

LHC-Beam Commissioning Working Group

Notes from the meeting held on
16 November 2010

1- Comments and following from last meetings

Gianluigi Arduini: The ion stop was extended to 62 hrs and will take place on 17-18-19 November - [Detailed program](#)

To note:

- Preparation of the 75 ns beam in the injectors will start tonight, as soon as the ion re-fill of the LHC is done and the SPS MD is complete (at 18h). Cavity of the PS will be retuned as soon as the LHC ramp is starting.
- Priority item: 75 ns to be done before any 50 ns measurements.
- Stability measurements with 50 and 75ns (measurements without ADT) is the only buffer in terms of beam time.
- Vacuum people will be on shift to cover the full period.
- All teams are available and agreed on the time schedule.
- If everything goes well, up to 680 bunches can be injected with 75 ns bunch spacing (APPROVED). Intensity per bunch will be adapted depending on the findings - starting from the nominal intensity. Reminder: 424 bunches were injected in the machine with 150ns bunch spacing.
- Abort gap cleaning will be switched on during filling processes.

2- LHC ion beam commissioning and operation – John Jowett ([slides](#))

John Jowett presented a detailed summary of the last weeks of ion commissioning and operation.

To note:

- o Smooth injection set-up and qualification;
- o Beam instrumentation working as specified;
- o Optics measurements were in good agreement with proton measurements at injection and 3.5 TeV;
- o Collimation checks at 450 GeV – cleaning efficiency as expected with ions.
- o Collisions set-up done – crossing angles set at correct values;
- o Betatron cleaning at 3.5 TeV and asynchronous dump tests: as expected;
- o IBS: Higher RF voltage reduces bunch length growth (maybe also final transverse emittance, to be confirmed). IBS does not fully account for transverse growth but is quite close, at least at first, in longitudinal. Bigger problem is injection, RF Group tried “pumping” RF voltage up between injections – see below Giulia Papotti report;
- o Strong vertical blow up mainly due to hump (and IBS)
- o SEU: more frequent than during proton operation see details in the week 45 operation summary from Monday morning ([slides](#)) by Mike Lamont and Ralph Assmann.

Conclusions:

- o Injectors are giving 70-80% beyond design single-bunch intensity –accumulation rate beyond expectation- which is wonderful, but has some consequences
 - Significant IBS growth and debunching at injection had to be overcome, seems to be in reasonable agreement with theory.

- Emittance blow-up in physics is mostly vertical, mostly not IBS, may vary in time
- Collimation of heavy ions:
 - Simulations roughly right but do not show all details – need considerable effort for refinement ... and counter-measures in future;
- BFPP limit, seen, analysis coming.

3- Updates on beam-beam observations– Werner Herr ([slides](#))

Werner Herr reported on recent observations of beam-beam effects with bunch trains and 50 ns spacing. Two sessions were foreseen with 12 and 24 bunches per train. The second was lost since stable beams were not established. Werner Herr summarized the interest in the experiments, mainly to study serious long range interactions for the first time.

Unfortunately, only with 24 bunches per train the full head-on and long range effects are present and the results with 12 bunches cannot be representative for the operational scenarios planned for 2011. The observations during the tests were difficult because the fast BCT was not available. Werner Herr presented the data for stable beams, analysed by Giulia Papotti, when FBCT was still available. The losses confirmed a dependence on the number of collisions, however a clear correlation for the long range encounters is not obvious. Furthermore, a bunch to bunch intensity variation of up to 40% makes the interpretation difficult. A study with the full long range pattern, i.e. 24 bunches and possibly a bunch by bunch diagnostics (tune!) should give a clear picture.

A further test was made by slowly separating the beams in steps in IP8 to test the luminosity reduction by offset collisions (à la IP2). No lifetime effects were seen, but the test should be repeated with all long range encounters to draw a conclusion.

In a last test the transverse damper was switched off to observe the effect on the spectra. Reducing the gain to 50% had no effect on losses. Switching the damper off completely caused some beam losses and it was switched on again. Repeating the test with a tune split between the beams showed no significant beam losses.

Werner Herr also reviewed a few basics on coherent beam-beam, the expectations and possible cures. According to his interpretation it is not clear whether the observed losses are caused by a coherent beam-beam effect, in particular since the damper was already needed before collisions and the sign of the chromaticity unknown. Tatiana Pieloni added that the origin of the observed beam excitation could as well be something else than beam-beam, such as an external perturbation.

The experiments should be repeated and a bunch by bunch diagnostics is highly desired (required) to interpret and understand the results. Tatiana Pieloni mentioned that a selection of some bunches can now be requested for tune measurement.

Werner Herr clarified that a spread in intensity should not deliberately be increased (10 to 20% in bunch intensity ratio are enough to damp the instabilities). He proposed to rather keep the ADT damper on.

4- RF improvements– Giulia Papotti ([slides](#))

Philippe Baudrenghien said that the motivation of these RF improvements was at the origin to cure the transmission losses.

Giulia Papotti explained that at each injection, the capture voltage was reduced to 3.5 MV – total length of the manipulation: 5 seconds. The RF voltage was put back at 7 MV between injections. The results were excellent: very little bunch lengthening and flat Fast BCT (no debunching). The transmission was much improved, with almost no losses at start of ramp.

Longitudinal blowup during ramp: the target bunch length is 1 ns for ions - was 1.2 ns for protons. Much work has been done by the RF teams on modeling and simulation, on implementation in the controls system (RF controls team and Delphine Jacquet) and HW system (RF teams). When the bunch length goes below the 1 ns, the blow up excitation is switched on and as this threshold value is reached the excitation is switched off. It is clearly seen that at LHC injection level, there is a slow bunch lengthening, up to 1.5 ns - BQM vetoes the SPS extraction if length >1.6ns- and that at flat top, the bunch lengths are nicely equalized.

5- Preparation of the 2011 Hardware commissioning campaign –Mirko Pojer, Matteo Solfaroli ([slides](#))

Matteo Solfaroli summarised the active on-going work performed on the preparation of the 2011 HW commissioning.

Matteo reminded that a HW Commissioning campaign is needed as lots of activities will be performed in the LHC underground, activities which cannot be fully controlled and, as well, a 100% correctly functioning of the machine protection system cannot be ensured.

The detailed list of the HWC activities was presented, together with the strategies and methods. This covered the EIQA, QPS and powering tests – to note the simplification of the power test execution - only 49% of the PIC tests will be repeated and only 29% of the others (incl. the 60A).

A draft planning was shown indicating the cryo-maintain readiness – 3 shifts, 7 days a week were assumed.

For a possible 4 TeV operation, no significant delay is expected in the HWC. The list of required additional tests was presented.

Conclusions:

- HWC will be short and quick - All SW already used, no heavy modification on circuits, no major modification on procedure, strongly reduced number of tests.
- Possible commissioning to 4 TeV wouldn't take much more time- studies on technical showstopper ongoing
- Difficulties in finding people to cover the shifts could slow down the commissioning time
- LHC should be ready for operation by 18 Feb.

6- 2011 LHC schedule – Mike Lamont ([slides](#))

Mike Lamont presented the draft 2011 LHC schedule:

- Beam back around 21st February
- 2 weeks re-commissioning with beam (at least)
- 4 day technical stop every 6 weeks
- Count 1 day to recover from TS (optimistic)
- 2 days machine development every 2 weeks or so
- 4 days ions set-up
- 4 weeks ion run
- End of run – 12th December
- **~200 days proton physics (special runs included)**
- First estimates of luminosity reach are included in the slides (not presented at the meeting, “reasonable” peak luminosity of 6.4×10^{32} , and ultimate reach of 2.2×10^{33} , with assumed corresponding parameters as described in Mike's slides).

Daily 8:30 HWC meeting in the CCC conference room (09:00 at weekends).

Next meeting: **23 November 2010**, 15:30, 874-1-01.

Malika Meddahi

LAST NAME	FIRST NAME	DEP/GROUP	Present
ALABAU PONS	Maria Carmen	BE-ABP-LCU	X
ALEMANY FERNANDEZ	Reyes	BE-OP-LHC	
AQUILINA	Nicholas	TE-MSC-MDA	X
ARDUINI	Gianluigi	BE-ABP-LIS	X
ASSMANN	Ralph Wolfgang	BE-ABP-LCU	X
BAER	Tobias	BE-OP-SPS	
BAILEY	Roger	BE-OP-LHC	
BARTMANN	Wolfgang	TE-ABT-BTP	X
BAU	Jean-Claude	BE-CO-HT	
BAUDRENGHIEN	Philippe	BE-RF-FB	X
BELLESIA	Boris		
BELLODI	Giulia	BE-ABP-HSL	X
BHAT	Chandrashekhara	BE-ABP	
BOCCARDI	Andrea	BE-BI-PM	
BOTTURA	Luca	TE-MSC-SCD	
BRACCO	Chiara	TE-ABT-BTP	X
BRUCE	Roderik	BE-ABP-LCU	
BRUNING	Oliver	BE-ABP	
BRUNNER	Olivier	BE-RF-KS	
BUFFAT	Xavier	BE-OP-LHC	
BURKHARDT	Helmut	BE-ABP-LCU	X
BUTTERWORTH	Andy	BE-RF-CS	X
CALAGA	Rama	BE-ABP-LCU	X
CALVIANI	Marco	EN-STI-EET	X
CARLI	Christian	BE-ABP-LIS	X
CARLIER	Etienne	TE-ABT-EC	
CAUCHI	Marija	BE-ABP-LCU	
CHAPOCHNIKOVA	Elena	BE-RF-BR	X
CHARRUE	Pierre	BE-CO-IN	X
CIAPALA	Edmond	BE-RF	
CROCKFORD	Guy	BE-OP-LHC	X

LAST NAME	FIRST NAME	DEP/GROUP	Present
DEHNING	Bernd	BE-BI-BL	
DENIAU	Laurent	TE-MSC-MDA	X
DOMINGUEZ SANCHEZ	Octavio	BE-ABP	
DROSDAL	Lene	BE-OP-LHC	X
DUBOURG	Sylvia	BE-ASR-AS	
FARTOUKH	Stephane	BE-ABP-LCU	
FERRO-LUZZI	Massimiliano	PH-LBD	
FORAZ	Katy	EN-MEF-LPC	
FUCHSBERGER	Kajetan	BE-OP-SPS	
GAROBY	Roland	BE	
GIACHINO	Rossano	BE-OP-LHC	X
GIANFELICE	Eliana	TE-ABT	
GIOVANNOZZI	Massimo	BE-ABP-LCU	X
GODDARD	Brennan	TE-ABT-BTP	X
GRAS	Jean-Jacques	BE-BI	
GRUWE	Magali	BE-ASR-SU	
HAGEN	Per	TE-MSC-MDA	X
HATZIANGELI	Eugenia	BE-CO	
HERR	Werner	BE-ABP-CC3	X
HESSLER	Christoph	TE-ABT-BTP	
HOFLE	Wolfgang	BE-RF-FB	
HOLZER	Bernhard	BE-ABP-LCU	
HOLZER	Eva Barbara	BE-BI-BL	X
IKEDA	Hitomi		
JACQUET	Delphine	BE-OP-LHC	
JEANNERET	Bernard	BE-ABP-CC3	
JENSEN	Lars	BE-BI-SW	X
JONES	Rhodri	BE-BI	
JOWETT	John	BE-ABP-LCU	X
KAIN	Verena	BE-OP-LHC	
KOZANECKI	Witold	PH-UAT	

LAST NAME	FIRST NAME	DEP/GROUP	Present
KOZSAR	Ioan	BE-CO-HT	
KRUK	Grzegorz	BE-CO-AP	
KURFUERST	Christoph	BE-BI-BL	
LAFACE	Emanuele	BE-ABP-LCU	
LAMONT	Mike	BE-OP	
LEVINSEN	Yngve Inntjore	BE-ABP-LCU	
MACLEAN	Ewen	BE-ABP	X
MACPHERSON	Alick	BE-OP-LHC	
MANGLUNKI	Django	BE-OP-SPS	X
MARSILI	Aurelien	BE-BI-BL	
MEDDAHI	Malika	TE-ABT-BTP	
MERTENS	Tom	BE-ABP-LCU	X
METRAL	Elias	BE-ABP-ICE	X
MONTABONNET	Valerie	TE-EPC-OMS	
MUELLER	Gabriel Johannes	BE-OP-LHC	
NEBOT DEL BUSTO	Eduardo	BE-BI-BL	X
NORDT	Annika	BE-BI-BL	
NORMANN	Lasse	BE-OP-LHC	X
PAPOTTI	Giulia	BE-OP-LHC	X
PIELONI	Tatiana	BE-ABP-ICE	X
POJER	Mirko	BE-OP-LHC	X
PONCE	Laurette	BE-OP-LHC	X
PUCCIO	Bruno	TE-MPE-MI	X
REDAELLI	Stefano	BE-OP-LHC	
ROESLER	Stefan	DGS-RP-AS	
RONCAROLO	Federico	BE-BI-PM	
ROSSI	Adriana	BE-ABP-LCU	
ROY	Ghislain	BE-ASR-SU	
SAPINSKI	Mariusz Gracjan	BE-BI-BL	
SCHMIDT	Frank	BE-ABP-ICE	X
SCHMIDT	Rudiger	TE-MPE-PE	Excused

LAST NAME	FIRST NAME	DEP/GROUP	Present
SIEMKO	Andrzej	TE-MPE	
SIGERUD	Katarina	BE-CO-AP	X
SIVATSKIY	Gennady	BE-CO-FE	
SLIWINSKI	Wojtek	BE-CO-IN	
SOLFAROLI CAMILLOCCI	Matteo	BE-OP-LHC	X
STEINHAGEN	Ralph	BE-BI-QP	X
STRZELCZYK	Marek	BE-ABP-LCU	X
TERRA PINHEIRO FERNANDES	Mario	BE-OP-LHC	X
THIESEN	Hugues	TE-EPC-MPC	
TODD	Benjamin	TE-MPE-MI	
TODESCO	Ezio	TE-MSD-MDA	X
TOMAS GARCIA	Rogelio	BE-ABP-CC3	X
UYTHOVEN	Jan	TE-ABT-BTP	X
VALENTINO	Gianluca	BE-ABP-LCU	
VALUCH	Daniel	BE-RF-FB	
VANBAVINCKHOVE	Glenn	BE-ABP-LCU	
VENTURINI DELSOLARO	Walter	BE-OP-LHC	X
VINCKE	Heinz	DGS-RP-AS	
VINCKE	Helmut	DGS-RP-AS	
WENNINGER	Jorg	BE-OP-SPS	X
WHITE	Simon	BE-ABP	X
WIENANDS	Uli	BE-OP	
WOLLMANN	Daniel	BE-ABP-LCU	
ZANETTI	Marco	PH-UCM	
ZIMMERMANN	Frank	BE-ABP-LCU	
TAVIAN	Laurent	TE-CRG	
SCHAUMANN	Michaela	BE-OP	X
EVANS	Lyn		X

