LHC-Beam Commissioning Working Group

Notes from the meeting held on
26 October 2010

1- Comments and Follow-up from the last minutes

Django Manglunki: The 11 bunch injection -11 being limited by the central timing incompatibility- could not be tested due to limits imposed by the SPS RF software –limits now removed. Therefore the tests were performed with 7 bunch injection and it was observed that the bunches shrunk due to particles leaving the buckets in the long injection flat bottom. These particles were indeed observed when acceleration started.

Brennan Goddard reminded that unbunched particles have been observed on the TDI during the ion test run.

Recommendation from D. Manglunki and J. Jowett (e-mail): start the ion run with 4 bunch injection and then move on to more bunches, if possible.

2- LHC beam commissioning: progress and issues – Malika Meddahi – Joerg Wenninger

Monday morning summary of Week 42 - slides from Malika Meddahi and Joerg Wenninger

To note:
- MSI aperture problem has been solved (acknowledgments to TE/VSC)
- Injection systems are ready for 32b
- Vacuum activities being seen with 368b
- Record peak luminosity delivered: 2.05e32

Brennan Goddard:
- Measured delay of MKI_B2 (delay with respect to the pre-pulse) slide. First bunch is being affected. Etienne Carlier will request an access to investigate and fix the problem.
- MSI aperture: updated plot of the losses was shown. Clear improvement after the TS. The hierarchy of losses is restored with losses at the entrance of MSIB, as designed. Note the low level of losses.

3- Beam-beam observations– Werner Herr (slides)

Werner Herr reminded the parameters which can be tuned for going to L>1e32: high intensity, small emittance, bunch trains, small beta*. He added that unfortunately, anything good for the luminosity is bad for beam-beam effect! (e.g. small beta are bad for long range).

Werner Herr analysed the stable beam period over the last weeks. For the first fill for which a luminosity of 1e32 was reached, looking at the losses as a function of the bunch collision pattern –bunch sorted according to their number of collisions- it is seen that about 1% of the intensity in beam 1 is lost in about 1mn. This is not a worrying behaviour, and is indeed as expected (example of the SPS where 10% of the beams was lost after putting them into collisions and example of RHIC). What was unexpected, was the loss pattern of some bunches of beam 2 which experienced fast losses. This behaviour was not observed during the next fills.

Fill with luminosity of 1.4 e32: no beam losses seen at the beginning of the fill. Do not understand why!

Observation which happened only once: bunch number 2, 3, 4 depopulated very quickly for beam 2. Nothing observed for beam 1. Bunch by bunch emittance measurements would be needed to make more correlation.

There is a clear correlation between bunch losses and number of head-on collisions.

The total tune shift (3 collisions) is about ~0.02 (assuming intensity of about 1.0 - 1.2x10^{11}, and normalised emittance ~1.8 - 2.2 μm)

Werner Herr reminded the strategy for optimization: If the limit is due to head-on beam-beam: then increase N, increase emittance, reduce beta*. This is not true if the limit is due to long range beam-beam: it is then better to keep the emittance small as long as head-on limit it not reached.

Tune observation (Tatiana Pieloni): observation of some noise on beam 2 (correlated with ADT switched on) and transferred to the other beam via beam-beam interaction.

Do we have problem with the long range effect? They do not play a role now as for the moment the head on beam-beam completely dominates the beam dynamics.

Expected maximum tune shift:
- Prudent design target : 0.02 (assumption: 0.005 from lattice at collision and assuming beam-beam of 0.015 with strong long range contribution)
- SPS: standard operation: 0.02 (with 3 head-on on 9 long range encounters

Can we do more? Yes, as it seems that there is a very small contribution from the machine non-linearities.

Summary 1:
- Losses in fill 1410 are difficult to explain, bunch-by-bunch diagnostics are necessary - Schottky highly desirable, gated BBQ ?
- Keep the (transverse) emittance small, it helps everywhere;
- More bunches (and maybe smaller beta*) increase long range.

Summary 2:
- Should try with 50ns bunch spacing, with minimum 24bunches per train, 12 bunches cannot give meaningful information;
- Proposed test with 50ns spacing:
  - Scan separation in IP1 and IP5 (if possible: simultaneously and separately)
  - Try separation in IP8 for luminosity leveling (all other IPs present, 50 ns spacing)
  - Go into collision separately

To note:
- Over 10 minutes, luminosity lifetime and bunch lifetime experience fast drop: not surprising, as the tails of the beams are being peeled.
- 3 sigma separation in ALICE with no effect in the machine
- L. Evans: performance of the machine is better than predicted concerning the linear effect.
- Keeping the longitudinal emittance small will not help: peak current should be kept down!
- Emittance blow-up is predicted by with self consistent beam-beam model: small and very slow emittance growth. But it gives no clue on the lifetime as it comes from the tail effects.
- Should investigate the limit on the nominal beam-beam tune shift. This is a crucial information for next year and also for the LHC upgrade.

4- <u>Planning of the LHC for the last 2010 days of proton operation</u> – Mike Lamont (slides)

Mike Lamont presented the LHC operation plans for the coming days until the start of the ion operation.

- Run for physics until Thursday
    i. 368 bunches…
    ii. 400+
    iii. Deliver 40+ pb-1 (all high luminosity experiments)
- Friday: Switch to 50 ns
- Monday/Tuesday next week: Provisionally machine development – see list of MD in the slides. To add on the MD list: aperture at 450 GeV and Wire Scan test, 3.5 TeV with a dedicated run.
- Wednesday – switch to ions. 2 days contingent on delivery of integrated luminosity target.

Daily 8:30 HWC meeting in the CCC conference room (09:00 at weekends).
Next meeting: **2 November 2010,** 15:30, 874-1-01.

<div align="right">Malika Meddahi</div>

LAST NAME	FIRST NAME	DEP/GROUP	Present	LAST NAME	FIRST NAME	DEP/GROUP	Present
ALABAU PONS	Maria Carmen	BE-ABP-LCU		DEHNING	Bernd	BE-BI-BL	
ALEMANY FERNANDEZ	Reyes	BE-OP-LHC	X	DENIAU	Laurent	TE-MSC-MDA	X
AQUILINA	Nicholas	TE-MSC-MDA	X	DOMINGUEZ SANCHEZ	octavio	BE-ABP	
ARDUINI	Gianluigi	BE-ABP-LIS	Excused	DROSDAL	Lene	BE-OP-LHC	X
ASSMANN	Ralph Wolfgang	BE-ABP-LCU		DUBOURG	Sylvia	BE-ASR-AS	
BAER	Tobias	BE-OP-SPS		FARTOUKH	Stephane	BE-ABP-LCU	
BAILEY	Roger	BE-OP-LHC		FERRO-LUZZI	Massimiliano	PH-LBD	X
BARTMANN	Wolfgang	TE-ABT-BTP	X	FORAZ	Katy	EN-MEF-LPC	
BAU	Jean-Claude	BE-CO-HT		FUCHSBERGER	Kajetan	BE-OP-SPS	
BAUDRENGHIEN	Philippe	BE-RF-FB		GAROBY	Roland	BE	
BELLESIA	Boris			GIACHINO	Rossano	BE-OP-LHC	X
BELLODI	Giulia	BE-ABP-HSL		GIANFELICE	Eliana	TE-ABT	X
BHAT	Chandrashekhara	BE-ABP		GIOVANNOZZI	Massimo	BE-ABP-LCU	
BOCCARDI	Andrea	BE-BI-PM		GODDARD	Brennan	TE-ABT-BTP	X
BOTTURA	Luca	TE-MSC-SCD		GRAS	Jean-Jacques	BE-BI	
BRACCO	Chiara	TE-ABT-BTP	X	GRUWE	Magali	BE-ASR-SU	
BRUCE	Roderik	BE-ABP-LCU	X	HAGEN	Per	TE-MSC-MDA	X
BRUNING	Oliver	BE-ABP	Excused	HATZIANGELI	Eugenia	BE-CO	
BRUNNER	Olivier	BE-RF-KS		HERR	Werner	BE-ABP-CC3	X
BUFFAT	Xavier	BE-OP-LHC	X	HESSLER	Christoph	TE-ABT-BTP	
BURKHARDT	Helmut	BE-ABP-LCU		HOFLE	Wolfgang	BE-RF-FB	
BUTTERWORTH	Andy	BE-RF-CS		HOLZER	Bernhard	BE-ABP-LCU	
CALAGA	Rama	BE-ABP-LCU	X	HOLZER	Eva Barbara	BE-BI-BL	X
CALVIANI	Marco	EN-STI-EET		IKEDA	Hitomi		
CARLI	Christian	BE-ABP-LIS	X	JACQUET	Delphine	BE-OP-LHC	
CARLIER	Etienne	TE-ABT-EC		JEANNERET	Bernard	BE-ABP-CC3	
CAUCHI	Marija	BE-ABP-LCU	X	JENSEN	Lars	BE-BI-SW	X
CHAPOCHNIKOVA	Elena	BE-RF-BR		JONES	Rhodri	BE-BI	
CHARRUE	Pierre	BE-CO-IN	X	JOWETT	John	BE-ABP-LCU	Excused
CIAPALA	Edmond	BE-RF		KAIN	Verena	BE-OP-LHC	X
CROCKFORD	Guy	BE-OP-LHC		KOZANECKI	Witold	PH-UAT	x

LAST NAME	FIRST NAME	DEP/GROUP	Present	LAST NAME	FIRST NAME	DEP/GROUP	Present
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KRUK	Grzegorz	BE-CO-AP		SLIWINSKI	Wojtek	BE-CO-IN	
KURFUERST	Christoph	BE-BI-BL		SOLFAROLI CAMILLOCCI	Matteo	BE-OP-LHC	
LAFACE	Emanuele	BE-ABP-LCU	X	STEINHAGEN	Ralph	BE-BI-QP	
LAMONT	Mike	BE-OP	X	STRZELCZYK	Marek	BE-ABP-LCU	X
LEVINSEN	Yngve Inntjore	BE-ABP-LCU	X	TERRA PINHEIRO FERNANDES	Mario	BE-OP-LHC	X
MACPHERSON	Alick	BE-OP-LHC		THIESEN	Hugues	TE-EPC-MPC	
MANGLUNKI	Django	BE-OP-SPS	X	TODD	Benjamin	TE-MPE-MI	
MARSILI	Aurelien	BE-BI-BL		TODESCO	Ezio	TE-MSC-MDA	X
MEDDAHI	Malika	TE-ABT-BTP	x	TOMAS GARCIA	Rogelio	BE-ABP-CC3	X
MERTENS	Tom	BE-ABP-LCU	x	UYTHOVEN	Jan	TE-ABT-BTP	X
METRAL	Elias	BE-ABP-ICE		VALENTINO	Gianluca	BE-ABP-LCU	
MONTABONNET	Valerie	TE-EPC-OMS		VALUCH	Daniel	BE-RF-FB	
MUELLER	Gabriel Johannes	BE-OP-LHC		VANBAVINCKHOVE	Glenn	BE-ABP-LCU	X
NEBOT DEL BUSTO	Eduardo	BE-BI-BL	X	VENTURINI DELSOLARO	Walter	BE-OP-LHC	
NORMANN	Lasse	BE-OP-LHC		VINCKE	Heinz	DGS-RP-AS	
PAPOTTI	Giulia	BE-OP-LHC	X	VINCKE	Helmut	DGS-RP-AS	
PIELONI	Tatiana	BE-ABP-ICE	X	WENNINGER	Jorg	BE-OP-SPS	
POJER	Mirko	BE-OP-LHC		WHITE	Simon	BE-ABP	
PONCE	Laurette	BE-OP-LHC		WIENANDS	Uli	BE-OP	
PUCCIO	Bruno	TE-MPE-MI	X	WOLLMANN	Daniel	BE-ABP-LCU	X
REDAELLI	Stefano	BE-OP-LHC		ZANETTI	Marco	PH-UCM	
ROESLER	Stefan	DGS-RP-AS		ZIMMERMANN	Frank	BE-ABP-LCU	
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					
SCHMIDT	Rudiger	TE-MPE-PE					
SIEMKO	Andrzej	TE-MPE					
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