Detector Construction, QC & Commissioning

issues for a Supercollider

remarks and personal views based on experience and plans from LHC experiments (ATLAS and CMS) and from the studies for LHC upgrades

Supercollider experiments: generalities & themes for this presentation

Trends affecting detector construction

Integration

QA/QC and project monitoring

Commissioning

Conclusion

Austin Ball, CERN

Supercollider experiments

high energy, high luminosity

-are big, few in number and costly
-risks are large, failure unthinkable

-involve many : countries
funding agencies
institutes
physicists

and need a large, well-equipped host organisation

timescale long: obsolescence built–in

experimental environment is hostile
special components
difficult maintenance
difficult disposal

collision rate & stored data volume are challenging

Trends affecting detector construction

sensor technologies : other talks this workshop

sociology
administrative & legal constraints

size of experiments :
industrial production
reception areas

custom detector manufacturing: automation & hand-building.

logistics

electronics

Sociological constraints

- **Supercollider projects take 10 years or more to build before operation**

  -subject to several rounds of national and international economic and political cycles
  unwise to plan based on the good times

  -overlap with comparable running experiments is reducing
  timescale too long for Ph.D students to see final data

  -human lifetime & fragility become non-negligible factors
  more people burn-out, move on or stagnate
  attrition of expertise between design , construction and operation
  start experiments with few personnel experienced in commissioning
  maintenance workers less willing to suffer mSv radiation doses?

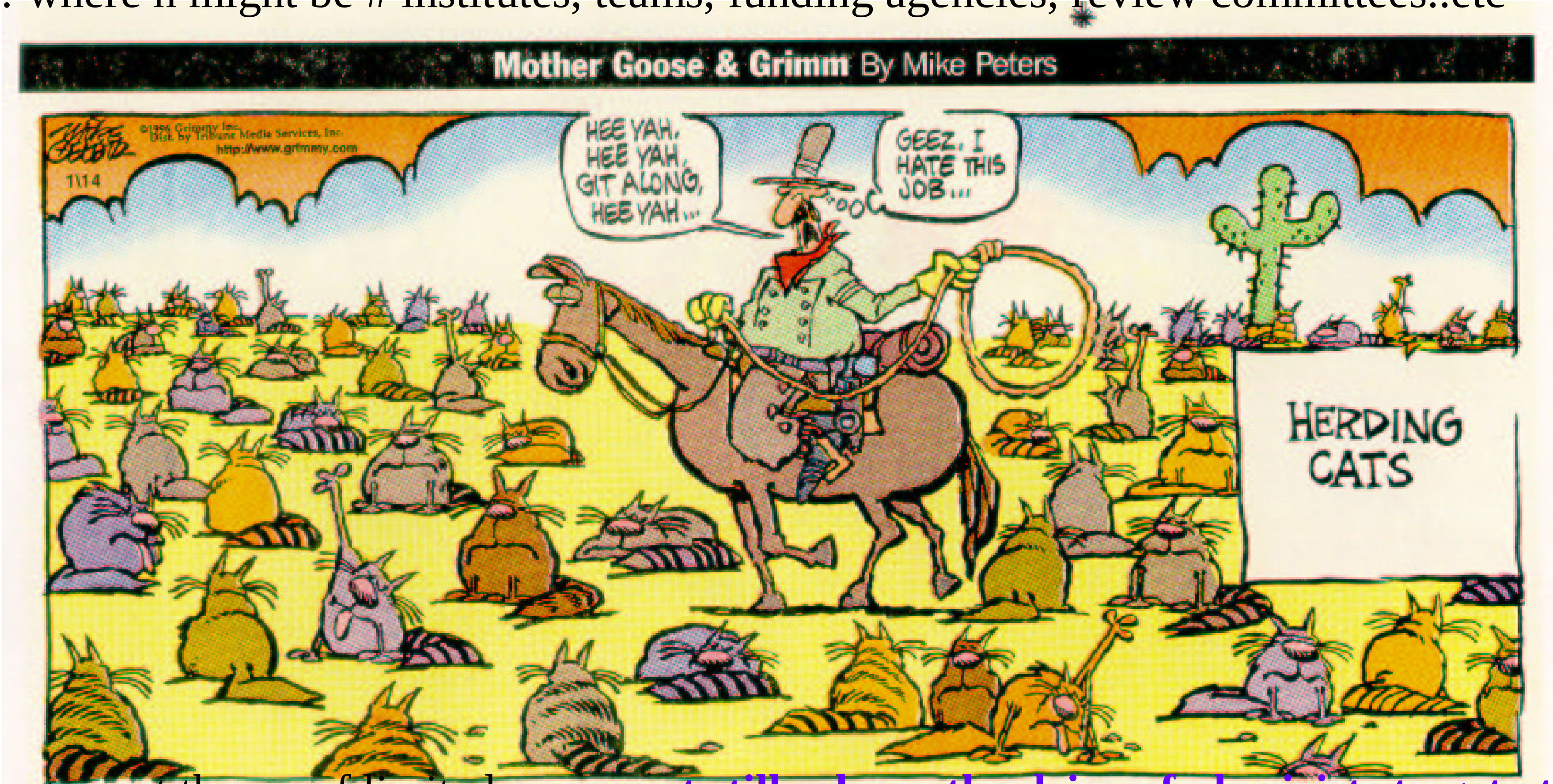
- **important to create opportunities for young people (from many fields) to contribute part of their careers in a satisfying way.**

Management and Communication

semi-academic heirachy in a collaboration is intrinsically (and usually beneficially) weak…

social complexity increases combinatorially $n(n-1)/2$

… where n might be # institutes, teams, funding agencies, review committees..etc



management theory of limited use- **must still rely on the drive of physicists to get at physics**

Administrative & Legal constraints

an increasingly regulated, accounts-driven world is becoming more hostile for research-type activities without an immediate economic objective and involving maxima & minima of construction activity

Host lab resources, diversity and expertise in both R & D and construction support reducing

Legal/practical restrictions are increasing on: staff mobility from institute to institute
hiring of temporary staff

Labour from developing economies will get less and less cheap and is not a long-term solution

Project financing is tending more and more towards P + M

more flexibility and easier accountability (in a open and de-regulated economy)
materials/personnel/travel/contingency etc all paid from budget
reduced or absent underlying infrastructure and permanent staff in institutes

Risk of inadequate continuity in the technical knowledge base

Administrative and Legal constraints

- **Tolerance for negative environmental impact is reducing (good thing!)**

HEP is generally not a polluting activity, but is affected (costs,time) for instance by:

restrictions on tunneling activities & surface infrastructure
restrictions on emissions (eg effluent detector gases) and contamination
requirements on traceability of waste and disposal methods(esp radioactive)
reduction in allowed radiation dose rates for workers

- **Equipment has to follow codes for industrial scale, permanent objects eg seismic stability**

- **Access to the latest microelectronic technologies is restricted.**

all the above constrain the design, construction, commissioning and operation of research facilities

(Note in passing: A supercollider project must take increasing care to avoid being classified with the nuclear industry in the minds of bureaucrats or of the public)

Industry can make large objects increasingly precisely

application of numerically control to large machine-tools *200μm precision on these holes*

disk diameter 14m

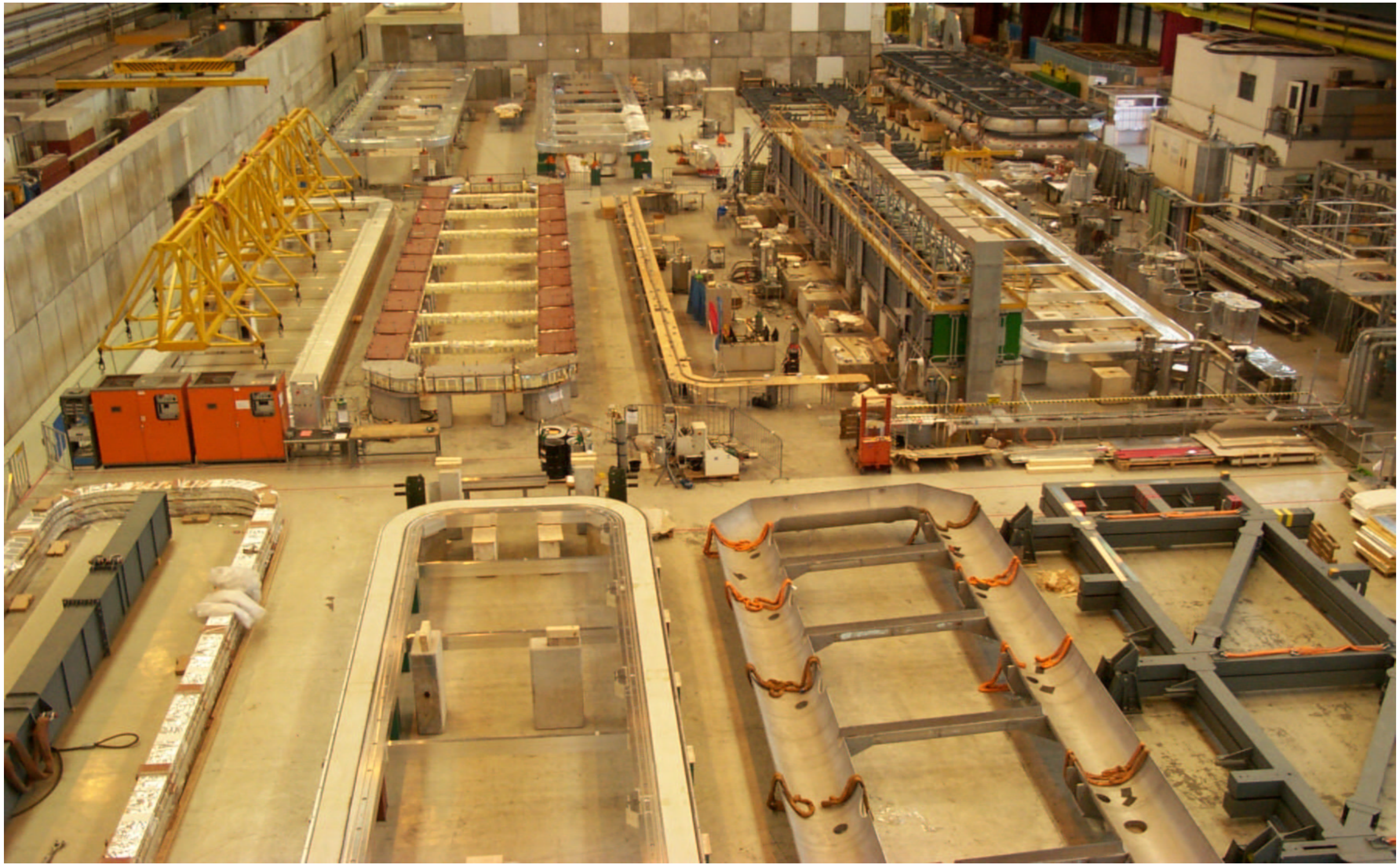
but transport to experiment site sets limits

and transport surprises are quite frequent…

& expensive….

back-up resources need to be industrial scale

ATLAS Barrel Toroid Integration and Test



industry can default due to

unattainable spec

unprofitability

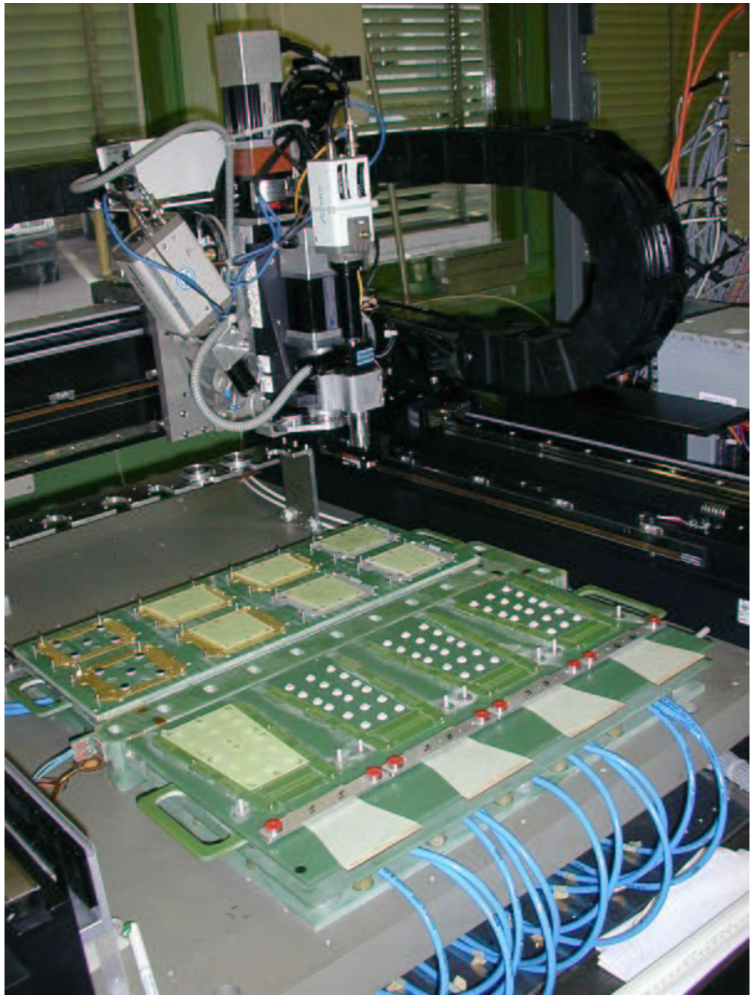
economic cycle effects

etc

→quite common in LHC projects

and reception/pre-integration areas large

Automation



“robots” increasingly applied to precise repetitivetasks with precision components

-adapting components to robot is non-trivial

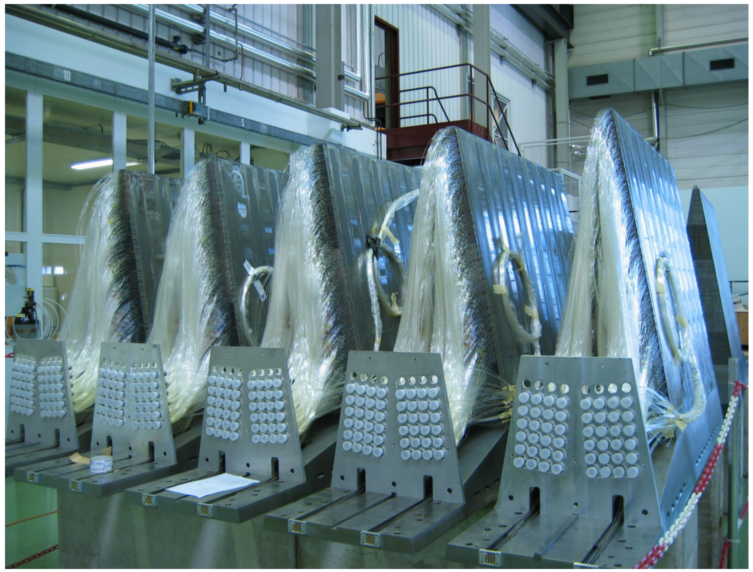
-mistakes are also made the same every time!

Manual assembly still needed…

nimble hands sometimes better custom robots

CMS forward calorimeter

600k quartz fibres inserted in absorber modules by hand in ~15 months.



Logistics

ideal world:

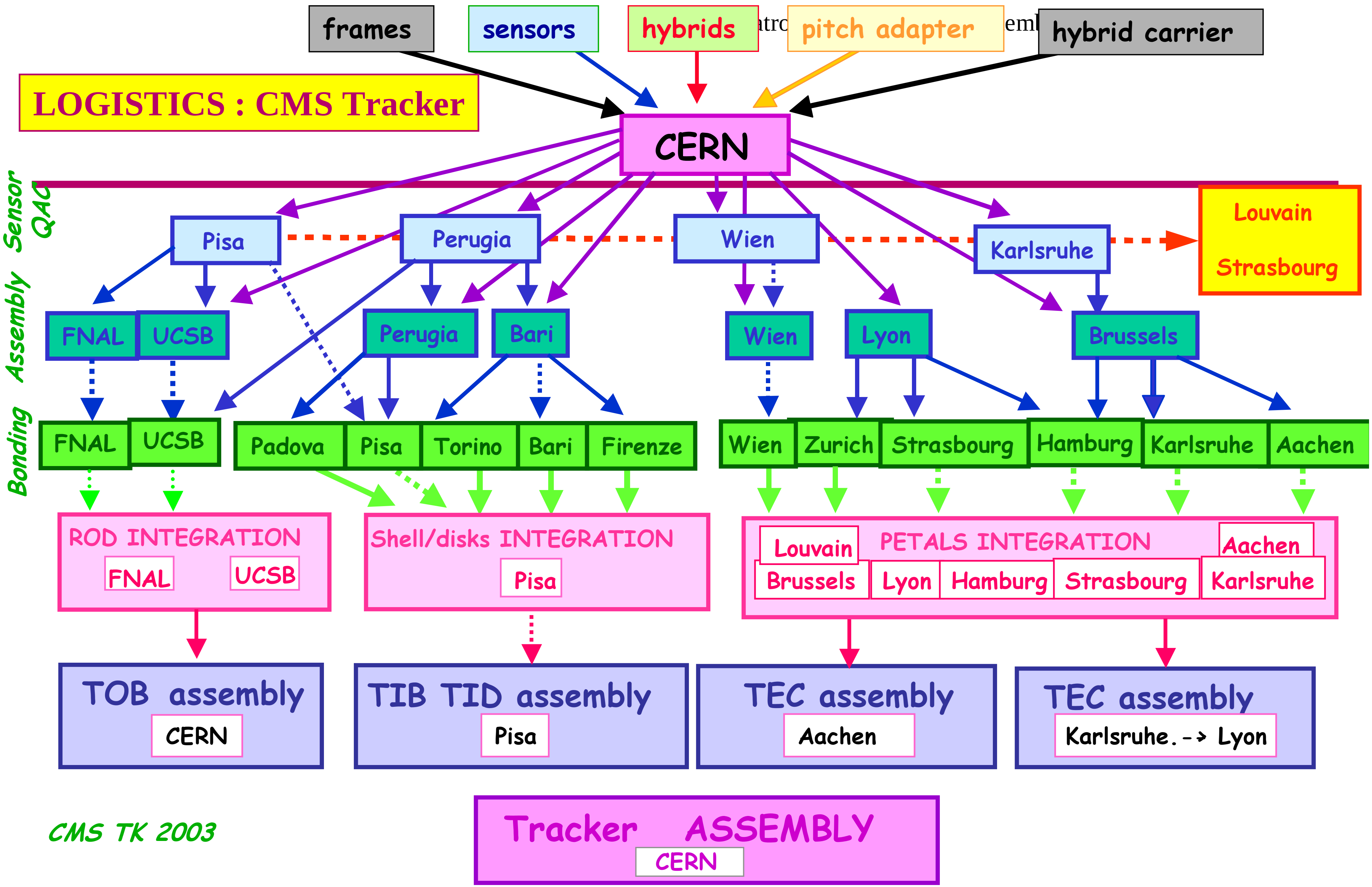
processes should be concentrated on one site or a small number of parallel sites
lines of communication shorter, responsibility clearer, uniform quality easier to maintain
ie input : procured materials <––> output: tested detectors
centres should be able to back each other up ie manufacture interchangeable between centres
number of different variants of a part should be minimised

“few specials” to fill acceptance hole can cost same design & prototyping effort as “standards”

in eg LEP collaborations, many sub-systems were still the prime responsibility of one institute
unfortunately, the nature of supercollider collaborations and their sociology tends towards distributed production, and even distributed processes:

- needed to maintain institute infrastructure, intellectual attraction and distribute expertise…

the logistic price of this must be factored in, not overlooked!!



LOGISTICS : CMS Tracker
frames
sensors
hybrids
pitch adapter
hybrid carrier
CERN
Sensor QAC
Assembly
Bonding
Pisa
Perugia
Wien
Karlsruhe
Louvain
Strasbourg
FNAL
UCSB
Perugia
Bari
Wien
Lyon
Brussels
FNAL
UCSB
Padova
Pisa
Torino
Bari
Firenze
Wien
Zurich
Strasbourg
Hamburg
Karlsruhe
Aachen
ROD INTEGRATION
FNAL
UCSB
Shell/disks INTEGRATION
Pisa
PETALS INTEGRATION
Louvain
Aachen
Brussels
Lyon
Hamburg
Strasbourg
Karlsruhe
TOB assembly
CERN
TIB TID assembly
Pisa
TEC assembly
Aachen
TEC assembly
Karlsruhe.--> Lyon
Tracker ASSEMBLY
CERN
CMS TK 2003

Logistics: transport carries risks

however careful the handling…. accidents *will* happen
to both big and small packages…

assess risks correctly, insure where appropriate

Electronics: 40% of cost, 90% of risk?

high collision rate → high current per electronic channel
high precision tracking & calorimetry → high channel count
high radiation environment → rad tolerance needed.(qualified COTS or custom-made)

electronics tasks were poorly represented in LHC experiment high level planning before mechanical manufacturing of detection systems was launched
subsequently on-detector electronics tasks suddenly appeared on critical path!!

usually due to

: underestimation of engineering resources
: over-dependence on a very few key individuals
: failed/poor yield submissions
: rad tolerance testing taking unforeseen time
: vulnerability to foundry delivery schedules
: vulnerability to technologies disappearing or changing
: single batch ordering incompatible with funding profiles

much electronics has been retrofitted to mechanically completed detectors→ risk

——> schedule pressure ——> burn-in treated as a contingency ——> pay the price later?

Electronics experience

Arrival of “final” electronics
+ serious consideration of services ——> mechanical integration “zombies”,
(cables, connectors, power distribution etc)

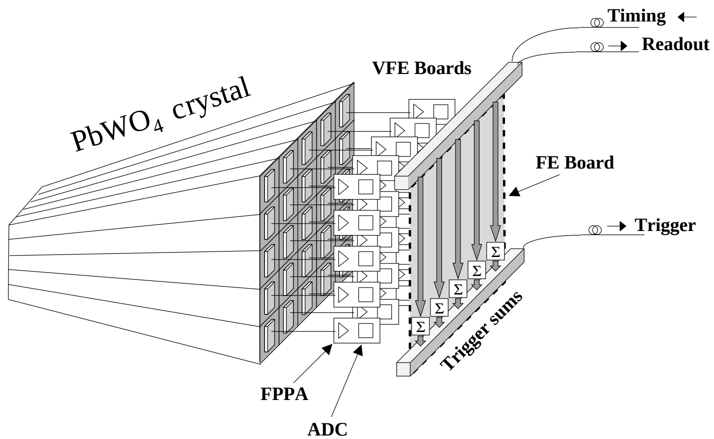
final system tests generally done late——> bad surprises coming late?
eg EMC and grounding issues.

Power density and cooling challenges of supercollider detectors are outside our previous experience and can be expected to give problems!
Power consumption of ATLAS/CMS on-detector equipment is of order 1.0 MW

Maintenance tools: rate of update, backward compatibility, obsolesence
issues underestimated

Electronics

Moore's law is still good for processor power but need not apply to other components



eg CMS ECAL front end electronics

before 0.25µm technology (fast, rad-hard data reduction on detector) was proven design minimised the risk from on-detector rad-hard components by shipping data from individual channels off-detector.

this design bet on a the plausible, but large, reduction (x5) in the cost of optical links …which never occurred (capacity of single fibres was nowhere near saturated).

(luckily the success of 0.25µm and the motivation of the teams working with it seem to have saved the day)

Electronics: the future

0.25µm a success at LHC! yield,noise, power consumption,
rad tolerance at reasonable cost
more signal processing on detector

represents the fruits of a long collaboration with IBM

progression will probably be → 0.13µm →0. 065µm. (x 16 more gates per unit chip size)
rad tolerance should be good (at least of 0.13µm with SiO_2 dielectric)
overcome any SEU effects by redundancy of key elements
refresh from local flash memory

Research collaboration with big vendors for our special requirements works!
but we represent a tiny market (IBM makes 40k 0.25µm wafers a week)…start early!
-experience suggest processes are stable when number of wafers made is large (say >10k)

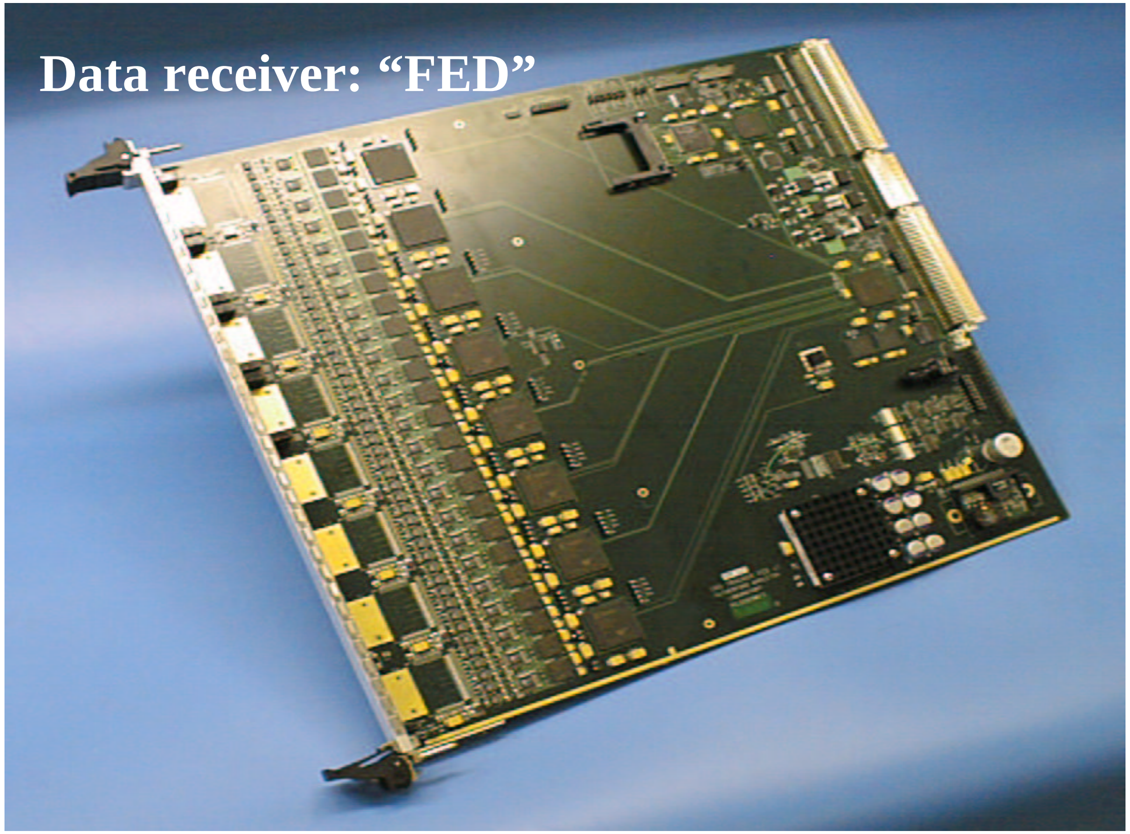
Optical links:
expect progression from 1.6 Gbit (now) → 10 Gbit (straightforward) → 10Gbit through mono-mode fibre to avoid dispersion

System design (across whole expt) is better as an input than an afterthought

Electronics: proliferation of FPGAs

- **Complex 9U digital board**
  - optical signal deserialiser
  - data digitisation
  - data reduction
  - cluster (hit) finding
  - calibration
  - synchronisation
  - data assembly and transmission
- **mostly empty space!**

…relies on FPGAs:



increasingly, DAQ functions are downloaded to FPGAs on- and off-detector

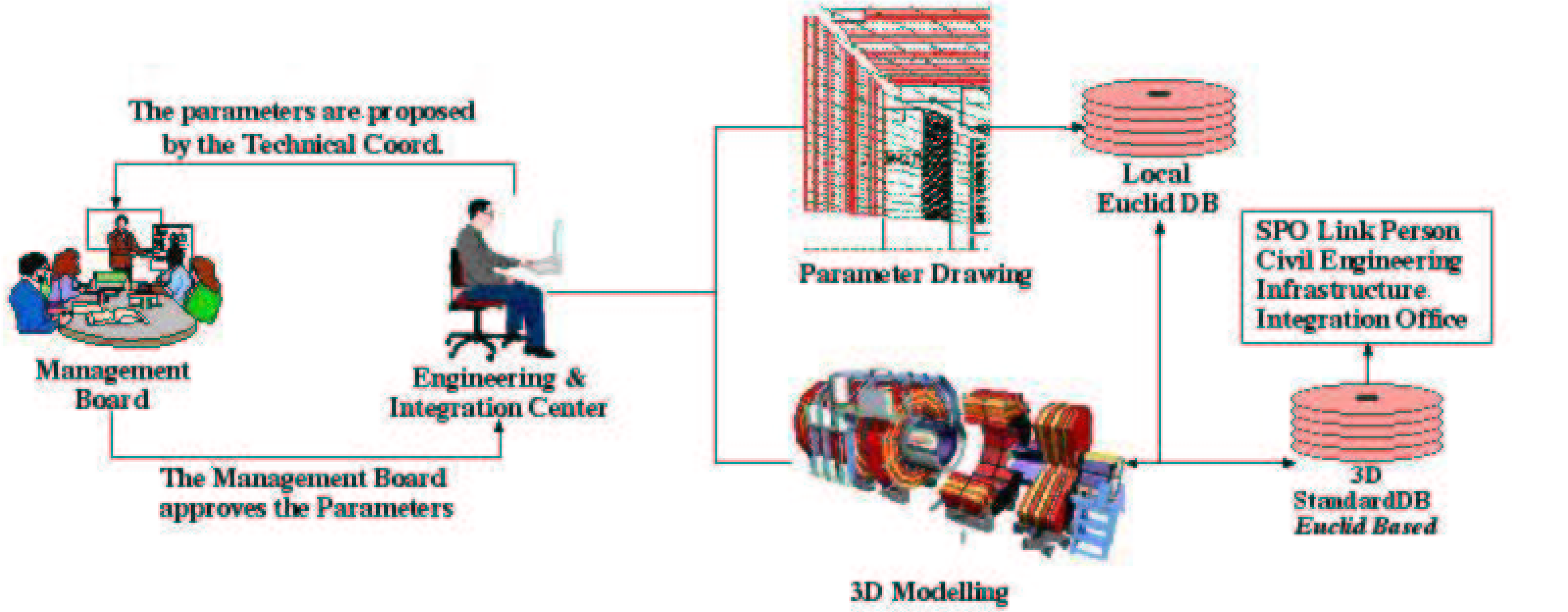
-requirements and cross-checks on algorithms are ~ as strict as for ASICS

-platforms to program FPGA's subject to obsolescence?

Engineering Integration

a thankless but vital task, needing a dedicated team and resources

eg Joint CERN-ETHZ project: supporting CMS Technical Coordination since 1997



Integration Coordinator + 3-4 CAD draughtsmen/engineers, QA/QC engineer

tasks**: parameter envelopes, change control , non-conformities**

tools: **3-D modelling : translation from multiple external CAD systems, CDD, EDMS.**

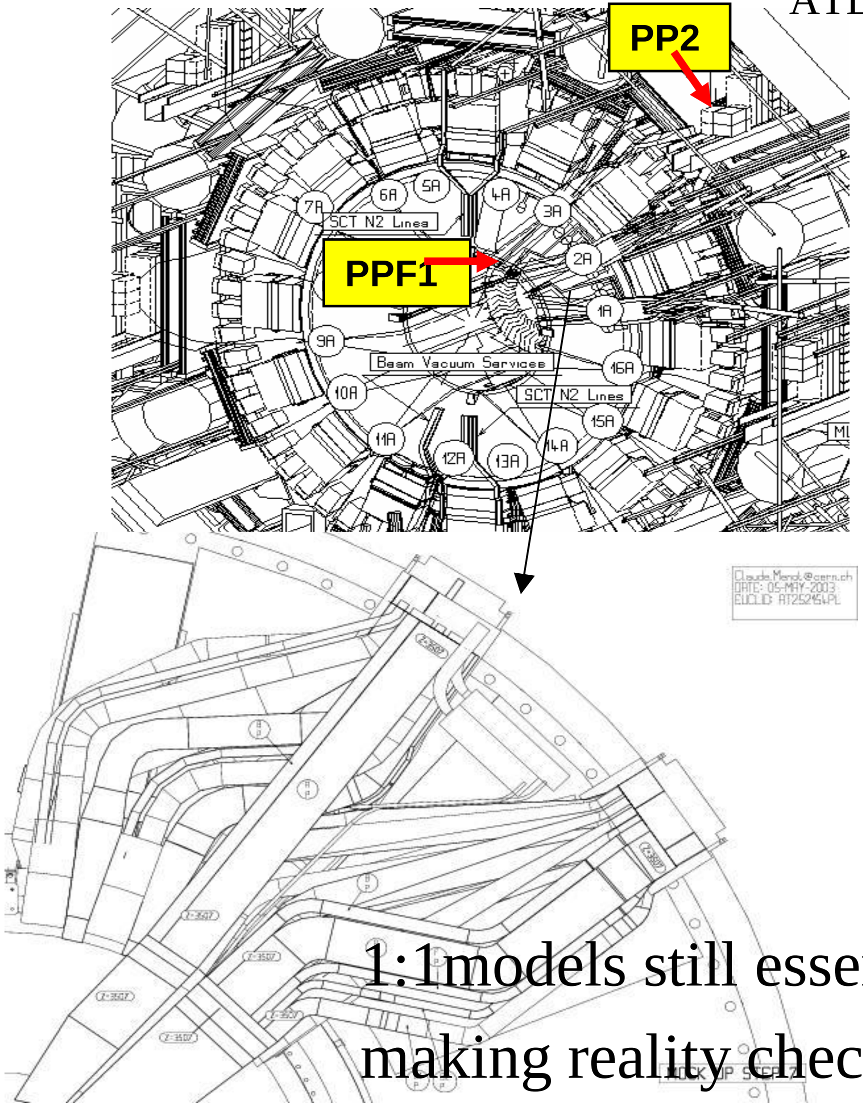
: full scale sectional model in bldg 867.

centre: **focus for detailed mech. engineering links between subsystems (link meetings)**

temporary facilities for collaborating groups.

Integration: Cabling modelling

ATLAS ID services



1:1models still essential in verifying layouts & making reality check with drawings and 3-D CAD.

Integration: cable procurement & installation

Subsystem/function cells could be not always correct because different cables of the same type could be joined in one row

LARG

Some of the listed cables needs to be installed together with cryogenic services: then installation starts earlier, 19.02.2004

ALL = EM Barrel SideA & SideC+ END-CAP Side A & Side C (EMB, EMEC, HEC, FCAL)

detector	subsystem	function	type	diame	N of c	Len, Km	reference	connector	connector	characteris	comments
LArg	All	Trigger Ca	Electrical	12.50	374	39.38				16 shielded t	Must go th
LArg	All	High Volta	HV	13.00	156	21.54				25 + 2 spare	-
LArg	All	Low Voltag	LV	13.00	66	5.08					-
LArg	All	Data and S	Optical	9.50	58	4.35	Ericsson C	12-way parallel optica		This is a cus	The cable
LArg	All	Monitoring	Electrical	20.00	74	5.31					Detector t
LArg	All	TTC Optica	Optical	3.00	244	16.38				Individual fibe	Must go th

function	2002 Se	Oc	No	De	2003 Ja	Fe	Ma	Ap	Ma	Ju	Jul	Au	Se	Oc	No	De	2004 Ja	Fe	Ma	Ap	Ma	Ju	Jul	Au	Se	Oc	No	De
Trigger Ca		Cables have been already ordered																			20				20			
High Volta				10					5												20				20			
Low Voltag							20		5												20				20			
Data and S					20				5												20				20			
Monitoring					20			5						20				20										
TTC Optica					20				5												20				20			

Please note that TTC optical fibers should be part of Level 1 Trigger

These cables must be installed together with the cryo services

PRR1 completed. Cable and connectors are CERN Stock Items

The optical fibres already passed PRR1 almost a year ago. However length was never specified, will be important to have a length approximation in January 2003

Tendering := PRR1 (Length with 20% accuracy, verification of CERN safety requirments)

Contract = PRR2 (Precise length)

Last acceptable day for delivery to CERN

Beginning of installation

tends to get neglected as unglamorous, by both detector & electronics specialists

→ easily comes on to critical path. Plan must include maintenance as well as installation

Quality Assurance/control

Quality assurance:
the set of planned and systematic activities which ensure that the experiment project:

attains the required performance
is completed and running on time
complies with legal and other rules and regulations
is safe, reliable and maintainable

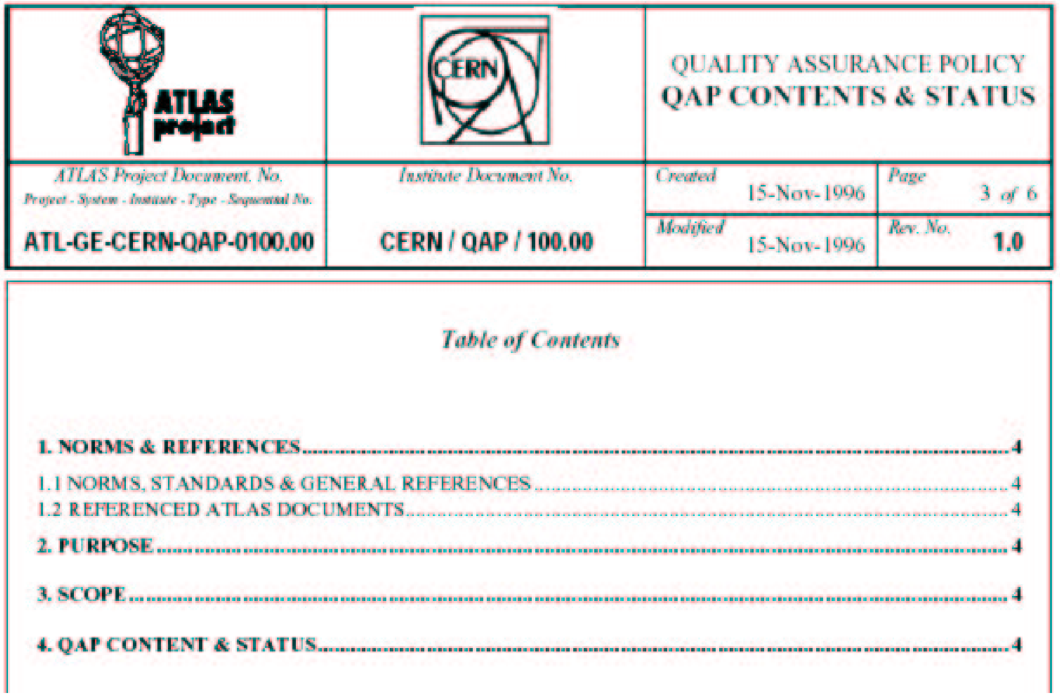
applies everywhere from design through prototyping, production, assembly & installation

includes well known concepts such as part identification, documentation, traceability, change control, peer review, scheduling & reporting, inspection & test (QC).

most of the activities are obviously needed, and were always done …. but….

Quality Assurance/Control

As collaboration size has grown, that which used to be done intuitively needs to become somewhat more formal….some differences of opinion on how formal…


ATLAS project

CERN

QUALITY ASSURANCE POLICY
QAP CONTENTS & STATUS

ATLAS Project Document No. Project - System - Institute - Type - Sequential No.	Institute Document No.	Created	Page
ATL-GE-CERN-QAP-0100.00	CERN / QAP / 100.00	15-Nov-1996	3 of 6
		Modified 15-Nov-1996	Rev. No. 1.0

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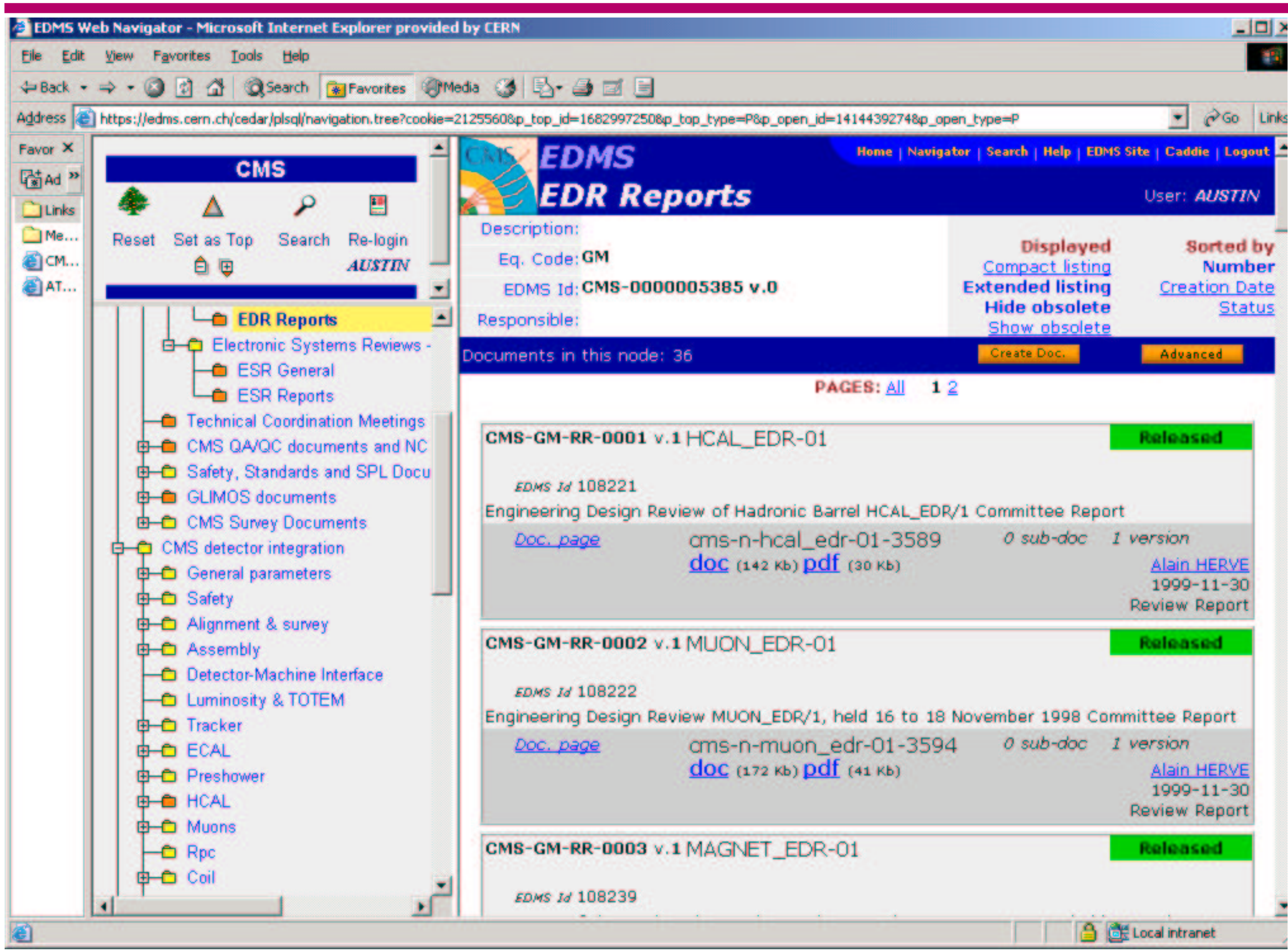
define rules, guidelines & procedures:

- introduce formalism only where it helps to improve the end result in the HEP environment
- still rely on, and encourage, the motivation of physicists to make a good detector

Engineering data & document management



important for
- -document organisation
- -reliable archiving
- -approval/ change control

- documenting important non-conformities and their resolution

CERN EDMS:took some time to customize for experiments
- -now vital
- -still cumbersome
- -can legitimise falsehoods & obsolete information

Review process

ALL experiments have adopted a similar sequence of project review designed to minimise risks in performance. cost and schedule:

for CMS:

preliminary design review or workshop

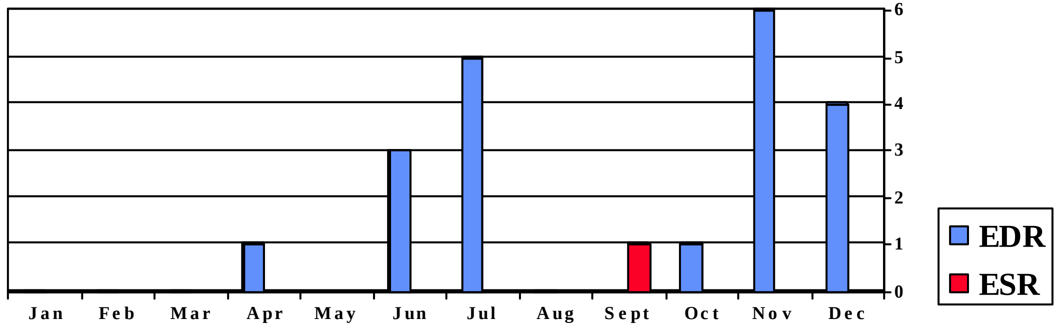
intermediate design review or workshop

engineering or final design review (s)→ authorisation to procure or manufacture

(committee include reps of all interfacing systems + external experts)

manufacturing progress review (including cost-to-complete)

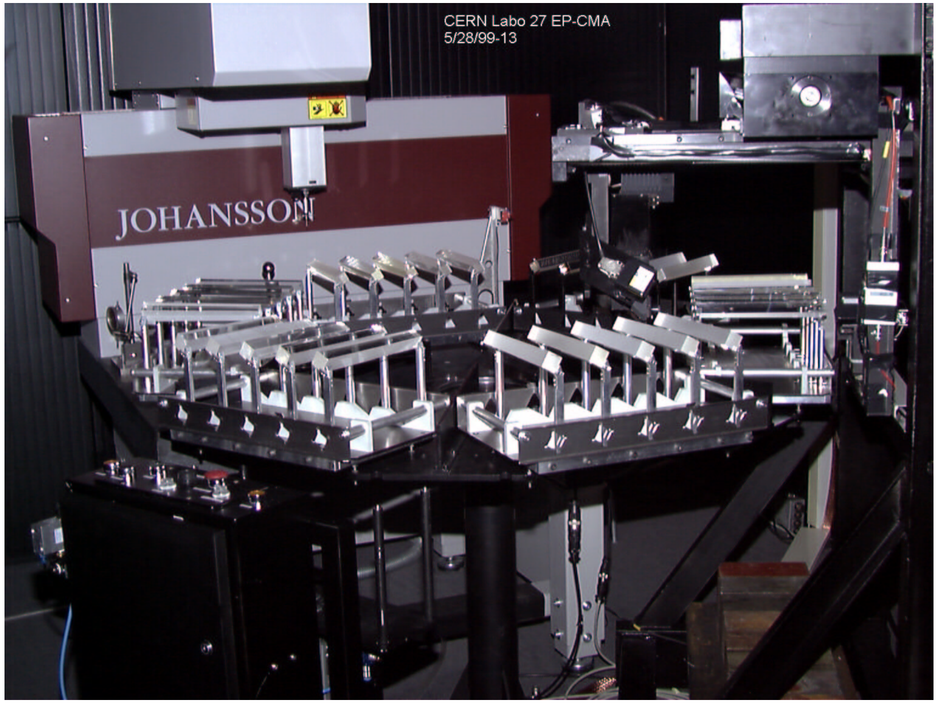
for pragmatism, items which largely factorise from the system design, can be authorised by smaller scale procurement readiness reviews



CMS reviews 2001
-note concentration in mid- & end-year!

Sophisticated test-rigs

CMS crystal measuring "ACCOS"

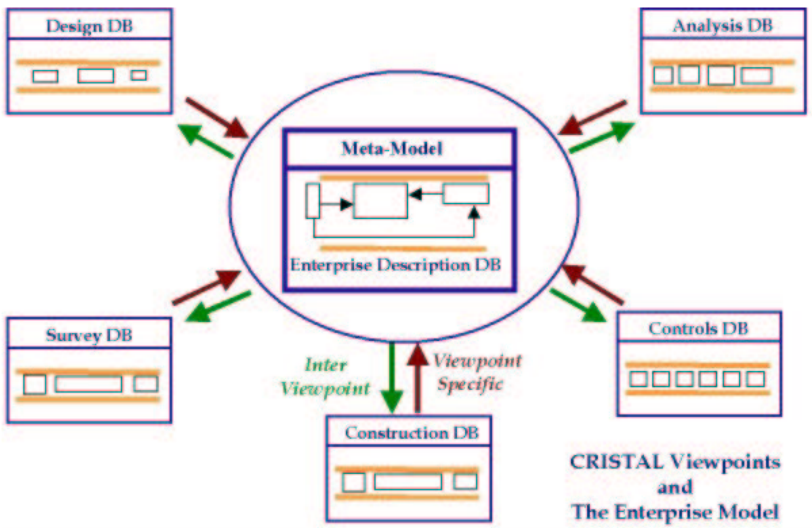


ATLAS MDT tomograph

Sophisticated QC devices needed to make repeatable precise tests on large numbers of items.
Development/adaption takes time. Can become single-point failures.
Some measurements contribute to first pass calibration of detector. -link to database

Construction database & process control

Detector Construction Management & Quality Control Tool



The C.R.I.S.T.A.L. project

Cooperative **R**epositories & **I**nformation **S**ystem for **T**racking **A**ssembly **L**ifecycle)

CERN, INFN, KFKI, LAPP, UWE

vital for CMS ECAL
application elsewhere proved elusive

•considerable resources are spent on developing tools which manage the construction process, maintain construction databases and facilitate data carry-over into operations.

•a customized central data-base system is needed and works well for individual complex detectors esp where detailed construction data carry forward into calibration.

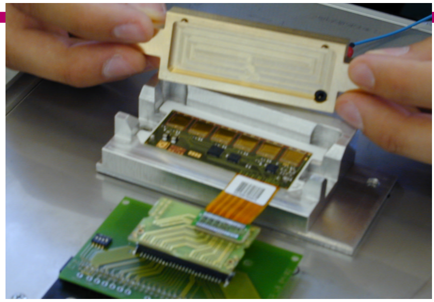
but

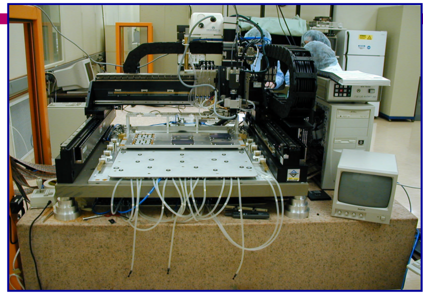
•differences in requirements usually too extreme for a generic system to work experiment-wide. (exc apparently worked for ALICE)

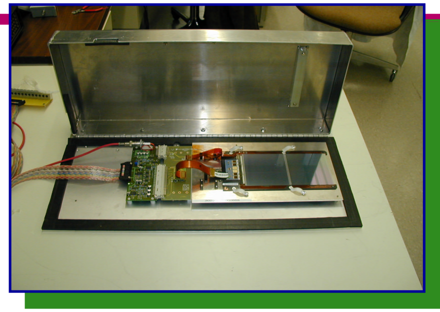
•central process control can contradict the distributed initiative needed to maintain uniform standards. except if central resources are overwhelming.

(IKEA kit model!)

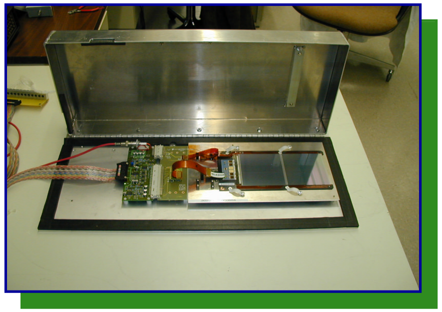
Process flow & QC: eg CMS Tracker modules

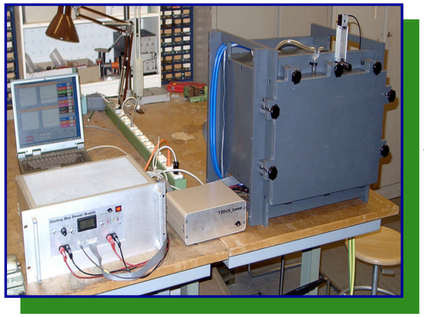

Quick test hybrid

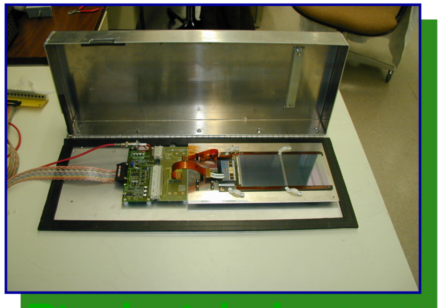

Gantry makes modules


Quick test unbonded module


Wirebond


Bonded module test


Thermal cycle module


Final pinhole test

Hybrids: tested ~10 times for ~80h, warm & cold

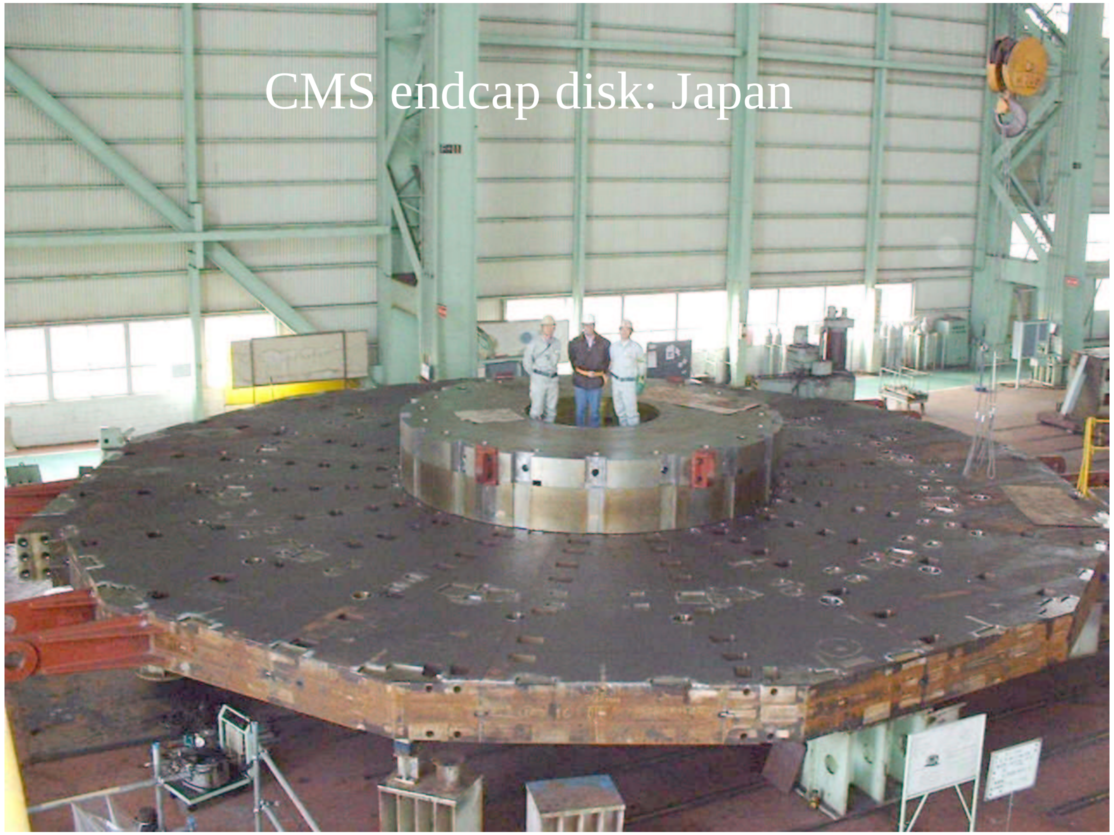
Modules: tested ~7 times for ~80h, warm & cold

standard procedures, dedicated database, cross checks between centres.

…watch for choke points & single-point failures!

Survey

Advanced techniques like photogrammetry needed as part of acceptance QC checks at manufacturer as well as after final assembly.
Data carry through into start-up calibration



Equipment Management Database

ORACLE

Locations

- Geometrical position
- Shape
- Parent/children
- Connected cable
- …

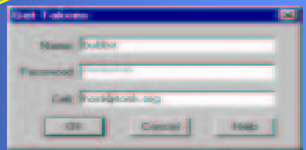
Parts

(Detectors, Racks, electronic boards, cables, etc., including spares)

- Location history for asset tracking / INB
- Specific parameters

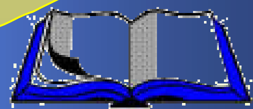
Conditions DB

Configurations DB



User authentication

DB data handler (procedures)



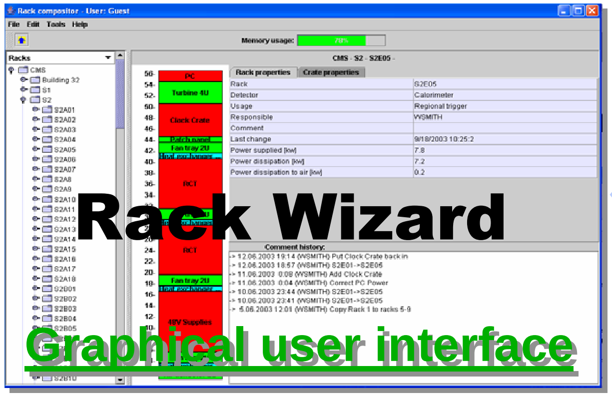
Logbook

Bar code reader

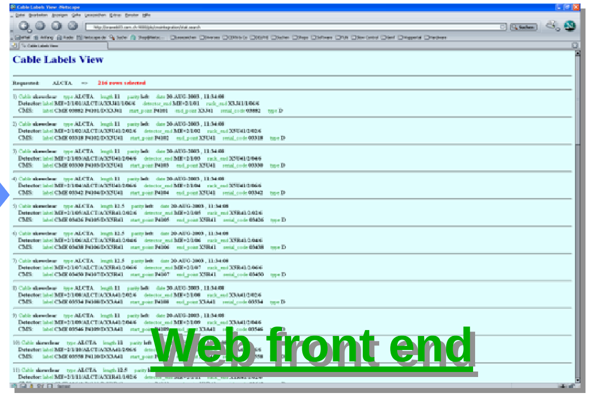
Label printer

XML

http

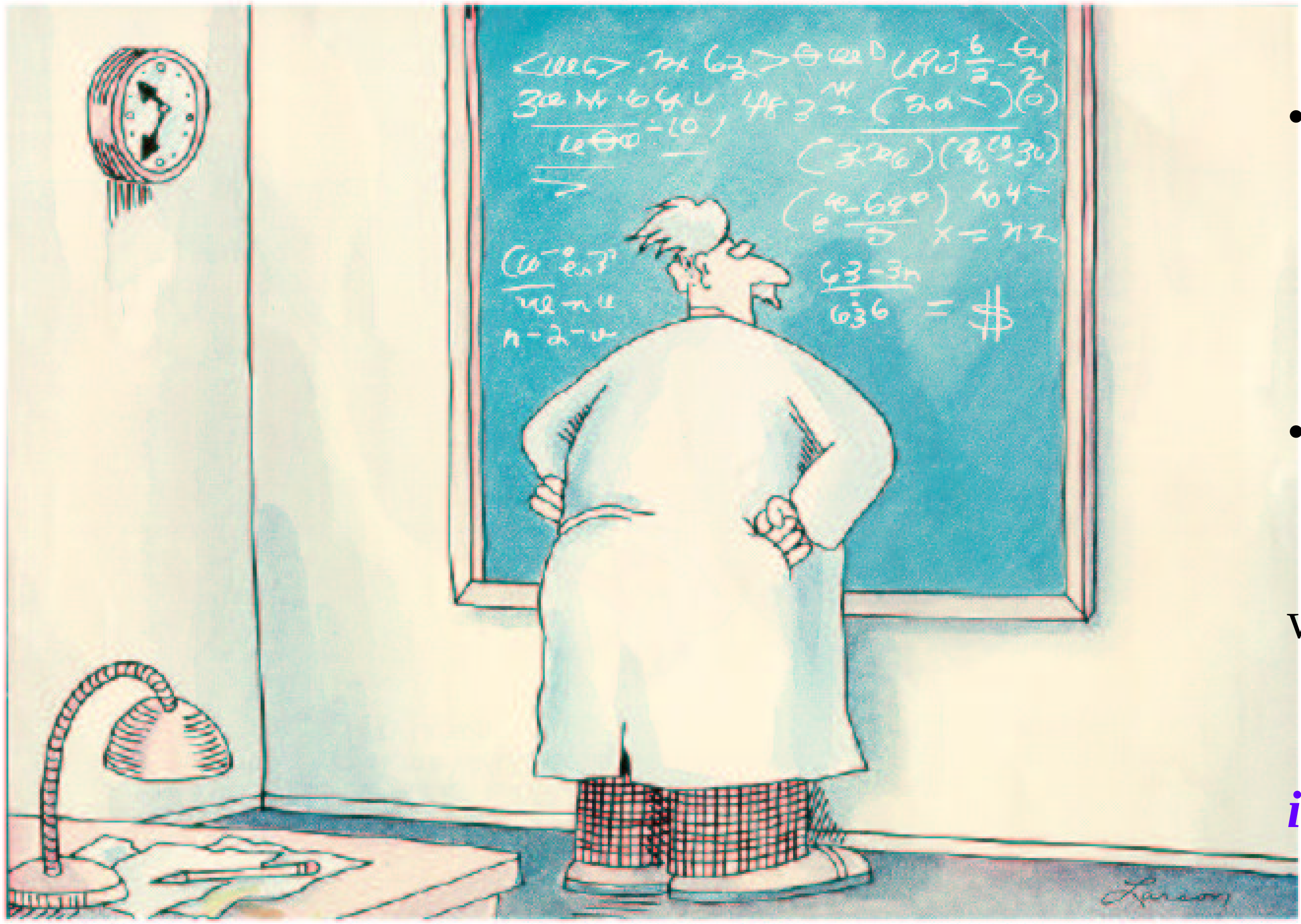


Graphical user interface



Web front end

Project planning and monitoring



"Einstein discovers that time is actually money" - Gary Larson

- overall timeframes set by
  accelerator start-up date
  critical sequences
  resource loading

- efficient progression towards completion requires a plan

  and

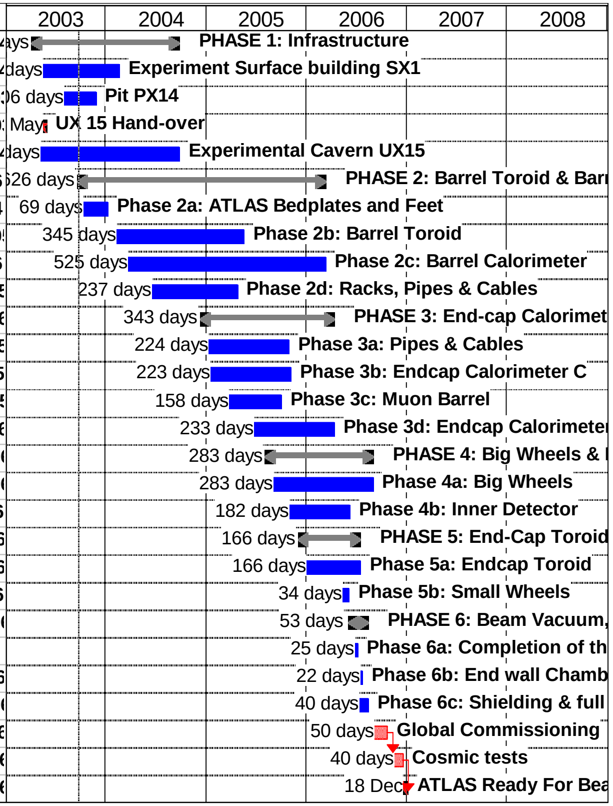
  with increasing tendency to P+M accounting in sub-projects

idle time becomes very costly
(standing/marching army)

Summary schedules

approx the same process for ATLAS/CMS

ID	Name	Start	Finish
1	PHASE 1: Infrastructure	4 Apr '03	24 Sep '04
2	Experiment Surface building SX1	15 Apr '03	16 Feb '04
22	Pit PX14	30 Jun '03	24 Nov '03
28	*UX 15 Hand-over*	12 May '03	12 May '03
29	Experimental Cavern UX15	4 Apr '03	24 Sep '04
135	PHASE 2: Barrel Toroid & Barrel Calo	18 Sep '03	9 Mar '06
136	Phase 2a: ATLAS Bedplates and Fe	18 Sep '03	6 Jan '04
144	Phase 2b: Barrel Toroid	7 Jan '04	17 May '05
422	Phase 2c: Barrel Calorimeter	20 Feb '04	9 Mar '06
640	Phase 2d: Racks, Pipes & Cables	13 May '04	22 Apr '05
704	PHASE 3: End-cap Calorimeters & Mu	6 Dec '04	12 Apr '06
705	Phase 3a: Pipes & Cables	6 Dec '04	27 Oct '05
803	Phase 3b: Endcap Calorimeter C	13 Dec '04	2 Nov '05
923	Phase 3c: Muon Barrel	21 Feb '05	28 Sep '05
984	Phase 3d: Endcap Calorimeter A	23 May '05	12 Apr '06
1118	PHASE 4: Big Wheels & Inner Detecto	2 Aug '05	31 Aug '06
1119	Phase 4a: Big Wheels	2 Aug '05	31 Aug '06
1337	Phase 4b: Inner Detector	28 Sep '05	8 Jun '06
1379	PHASE 5: End-Cap Toroid & Small Wh	28 Nov '05	17 Jul '06
1380	Phase 5a: Endcap Toroid	28 Nov '05	17 Jul '06
1464	Phase 5b: Small Wheels	18 Apr '06	2 Jun '06
1489	PHASE 6: Beam Vacuum, End wall Ch	1 Jun '06	14 Aug '06
1490	Phase 6a: Completion of the Beam	1 Jun '06	5 Jul '06
1532	Phase 6b: End wall Chambers (EO)	23 Jun '06	24 Jul '06
1557	Phase 6c: Shielding & full Magnet t	20 Jun '06	14 Aug '06
1580	Global Commissioning	15 Aug '06	23 Oct '06
1581	Cosmic tests	24 Oct '06	18 Dec '06
1582	*ATLAS Ready For Beam*	18 Dec '06	18 Dec '06

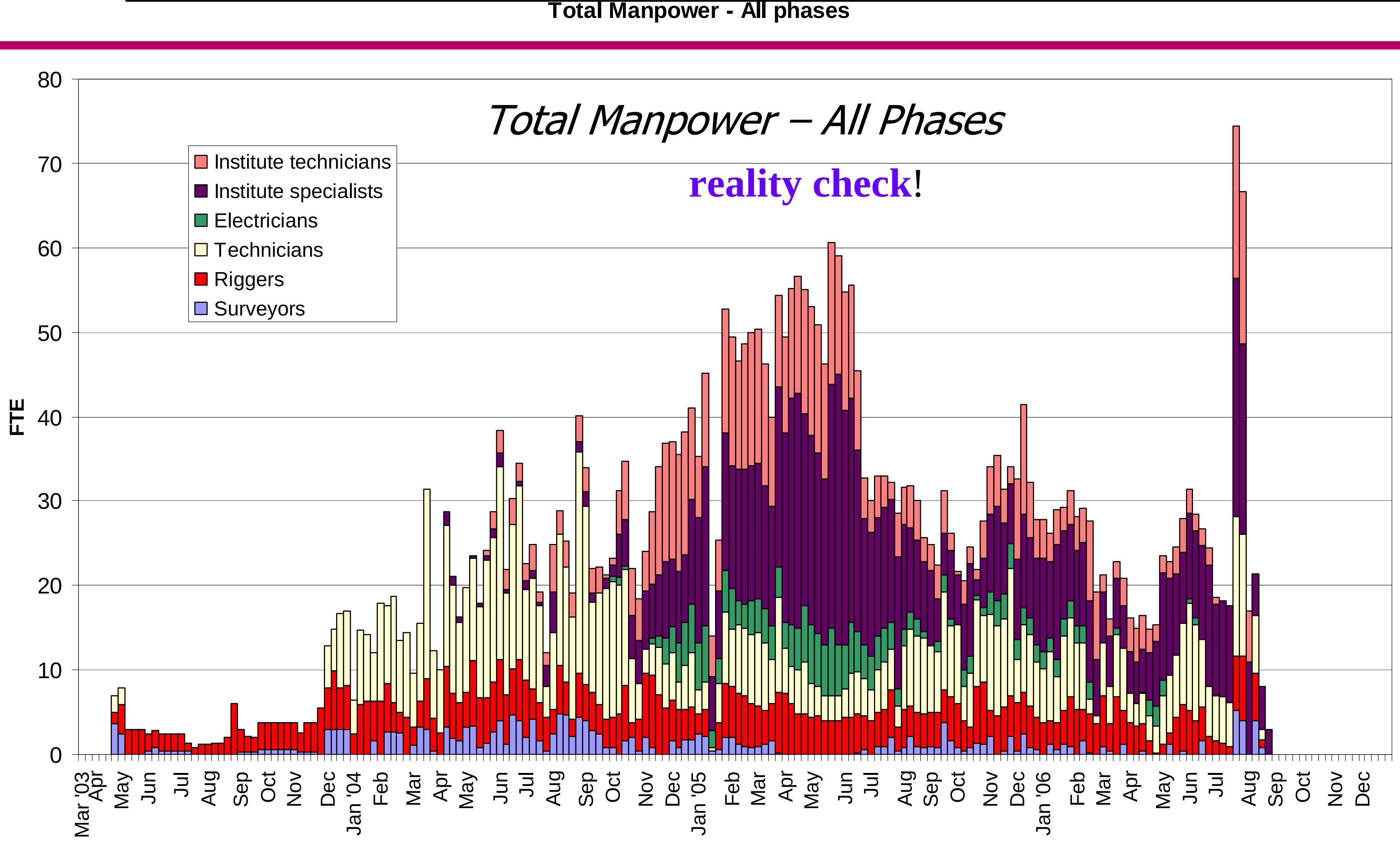


ATLAS Installation v 6.12

- top down structure
- "ready-for installation" milestones link sub-detector schedules to the master plan
- task-bars linked to expanded schedules and work-packages
- project milestones linked to task completion
- resource loading (at least as a reality check)

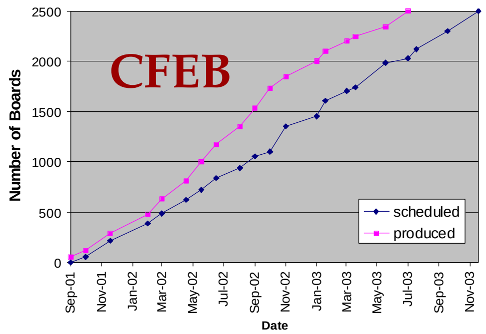
only significant difference in schedule definition and monitoring of different experiments is the extent to which "work-package" formalism is applied

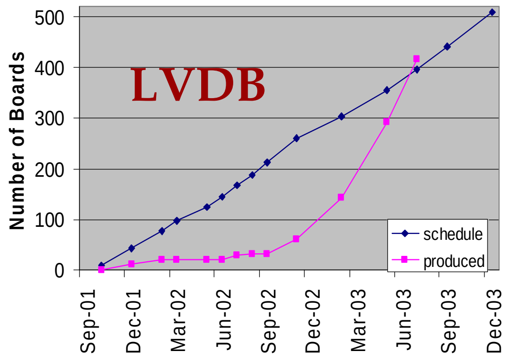
Installation Manpower in UX15 (excl contractors)

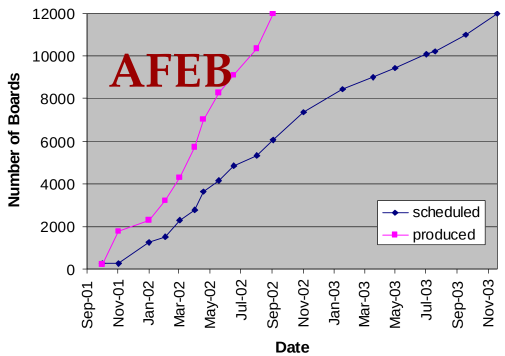


Cumulative production charts

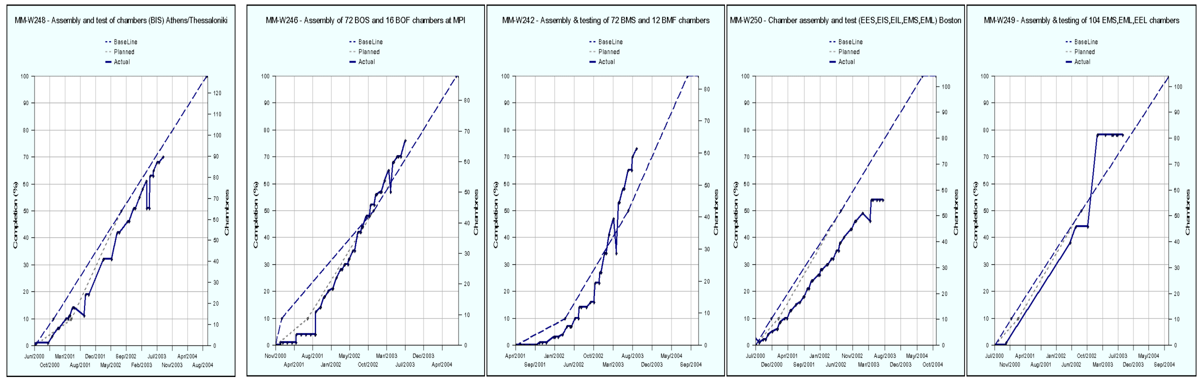
CMS CSC electronics







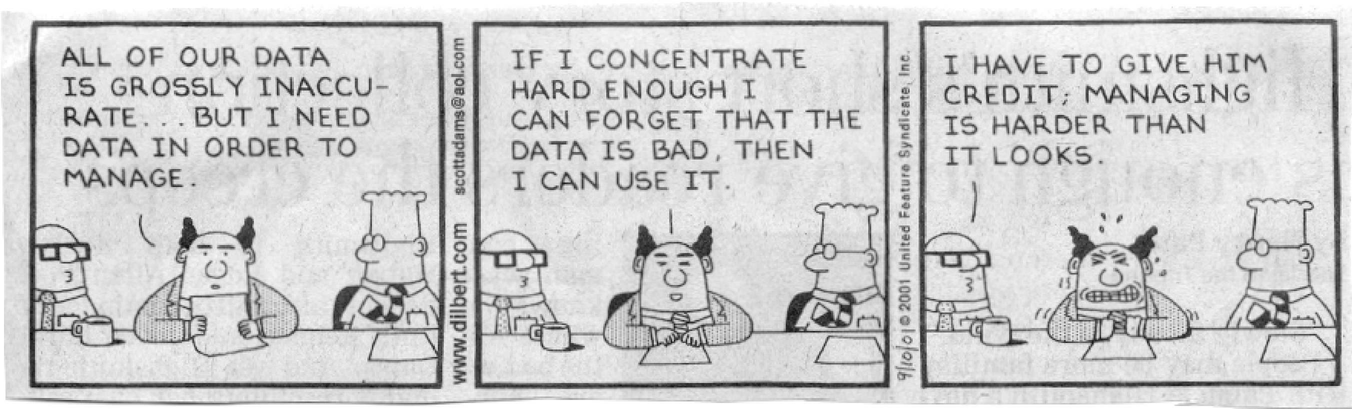
ATLAS MDT work-packages



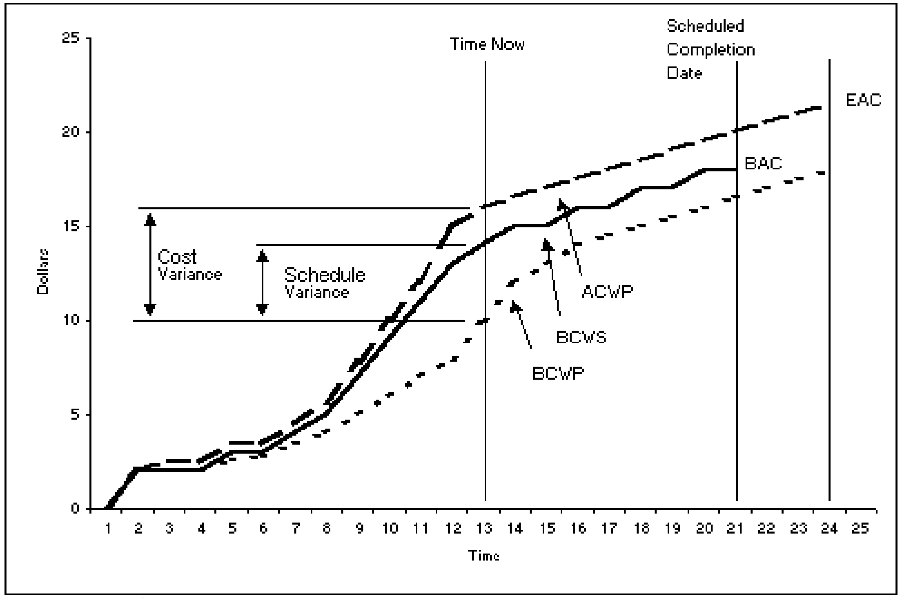
probably the most useful and motivating project monitoring tool for on-time delivery
even though the planning curves are hardly ever repoduced

care needed not to forget to monitor non-glamorous ancilliary or off-the shelf items.

Project progress & cost monitoring



- Money is getting tighter and more project based.
- There is pressure to monitor progress using techniques like: " Earned Value Management" familiar to our U.S. colleagues



- track: work completed
  time taken
  costs incurred

  regularly against a baseline planning
- Effective for comprehensive P+M funding **provided** the input data correspond to reality

but needs a large admin staff (~1/30 ratio?)
tends to stifle commitment to deliver

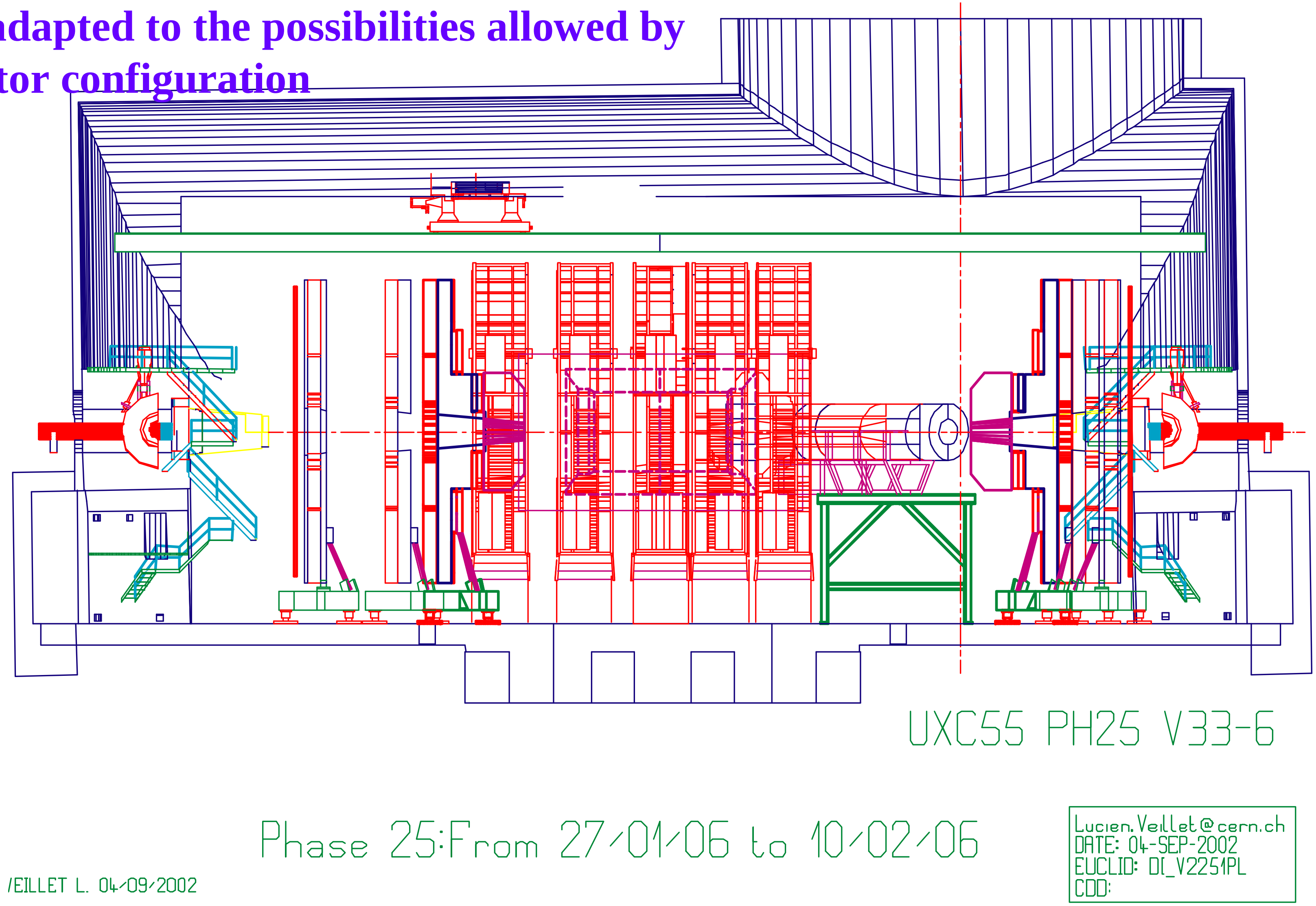
in fact the simple estimated cost-to-complete, compared with available budget seems most adaptable and applicable to the mixed accounting systems of LHC–type collaborations

Commissioning

Basic steps
Synchronisation
Cosmics
Halo and beam-gas
First beam

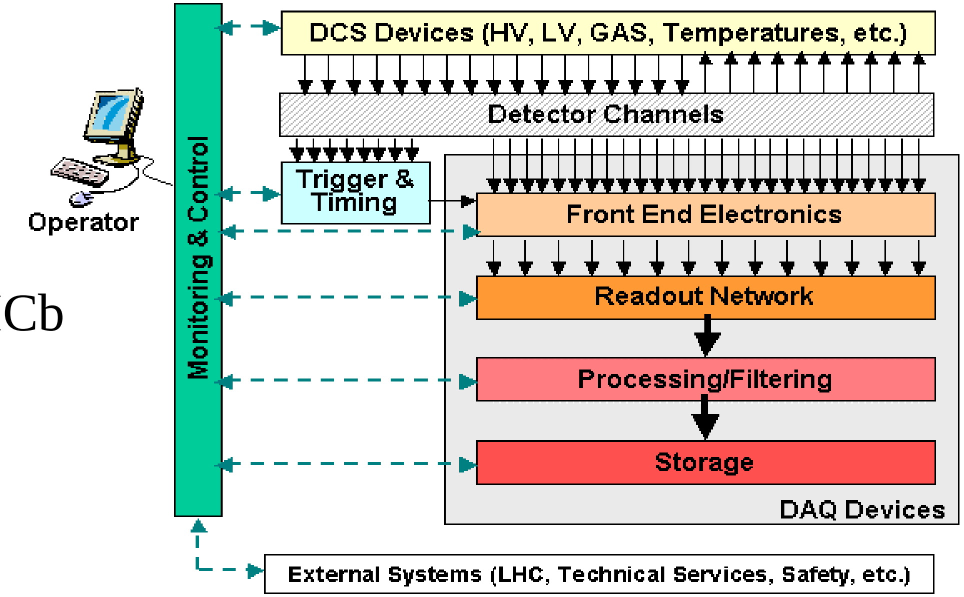
Commissioning: in parallel with assembly

must be adapted to the possibilities allowed by the detector configuration



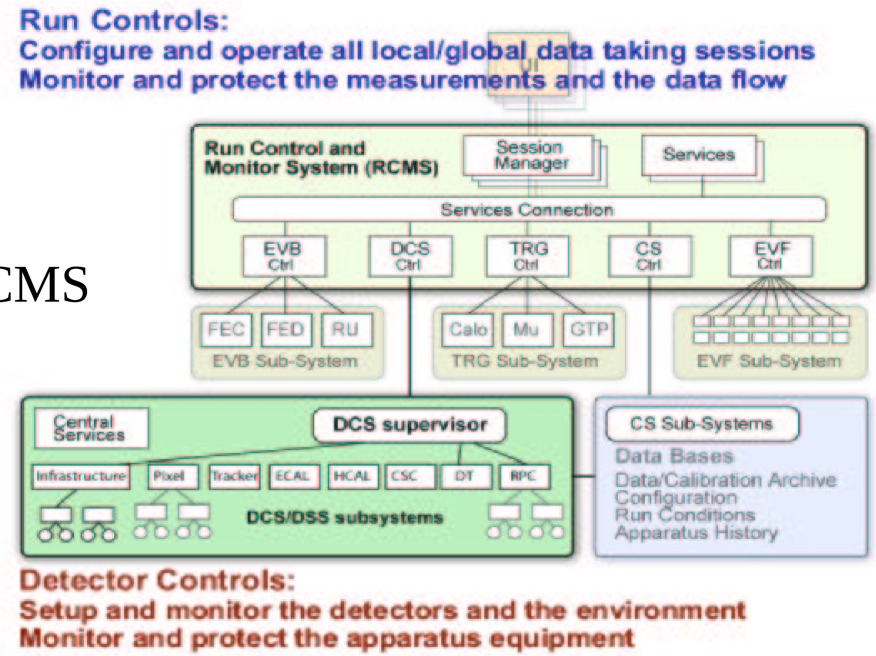
Control system

LHCb



LHCb's Experiment Control System is in charge of the configuration, control and monitoring of all the components of the online system. This includes all devices in the areas of: data acquisition, detector control (ex slow controls), trigger, timing and the interaction with the outside world

CMS



architectural differences between experiments (slow control & run control) easily obscure that:

- **a working, robust slow control system is a pre-requisite for commissioning**
- what really helps is to have infrastructure services, experiment and accelerator all using the same slow control SCADA.

Pre-commissioning: CMS (on surface)

ATLAS pre-commissioning similar

Basic sub-detector commissioning: (2003-2005)

0) Basic functionality test of individual detector elements after installation
1)Connection to “on-yoke” service lines :water, gas, power etc and readout.
2)Connection “slice-by-slice” to SX5 services and control room.
3)Detector safety system activated & security checked by GLIMOS and/or TIS
4)Gas/cooling/LV power/HV power channel-by-channel checks.
5)Checks with Local + Test beam DAQ: channel by channel diagnostics
6)Calibration & system fault-finding (noise etc). Test beam DAQ

Advanced commissioning: (2004-2005)

7)Test FED’s as a data-source (1’st stage of CMS DAQ)
8)Test generation of trigger primitives.
9) More advanced tests with elements of final DAQ chain.

but with priority to:
CMS construction. magnet test and basic sub-detector commissioning
Triger/DAQ system preparation for installation in SCX

Commissioning:ATLAS phases

CMS underground commissioning similar

Phase A
System commissioning to ROD level.
System commissioning for LVL1 and DAQ
Check cable connections.
Infrastructure commissioning
(refrigerators, water cooling, etc.)

Phase B
ROD – Local DAQ connections established.
Calibration runs on local systems.
Skeleton TTC system needs to be available.

Phase C
System/Trigger/DAQ combined commissioning

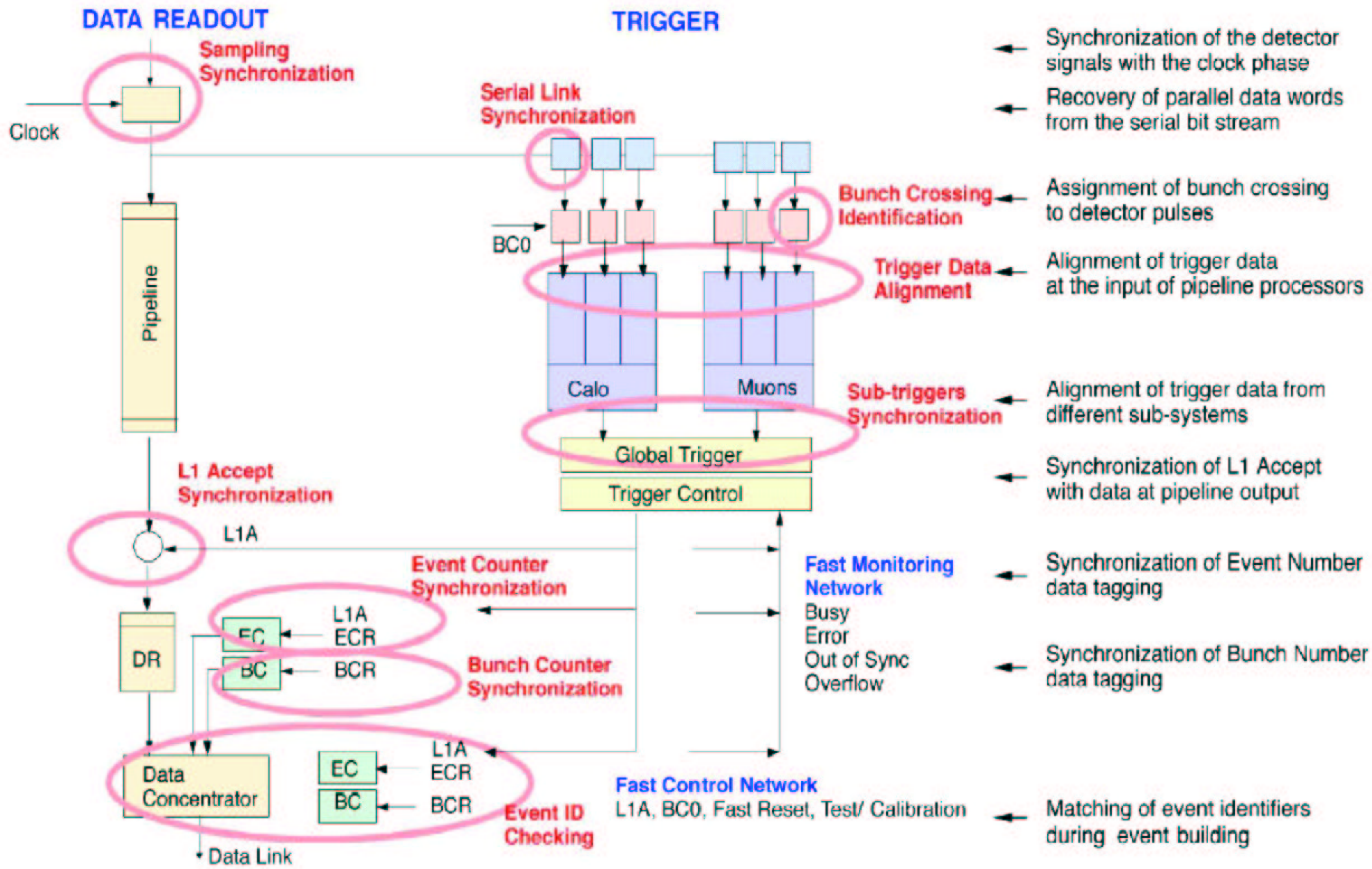
Phase D
Global commissioning
cosmic ray runs, planning for initial physics runs; initial off-line analysis software available, first collisions.

Commissioning with "physics data" starts here

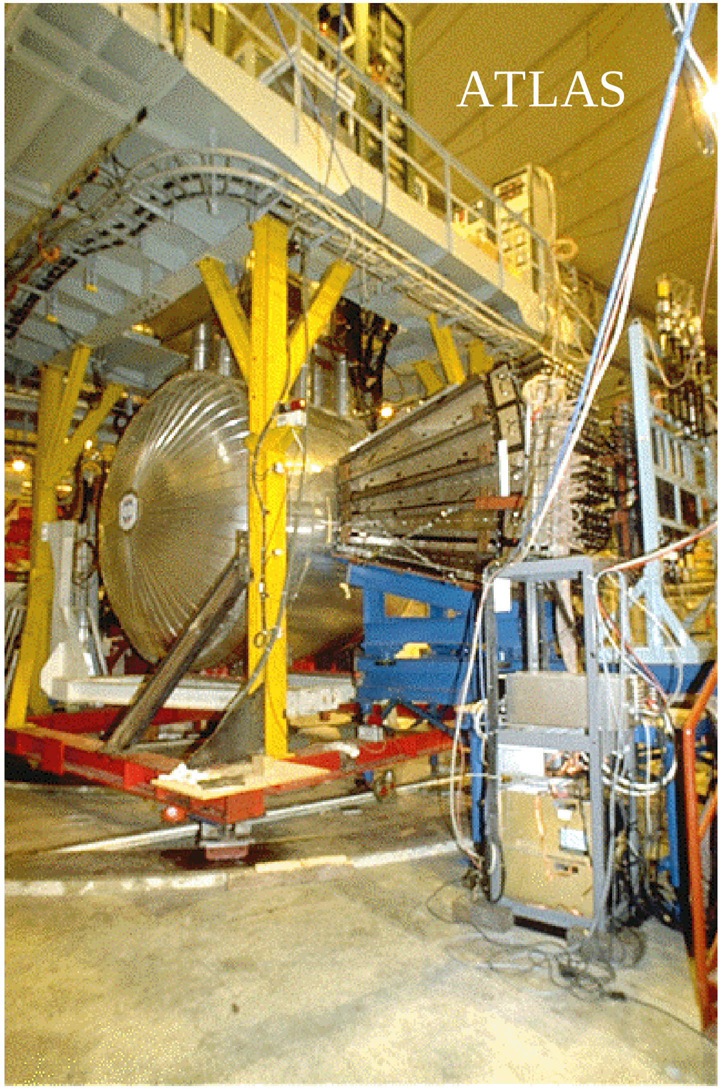
1/03	03/04	08/06	11/06

Commissioning : Synchronisation (CMS)

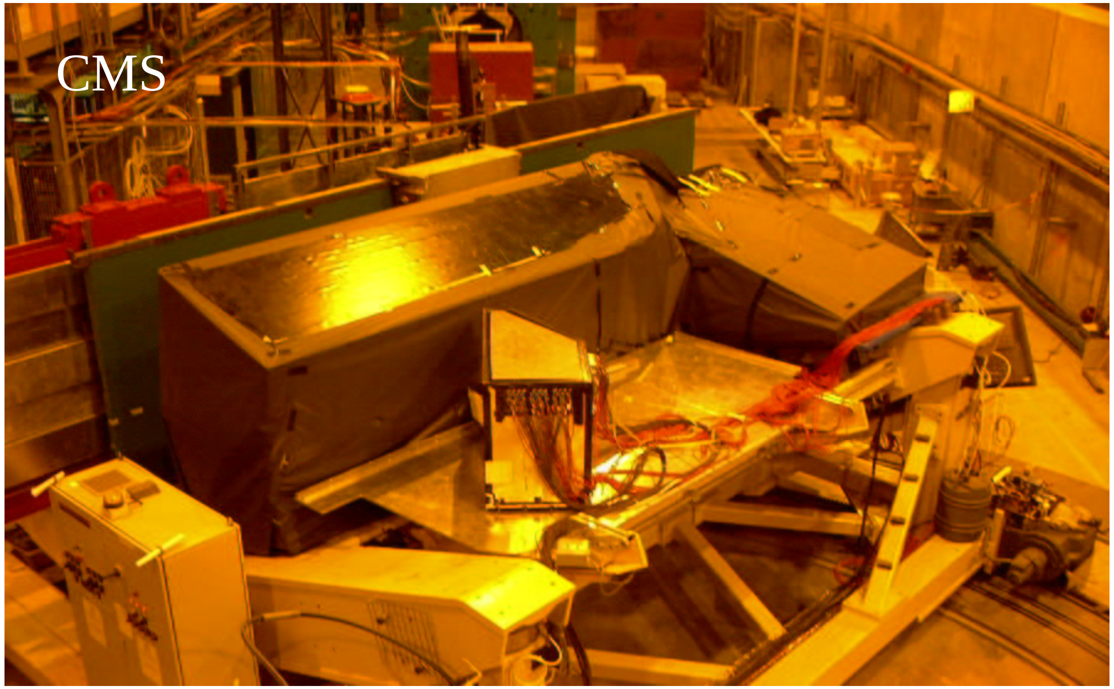
the trickiest part of trigger/DAQ system integration



Test beams: combined tests



- Beam Test, including with final bunch structure
  - checks systems and their physics response, separately and in combination.
  - **checks synchronization and establishes first pass phase offsets.**



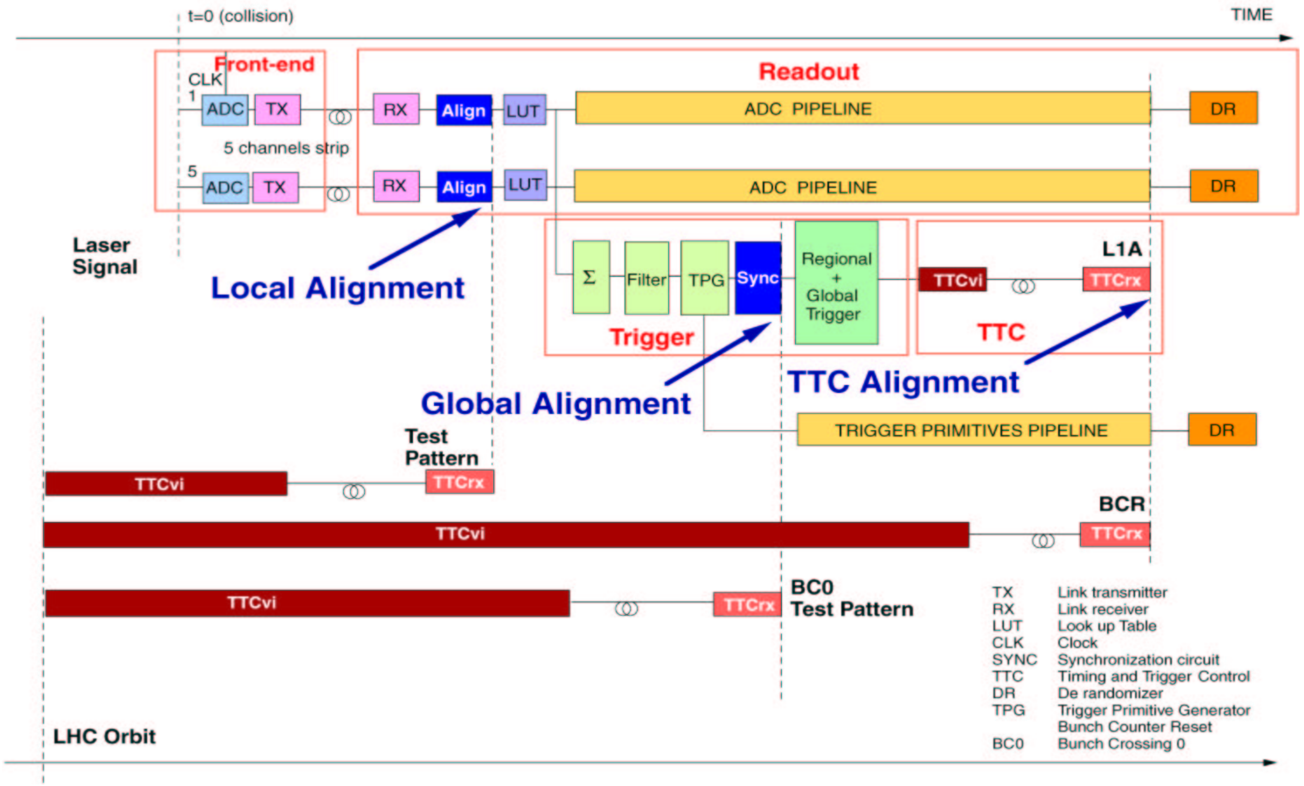
Commissioning: Timing Model

Timing Model implemented in a Simulation Tool:

First estimation of timing parameters
Help to diagnose synchronization problems

Timing Diagram (example):

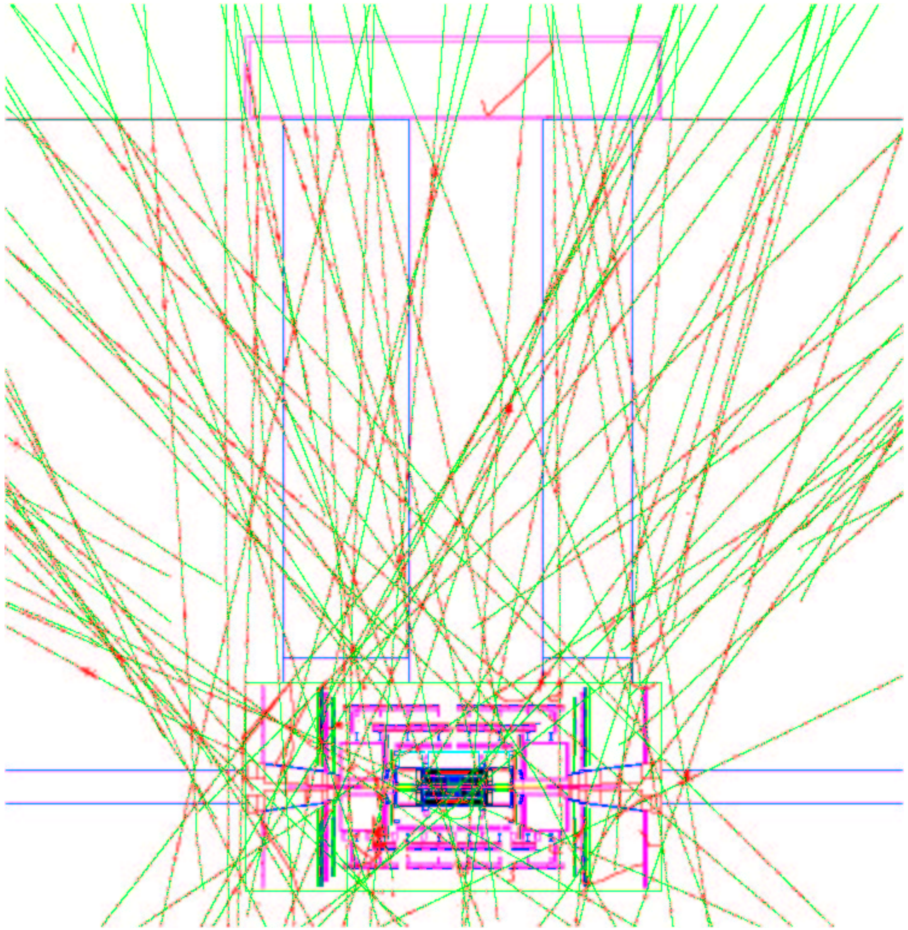
Thousands of timing parameters



Timing Parameters:

Clock Deskewing
Bunch Crossing Assignment
BC0 adjustment
L1A timing adjustment
TTCrx parameters
TTCci parameters
Cable lengths
etc.

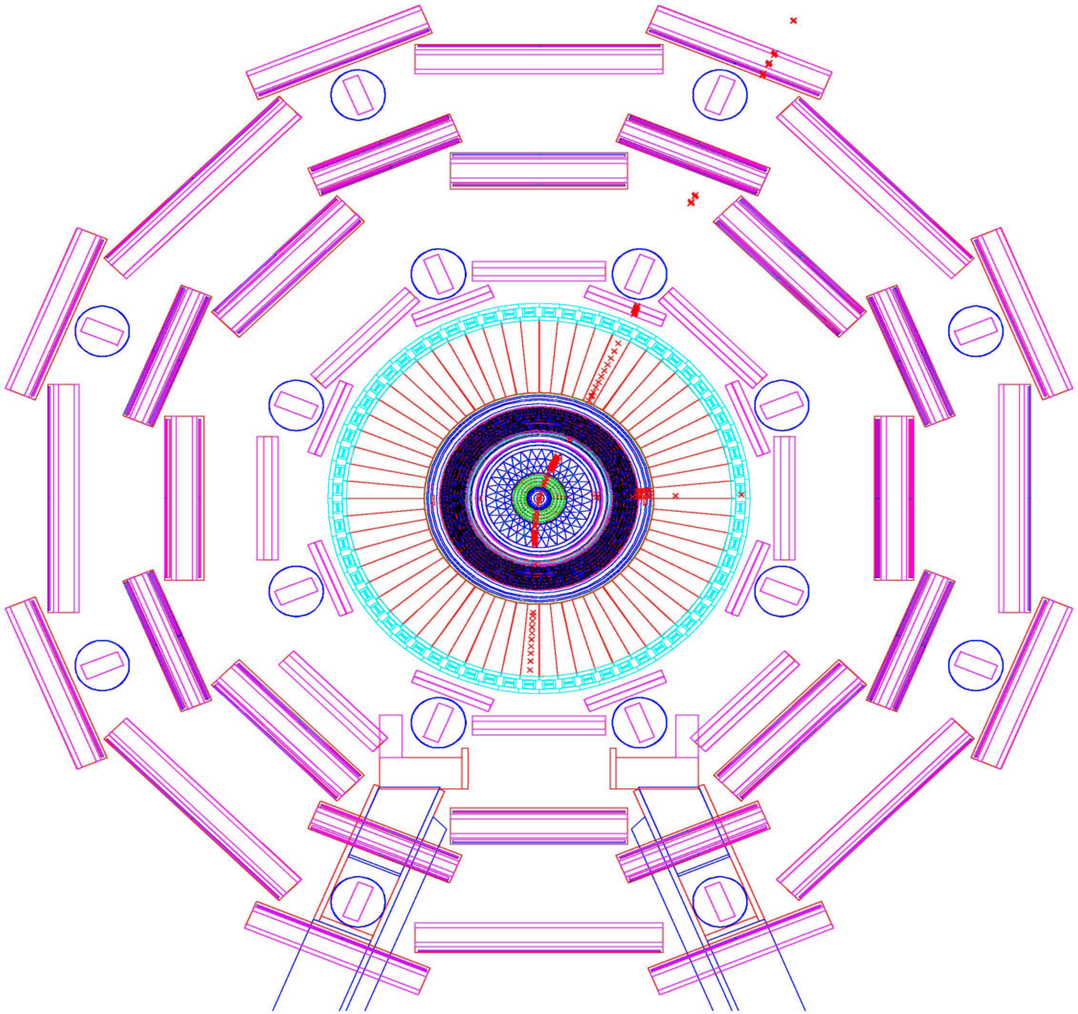
Commissioning: final phase w/o beam: Cosmic μ's?



Cosmic muons in ATLAS in 0.01 s ....

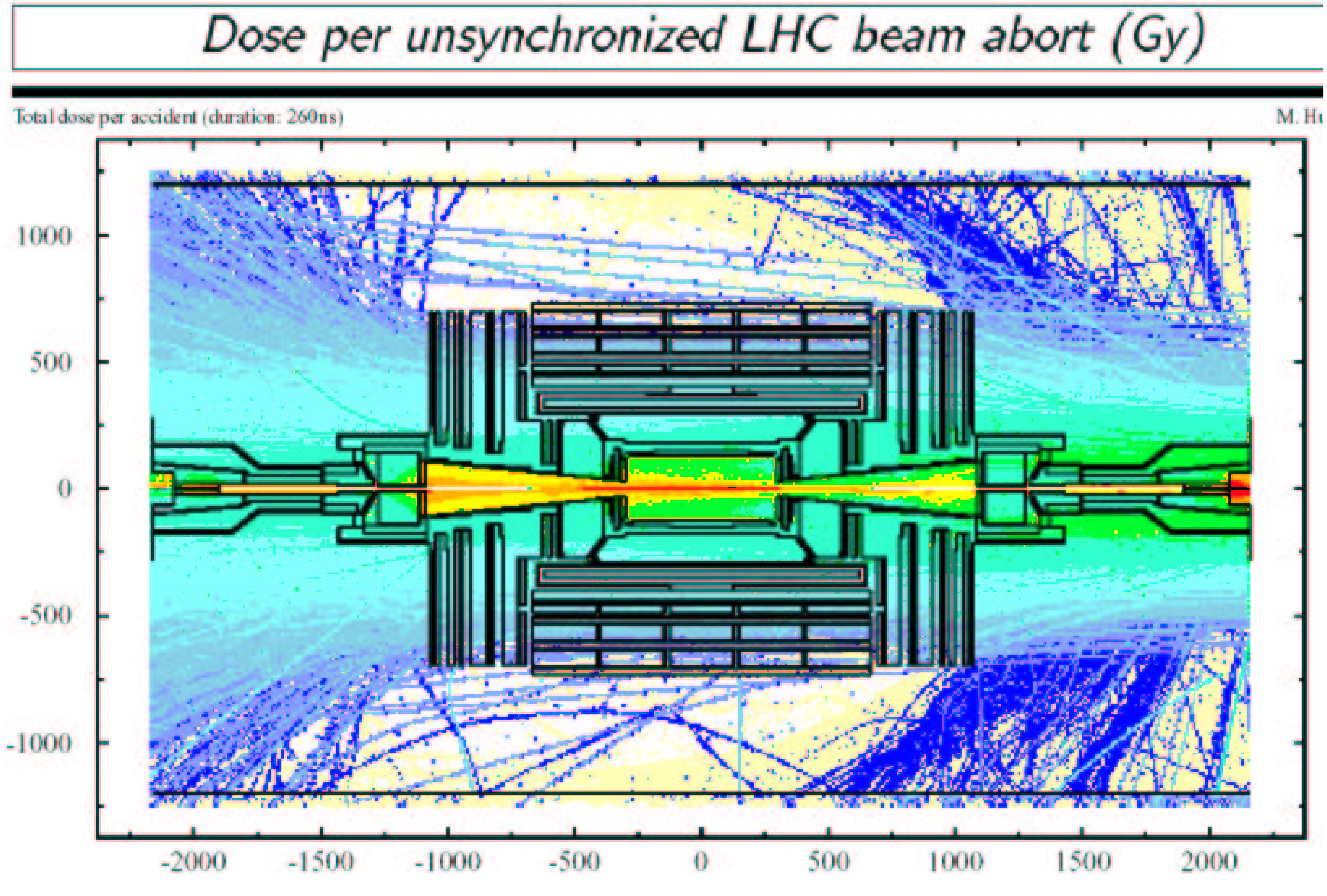
Cosmic event in ATLAS

- One track reconstructed in Muon chambers
- Two tracks reconstructed in Inner Detector
- Will happen every
  ~ 10 s



Commissioning: first beam

could be quite dirty!!



Commissioning: beam monitor

an absolute pre-requisite for experiment protection & study of beam backgrounds

must have confidence of experiment(s) and machine and be ready for first beam

tests of various sensors planned, but appears in no budget line of LHC expts

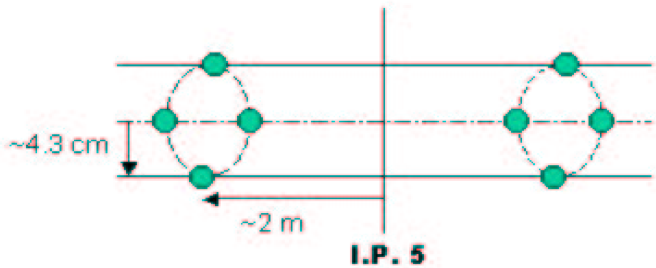
Beam Conditions Monitor

Protection against fast beam losses

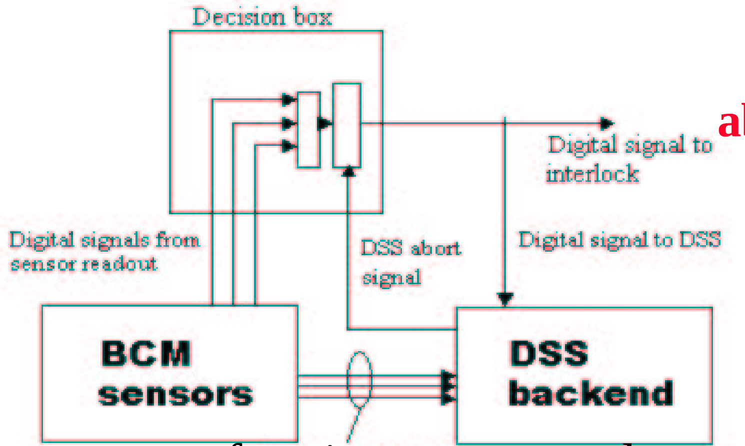
Independent action from the DSS

2 "collars" of sensors around the beam pipe near the pixel region and more sensors located near the TAS

BCM geometry must allow for the detection of showers within the experiment that result from beam deterioration



eg CMS-EST joint project

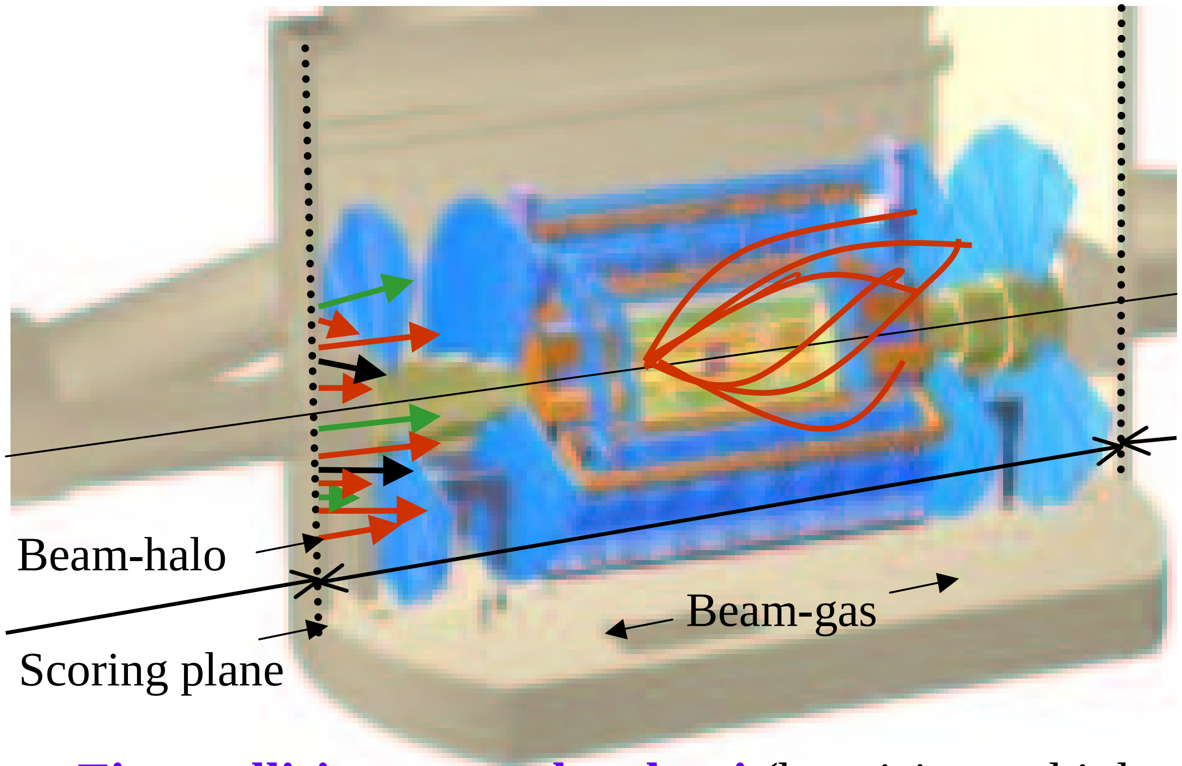


abort beam!

tests of various sensors planned

Commissioning: first beam

Single beam : beam-gas events



ATLAS estimates:

muons with E> 100GeV: 1 kHz

E> 1 Tev 10Hz

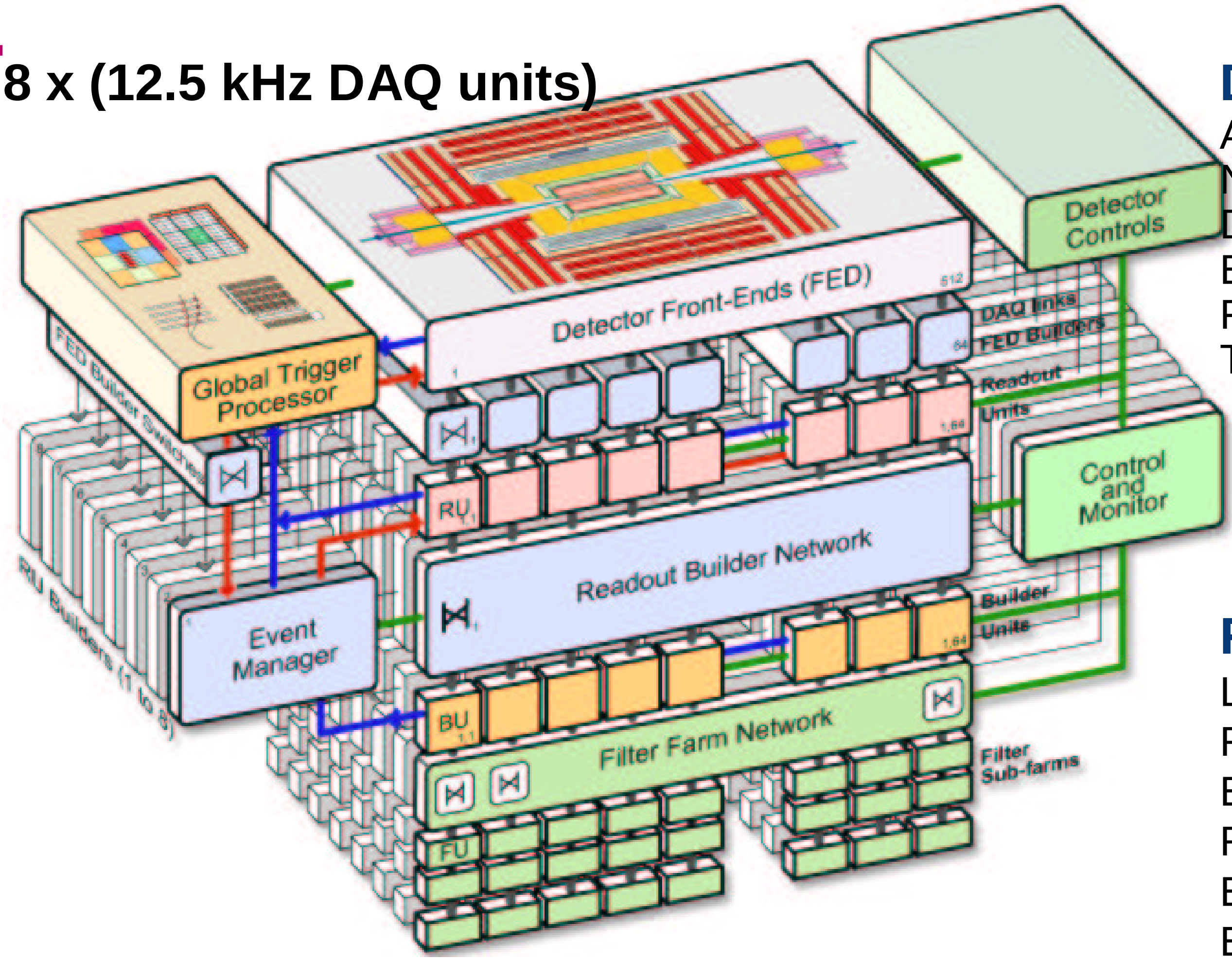
could give >10^6 useful tracks in every subdetector in a 2-month period of single beam tuning.

First collisions: very low lumi (but rising to high current per bunch)

synchronisation, check DAQ/filter/offline chain at full rate
calibrations using min. bias distributions and leptons from W,Z decay
first physics distributions (missing Et..etc)

Commissioning: CMS DAQ system scaling

1 - 8 x (12.5 kHz DAQ units)



Data to surface:

Average event size	1 Mbyte
No. FED S-link64 ports	700
DAQ links (2.5 Gb/s)	512+512
Event fragment size	2 kB
FED builders (8x8 dual)	64
Technology(2004)	Myrinet

Readout Builders (x8):

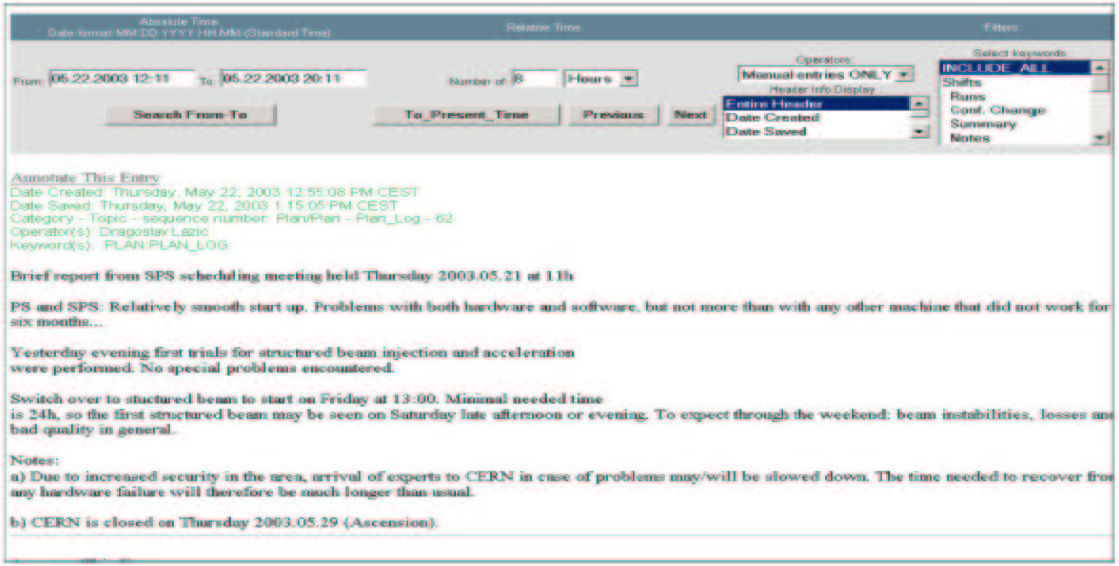
Lv-1 max. trigger rate	12.5 kHz
RU Builder (64x64)	.125 Tbit/s
Event fragment size	16 kB
RU/BU systems	64
Event filter power	10^5 SI95
EVB technology (2006)	Open

mimimum for start-up due to budget restrictions: progressively commission slices to match expected L1 rate in first physics runs

Remote Participation

tests are going on to evaluate the best way to use "virtual control rooms" around the world to assist in the commissioning

CMS test beams 2003



Absolute Time
Date format: MM.DD.YYYY HH:MM (Standard Time)
Relative Time
Filters

From: 05.22.2003 12:11 To: 05.22.2003 20:11
Number of: 8 Hours
Operators: Manual entries ONLY
Header Info Display: Entire Header / Date Created / Date Saved
Select keywords: INCLUDE_ALL / Shifts / Runs / Conf. Change / Summary / Notes
Search From-To | To_Present_Time | Previous | Next

Annotate This Entry
Date Created: Thursday, May 22, 2003 12:55:08 PM CEST
Date Saved: Thursday, May 22, 2003 1:15:05 PM CEST
Category - Topic - sequence number: Plan/Plan - Plan_Log - 62
Operator(s): Dragoslav Lazic
Keyword(s): PLAN:PLAN_LOG:

Brief report from SPS scheduling meeting held Thursday 2003.05.21 at 11h

PS and SPS: Relatively smooth start up. Problems with both hardware and software, but not more than with any other machine that did not work for six months...

Yesterday evening first trials for structured beam injection and acceleration were performed. No special problems encountered.

Switch over to stuctured beam to start on Friday at 13:00. Minimal needed time is 24h, so the first structured beam may be seen on Saturday late afternoon or evening. To expect through the weekend: beam instabilities, losses and bad quality in general.

Notes:
a) Due to increased security in the area, arrival of experts to CERN in case of problems may/will be slowed down. The time needed to recover from any hardware failure will therefore be much longer than usual.

b) CERN is closed on Thursday 2003.05.29 (Ascension).

We have new tools for tb2003. There are 2 webcams and a good Polycom system. There is an e-log which allow remote parties to follow the progress. The daily meeting is very useful to increase HCAL participation.

Conclusion

Supercollider experiments are becoming increasingly challenging to build

due to performance parameters, timescale, sociology, external rules and regulations

LHC experiment construction experience shows that it can be done

: tools/expertise exist in the detector-building community

:industry is capable of fulfilling many requirements

Integration will remain a thankless but vital task

Many useful management and QA techniques are applied already at LHC and elsewhere

-:formalism has increased

-add new procedures only if clearly beneficial

- beware divergence between reality and state model

Commissioning: LHC experiment plans will be tested in the coming 3-4 years

- under development now…
- exploit pre-commissioning tests, test-beams, cosmic ray data, beam-gas data to prepare the experiments for the first colliding beams at LHC