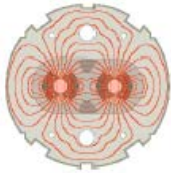


# Accelerator systems

Accelerator systems	LHCCWG	EiCs and Operators
Arc circuits (warm and cold magnets)	R.Saban	W.Venturini
Injection systems (+TDI...)	J.Uythoven	V.Kain, G.H.Hemelseot
Beam Dump Systems (+TCDQ...)	B.Goddard	V.Kain, R.Suykerbuyk
Distributed BI Systems (BPM, BLM)	R.Jones	L.Ponce, F.Follin, A.Rey
Specific BI Systems (Q, WS...)	J.J.Gras	G.Crockford
RF systems (+damper...)	A.Butterworth	M.Gruwe, D.Jacquet
Collimation	R.Assmann	S.Redaeli
Experimental magnets	M.Lamont	D.Jacquet
Access system	(T.Pettersson)	M.Gruwe
Cryogenics	G.Arduini	E.Veyrunes
Vacuum	F.Zimmermann	R.Giachino
Machine Protection	J.Uythoven	A.MacPhersen, R.Giachino
Radio Protection	(D.Forkel-W)	F.Pirotte
Sequencer	M.Lamont	R.Aleman
Settings management (+Fidel...)	M.Lamont	L.Normann, D.Jacquet
LSA core	M.Lamont	A.Rey
Timing	M.Lamont	M.Albert
Software Interlock System	J.Wenninger	L.Pereira
Logging	M.Lamont	G.H.Hemelseot
Global post mortem analysis	M.Lamont	M.Lamont



# Access system (LACS and LASS)

## ■ LASS supervision software a problem

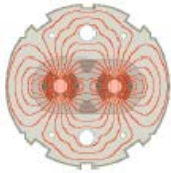
- Slow
- Inconvenient interface
- Connectivity problems

Is it clear that we're going to get this improved ?

## ■ Access system tests at 6 levels

1. Local acceptance tests of EIS and interfaces
2. Integration of above into control room
3. Functional site
  - 2 3 4 7 8 done with some NC, rest by end of year
4. Functional inter-site
  - Only after above
5. Global
  - Only after above
  - Week2 2008 but looks very tight
6. DSO tests and OP acceptance
  - Still to be defined
  - Needs training of people (patrols and consoles)
  - Do some of this during week2

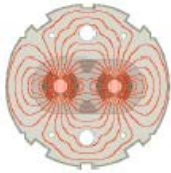
Looks like week2 2008  
will be doing 3 and 4



## Access system from Global Tests to start of beam

- After global tests, access system will be put back as it is now because of installation (no dosimeter, no biometry, no tokens,...)
- In addition:
  - Some non-conformities to be fixed
  - Points 7 and 8 have a different LASS version than other points. Will have to be upgraded
  - Additional ventilation doors to be installed
  - Some improvements required
  - IHM supervision of LACS to be improved => new version
- DSO tests (partly repetition of functional and global tests) and acceptance of the system by OP will have to be done at some point
  - Will have to include non-final configuration
  - Beam in some sectors, access in others
- There will be new versions of both LASS and LACS available a few months later
- Maintenance tests (once a year, after shutdown) will be a sub-set of the integration/functional/global tests. Still to be defined

Need a timetable for this  
Sometime in Q2 2008 ?



# Cryogenics

- All plants now close to being ready
- Presently commissioning done in the field/local control rooms
- Will move to CCC when 2 sectors cold
  - 2\*8 with on-call experts
- Applications leave a lot to be desired
  - Improvements requested (non-expert, general views)
  - Project is low priority for ACR
  - No resources in CO to develop it
- TI works on a TIM solution
- Beam oriented display could be developed

Commissioning is going to be tedious. Can we help?

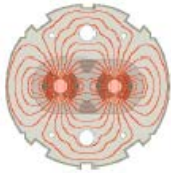
Surveillance of the system  
a major concern



# Vacuum systems

- ## Need a timetable for this



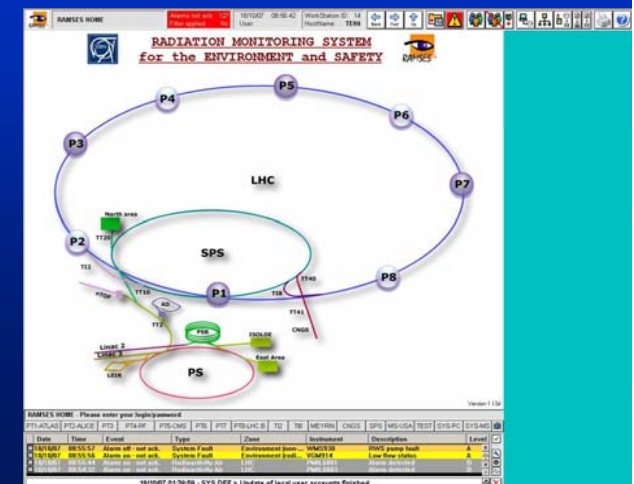


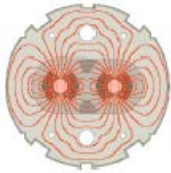
# Radioprotection

- **RADIATION Monitoring System for the Environment and Safety**
  - Some 360 channels in all
  - Environment
    - stray, ventilation, water, met data ...
  - Safety
    - dominated by 168 Induced Activity Monitors installed in high loss zones
- Installation well advanced
- Software will be installed on console before end of year
  - No login required to access

Need to look how OP will use this (and RADMON)

Should follow in any case



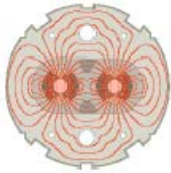


# Machine protection

Can we leave this to  
MPSC?

- Our Machine Protection System comprises a large number of varied systems
  - Careful management and tracking of MPS commissioning must be in place
  - Commissioning plans must incorporate prioritising and fall-back planning
  - MPS Commissioning procedures address almost all relevant systems
    - Detailed MPSC procedures for key systems are well advanced
- SPS Extraction logic should be finalised
  - Permits Safe Machine Parameter Controller to be implemented
- Full BIS System to be commissioned by May (Extraction BIC by end of March)
  - Are more resources required to finish full system in time
- MCS implementation in place, MPS related commissioning needs to be scheduled
  - Checking of MCS+ RBAC with SIS + FESA should not be underestimated
- Responsibility for critical settings/interlock input disabling not left to one person
  - MPS needs to consider a review panel to deal with MPS operational issues
- We need to require quality control of the interlock inputs coming from the Expts

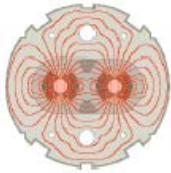
R.Bailey, November 2007



## BI generally

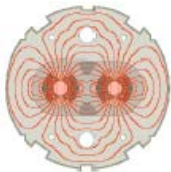
- **BI have a clear framework in place to prepare for the cold-checkout**
- **A close collaboration between BI, OP and ABP is encouraged**
- **Some instruments still missing manpower for application software**
- **OP fixed display requirements for BI need to be defined**
  - **Which systems**
  - **Who does them**
- **Interfaces to BIC, Sequencer need to be clarified**
- **Need an OP person for each system**





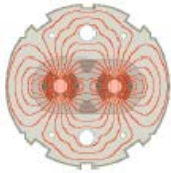
## BI teams

Activity	AB/BDI	Other CERN	LARP/KEK
Screens <ul style="list-style-type: none"> <li>•BTVI</li> <li>•BTVM</li> </ul>	E.Bravin A.Guerrero	H.Burkhardt (AP) G.Arduini (AP) <b>F.Follin (OP)</b>	
BCT <ul style="list-style-type: none"> <li>•FD (dump line)</li> <li>•DC (ring)</li> <li>•FR (fast ring)</li> </ul>	P.Odier D.Belohrad M.Ludwig	H.Burkhardt (AP) J.Jowett (AP) <b>M.Albert (OP)</b>	
BPM <ul style="list-style-type: none"> <li>•Ring</li> <li>•Dump line</li> <li>•Interlocked point 6</li> </ul>	R.Jones L.Jensen	<b>J.Wenninger (OP)</b> <b>V.Kain (OP)</b> W.Herr (AP) I.Papaphilippou (AP)	
BLM	B.Dehning E.Holzer S.Jackson	<b>L.Ponce (OP)</b> <b>F.Follin (OP)</b> <b>A.Rey (OP)</b> R.Assmann (AP) H.Burkhardt (AP) S.Gilardoni (AP)	
Q, Q', C <ul style="list-style-type: none"> <li>•BQBBQ (+ PLL)</li> <li>•BQHT Head tail</li> </ul>	R.Jones M.Gasior P.Karlsson S.Bart-Pedersen	S.Fartoukh (AP) O.Berrig (AP) R.Steinhausen (BI) <b>J.Wenninger (OP)</b> <b>F.Follin (OP)</b>	C.Y.Tan P.Cameron



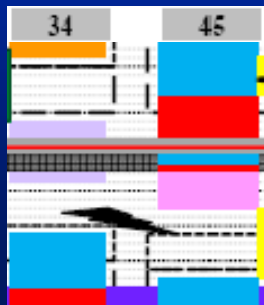
## BI teams

Activity	AB/BDI	Other CERN	LARP/KEK
Profile monitors <ul style="list-style-type: none"> <li>•BSRT (sync light)</li> <li>•BGI (ionisation)</li> <li>•BWS (wire scan)</li> </ul>	S.Hutchins J.Koopman A.Guerrero	H.Burkhardt (AP) S.Gilardoni (AP) M.Giovannozzi (AP) <b>L.Ponce (OP)</b> <b>G.Crockford (OP)</b>	E.McCrory A.Jansson
BQS Schottky monitors	P.Karlsson R.Jones	E.Metral (AP) C.Carli (AP) F.Zimmermann (AP) <b>G.Crockford (OP)</b>	R.Pasquinelli A.Jansson
BRAN Luminosity monitor	E.Bravin S.Bart-Pedersen	R.Assmann (AP) F.Zimmermann (AP) <b>R.Alemaný (OP)</b> <b>M.Albert (OP)</b>	Toohig fellow
BSRA Abort gap monitor	S.Bart-Pedersen S.Hutchins	<b>L.Ponce (OP)</b>	
BST	P.Karlsson	<b>M.Albert (OP)</b>	



# RF

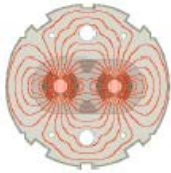
System	Sub systems	Status	Comment
Power systems	Modulators, Drivers, Klystrons, Circulators, Loads, Couplers	Ongoing for 8 cavities Other 8 need hardware change	Specialist activity
Cavities	Needs power systems done Needs Cryo, Access, RAMSES Conditioning	Labview automation, 1 week to prepare 1 week conditioning 4R about to start	OP can help
Feedback loops	Needs conditioning done Need cavities cold	2 weeks per cavity	Specialist activity
Synchronisation	Kicker pulses, Beam dump signal, Frequency clocks	Tests start mid-January 8 weeks needed Needed 3 months b4 beam	Specialist activity
Beam control	Reference generation, Frequency program, synchro loop, radial loop, phase loop	Tests from March until beam Mostly with beam	Specialist activity



Does this fit with  
schedule?

What can we be doing in  
the coming weeks?

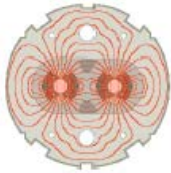
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# Arc circuits

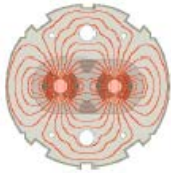
- **The meat of Hardware Commissioning**
- **Delivers**
  - **Circuits tested to maximum current and Powering All Circuits**
  - **List of non-conformities**
- **Still to do**
  - **Training of magnets if they didn't reach 7TeV**
  - **PACs**
  - **Operate with real LHC cycles (ramp and squeeze)**
    - **Requires generation, load, trim, sequencer (FIDEL and LSA)**
    - **In turn requires database**
- **SM18 tests ongoing**
- **Dry runs (hardware commissioning shadowing) also foreseen**

Still need to define exactly  
what role we will play  
through 2008



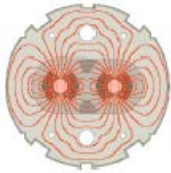
# Experimental magnets before beam

- **Warm dipoles**
  - LHCb magnet and compensators have been fully commissioned (with OP)
  - Alice magnet commissioning before Christmas (with OP), compensators March
- **Solenoids and ATLAS toroid**
  - ALICE solenoid (warm)
  - CMS solenoid
    - Tested on the surface, magnetic measurements done
    - Cool down November, powering beginning of 2008
  - ATLAS solenoid tested and magnetic measurements done
  - ATLAS toroids
    - All 8 tested individually
    - End caps still to do
    - Tests in series still to do
- **General**
  - OP is doing the commissioning from the CCC after all the tests from field have been performed by the experts
  - The software needed is the basic LSA applications : equip state, settings generation, trim application and LHC sequencer
  - The CMS current regulation as a function of the DEWAR level during physics has to be sorted out



## Experimental magnets with beam

Magnet	Machine parameter	Energy dependent	Strategy
LHCb dipoles	H Orbit	Yes	Bring on after phase A4 Off for ramp commissioning
ALICE dipoles	V Orbit	Yes	Bring on after phase A4 Off for ramp commissioning
ALICE solenoid	Coupling	No	Bring on after phase A4 Leave on
CMS solenoid	Coupling	No	Bring on after phase A4 Leave on
ATLAS solenoid	Coupling	No	Bring on after phase A4 Leave on
ATLAS toroids	None	No	Bring on before beam



# Injection

- T18 commissioned with beam in 2004
- T12 commissioned with beam in 2007

- **Injection needs**

- Last 200m of transfer line
- MSI
- MKI
- TDI
- TCDD
- TCLI
- BI (BTV and BLM)
- Interlocking safe injection
- RF pre pulse
- LBDS
- Timing
- Software

Reliant on  
collimator controls

Injection steering  
Configuration

Equipment installed  
Stand alone testing underway

Injection permit needed on interlocked  
elements such as MKI

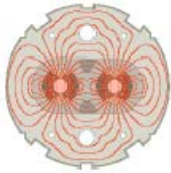
Need a pre-beam situation where we can  
bypass interlocks for testing

Need to elaborate  
details of full  
system tests

- **Dry runs dry runs dry runs**

- E.g. MKI with RF pre pulse in December

R.Bailey, November 2007



# Beam dump

## ■ LBDS consists of

- MKD (15 magnets / beam)
- Q4 (actively needed)
- MSD (15 magnets / beam)
- MKB (4 magnets / beam)
- TDE
- Protection elements (TCDQ, TCS)
- BI (BTV, BCT, BLM, BPM)
- Software
  - XPOC (runs after each dump)
  - Critical settings
  - LBDS monitoring (Eric)

Equipment installed  
Stand alone testing underway

Software in hand

## ■ Reliability tests

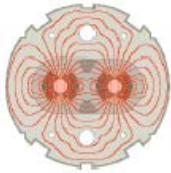
- Stand alone - during hardware commissioning - 10 weeks
- Fully connected – during machine checkout
  - 450GeV 2 weeks
  - 7TeV 4 weeks

Need to elaborate  
details of full  
system tests

## ■ Scenario tests

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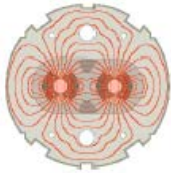




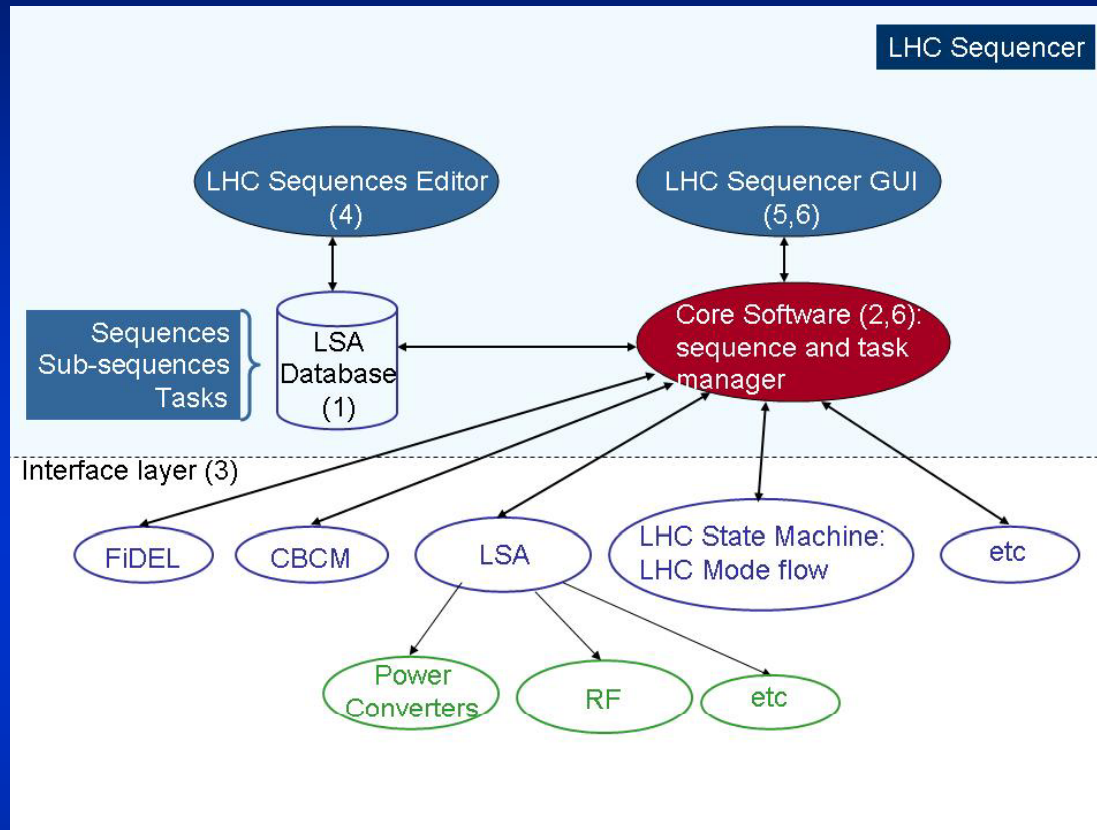
# Collimation

- 71 collimators expected for first runs at 7TeV (c.f. 98 phase I)
- Controls and plans for commissioning without beam OK
- Outcome of the collimator hardware commissioning should be
  - Validation of single collimator HWC, all relevant functionality
  - Settings and sensor readouts (position, temperature, switches,...) verified
  - Control of each collimator from CCC is declared “safe”
  - Machine protection functionality (without beam) partially established
- Machine checkout phase should be focused on
  - Perform global, simultaneous system checks
    - Control an *ensemble* of collimators
    - Address timing and synchronization issues
    - Function-driven motion, “tracking” tests with other equipment
    - Establish full machine protection functionality without beam
  - Verify interfaces to other accelerator systems
    - Beam loss monitors: configuration/acquisition of distributed system
    - Sequencer driven commands, machine modes
  - Management/validation of measurement data
    - Verify logging of distributed systems (big data sets!)
    - Consistency and sanity checks; global system status
- Significant contributions from OP
  - So far: involvement in HWC + software issues (Stefano, Delphine, Eric)
  - Expected to grow during checkout - collimator experts still driving tests

Need to elaborate  
details of full  
system tests

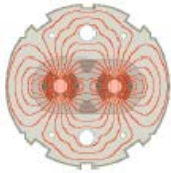


# Sequencer



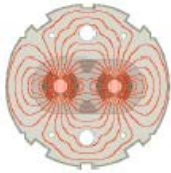
- **Prototype already in place**
  - SM18
  - LHCb magnets
  - R&S in sector 78
- **Progressive development**
  - Dry runs
  - Machine checkout
  - Beam commissioning

**Need to sort out once and for all the matter of using the LSA sequencer or the CO version**



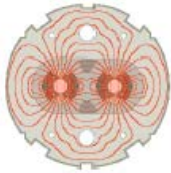
# Settings management

- 70% of Parameter space covered
- Slowly moving into exploitation
- HWC shadowing important step
  - Allows us to familiarize with the different software components
- We all will need to learn how to...
  - Precycle
  - Create Actual settings
  - Prepare ramp
  - Create stops (breakpoints) in ramp etc.
  - Start ramp
  - Trim parameter
  - Incorporate
  - Etc.etc.etc
- Do we need more training than what the HWC will give us?



## LSA core

- **LSA Core is meant to meet OP requirements**
  - A large pool of LSA developers is in OP
  - We can already take benefit from SPS experience
  - LSA Core is flexible enough to include new functionalities and improve the existing ones
  - Building new interfaces using LSA requires some investment but, as you know, “good operation software is made by operation”
- **Most of the new features is almost complete and can be tested**
  - Core functionalities are implemented
  - We could either try and use existing GUIs or develop our owns
- **We should also stay in contact with new functionalities**
  - BLM Thresholds edition (do we agree with what we’ve been proposed?)
  - Settings copy for LHC, specifications would be welcome
  - A review of “access to settings, who do what and what can we see?” would be interesting.



# Timing

## ■ Central timing

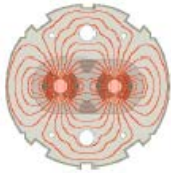
- Machine processes events
  - Event tables
- Asynchronous events
- External events (post mortem)
- Telegram
- Distribution of SBF etc
- UTC time reference

## ■ Beam Synchronous timing

- 40MHz
- 11kHz revolution frequency
- Mainly for BI

Need to get using these systems

- Timing infrastructure is not yet fully available
- First BST tests could be performed end of this year
- First injector chain timing tests under sequencer control early next year
- Timing check procedures for fast and slow timing probably need to be executed regularly by the sequencer (each fill ?)



# SIS

## ■ SIS core

- Operational for the SPS
  - Some improvements for next year
    - Beam stop reason ..
- Need a new server ( + spare) with a timing card connected to the LHC timing system
- SPS : States updated every cycle
- LHC : updated with a fixed clock ( 2 – 5 seconds period – to be defined) derived from the timing system clock
- LHC : acts on two injection BIC's + ring

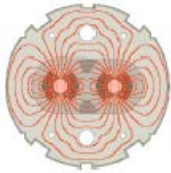
## ■ Interlocks foreseen

- Surveillance of all non HW-interlocked PC
  - around 1200 correctors
    - Injection inhibit
- COD settings and separation dipole currents (experiment protection)
  - Injection inhibit
- Integrated COD field for Dump safety
  - Dump beam
- RF System
  - Surveillance of He levels
- Screens positions
- MCS
  - Check BLM settings etc
    - Verify consistency database and front-end setting
    - Frequency to be defined...

Beam quality and operational efficiency checks

Tests during checkout for non-beam related tests (that are defined)

Many tests need dedicated time during beam – possibly pre-tested



# Logging

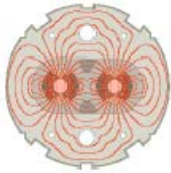
## Measurement Service

- Data persistence of 1 week
- Data loading not more frequent than once every 5 seconds per client
- Data sampling at 2Hz max per variable
- Java clients from the pub-sub world
  - Mainly cyclic beam-related data from injectors
    - ↳ Intensities, profiles, losses,...
  - Commissioning of LHC Individual system and integrated HWC data
    - ↳ Power Converters, Kickers, Septa, RF, Radiation Monitors, Vacuum
    - ↳ Beam Instrumentation to come
- Filtering towards logging every 15 minutes for each variable
  - Logging toggle, dead band, dead time, fixed frequency
- METER interface for rapid data browsing, data extraction

## Logging Service

- Data persistence of 20 years
- Data loading not more frequent than once every 10 minutes per client
- Data sampling at 1Hz maximum per variable
- Clients
  - Measurement Service (*filtered*)
    - ↳ Injectors, LHC HWC
    - ↳ Derived data, statistics
  - PVSS Industrial systems
    - ↳ Cryo, QPS, Collimators, Survey, Vacuum, PIC, WIC, Experiments, CNGS, CIET
  - TIM database (*filtered*)
    - ↳ Technical services
- *No filtering between PVSS and logging*
- TIMBER interface for off-line correlation, data extraction

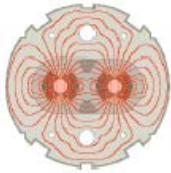
Some worries about who should do what in defining the data tables



## Logging needed for ???

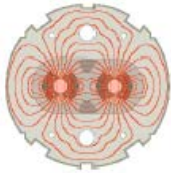
Arc circuits (warm and cold magnets)	
Injection systems (+TDI...)	
Beam Dump Systems (+TCDQ...)	
Distributed BI Systems (BPM, BLM)	
Specific BI Systems (Q, WS...)	
RF systems (+damper...)	
Collimation	
Experimental magnets	
Access system	
Cryogenics	
Vacuum	
Machine Protection	
Radio Protection	





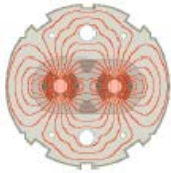
# Post mortem system

- Data gathering looks OK
- Data browser is another story
  - AB/PO unsatisfied with progress made end of 2005 to end of 2006 (JAVA->labview)
- Event builder for hwc
  - Prototype for sector 45 powering
  - Validate approach on this
- For beam in 2008, two main requirements
  - first prototype of an event builder for beam related events (which could be an extension of the 'HWC event builder', currently only focusing on powering data)
  - browsing tool, giving the possibility to visualize and manually analyse data from few 'new' data sources essential for first beam operation such as the BLMs and BPMs
- The plan
  - The approach chosen for the HWC event builder should be generic enough to also allow for inclusion of data sources of beam related equipment.
  - Note that none of this is dependent on Lab-View, Java, etc.. but will be done on a very low level in Perl, C++ scripts and data-driven by the arrival of new PM files.
  - The processed events will then be used to populate a DB structure, allowing for easy access, browsing, statistics, etc...
  - In a very similar way, data could be retrieved from the BIC system and first beam related clients (BLMs, BPMs) to build up first simple beam events
  - The required viewers for BLM and BPM data could be developed in parallel to this activity, using either Java, Lab view, etc...
  - OP needs to checkout the HWC event builder



## Fixed displays needed for ???

Arc circuits (warm and cold magnets)	
Injection systems (+TDI...)	
Beam Dump Systems (+TCDQ...)	
Distributed BI Systems (BPM, BLM)	
Specific BI Systems (Q, WS...)	
RF systems (+damper...)	
Collimation	
Experimental magnets	
Access system	
Cryogenics	
Vacuum	
Machine Protection	
Radio Protection	



# Summary

- Meeting very useful to get an overview of what is going on
- Clear need for integration of different systems
  - From IST to first beam
- What next ?
- Early in 2008
- Readiness reviews (full day for each, not just OP)
- Status, problems, timetable for 2008 for
  - Accelerator systems
    - Injection, RF, Collimation, BI, ...
  - Accelerator physics systems
    - Aperture, Beta beating, Dispersion, Optics, ...
  - Controls
    - LSA, Logging, Post mortem, Fixed displays, ...