EXPERIMENTAL MAGNETS COMMISSIONING



LAYOUT

- About the magnets
- Status and plans
- Commissioning of the dipoles
- Commissioning of the solenoids
- Atlas toroids and end caps

- All experimental magnets are driven by standard FGC and power converter
- They have their own safety and control system developed by the PH/DT1 group.
 - Magnet control system (MCS) : process to execute automatically the various running modes of the magnets, regulate the He flow according to the current in the magnets, perform some parameters monitoring.
 - Magnet safety system (MSS) : process that ensure the warm or cold magnets safety (includes quench detection, voltage measurement and temperature measurement). The magnet is put in security state in case of problem (slow dump for cold magnets and fast dump for warm magnets) The MSS of Alice and LHCb dipole have a hardware link to the

BIC. For instance the solenoid MSS are not connected, but it is ready in case it's needed.

- LHCb and Alice spectrometers:
 - warm dipoles magnets Imax ~ 6000A, Di/Dt max 4A/s
 - Create a bump on the beam -> compensators magnets
 - Have to follow the LHC ramp (settings generation)
 - Polarity change (at each fill for LHCb, 2 to 4 times/run for Alice)





- Alice solenoid
 - Warm magnet, $Imax = 30\ 000A$, DI/Dt = 15A/s
 - Stays ON and at full current during beam operation.
 - Affect only the beam coupling, can be ramped any time, doesn't need to follow LHC ramping.





- Atlas :
 - Central solenoid : Imax = 6000A.
 - 8 barrel toroids and 2 end cap, in series with one FGC.
 Imax = 20 000A, max DiDt : 1.7 A/s
 - The solenoid affect only the beam coupling, the barrel toroids and end-cap don't affect the beam at all. They can be ramped any time, doesn't need to follow LHC ramping.



- CMS Solenoid
 - Imax = 19 500A, DiDt max = 1.7A/s
 - Affect only the beam coupling, can be ramped any time, doesn't need to follow LHC ramping.
 - The max current in the magnet depends of the helium level in the DEWAR. During shut-down periods, this is controlled by the MCS process. During physics, this regulation is the responsibility

of operation team. The DEWAR level value will be published in DIP, it has to be treated by LSA.





Status and plans

- LHCb: commissioned in October 2007
- Alice: commissioning foreseen week 50 and 51 (critical days?)
 Magnetic field measurements done (transfer function)
 The compensators won't be installed before march 2008.
- CMS : tests on the surface have been performed during 1month 1/2

Magnetic fields measurements done. Underground installation completed, cool down foreseen in November and powering mid-january.

 Atlas: the central solenoid has been tested, and magnetic measurement done. The 8 barrel toroids have been tested individually. The end caps have still to be tested individually.
 Plan to test the toroids and end cap in series during 2008.

From Field by experts:

- Tests without currents :
 - Magnet Control system verification (MCS)
 - Magnet safety system verification (MSS)
 - BIC
 - Isolation test
 - Power Converter installation
- Tests with current :
 - Power Converter commissioning
 - BIC
 - Current to nominal in local mode
 - Polarity measurement : convention
 - movements and temperature survey

From CCC without beam

- We want to test the magnet together with the 3 compensators
- The settings have to be created for each magnet using :
 - Magnets strengths for "bump ON" defined in MAD
 - Transfer function : from magnetic measurement for LHCb magnet, from magnet descriptions for the compensators
 - LHC momentum ramp
- \Rightarrow Check if the generated settings aren't above Imax
- \Rightarrow Create a Knob to scale the bump amplitude.

Commissioning steps without beam

- Set the max di/dt to 4 for LHCb
- Load the generated settings for LHCb and the compensator
 =>Check that the max di/dt of the generated function isn't higher than 4 for LHCb.
- Compensator + LHCb to nominal following the LHC ramp
- Polarity change : the 4 magnets polarity has to be changed to invert the bump. (power supplies have to be switched OFF)
 We need a sequence to change the polarity

Commissioning with beam

- The dipoles and their compensators will be OFF for the initial commissioning of the beam
- Commissioning of the dipoles and their compensators at 450 Gev :
 - Check the bump closure and the bump amplitude
 - Control the beam losses
 - Change the polarity : should be a sequence in the sequencer.
 - Check the bump closure again and amplitude again

- Commissioning of the dipoles and their compensators at high energy :
 - We use a knob to define the bump amplitude
 - We trim the knob to 10% of the full strength amplitude
 - Check the bump closure
 - Measure the bump amplitude
 - Control the beam losses
 - Next ramp we change the polarity
 - Next ramp we increase the bump amplitude by trimming the knob
 - We repeat this procedure until the bump reaches the full strength.

Commissioning of the Solenoids

From field by experts

- Cool down of CMS and Atlas magnets
- MCS and MSS verification
- Current to nominal
- Polarity and field measurements
- Temperature and movement survey

From CCC without beam

- Ramping of the magnets : simple ramp to I nominal with defined di/dt
- No settings generated.
- Polarity change?
- For CMS: check the feedback loop Imax/DEWAR level.

Commissioning of the Solenoids

Commissioning with beam

- First the coupling has to be measured with all solenoids OFF.
- Switch ON Atlas magnet : set the current to max with the right DI/Dt. The ramping takes several hours.
- During the ramping, measure the coupling and correct it by trimming the skew quadrupoles.
- Then use the same procedure for Atlas and then Alice solenoids
- All the solenoid stay ON for the rest of the beam commissioning

Barrel Toroids and End Caps

Commissioning without beam

- The toroids and end caps will be powered and measure separately
- Then all the elements will be in powered together by a unique FGC.
- Commissioning with beam
 - This magnets have no interaction will beam
 - They will be powered with Atlas solenoid.



Conclusions

- LHCb magnet has been fully commissioned without beam
- Alice commissioning before Christmas
- CMS at the beginning of 2008.
- 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 physic has to be sorted out.