Summary of MDT-elx UpgradeWorkshop (may, 29-31)

Participants:

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A. Barajas-Velez, M. Fras, A. Rudert (MPI elx designers)

Brief history of SLHC upgrade discussions

- Discussion going since about 2005: recent Workshops:
- ATLAS Upgrade workshop, oct. 1st-3rd, 2006
- ATLAS Larg Calorimeter Upgrade Workshop, dec., 4th, 2006
- ATLAS Tracker Upgrade Workshop, dec., 6-8th, 2006

- ATLAS Muon detector Upgrade Workshop, jan., 25.-26th, 2007
- Common ATLAS-CMS Electronics Workshop, march, 19-21st, 2007
- Upgrade of ATLAS MDT Electronics for SLHC, may, 29-31st, 2007

The main problems of the Muon system at SLHC

Brief summary about ATLAS Shielding

- The muon detector was not designed for high rates
  - there are few muons in any given event (right!)
  - try to cover 5000 sqm as cheaply as you can (wrong!)
  - as hits are so rare, only use 3 tube layers per ML (wrong!)
  - because of little ionisation, don't worry about ageing; use fast gas with hydrogene (wrong!)
  - use large dead time to reduce data volume (wrong!)
- The high BG only became a design issue, when detailed calculations became available (1994)
  - try to solve it with electronics (partly successful; wait for beam)
- Run at SLHC and try to do it with elx again (that's why we are here)
  - if not possible, improve shielding by large factor, construct new muon chambers or forget about SLHC (unlees you don't care about muons)

Brief summary about ATLAS Shielding II

- Assumptions about BG sources
  - main source of hadron production is interaction point (right!)
  - other sources can be neglected (wrong!)
  - cover as much volume as possible with EC toroids (wrong!)
  - try to do the beam pipe as cheaply and simply as possible (wrong!)
- The 2nd most important source of hadrons is where the elastically scattered protons hit the beam pipe
  - too little space left for efficient shielding
  - BG is not around 1 MeV, but contains hard component in gammas and hadrons (→ problem for TGCs → false triggers)
- Radical solution: replace EC toroids by iron core toroids
  - not attractive for physics
  - very expensive and time consuming
  - are there better solutions?

The basic problem in the Muon system:

2003 calculations by Radiation Task Force

(M. Shupe et al.)

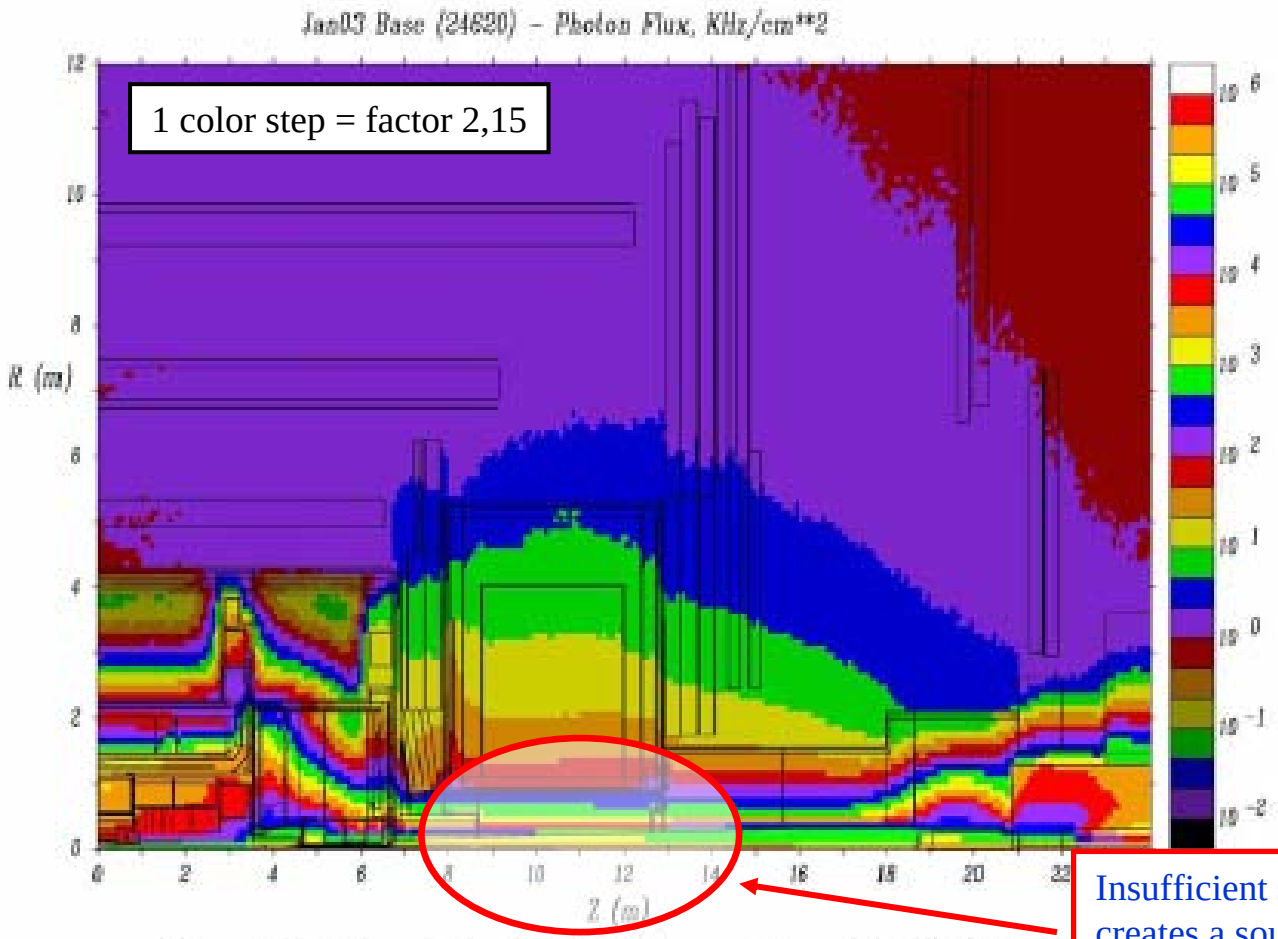

Figure 5.13 Photon flux in a full Atlas quadrant (GCALOR – Ja

Author's conclusion: the EC (air core) toroid is essentially transparent to γ's.

→Space between beam-pipe and inner radius of the EC toroid is already optimised for shielding (W instead of Cu brings little gain)

→Be-pipe in this region would improve by factor 2-3 (cost 2 MCHF)

→ replace air by iron core toroid for SLHC ??

Insufficient shielding creates a source of γ's which dissipate freely into the hall according to $1/r^2$

Total neutron and photon flux

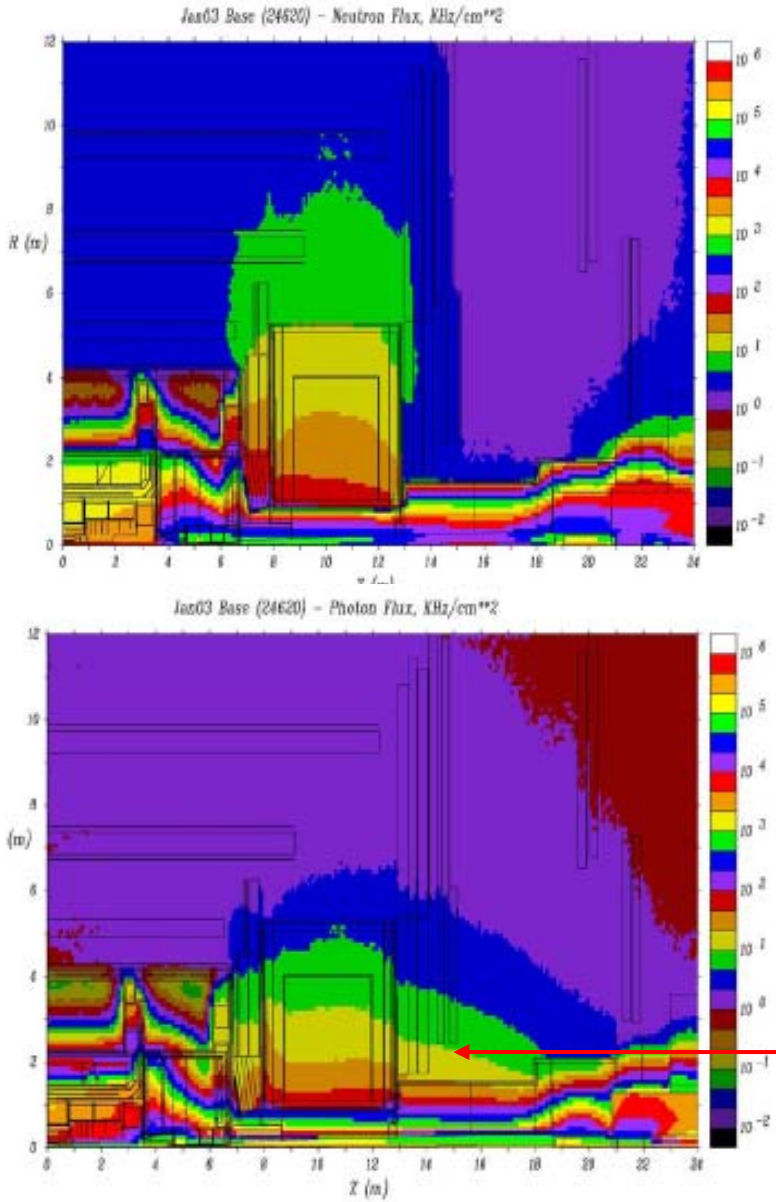

Figure 5.13 Photon flux in a full Atlas quadrant (GCALOR – Jan03).

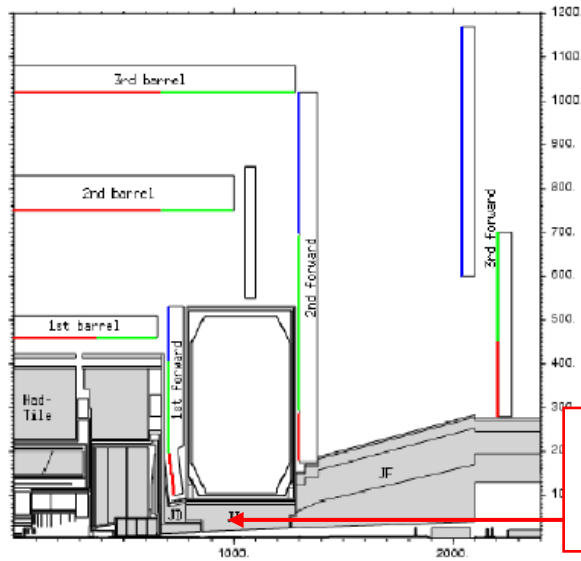

Figure 4.18 The Atlas geometry in the FLUKA AV16 configuration, similar to "Aug01" GCALOR layout with previous JF concept: the picture represents a simple slice at a fixed phi angle. Horizontal axis gives Z in cm and the vertical axis R in cm. The old muon chambers positions have been kept for backward compatibility with earlier estimates.

region of main n/γ leakage into the EC

in the region of the BW-tip the γ -distribution does not correspond to the n-distribution → 'prompt' γ's from hadron showers created in the beampipe and shield are dominating NOT γ's from conversions of thermal n's

Upgrade of MDT electronics for SLHC

http://indico.cern.ch/conferenceDisplay.py?confId=16061

Tuesday 29 May 2007

MDT On chamber electronics - Salle B, Main Building (09:40-15:35)

time	[id] title	presenter
10:30	[1] Introduction (00h10')	RR
10:40	[2] The SLHC Upgrade program (00h30')	N. H., T.B.C.
11:10	[3] Operation of MDTs at high rates at the GIF facility (00h30')	O. KORTNER
11:40	[4] Design criteria and limitations of the ASD (00h30')	J. OLIVER
12:10	[5] An amplifier for high rates at the TRT (00h30')	M. NEWCOMER
12:40	Lunch (01h20')	
14:00	[6] Simulation tools for chamber plus amplifier behaviour (00h20')	W. RIEGLER
14:20	[7] Limitations of the AMT (TDC) and Upgarde for SLHC (00h30')	Y. ARAI
14:50	[10] The Giga Bit optical Transmitter (GBT) (00h30')	S. MARCHIORO
15:20	End of the session (00h15')	

frontend-related

Wednesday 30 May 2007

Off chamber electronics and Readout Architecture - Salle B, Main Building (09:30-15:15)

time	[id] title	presenter
09:30	[13] MROD performance and Upgrade options (00h30')	J. VERMEULEN
10:00	[14] Possible reduction of the MDT data volume by selective readout (00h45')	RR / T. WIJNEN
10:45	Coffee break (00h25')	
11:10	[15] Operational principle of the MUCTPI and its interfacing to the LVL2 system (00h30')	S. HAAS
11:40	[9] Performance, limitations and Upgrade options for the CSM (00h30')	J. CHAPMAN
12:10	Lunch (01h50')	
14:00	[16] Simulation of the trigger in ATHENA (00h30') **Any losses to expect?**	S. HORVAT
14:30	[17] Radiation tolerance issues for the Power supplies at SLHC (00h30')	A. LANZA
15:00	End of the session (00h15')	

digital part

Thursday 31 May 2007

Possible Organisation of the MDT elx Upgrade - Salle B, Main Building (09:30-12:20)

time	[id] title	presenter
09:30	[21] Summary of Upgrade discussions (00h20')	RICHTER, Robert
09:50	[18] Responsibilities, available resources, action items (02h00')	
11:50	[19] Present EoIs (00h10')	RR
12:10	[20] AOB (00h10')	

who does what?

General conclusions wrt SLHC

- Exact BG rates at SLHC "unknown but probably high"
  - uncertainty of LHC simulations
  - uncertainty of SLHC upgrade scenario
  - uncertainty of shielding configuration at SLHC
- "Birth defects" of the MDT system make the Upgrade difficult
  - was designed for low BG, low cost → large tube diameter
  - only 2 x 3 layers give minimum redundancy
  - late decision for slow drift gas made things worse
- Consequence: some MDTs (3cm) chambers will be too hot to be used at SLHC
  - hit efficiency dropping → reconstr. eff. dropping
    → **elx can't rescue this, even with shorter deadtime**
  - need **new chamber type** for hottest regions
  - **let's concentrate on the moderate rates** in the **majority of MDTs**
  - do detailed simulation for tubes in γ-BG and B-field

frontend-related

- Selective RO seems to be technically feasible
  - → keep option open
  - In some regions of the detector trigger chamber coverage is not tight enough, so Selective RO can't work. (Sandra)
    - → **Be prepared to transmit full data rate to the MROD**
    - → How to get this volume out to the ROBins?? (Jos)
- Rad-tol issues serious for TDCs, CSMs and power supplies

digital part

Some technical issues for the Upgrade

- Frontend: fix the following problems
  - meta-stable state in FF → fix pair mode
  - allow adjustment of dead-time 100 – 800 ns
  - prevent very small pulses from triggering the dead-time
  - allow for one threshold per channel (NOT one per 8-ch-chip, as is now)
  - select appropriate technology (rad-tol, cheap, available, long-term support)
- TDC:
  - need more storage
  - need higher rad-tol
  - FPGA or ASIC? → study rad-tol of new generation XILINXes (Virtex-4/-5)
  - increase BW to CSM
    - 80 → 160 MHz? (x 2)
    - use pair mode? (x 2)
    - option to use two output channels in parallel? (x 2)

Some technical issues for the Upgrade (cont.)

- CSM:
  - need higher rad-tol → study rad-tol and SEUs of new generation XILINXes
  - explore interfacing to GBT ("GigaBit Transmitter"), as GOL will not be available

- MROD:
  - interface to GBT → more BW
  - study handling 10 x higher BW (several technologies available)
  - how to transfer high data volume into the ROBin?
    - use one MROD per CSM? Design new, faster ROBin?
    - use faster link? Is GBT sufficient?
    - what is the DAQ doing with the large data volumina?
      - not our problem?
      - at some point the total data stream FE-to-EF-to-tape must be analyzed !

What should we do?

- wait until we know BG rate at LHC? (2008?)
- wait until exact time schedule for SLHC is known (200?)
- wait until SLHC is approuved? (20??)
- work on a concept for higher tube efficiency and higher readout BW?
  - this may be useful for the hottest chambers already at LHC as an upgrade to 2 x nominal may be part of the standard LHC program
  - prepare EoIs and proposals to the ATLAS steering group to stay in pace with the development
  - prepare a concept for a prototype readout chain to test performance
    - start with detailed simulation of tube behaviour in n/γ background (in B-field)
  - explore potential of new technologies

Profit from ATLAS Upgrade SG infrastructure

R&D Projects

- EoI: Expression of Intent to make a proposal
  - Supposed to help publicise your project informally, allowing other groups to join it and improve it
  - Should be followed by full proposal soon after (e.g. 3 months)
- Proposals:
  - Give technical description, aims, institutes/task-sharing, rough costing, rough schedule
  - USG reviews and recommends for approval (or not) as "R&D relevant to the ATLAS Upgrade"
  - Forwards to CB (i.e. all ATLAS institutes) for comments, more collaborators, improvements
  - Sends (improved) report to EB for approval as "ATLAS Upgrade R&D"
  - Should help with financing
- Currently:
  - 5 EoIs
  - 2 Proposals under review
  - 6 Approved
  - All ID except 2!

Concrete steps

- general agreement to put manpower and financial resources into an R&D project, pursueing the concept of a BW increase
- have regular follow-up workshops at about 3-4 months interval
- phone conferences about every 4 weeks
- work together on detailed proposal to get approuved by the ATLAS Upgrade Steering group