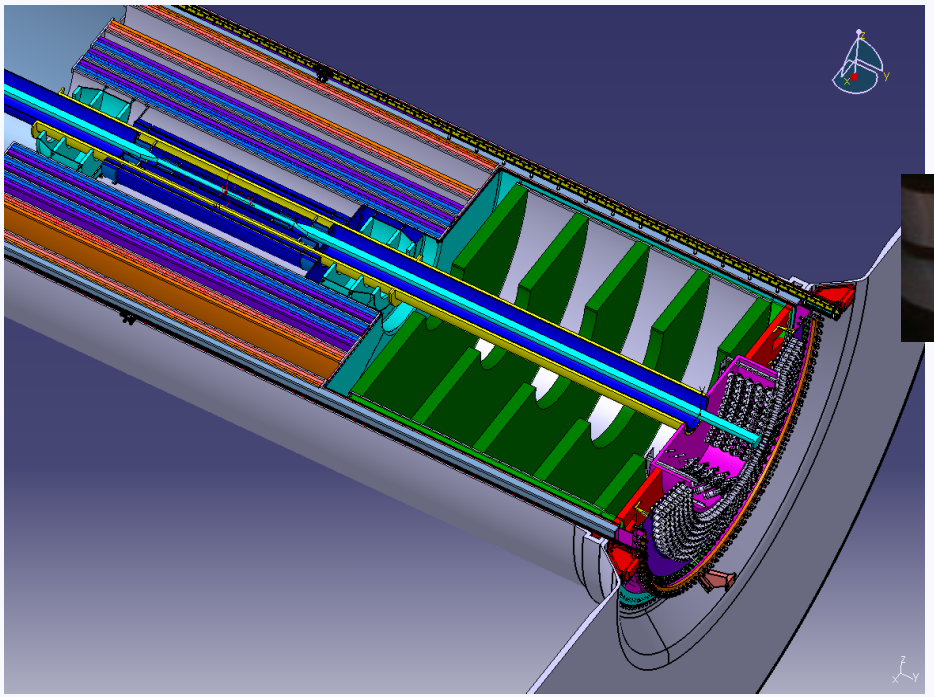
- For full Phase II sLHC, we may have 400 pile up events / BC, High radiation levels
  - Changes in brief:
    - Fully replace ID with all-silicon tracker (layout)
    - LAr and tiles: electronics and readout schemes and trigger
    - Some forward LAr Calorimeter Work
    - Forward muon chambers, maybe more; Be beampipe; more shielding
    - Trigger and DAQ enhancements
  - Magnets and most detectors remain in place

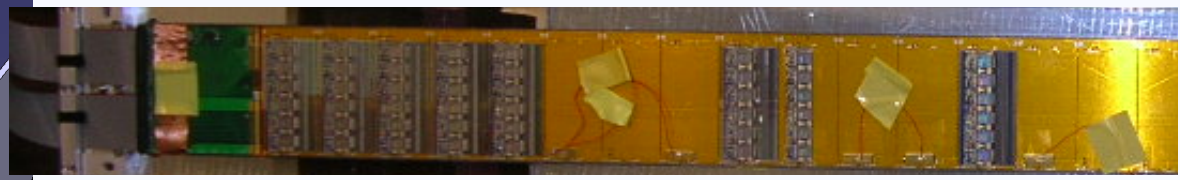
ID Changes

- All new
- All Si; 4 pixel layers, 3 short strip layers, 2 long strip layers
  - Increased granularity to keep occupancy low
- Work on optimising layout: number of layers, radii to change technology.
  - Goal is efficient track finding with good determination of track parameters, with low fake rate: same performance sLHC <-> LHC
- Powering: not 1 module 1 PS!
  - Insufficient space for cables, need to reuse what services we have
  - Serial, DC-DC work on-going

ID Strips

- Layout changing to “fixed length” barrel
- Prototype short-strip sensors undergoing tests (Nobu et al)
- ABCNext chips received and being tested – excellent results so far
- Opto-electronics: Versatile link and GBT as Super Module Controller
- Good progress on powering schemes
- DCS advancing

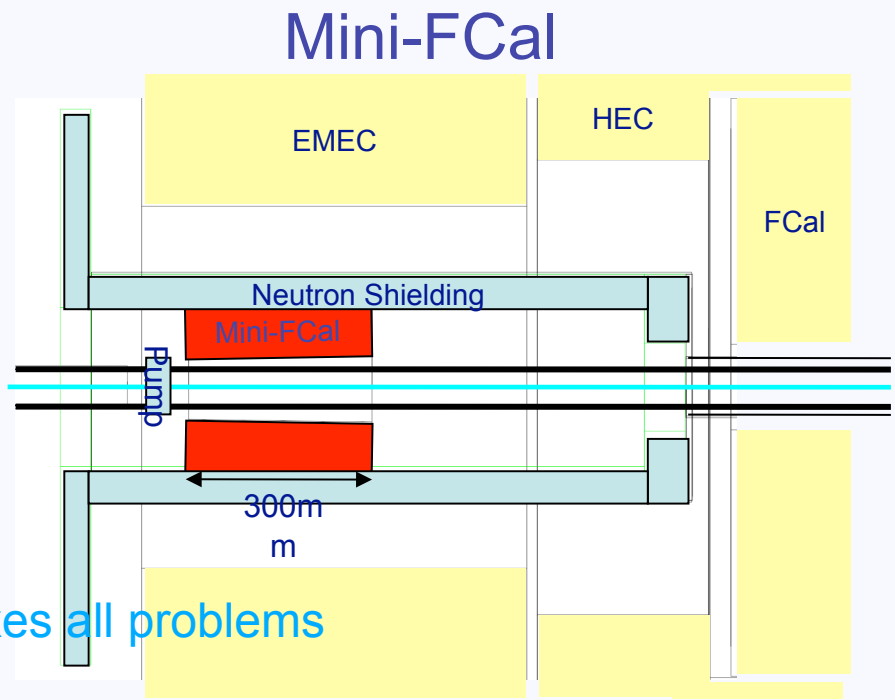




Lar and Tiles

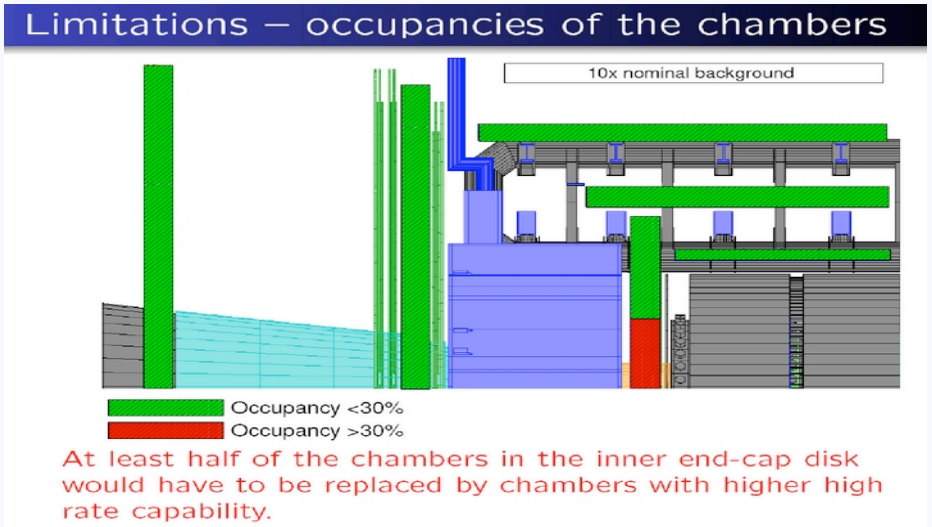
- Power supplies and FE electronics changes being studied, also more flexibility trigger

- Most of Lar detector will perform well at sLHC except possibly FCAL
- FCAL:
  - High current --> big V drop
    - Replace R
  - Ion build up in LAr gaps
    - Smaller gaps
  - Boiling of LAr
    - More cooling loops
  - But replacing is >= 14 months;
  - Consider alternative mini-FCAL, but only if it fixes all problems

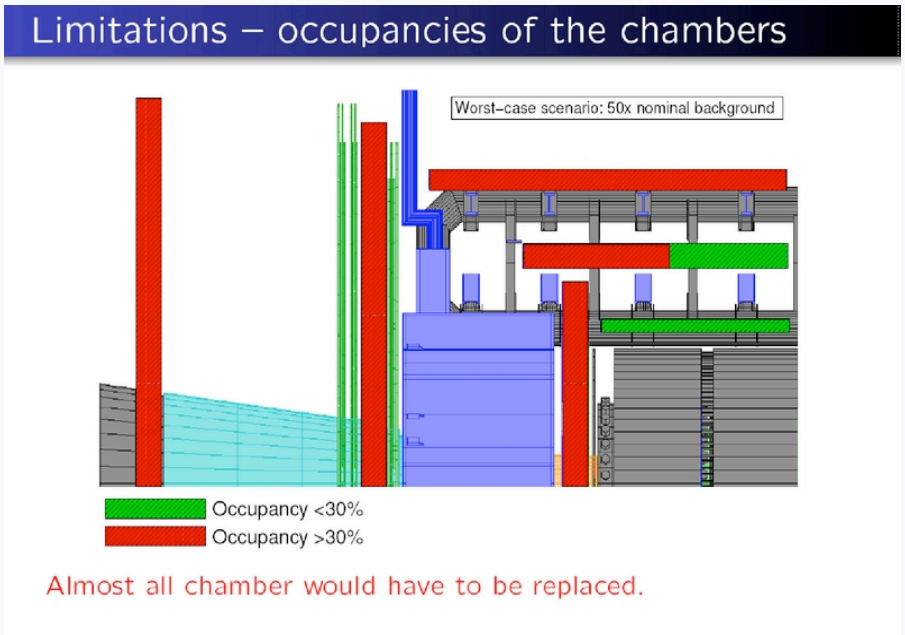


Phase II Changes: Muons

- Reminder: if background ~ as predicted, only forward chambers need to be replaced. If 5x predicted, most chambers need replacing
- Very important to measure BG
  - ~6 types of radiation monitor in ATLAS; R&D project to compare to predictions
- Smaller chambers would leave more space for more shielding:
  - micromegas and new TGC's can make trigger and do precision measurement in one chamber



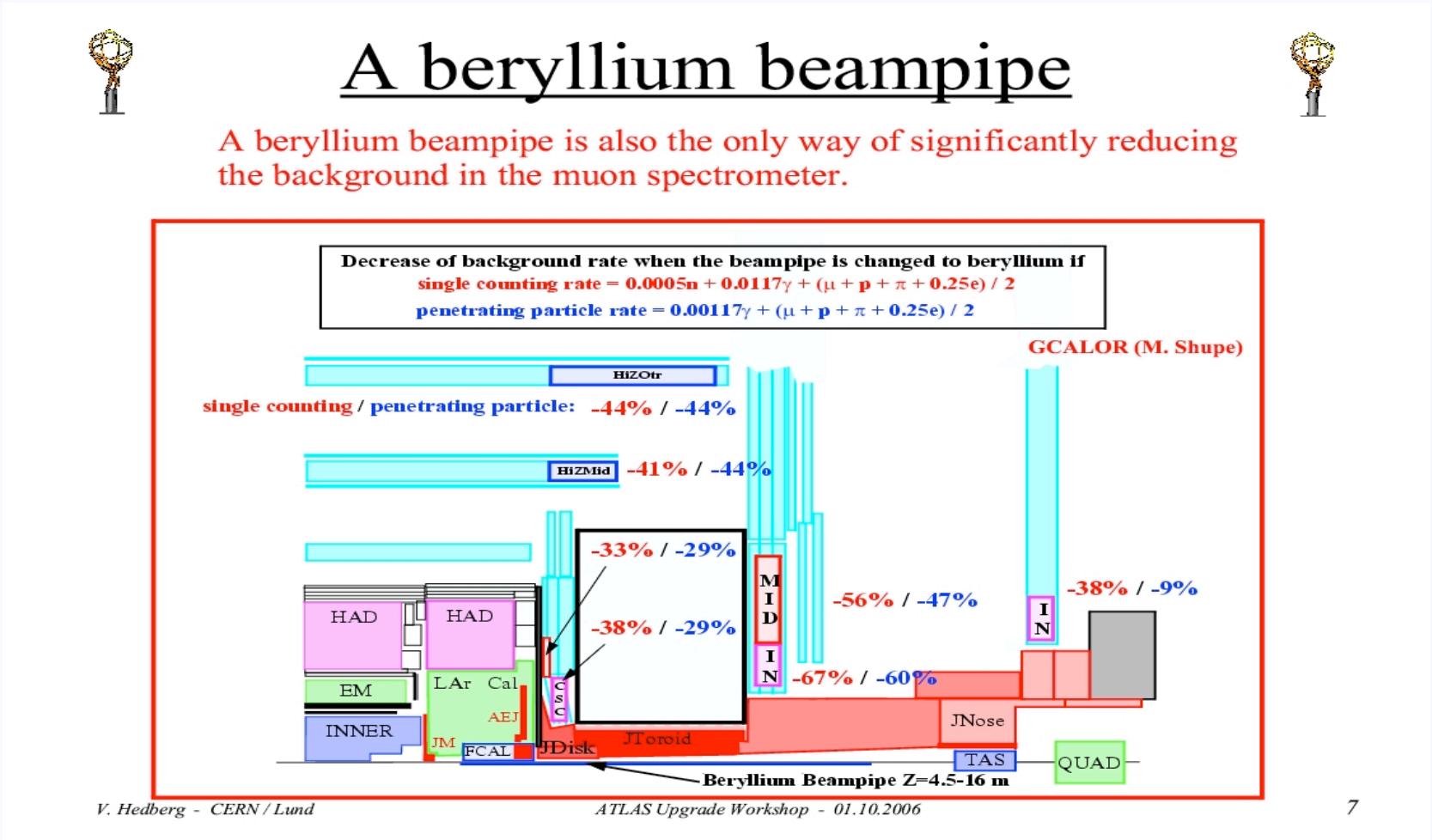
If safety factor not needed



...Worst case

Shielding and Background reduction

- Already highly optimised; main improvement is change SS to Be beampipe z = 4.5 to 16 m
  - Expensive by beampipe standards, but much cheaper than muon chambers



LoI for Phase-II

- ATLAS LoI written in 1992; 17 years before start-up!
- Phase-II schedule is still uncertain, but does not really affect LoI too much
- Timely to refine the ATLAS Upgrade definition – more is known now than when the current documents were written
- LoI will still have choices – but will help focus the work needed to make those decisions
- Writing the LoI will need a changed organisation – who organises what; initial groups developed and need to move towards new system (ID, calorimeters,muons, etc)
- And it needs better understanding of scope of upgrade
  - Basic ID Layout + Trigger and DAQ understanding – more later
- LoI will have table of institutes <--> interests
  - Will start to form interim MoU – basis for starting funding applications/negotiations
- To be followed by TP for ATLAS Upgrade approval
  - With further development of an interim MoU
- Then TDR, MoU, ...

Layout

- The current ATLAS ID Strawman Layout was built up assuming 230 ev/BC (10x nominal LHC)
- 4 pixel layers, 3 short strip layers, 2 long strip layers
- Studies show that at 10^{35} cm^{-2} s^{-1} the occupancy reaches 2.6 % in worst areas, several areas >> goal of 1 %
  - Detrimental to performance: vertex parameters, fake track rate...
- However, need to understand cause and see:
  - Can tracking improvements etc. rescue it
  - Or do we need higher granularity - 5th pixel layer, move short strips further out
- This needs many experts working together: simulation software, simulation users, tracking software developers, ...
  - Propose to bring these together as a Task Force to come up with an optimised layout, with detailed simulations predicting good performance
  - Needed ~6 months for the LoI

Trigger and DAQ

- LoI should have a clear roadmap for TDAQ at sLHC
- Many choicess to optimise – among them:
  - Accept rates at all levels; LVL1 latency
  - Move part of LVL2 into LVL1 with more hardware
    - E.g. combined objects like muons and jets
  - Associative memory track-finder
  - Better muon trigger chambers
  - Inner-tracker trigger at level-1
- Again, we need a major study to find an optimum for ATLAS
- Requires trigger simulation at 400 events pile-up, including previous and following bunch crossings etc.
- If a track trigger at LVL1 is really needed (as at CMS) then major development is needed, especially electronics chips
  - Could determine the Upgrade schedule

ATLAS Upgrade Week

- 23rd - 27th Feb at CERN (first all ATLAS week of this type)
- Bring all systems together, technical discussions, motivation, ...
- Discuss organisation for LoI and IBL-TDR
- The major focus points:
  - Go through all the work going on in the areas of ID, calorimeters, muons, integration
  - Layout task force – how to organise?
  - TDAQ issues – bring together ID, Calo, Muons and TDAQ to start to understand the problems, possibilities, and come up with a plan for sufficient understanding for the LoI

Schedule LHC, Phase-I, Phase-II

- Need to understand and absorb the Chamonix LHC plan
  - What is the interplay between LHC schedule and upgrades?
  - When will Phase-I happen (one year later? more?)
  - Are there new possibilities – more time before radiation damage is significant for example
  - Less worried about Phase-II: we have a lot of studies to do anyway

Summary

- ATLAS 2009 plans include preparation of IBL-TDR and Phase-II LoI
- Layout task force to develop credible ID layout
- TDAQ + systems to come together and develop trigger/ DAQ strategy
- Need to absorb implications of LHC schedule on Phase-I and Phase-II