LHC-Beam Commissioning Working Group

Notes from the meeting held on

23 November 2010

1- Comments and following from last meetings

No major comments.

2- Report from the 75 and 50ns bunch spacing operation - Report from the ion operation re-start – Gianluigi Arduini (slides)

Thanks to all teams involved in the MD – intense period.

Motivation was to complete observations from 50 ns beam on e-cloud build up, especially on heat load at 3.5 TeV after scrubbing, and to compare behavior of 75 ns beam.

Total of 65 h effective (out of 75 h eventually allocated to MD). It took about 24 hours to switch to high intensity 75 ns beam, due to some unexpected problems with RF synchronisation and capture, and injector tuning. Eventually managed to make a lot of tests and also progress with stored intensity at 450 GeV.

75 ns observations: had 680b at 0.9e11 p+ in both beams with batch spacing of 1.85 us, and went to 824b of 1.1e11 p+ with 1.005 us spacing in one beam (gave problems with FBCT). Kept the 680b beam for 2 hours for UFOs – none seen.

Saw some intensity related effects on RF cavity 7B2 for beam 2 – does not appear to be beam loading; possible sources are beam induced multipacting or micro-quenches – conditioning at higher voltage might help. Investigations planned for 2011.

For 680b in both beams had 6e13p total p+ per beam; saw that losses larger on earlier injected batches. In general losses were located at the tails of the batches, seems to be H instability, stabilized by Q' increase from 14 to 24. Higher Q' seemed to help for 1.005 us batch spacing too, but reduced lifetime to 5-10 hours. Not sure the H instability effect was limited to electron cloud. Bunch by bunch data being analysed.

Losses seen in IRs with 488b and linked to the pressure rises. To be analysed further.

For vacuum tested with fill of 12/8+(2*24) bunches, see maybe factor 4 higher pressure for the 50 ns case, for this small number of bunches.

For 75 ns see no significant heat load in the beam screens in the arcs, but clear load in arcs for 50 ns. For both beams saw significant heat load for triplets.

Summary and conclusions:

- Transition to p+ took longer than expected – some improvements possible;
- A lot of analysis ongoing for several data sets;
- 75 ns clearly better than 50 ns but will still need scrubbing (or solenoids) to ramp large number of bunches;
- Hardly visible heat load in beam screens in arcs for 75ns but important activity in triplets, especially L8;
- 50 ns beam showed that 450 GeV scrubbing is effective at 3.5 TeV. Heat load in arcs went from 40 to <10 mW/m/beam;
- Strategy for 2011 startup to be decided – could envisage scrubbing with 50 ns then running for physics with 75 ns. Scrubbing needed for arcs anyway. Will check number of A.h of scrubbing accumulated – what counts is time spent with

high pressure. Need to base the plan on the observations and data taken, including aspects like bunch length.

Switch back to ions went faster. Transverse feedback deployed for injection and working OK, and also tested at end of fill – no bad effects seen.

Wolfgang Höfle (e-mail): Now that the damper is on by default for ions at the flat bottom and during the last collisions as well, someone should look at the beam size evolution- Federico Roncarolo

3- Vacuum observations during the 75 and 50 ns bunch spacing operation - Vincent Baglin (slides)

75 ns – 680b in both beams with 14 injections, 1.85us gap between batches, 0.9e11 p+ per bunch. Mainly pressure increases at D1 – less in other regions. Needed to stop after 10 injections to allow pressure to recover, to not pass the 4e-7 mbar interlock limit. Stayed for ~2 hours before dumping beams.

With injecting intensity see about linear increase in P1 and P3, and a threshold at about 250b per beam in P2 and P8. No significant increases in P5 and P7.

Pressure normalized to intensity in 'coast' shows decrease by factor 2 by D1 over 2 hours.

Checked pressure rise vs current for different filling patterns and bunch intensities for the worst gauge VGPB.2.5L3.B1 which is next to quadrupole with elliptical chamber – adjacent chambers not NEG coated. Seems to indicate that threshold is about 0.9e11 for 75 ns beam. Different slopes seen with single trains and multiple trains – still to understand.

50 ns – found factor 2 between slopes for the same gauge with same beam pattern.

Ramp – generally saw only SR desorption near the end of the ramp. In P1 saw pressure changes correlated to the bunch length and SR appearing at 2 TeV. In P8 near MKI saw only a slight pressure increase following similar pattern. Compared to ramp in October pressure is about a factor 20 lower.

Conclusions

- 2 beams injected with 680b at 75 ns and did not interlock.
- Saw some conditioning during 2h storage at 450 GeV.
- Threshold about 0.9e11 for 75 ns.
- 50 ns is twice as bad as 75 ns.
- Test ramp saw no pressure rise above 7e-10 mbar, and conditioning is ongoing.

4- Cryogenics observations during the 75 and 50 ns bunch spacing operation - Laurent Tavian (slides)

Measurements calibrated – find a factor 2 between the loops – not yet understood. Accuracy is about +/-0.5 W, and response time is about 45 minutes.

75 ns up to 680b per beam at 450 GeV, no visible extra heat load due to e-cloud.

50 ns 108b ramped to 3.5 TeV, some indications of some activity at about 10 mW/m on beam 2. On 31 October saw much higher activity, about 20 mW/m/beam, so seems to be some scrubbing.

With 50ns and 444b per beam at 450 GeV, saw at least 40 mW/m/beam (with calibrated loops). Integral of the power around the machine was 2 kW.

Also qualitative observation on inner triplet, with 75 ns and 680b per beam at 450 GeV, significant activity at P2 and P8, and nothing in P1 and P5 (cold/warm D1 difference?), seems to be 2 beam effect.

5- Preliminary findings from instability measurements during the 75 and 50 ns bunch spacing operation - Elias Metral
Next week.

6- Injection observations with 75ns - 50 ns bunch spacing - Chiara Bracco (slides)

First injections of 75 ns and of 48b total (previously 32 and 36b). TL steering with 8b – kept the TCDIs in original locations and at +/-4.5 sigma. Needed abort gap cleaning on when injecting above 24b. Losses with 48b per injection were about factor 2-3 below the dump limit – losses were increasing with injected intensity.

Not very stable as needed to resteer TLs after about 10 h – maybe injectors. Accumulation of 680b per beam was OK, with up to 824 for one beam.

For 1.2-1.3e11 per bunch losses seemed to scale with intensity; reached 60-70% of dump level.

For 50 ns behavior was reproducible, needed good control of unbunched beam; abort gap cleaning deployed but also need the injection gap cleaning. 48b were at about 70% of dump levels.

First asynchronous dump occurred – failure of chip of trigger fan-out unit – 2 MKD pre-triggered, the rest followed. This changes the load case on the TCDQ and collimators – less load on collimators, and more on TCDQ – may need to re-examine the logic depending on the expected frequency and impact on the reliability.

96b per injection for 2011 looks OK – this is fine for 75 ns and may limit injected intensity per batch for 50 ns.

7- AOB

Stable phase shift (energy loss) for 50 ns and 75 ns beams – Elena Shaposhnikova (slides)

For power of 1 kW expect a phase shift (average of all bunches) of about 0.9 deg for 100 nominal bunches.

B2 data not reliable, but for B1 data looks reasonable, and could probably resolve a fraction of a degree.

For B1 with 8e13 p+ total see a phase shift of about 0.6 degrees.

For B1 with 1.1e13 p+ see 0.2 deg change, with 5e13 see 0.8 deg, with a threshold at about 2e13 where the slope changes.

In summary see visible phase shift for B1, larger with 50 ns spacing. Non-linear dependence on intensity. Needs calibration and understanding vs cryogenic measurements, may be possible to add filters and improve data quality.

Would also be interesting to compare with data on 31/10 where effect seen on vacuum and cryo was larger.

Daily 8:30 HWC meeting in the CCC conference room (09:00 at weekends).
Next meeting: **30 November 2010,** 15:30, 874-1-01.

Brennan Goddard

LAST NAME	FIRST NAME	DEP/GROUP	Present
ALABAU PONS	Maria Carmen	BE-ABP-LCU	
ALEMANY FERNANDEZ	Reyes	BE-OP-LHC	
AQUILINA	Nicholas	TE-MSC-MDA	
ARDUINI	Gianluigi	BE-ABP-LIS	X
ASSMANN	Ralph Wolfgang	BE-ABP-LCU	
BAER	Tobias	BE-OP-SPS	X
BAILEY	Roger	BE-OP-LHC	
BARTMANN	Wolfgang	TE-ABT-BTP	X
BAU	Jean-Claude	BE-CO-HT	
BAUDRENGHIEN	Philippe	BE-RF-FB	
BELLESIA	Boris		
BELLODI	Giulia	BE-ABP-HSL	
BHAT	Chandrashekhara	BE-ABP	X
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	X
BURKHARDT	Helmut	BE-ABP-LCU	
BUTTERWORTH	Andy	BE-RF-CS	X
CALAGA	Rama	BE-ABP-LCU	X
CALVIANI	Marco	EN-STI-EET	
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	
CIAPALA	Edmond	BE-RF	
CROCKFORD	Guy	BE-OP-LHC	

LAST NAME	FIRST NAME	DEP/GROUP	Present
DEHNING	Bernd	BE-BI-BL	
DENIAU	Laurent	TE-MSC-MDA	X
DOMINGUEZ SANCHEZ	Octavio	BE-ABP	X
DROSDAL	Lene	BE-OP-LHC	
DUBOURG	Sylvia	BE-ASR-AS	
FARTOUKH	Stephane	BE-ABP-LCU	X
FERRO-LUZZI	Massimiliano	PH-LBD	X
FORAZ	Katy	EN-MEF-LPC	
FUCHSBERGER	Kajetan	BE-OP-SPS	X
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	
HATZIANGELI	Eugenia	BE-CO	
HERR	Werner	BE-ABP-CC3	Excused
HESSLER	Christoph	TE-ABT-BTP	
HOFLE	Wolfgang	BE-RF-FB	Excused
HOLZER	Bernhard	BE-ABP-LCU	
HOLZER	Eva Barbara	BE-BI-BL	
IKEDA	Hitomi		
JACQUET	Delphine	BE-OP-LHC	
JEANNERET	Bernard	BE-ABP-CC3	
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JONES	Rhodri	BE-BI	X
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LEVINSEN	Yngve Inntjore	BE-ABP-LCU	
MACLEAN	Ewen	BE-ABP	
MACPHERSON	Alick	BE-OP-LHC	
MANGLUNKI	Django	BE-OP-SPS	X
MARSILI	Aurelien	BE-BI-BL	
MEDDAHI	Malika	TE-ABT-BTP	X
MERTENS	Tom	BE-ABP-LCU	
METRAL	Elias	BE-ABP-ICE	X
MONTABONNET	Valerie	TE-EPC-OMS	
MUELLER	Gabriel Johannes	BE-OP-LHC	X
NEBOT DEL BUSTO	Eduardo	BE-BI-BL	X
NORDT	Annika	BE-BI-BL	
NORMANN	Lasse	BE-OP-LHC	
PAPOTTI	Giulia	BE-OP-LHC	X
PIELONI	Tatiana	BE-ABP-ICE	X
POJER	Mirko	BE-OP-LHC	
PONCE	Laurette	BE-OP-LHC	
PUCCIO	Bruno	TE-MPE-MI	
REDAELLI	Stefano	BE-OP-LHC	
ROESLER	Stefan	DGS-RP-AS	
RONCAROLO	Federico	BE-BI-PM	
ROSSI	Adriana	BE-ABP-LCU	
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SCHMIDT	Rudiger	TE-MPE-PE	

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SOLFAROLI CAMILLOCCI	Matteo	BE-OP-LHC	Excused
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STRZELCZYK	Marek	BE-ABP-LCU	
TERRA PINHEIRO FERNANDES	Mario	BE-OP-LHC	X
THIESEN	Hugues	TE-EPC-MPC	
TODD	Benjamin	TE-MPE-MI	
TODESCO	Ezio	TE-MSC-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	Excused
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	X
TAVIAN	Laurent	TE-CRG	X
BAGLIN	Vincent	TE-VSC	X
EVANS	Lyn		X
PRIOR	Gersende	BE-ABP	X
BREGLIOZZI	Giuseppe	TE-VSC	X
MAURY CUNA	Humberto	BE-ABP	X