INTENSITY LIMITATIONS FROM ELECTRON CLOUD IN THE LHC

E. Métral (replacing G. Arduini)

- **MD requested by Gianluigi on 15/03/11 (revised on 02/08/11)**
- **Participants:** G. Arduini, Ph. Baudrenghien, V. Baglin, H. Bartosik, S. Claudet, O. Dominguez, W. Höfle, J.M. Jimenez, E. Métral, M. Pojer, G. Rumolo, B. Salvant, E. Shaposhnikova, L. Tavian, W. Venturini, F. Zimmermann, etc. => *This is not the final list yet!*
- **Goal:** Study of electron cloud effects with 25 ns beams (as vacuum pressure rises, heat loads, coherent and incoherent effects generating blow-up and losses are expected) + effectiveness of the scrubbing for operation with 25 ns beam

REQUESTS

Approved limit at the moment

- 2 dedicated (i.e. no // studies possible) MDs:
  - 1st of 8h => Inject trains of 72 b (144 b if possible) up to ~ 1400 b
  - 2nd longer (to be defined after the 1st MD) => Try and inject trains of 288 b (according to progress with injection MD) up to ~ 2600 b
- Energy: 450 GeV/c only

After approval…

- Intensity / bunch: At least ~ 1.2E11 p/b
- Transverse emittance (rms norm.): Smallest possible and ≤ nominal one (3.5 microm). Some measurements earlier this year seemed to indicate (surprisingly?) that ~ 2.5 microm could be obtained…
- Bunch length (4 sigmas): ~ 1.5 ns
- Optics / orbit / collimation: No change required
- RF: Change might be needed
- Transverse damper: Careful setting-up for the operation with 25 ns bunch spacing required

POSSIBLE PLAN (for a 1st 7h MD as currently foreseen)

- **Split into 2 parts of ~ the same length**
- **1st Part => Injection of beams with different filling patterns (optimization ongoing…) to constrain SEY and R**
- **2nd Part => Injection of several trains of 72 bunches with a bunch spacing of 925 ns in the LHC, up to ~ 1400 bunches (see Appendix)**
- **For the 2 parts the following measurements should be performed:**
  - **Vacuum and heat loads in all machine regions (Vacuum, Cryo, Walter, Mirko…)**
  - **RF stable phase dependence on intensity (RF, Elena, Juan…)**
  - **Beam stability and transverse emittances evolution (ABP+BI… => Mini teams to be organized as already done during the 50 ns scrubbing)**
  - **RF and damper checks in // (RF, Wolfgang, Philippe, Daniel…)**

APPENDIX:

FILLING PATTERNS (for the 2nd part of the MD)

25 ns with 72 bunches

Bucket for the first bunch of the train (LHC buckets)	Space taken by the train including empty slots (25 ns slots)	# bunches train	# PS trains/SPS Inj		
1	37		1	spacing btw. Bunches	25
371	48	12	1	spacing btw. SPS trains	225
851	108	72	1	spacing btw. LHC trains	925
1931	108	72	1	# PS trains/SPS Inj	1
3011	108	72	1	#bunches/ PS train	72
4091	108	72	1		
5171	108	72	1		
6251	108	72	1		
7331	108	72	1		
8411	108	72	1		
9491	108	72	1		
10571	108	72	1		
11651	108	72	1		
12731	108	72	1		
13811	108	72	1		
14891	108	72	1		
15971	108	72	1		
17051	108	72	1		
18131	108	72	1		
19211	108	72	1		
20291	108	72	1		
21371	108	72	1		
22451	108	72	1		
23531	108	72	1		
24611	108	72	1		
25691	108	72	1		
26771	108	72	1		
27851	108	72	1		
28931	108	72	1		
30011	108	72	1		
31091	108	72	1		
		2100			

31181 is the last possible bucket for injection of the 1st bunch of the train

25 ns with 72+72 = 144 bunches

Bucket for the first bunch of the train (LHC buckets)	Space taken by the train including empty slots (25 ns slots)	# bunches train	# PS trains/SPS Inj		
1	37		1	spacing btw. Bunches	25
371	48	12	1	spacing btw. SPS trains	225
851	188	144	2	spacing btw. LHC trains	925
2731	188	144	2	# PS trains/SPS Inj	2
4611	188	144	2	#bunches/ PS train	72
6491	188	144	2		
8371	188	144	2		
10251	188	144	2		
12131	188	144	2		
14011	188	144	2		
15891	188	144	2		
17771	188	144	2		
19651	188	144	2		
21531	188	144	2		
23411	188	144	2		
25291	188	144	2		
27171	188	144	2		
29051	188	144	2		
30931	188	144	2		
		2460			

25 ns with 72+72+72 = 216 bunches

Bucket for the first bunch of the train (LHC buckets)	Space taken by the train including empty slots (25 ns slots)	# bunches train	# PS trains/SPS Inj		
1	37		1	spacing btw. Bunches	25
371	48	12	1	spacing btw. SPS trains	225
851	268	216	3	spacing btw. LHC trains	925
3531	268	216	3	# PS trains/SPS Inj	3
6211	268	216	3	#bunches/ PS train	72
8891	268	216	3		
11571	268	216	3		
14251	268	216	3		
16931	268	216	3		
19611	268	216	3		
22291	268	216	3		
24971	268	216	3		
27651	268	216	3		
30331	268	216	3		
		2604			

25 ns with 72+72+72+72 = 288 bunches

Bucket for the first bunch of the train (LHC buckets)	Space taken by the train including empty slots (25 ns slots)	# bunches train	# PS trains/SPS Inj		
1	37		1	spacing btw. Bunches	25
371	48	12	1	spacing btw. SPS trains	225
851	348	288	4	spacing btw. LHC trains	925
4331	348	288	4	# PS trains/SPS Inj	4
7811	348	288	4	#bunches/ PS train	72
11291	348	288	4		
14771	348	288	4		
18251	348	288	4		
21731	348	288	4		
25211	348	288	4		
28691	348	288	4		
		2604			