WP4 Activities

J. Nash – SLHC-PP SG

Task 4.1

Description of work

Task 4.1 Coordination and organisation of CMS2

Overall coordination task for managing the upgrade of the experiment for SLHC; identification of participating institutes and their contribution, including activities related to seeking and integrating new partners; definition of the organisational project structure needed to manage the consortium of institutes participating in the construction and modification work; negotiation with institutes and funding agencies to establish collaboration agreements, cost books and reporting methods; exchange and dissemination of scientific and technical information (CERN, Imperial)

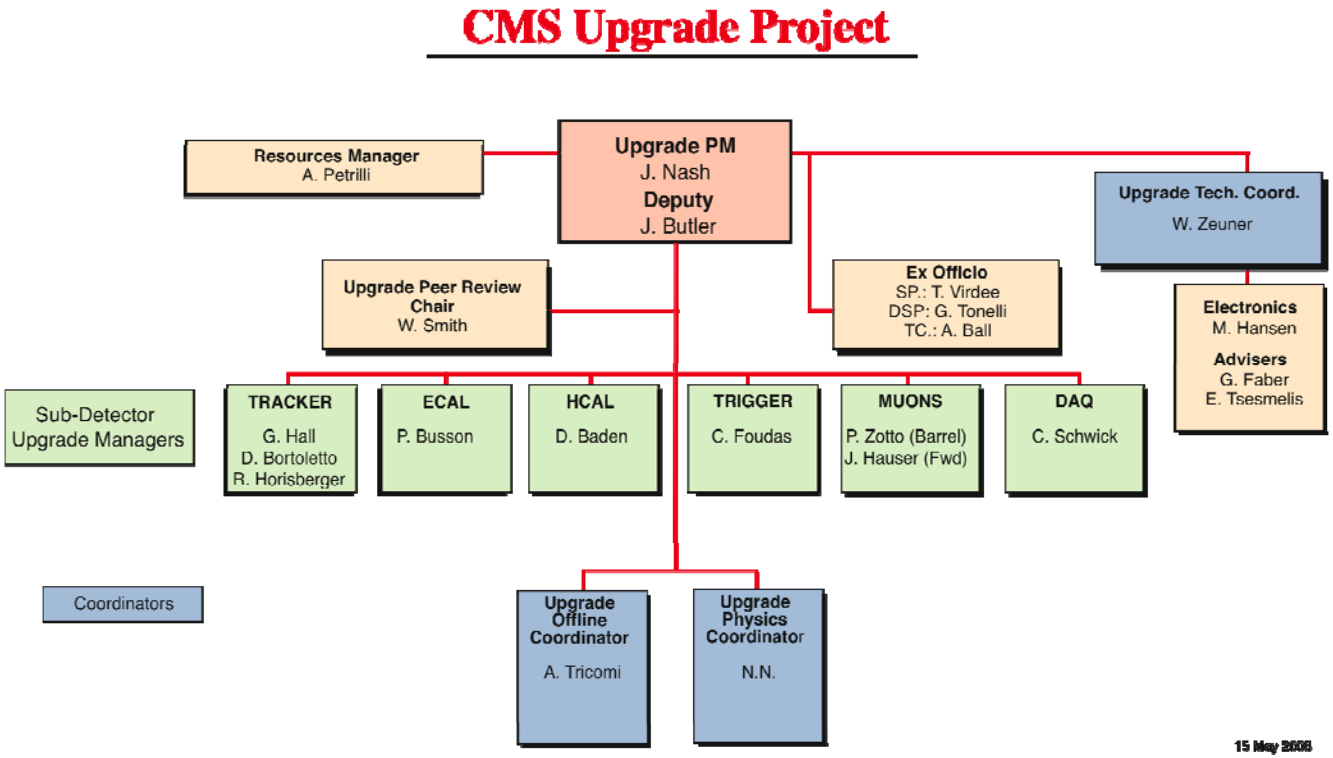
Deliverables task 4.1	Description	Nature	Delivery date
4.1.1	Project Structures for construction of systems and sub-systems	O, R	M12
4.1.2	Cost book and MoU for the upgrade and installation phase	R	M36

Milestone	Description	Nature	Expected date
4.1	Upgrade Project Scope defined	R	M18

Task 4.1.1 – Management Structure

- Project management structure defined
- Management team put in place
- Team and mandate approved by CMS
  - Now a "project" (ala Tracker/ECAL…)
- Regular meetings of management team
- Monthly meetings of overall upgrade team
  - Regular meetings of many subgroups within sub-detector upgrade projects
- Two Workshops held, more planned

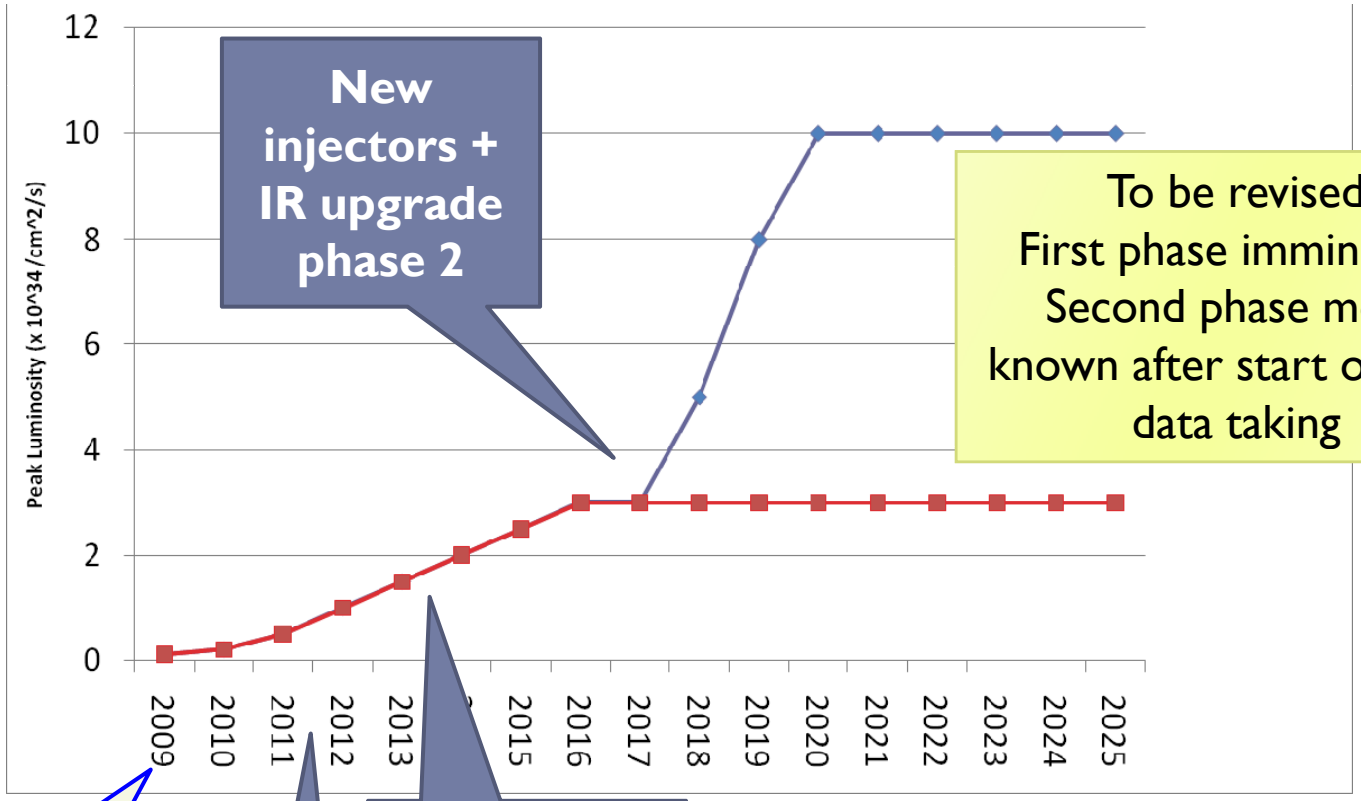
Upgrade project organization



Milestone 4.1 – Upgrade Scope

- Workshop in May 2008 at CERN to define the scope of upgrades
  - What needs to be done in Phase I, Phase 2
- Follow up workshop held November 2008 in FNAL (150 participants) to track progress, and prepare work plan for the following six months
  - Goal prepare TP for phase I upgrades
- Workshop to be held in May 2009 to present, approve plans for phase I upgrades, and also progress towards a "Strawman" for phase 2 upgrades.

Agreed Scenario for Peak luminosity (CMS/ATLAS/Machine/LHCC)



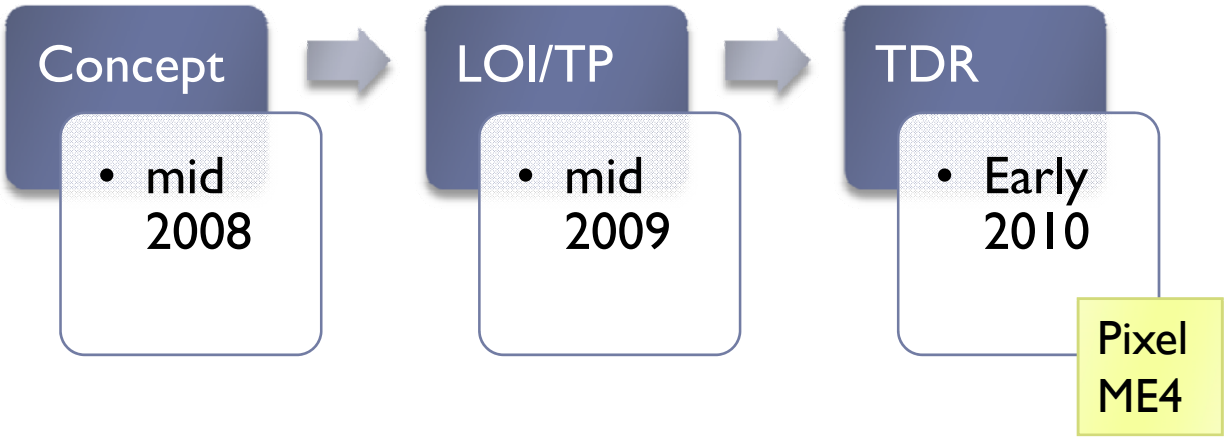
Agreed at the May 2008 Upgrades Workshop
http://indico.cern.ch/conferenceDisplay.py?confId=28746

Upgrade Scope

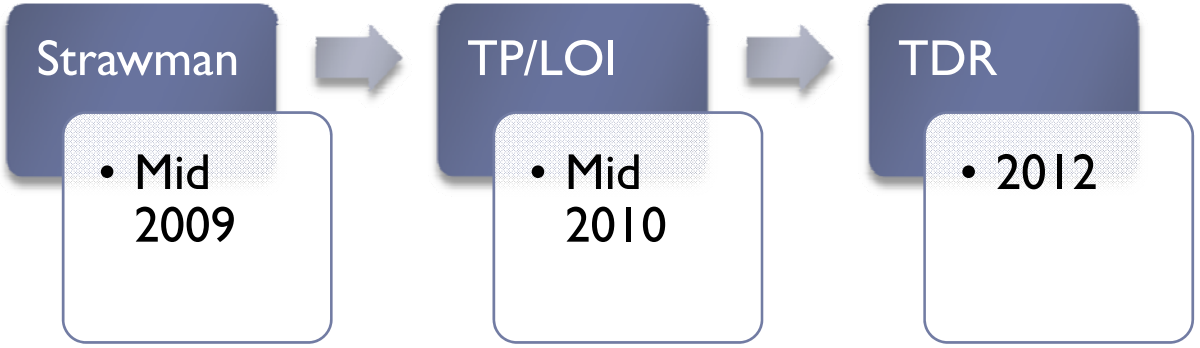
System	Phase 1	Phase 2
Pixel	New Pixel Detector (1 or 2 iterations?)	
Tracker	FEDs?	New Tracking System (incl Pixel)
HCAL	Electronics + PD replacement	HF/HE?
ECAL	TP (Off Detector Electronics) ?	EE?
Muons	ME4/2, ME1/1 ,RPC endcap, Minicrate spares, some CSC Electronics	Electronics replacement
Trigger	HCAL/RCT/GCT to µTCA	Complete replacement

Documents

Work Plan agreed at the May Workshop



Phase I Upgrades



Phase 2 Upgrades

November Workshop at FNAL

- Meeting held 19-21 November 2008 at FNAL
  - http://indico.cern.ch/conferenceDisplay.py?confId=41832
  - Checkpoint to assess progress towards 2009 milestones
  - Goals for the meeting
    - follow progress, concentrate on phase I, some look at critical Phase 2 areas
    - establish the workplan for the coming 6 months
      - Key output for this workshop: a program of work which helps us arrive at a planning for the Phase I upgrades.
- Excellent levels of attendance and quality of discussion indicate what a success this meeting was
  - Around 150 participants many from outside the US
  - Workshop atmosphere
    - Good to think outside of the box – CMS has been successful by being ambitious
- Real progress has been made in identifying key areas to focus effort on in the coming months
  - Also a chance to look at "cross-disciplinary" areas

BPIX Options

for 2013 replacement/upgrade

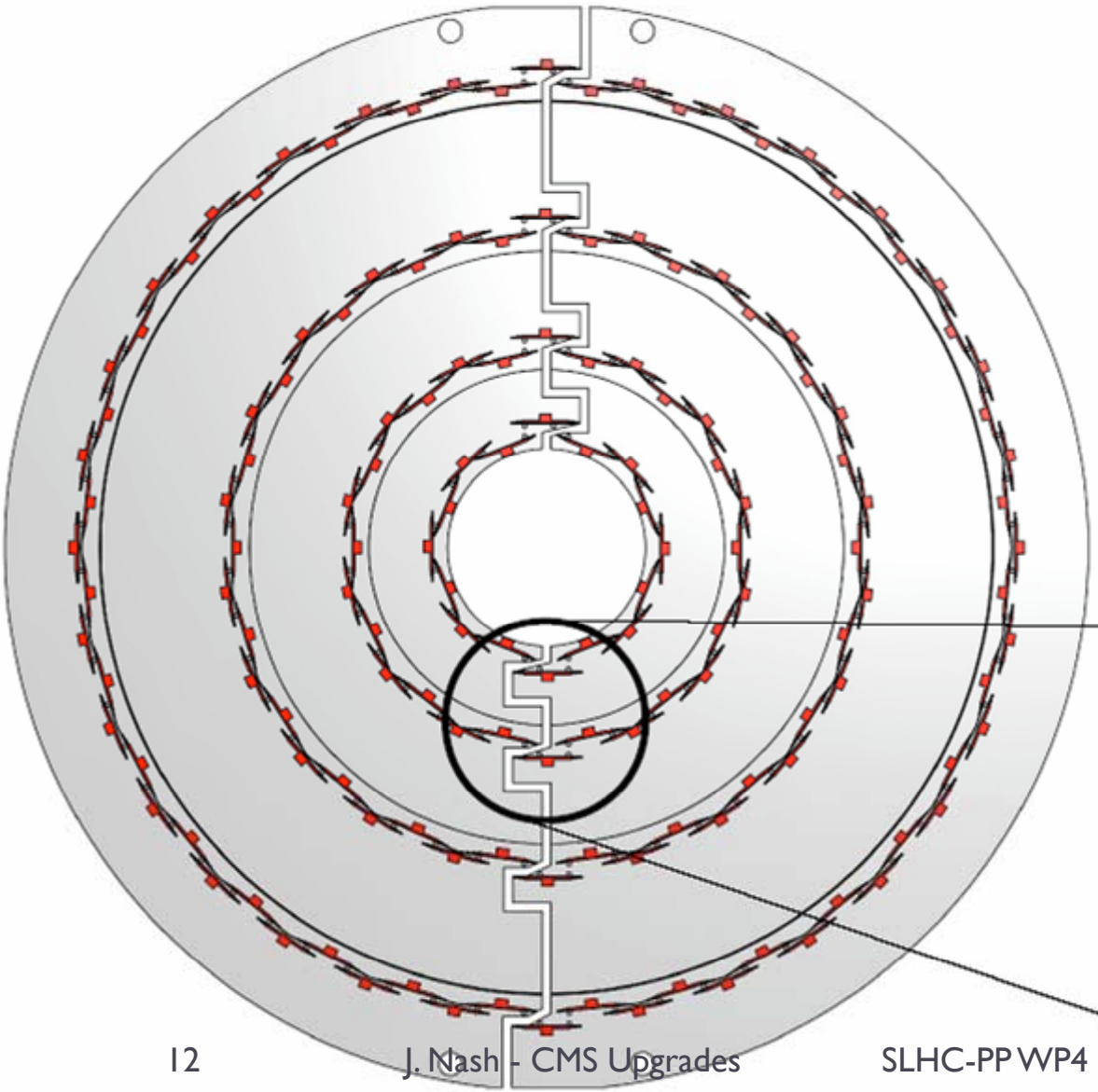
Slide from
21. May 2008

	Option	Layer/Radii	Modules	Cooling	Pixel ROC	Readout	Power
as 2008	0	4, 7, 11cm	768	C_6F_{14}	PS46 as now	analog 40MHz	as now
	1	4, 7, 11cm	768	C_6F_{14}	2x buffers	analog 40MHz	as now
	2	4, 7, 11cm	768	CO_2	2x buffers	analog 40MHz	as now
	3	4, 7, 11cm	768	CO_2	2x buffers	analog 40MHz μ-tw-pairs	as now
	4	4, 7, 11cm	768	CO_2	2xbuffer, ADC 160MHz serial	digital 320MHz μ-tw-pairs	as now
	5	4, 7, 11, 16cm	1428	CO_2	2xbuffer, ADC 160MHz serial	digital 640 MHz μ-tw-pairs	DC-DC new PS

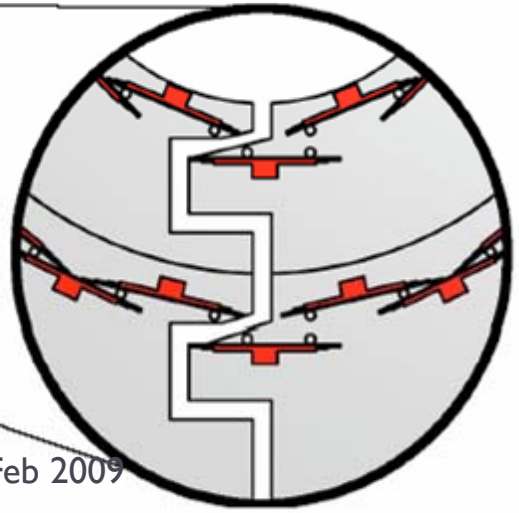
After many discussions, considerations & iterations

- **4 layer pixel system 4, 7, 11, 16 cm** → 1216 full modules
- **CO2 cooling based**
- **Ultra Light Mechanics**
- **BPIX modules with long 1.2m long microtwisted pair cables**
- **Shift material budget from PCB & plugs out of tracking eta - region**
- **ROC buffers for 1.5 x 10^{34} and serial binary readout @160 MHz**
- **Serialized binary optical readout at 320 MHz to old, modified px-FED**
- **Recycle & use current AOH lasers → 320MHz binary transmission**
- **Same FEC's , identical TTC & ROC programming**
- **Keep LV-power supply & push more current through cables**

BPIX Upgrade Phase 1 (2013) , 4 Modules long

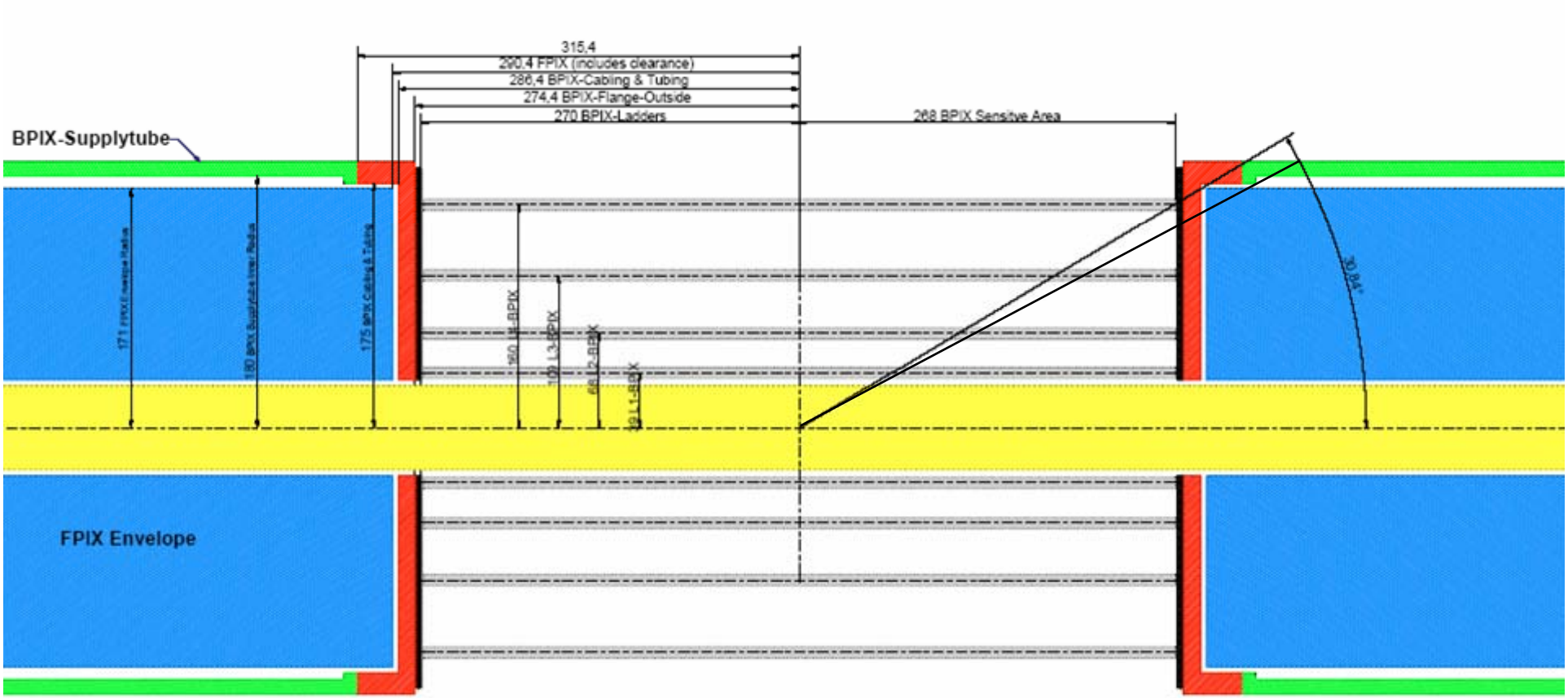


- Two identical half shells
- 1 type of fullmodule only
- Layer 1: R 39mm; 16 faces
- Layer 2: R 68mm; 28 faces
- Layer 3: R 109mm: 44 faces
- Layer 4: R 160mm: 64 faces
- Clearance to beampipe 4mm



BPIX/FPIX Envelope Definition for 4 Layer Pixel System

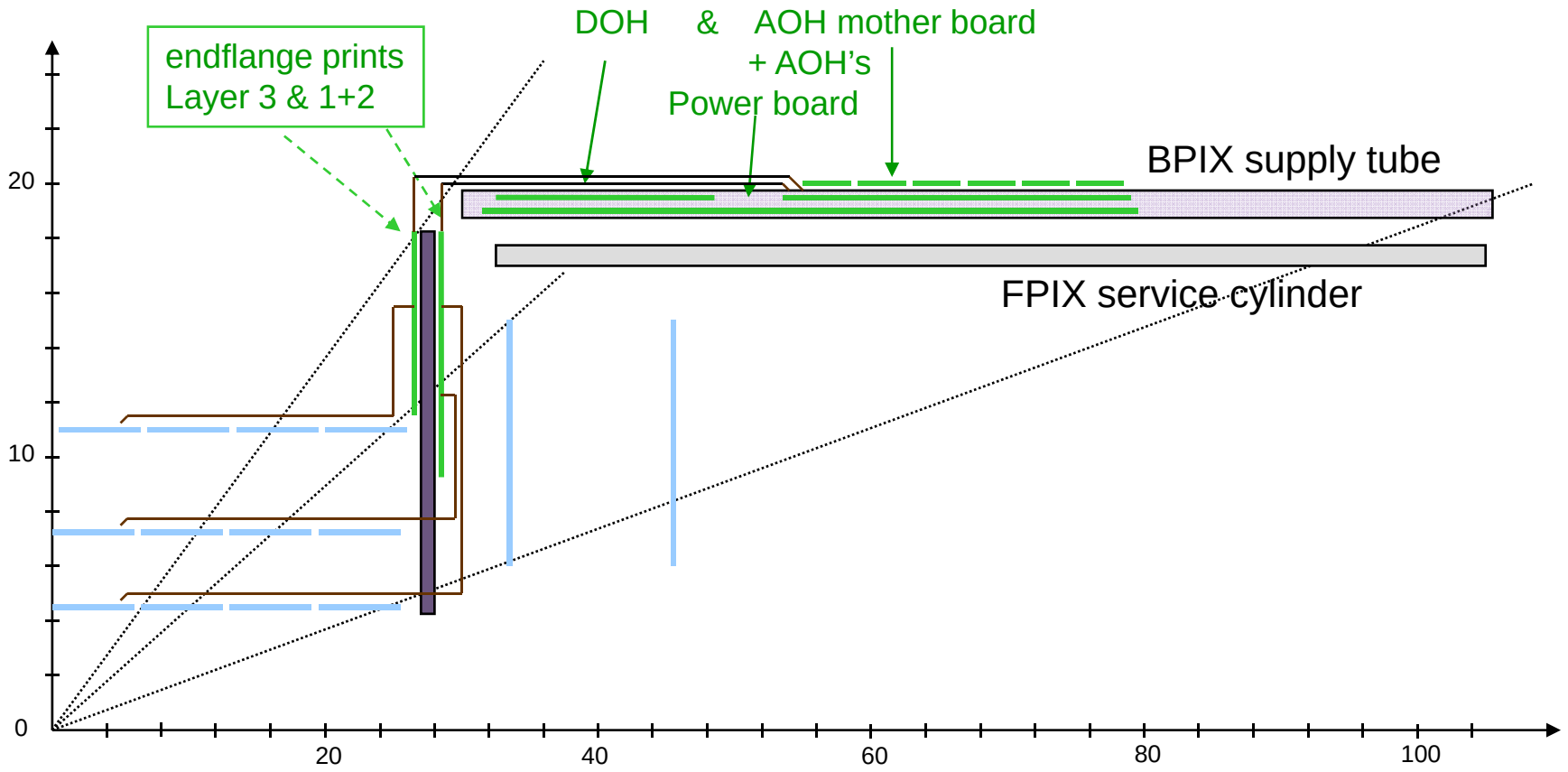
All barrel layers 4 module long → small eta hole of $\Delta\eta \sim 0.08$ at $\eta=1.288$



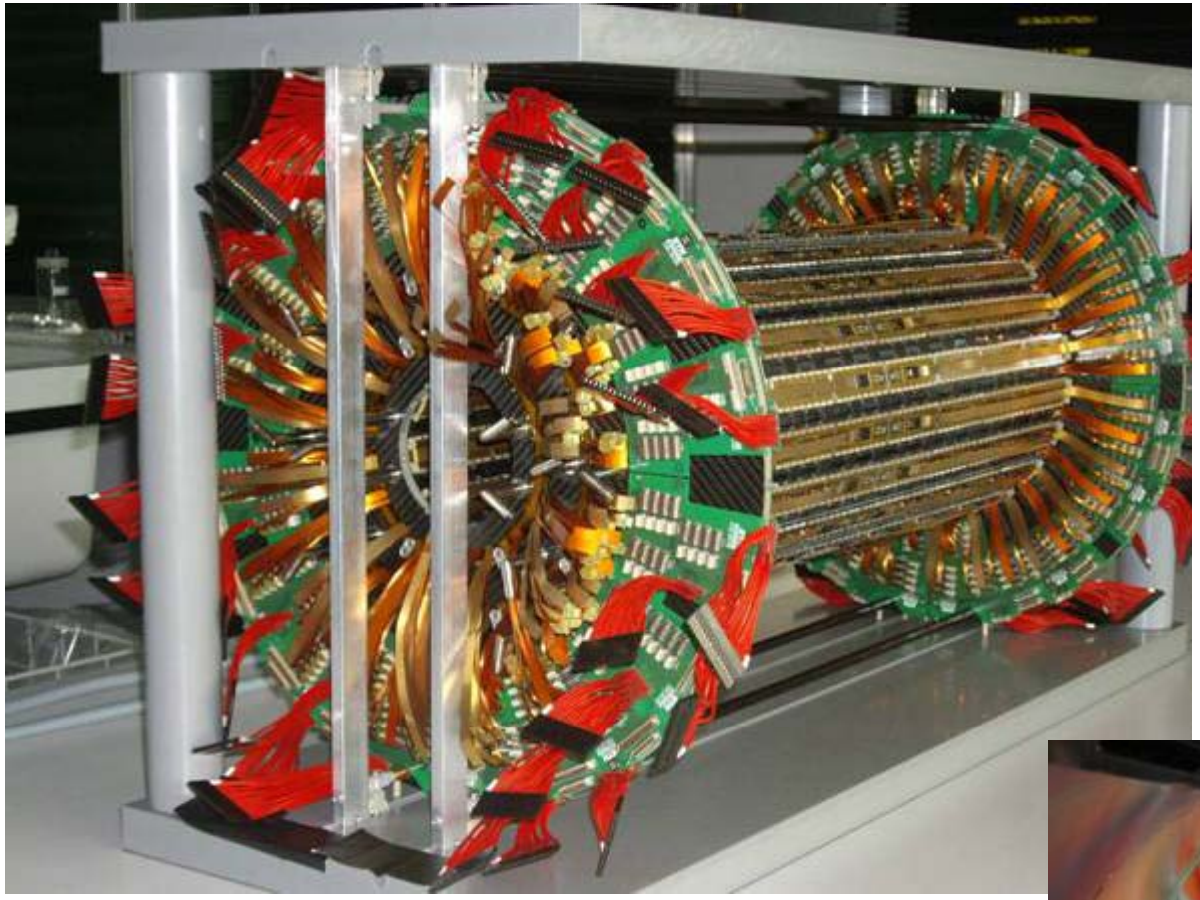
Various iterations forth and back by R.H. / Silvan Steuli / Kirk Arndt

→ no further changes since 2.12.2008 !

Current Pixel System with Supply Tubes / Cylinders

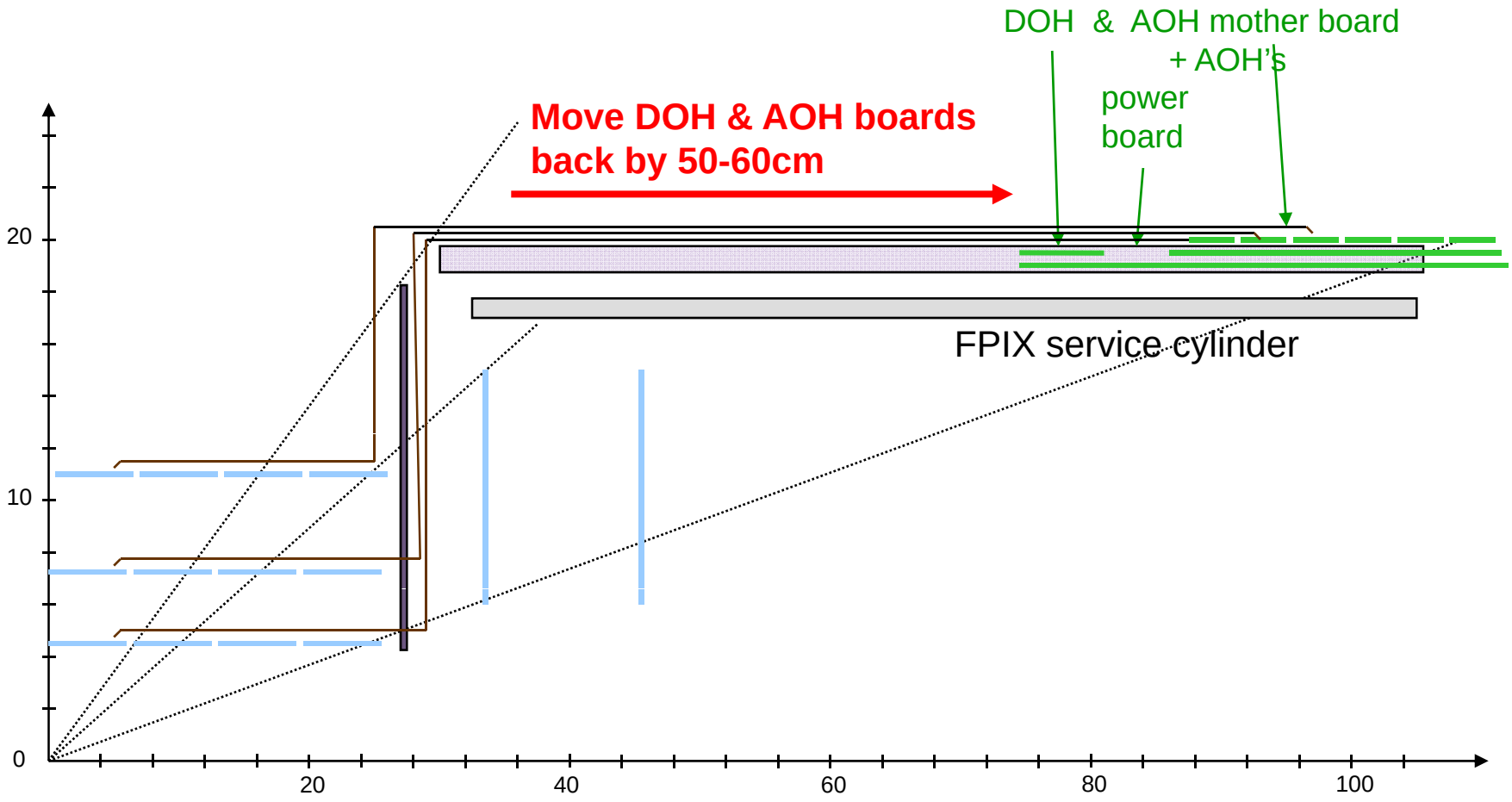


BPIX Cabling & flexible cooling pipes



Shift PCB/Plug Material out of tracking Volume

- Modules with long pigtails (1.2m) CCA wires 16x(2x125μ)

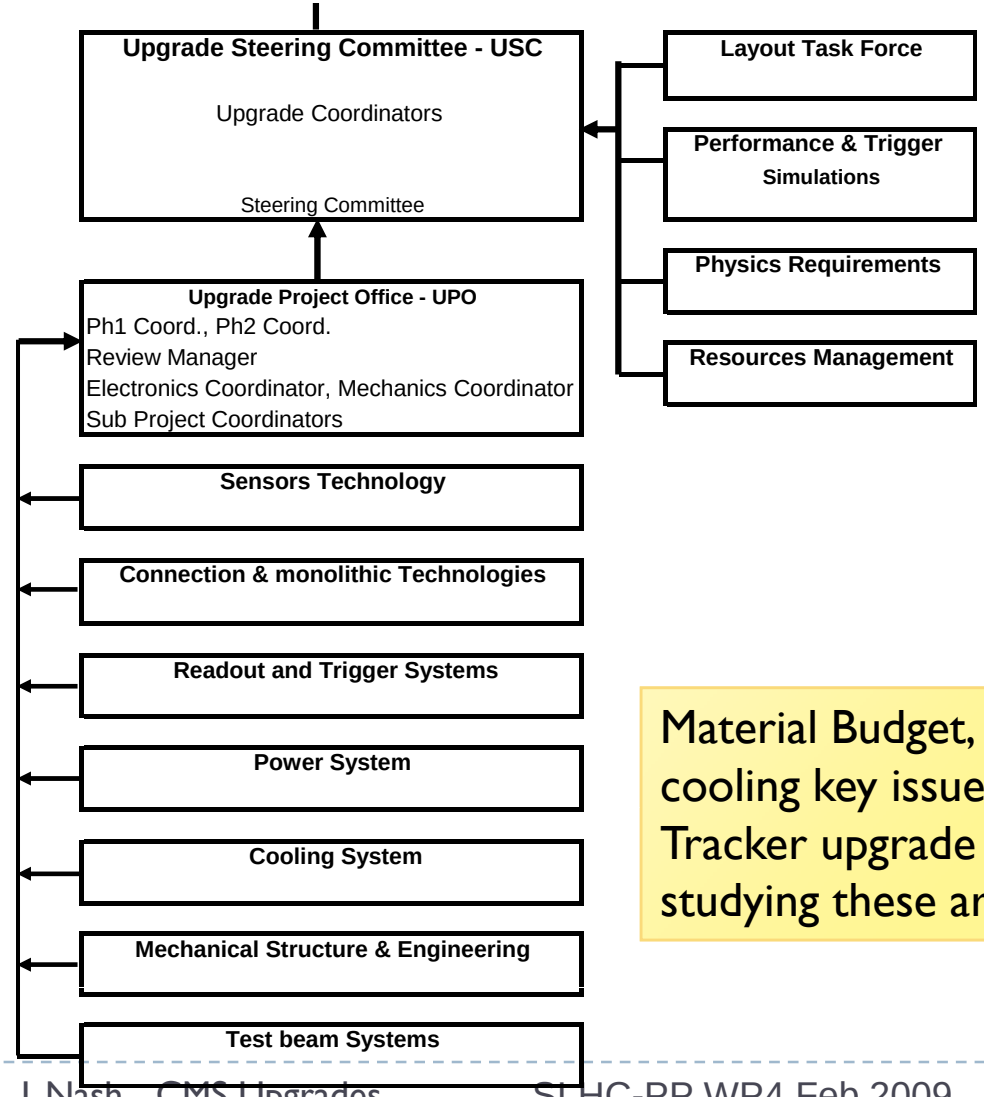


Transparecy 21.May 2008

New weight of replacement/upgrade BPIX detector (2013)

	Present BPIX	New 2013 BPIX	Comments
Empty mechanics	1103 g	550 g	possible, with ~ 94g for 1.5mm/1.4mm pipes
384 Module	872 g	522 g	1.36g/mod no SiN strips 75µ ROC no HV-cap
384 Signal cable	167g	7 g	2 x (2x125µ CCA)
384 Power (6x250µ CCA)	82g	68 g	5x250µ CCA
384 Power plug	16g	0 g	none
32 Print	499 g	32 g	radial power cable to ST
Cooling (C_6F_{14})	810 g	83 g	CO_2 in 1.45mm diam. pipe
Silicon tube incl. fluid	372g	5 g	CO_2 pipes to supply tube
Total	3921g	**1267 g**	**factor 3.1 down**

Moving to Phase II
Tracker - Draft Upgrade Structure

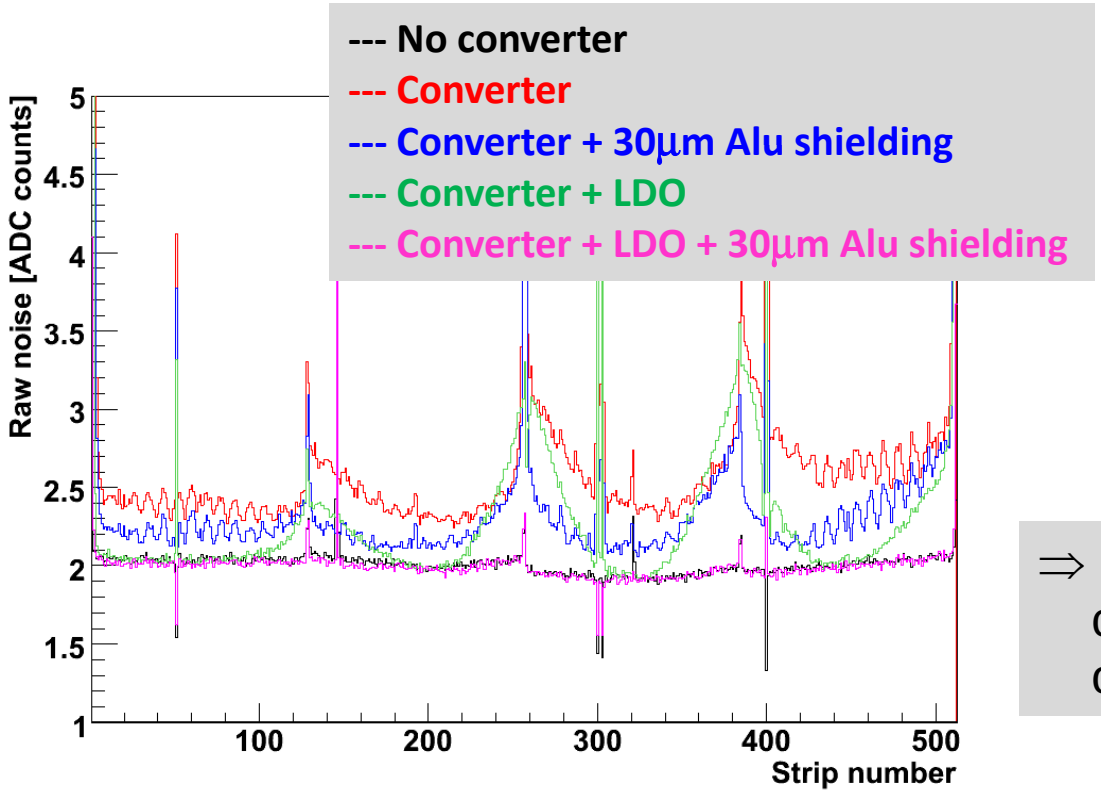


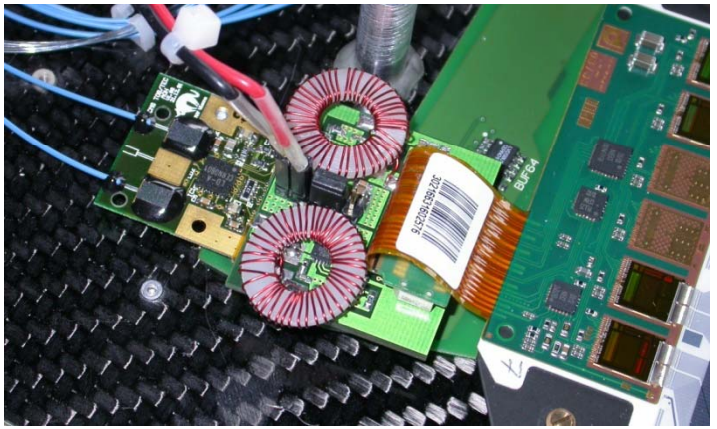
Material Budget, Power Consumption, cooling key issues for a new tracker Tracker upgrade team has been actively studying these areas

System Test with DC-DC Converters

- Results summarized by Lutz in October meeting

  http://indico.cern.ch/getFile.py/access?contribId=0&resId=0&materialId=slides&confId=41790





⇒ Noise of Enpirion converters can be controlled by combination of shielding and filtering (LDO).

- Studies with commercial buck converters documented in Jans thesis CMS TS-2009/003

  "System Test Measurements with a DC-DC Conversion Powering Scheme for the CMS Tracker at SLHC"

C02 Cooling for phase II

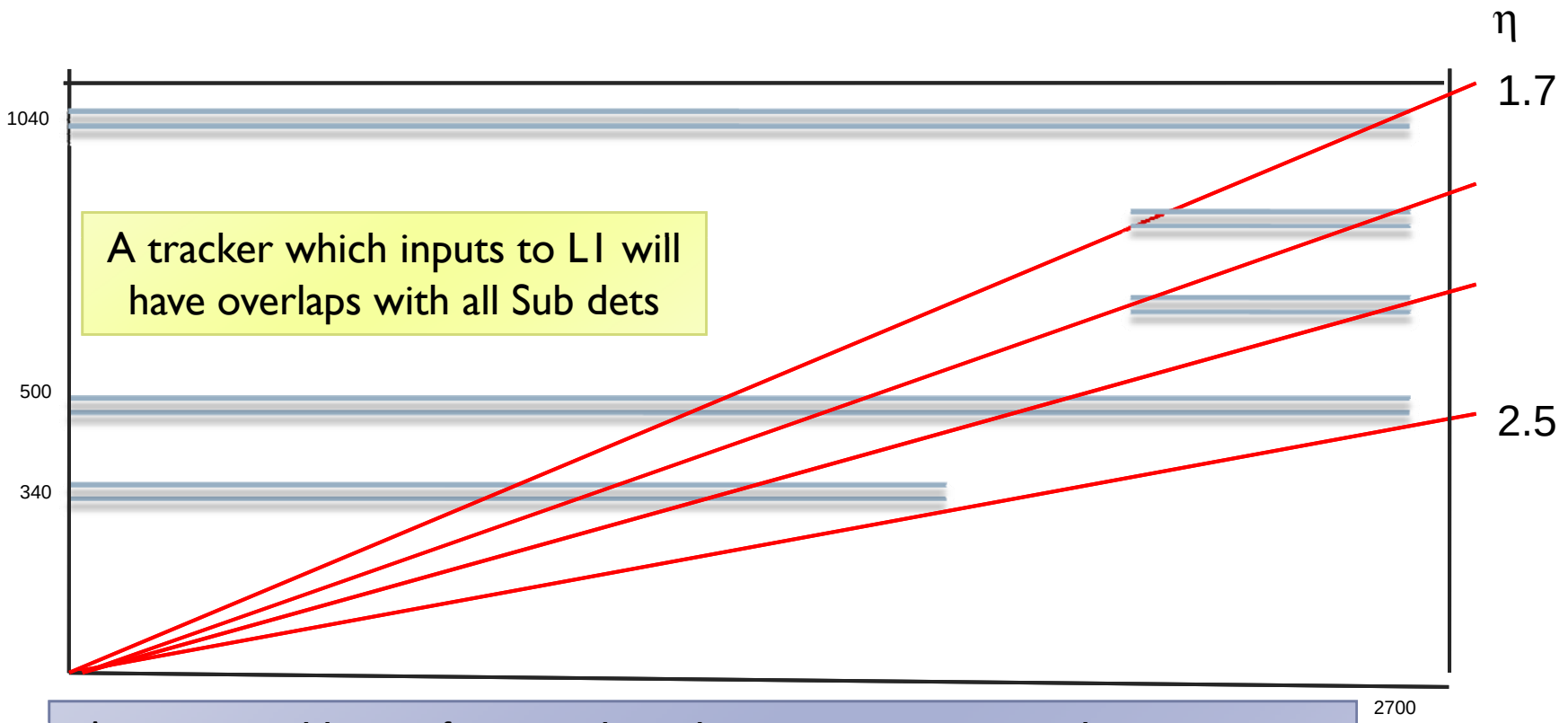
- Almost essential to re-use the current cooling pipes on YB0, can this be done?
- Met with CERN safety commission to discuss issues
- Looks possible, agreed plan of validation with CERN safety

Summary

- With this system design, max coolant temp at 15 degrees C and safety valve at 57 bar, the currently installed copper tubes can be approved by CERN safety
- We will build one equivalent circuit for destructive testing by CERN safety
- We will pressure test the installed copper tubes with gas at 1.25x57=71 bar

28 January 2009 Hans Postema - CERN 24

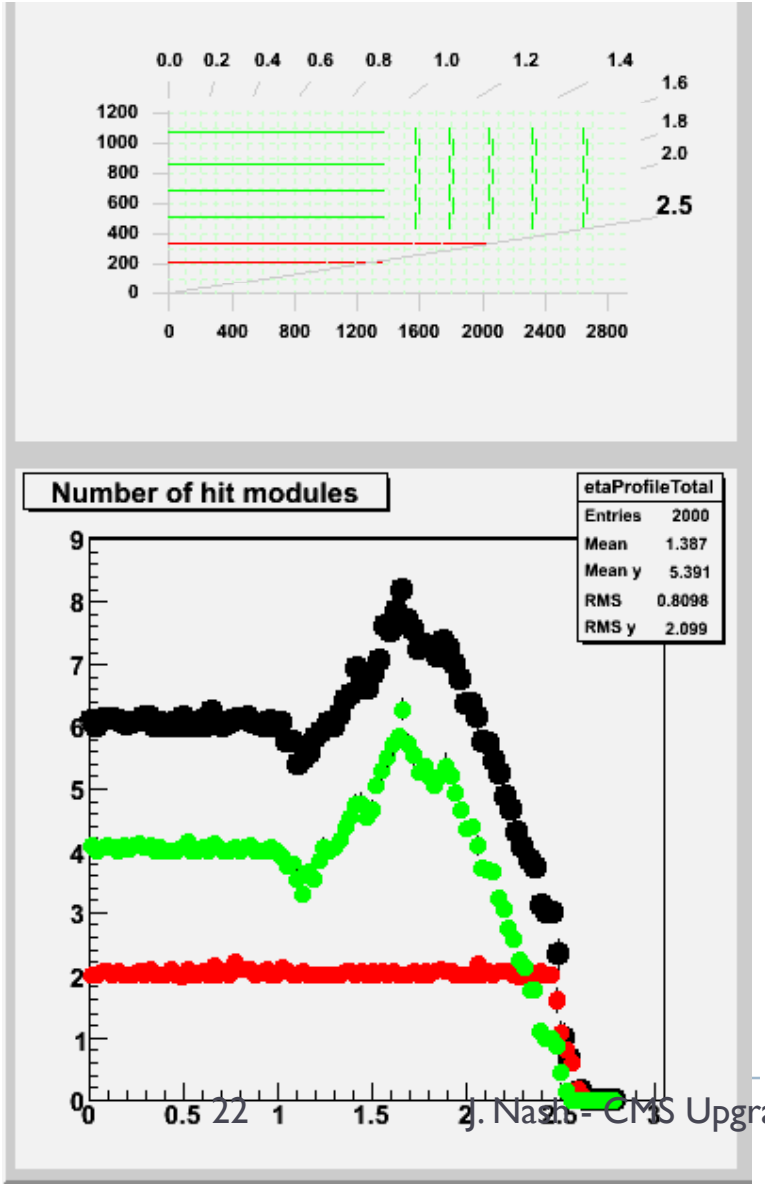
Example:
Layout for the Tracking Trigger Project

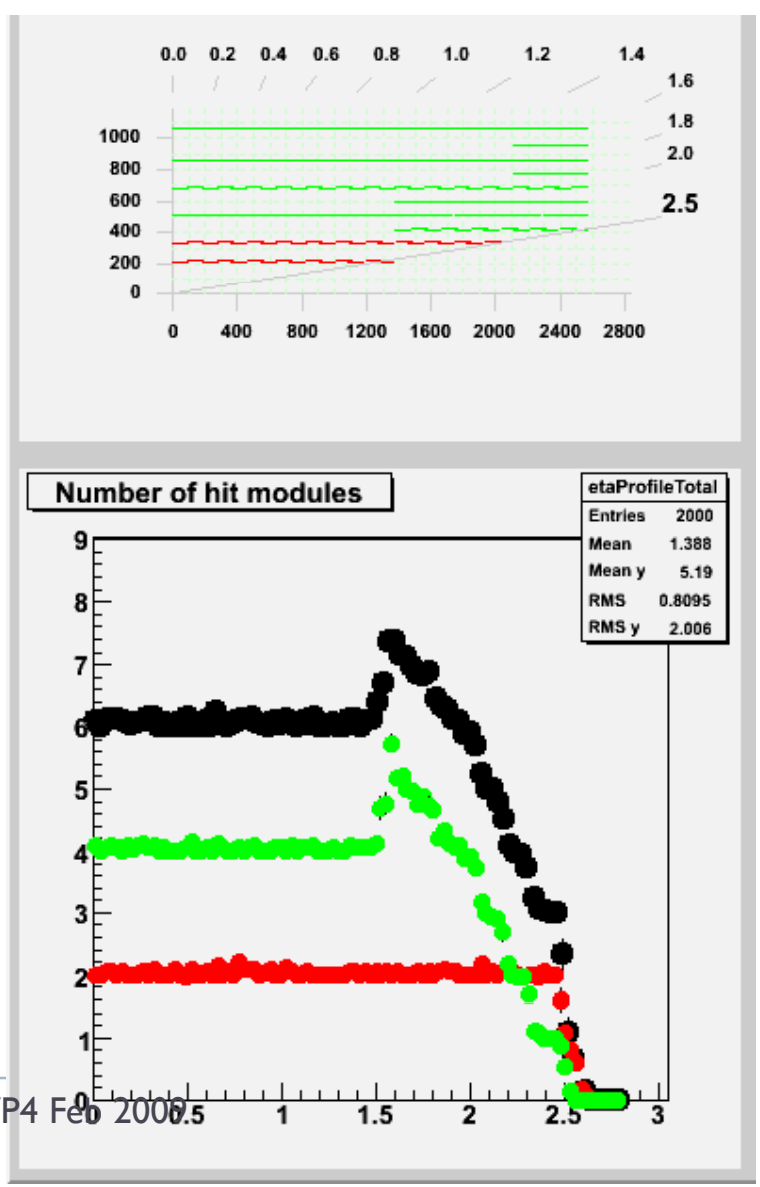


- A conceptual layout for a tracking detector was proposed
  - Trigger groups to understand what could be achieved with stubs
  - Tracker produces stubs to feed the Trigger
- Layout concept for stacked rods proposed
  - study groups to look at the practical aspects – What questions do we need to answer to understand if this can be built?

Examples with two "Pt" layers at lower radii

Layout Task Force
D. Abaneo





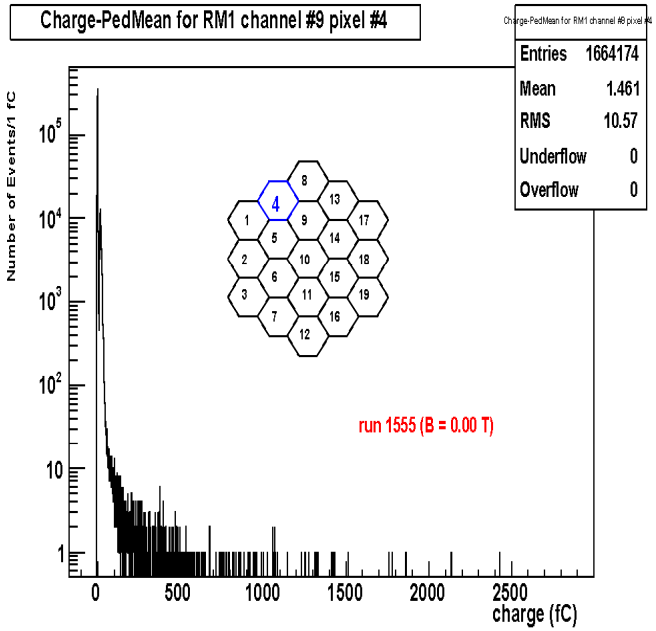
Trigger

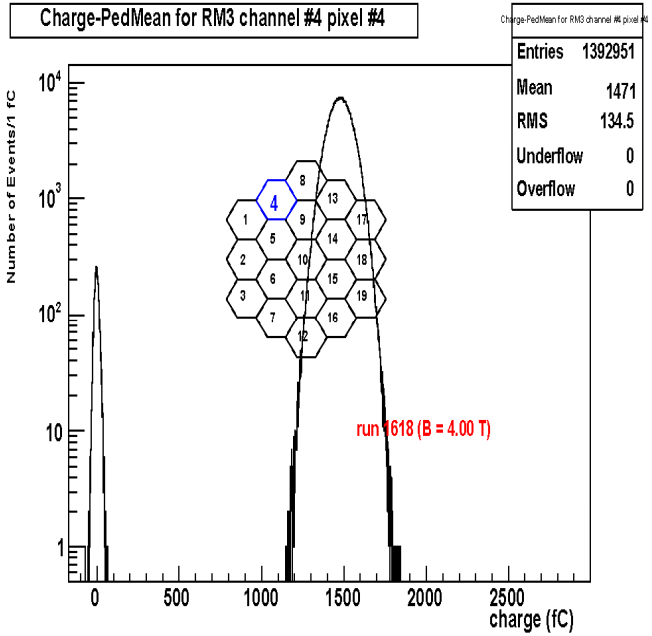
- Technologies for Phase I upgrades
  - Micro TCA implementations
  - The hope is to develop a common infrastructure for use in trigger upgrades
    - Reduce the large number of standards currently in use in the trigger system
    - Increase reliability/flexibility
- Tracking Trigger discussions
  - Possible candidate architectures
  - Simulations
  - Key R/D for phase II
    - Need to establish which ideas most likely to be successful and dedicate sufficient resources to determine viability
      - Can it be implemented
      - How well does it work
      - Power/Material implications

Figure 1: micro TCA crate with single high backplane

Calorimeters

- HCAL
  - Progress on using Silicon PMs as a new Photo Detector
  - New off detector electronics
  - Upgrade strategies
- ECAL
  - Data on radiation damage to crystals and VPTs in the EE
    - Establish what will be the performance at SLHC
  - Simulations of SLHC and EE
    - How well will the EE perform given any performance degradation
  - ECAL/HCAL joint electronics issues
    - e.g. Trigger electronics





WP 4.2 Deliverables

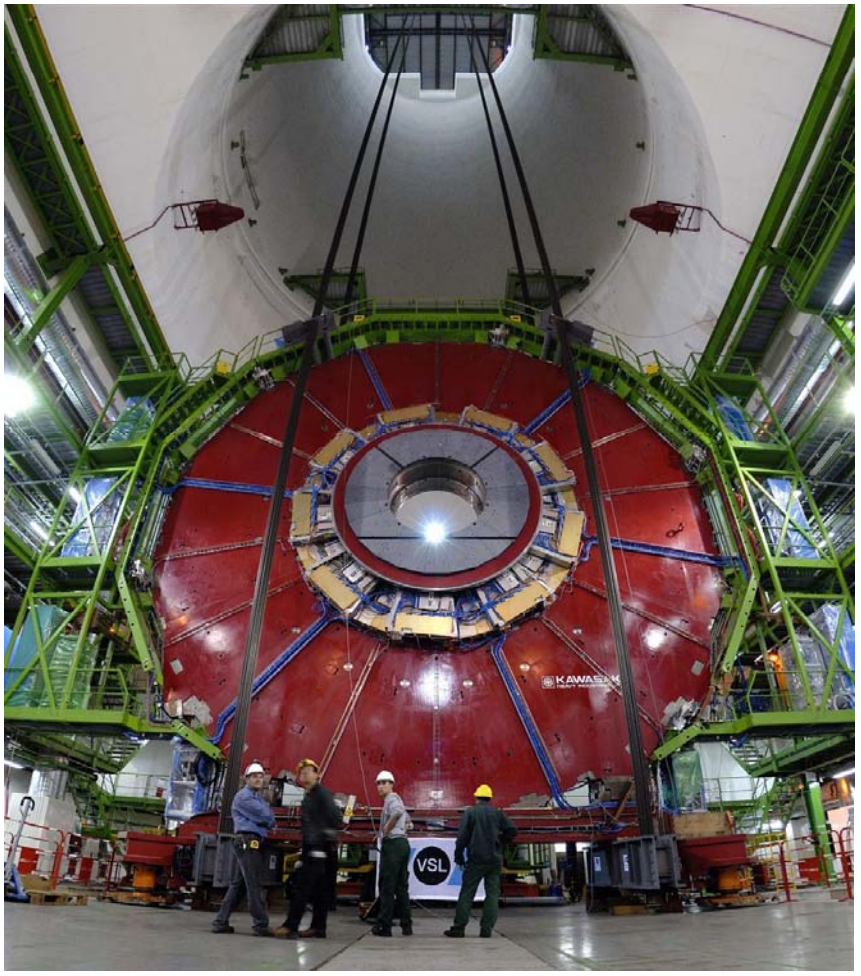
Deliverables task 4.2	Description	Nature	Delivery date
4.2.1	Personnel and working practices of the Technical Coordination unit in place	O, R	M12
4.2.2	Key structural requirements (information repository, tools, coordination framework, safety and quality systems, integration office) and scheduling and reporting mechanisms in place	O, R	M18
4.2.3	Pilot design and schedule for the upgrade project published.	R	M36

Task 4.2.1 – Upgrade TC Unit established

- Upgrade TC named (W. Zeuner)
- Working within the current technical coordination unit.
- Have started work on defining the working methodology
- Planning for Muon system phase I upgrade (ME 4/2 Construction and installation) progressed well at the FNAL workshop
- Meetings between Executive Board, and Project Managers to discuss procedures for reviews, TC needs for upgrades, engineering support issues

Muons

- Planning for Phase I upgrades
  - CSC production
  - RPC production
- Planning for installation
- Concepts for using the Muon system in a tracking trigger



ME4/2 Upgrade Schedule

- t_0 -- CD2 approval, money flows, begin work on Bldg 904
- t_0+3 months -- orders sent out for all parts
- t_0+6 months -- production tooling shipped to CERN and assembled in Bldg 904
- t_0+9 months -- chamber parts delivered, shipped to CERN
- t_0+12 months -- production begins at Bldg 904 at 2 CSCs/month
- t_0+15 months -- production ramps to 4 CSCs/month
- t_0+ 18 months -- FAST site begins assembly & testing at CERN (Bldg 904?), spare CFEB boards installed on ME4/2s
- t_0+24 months -- 42 CSCs finished and tested -- ready for installation of 1st endcap, recover 200 CFEB boards from ME1/1s
- t_0+33 months -- all 76 CSCs finished
- t_0+36 months -- final 36 chambers ready for installation on 2nd endcap

Future meetings

- Upgrade Days
  - Meetings scheduled once per month
    - Keep momentum
    - Track progress
  - Topics which cross detector groups, or go into depth on a particular topic
    - Examples : Sensor R/D, HCAL/ECAL common readout electronics, tracking trigger issues
- Upgrade Workshop 13-15 May 2009 CERN

Spend Profile

	CERN	DESY	ETHZ	Imperial
Total Project	48	18	15	9
Spend to date	12.2	1.9	2.8	2.8

Reports

- We have to produce reports this month for the two deliverables we have achieved.
- Fairly lightweight
  - See http://info-slhc-pp.web.cern.ch/info-SLHC-PP/MILESTONES.htm#Milestones
  - J. Nash for 4.1.1
  - W. Zeuner for 4.2.1
- In 6 Months time we have a milestone to report on
  - Project scope defined
  - should be a direct outcome of our May workshop.

Conclusions

- Good progress on tasks/Milestones
  - Upgrades teams established
  - Upgrade Scope understood
    - Details being studied/prepared
- Phase I/Phase 2 split actually allows us to deliver a fairly complete upgrade plan during the course of this FP7 project