

STRATEGY FOR MACHINE DEVELOPMENT STUDIES IN 2010

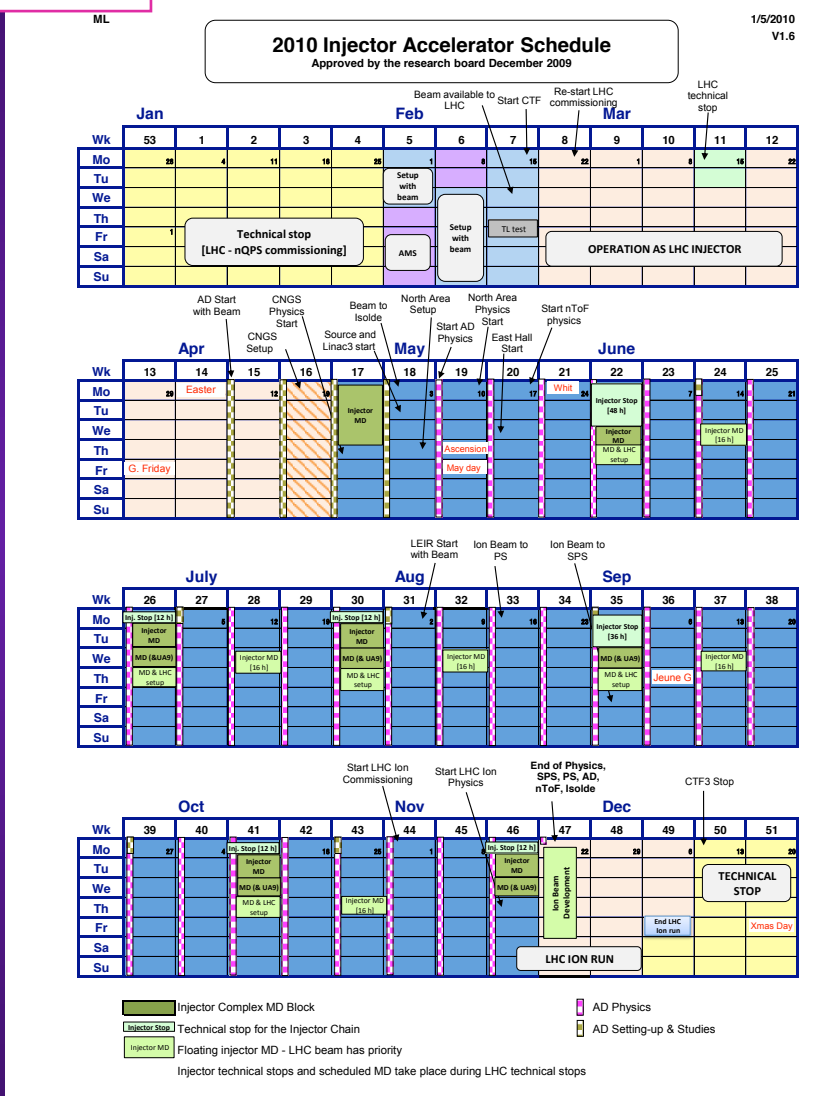
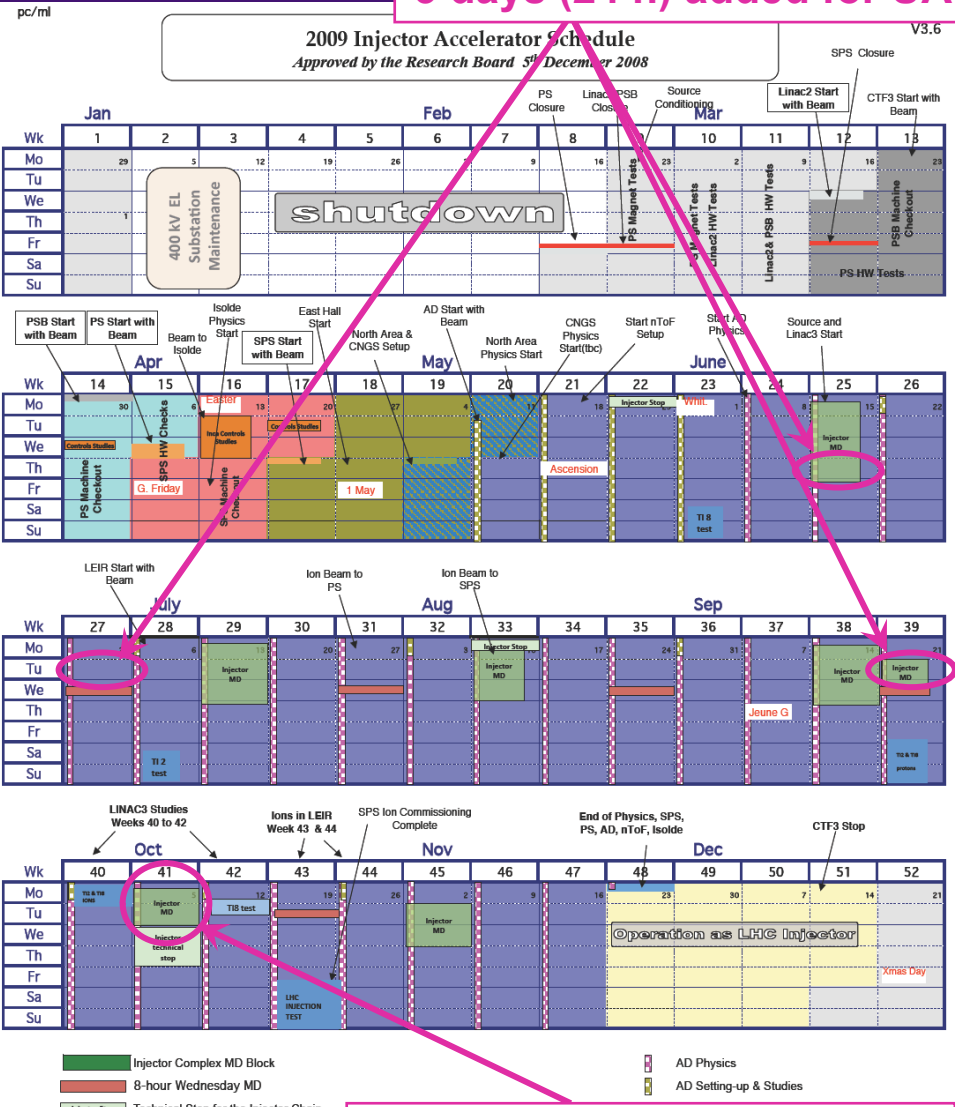
E. Métral (for MSWG)

- ◆ All the information during the year: https://ab-mgt-md-users.web.cern.ch/ab-mgt-md-users/2010/2010_md_planning.htm
- ◆ Many thanks to Mike Lamont, Klaus Hanke and Horst Breuker for all the discussions and close collaboration!

- ◆ **2010 injector accelerator schedule vs. 2009 => Issues to be solved:**
 - More Technical Stops needed (for SPS RF power maint., E. Montesinos)
 - UA9 studies (in coast) => 5 times 24 h (approved at LMC36 and SPSC95)
 - Fragmented ion beam tests for NA61
- ◆ **Consequences of Chamonix10 (and new Task Forces) => Identify bottlenecks in the Injector Chain trying to produce the ultimate LHC intensities + Detailed studies of the origin of the beam losses**
 - Reminder on LHC25 and LHC50
 - The 1st MD block of week 17 => Nominal intensity in SPS with LHC25
 - The 2nd MD block of week 22 => Maximum intensity with LHC25 (with larger transverse emittances from PSB)?
 - Then, study of max. intensity of LHC25-1 batch, LHC50 etc.
- ◆ **The 2 requests from M. Ferro-Luzzi (for ALICE) => Endorsed by LMC28 (https://espace.cern.ch/lhc-machine-committee/Minutes/1/lmc_28.pdf) and already planned with S. Hancock (150 ns bunch spacing production in the PS)**
- ◆ **Summary of required beams and SPS supercycles**
- ◆ **Appendix: All the requests => LINAC3, LINAC2, PSB, PS and SPS**

2010 INJECTOR ACCELERATOR SCHEDULE vs. 2009 (1/5)

3 days (24 h) added for UA9 and ions



1 block cancelled (due to a problem with PS injection septum 42)

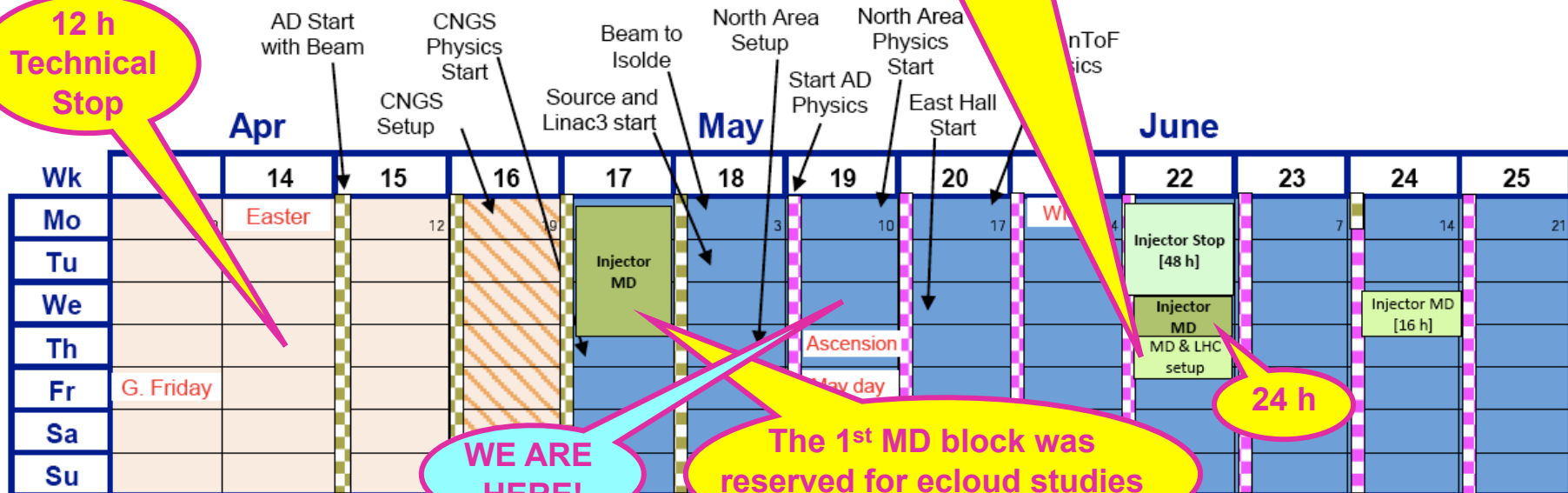
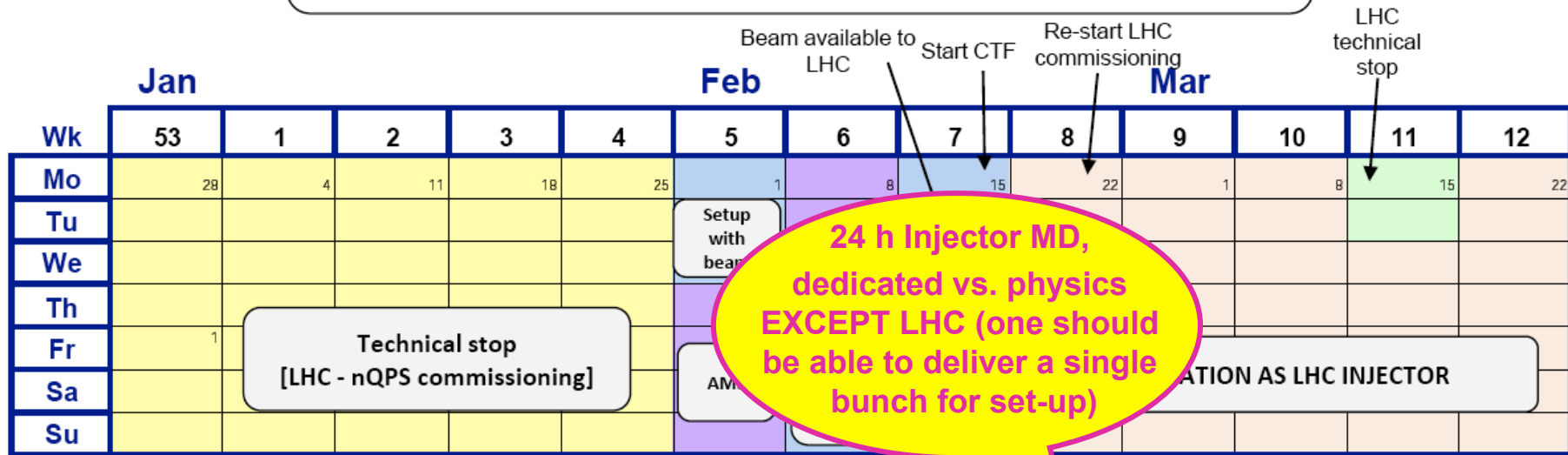
2010 INJECTOR ACCELERATOR SCHEDULE vs. 2009 (2/5)

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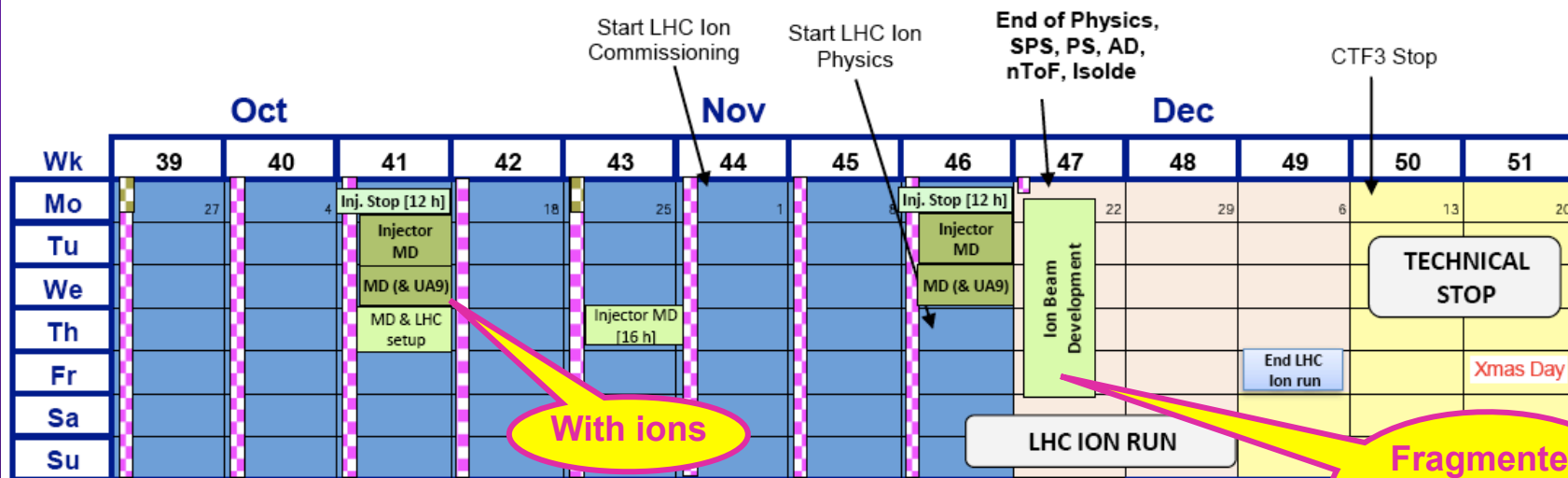
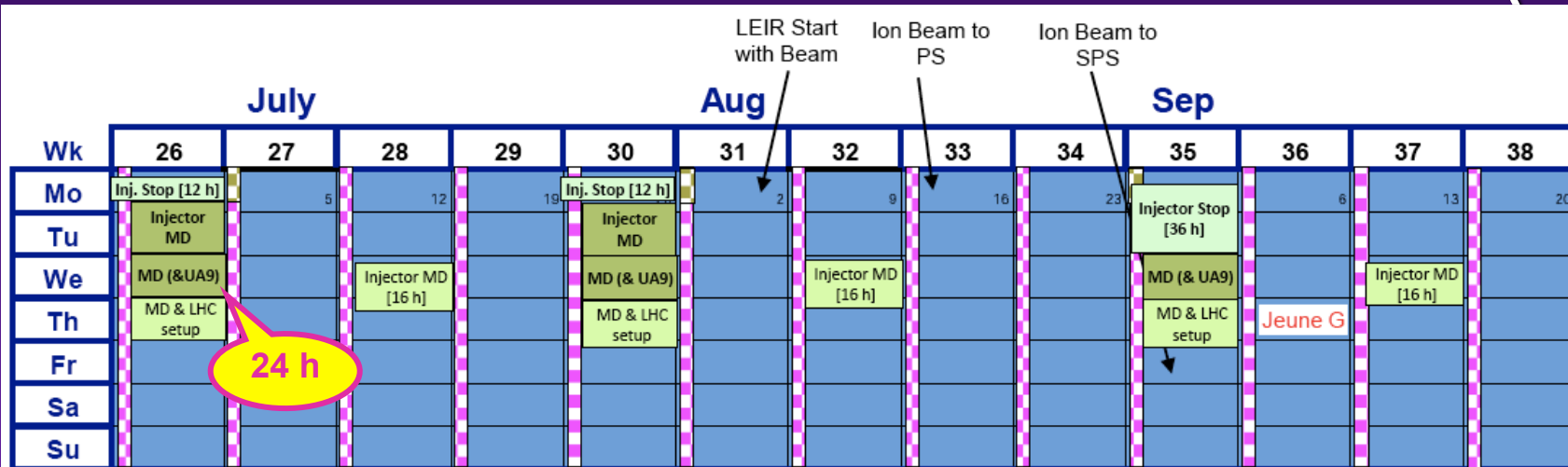
1/5/2010
V1.6

2010 Injector Accelerator Schedule

Approved by the research board December 2009



2010 INJECTOR ACCELERATOR SCHEDULE vs. 2009 (3/5)



- Injector Complex MD Block
- Injector Stop Technical stop for the Injector Chain
- Injector MD Floating injector MD - LHC beam has priority
- AD Physics
- AD Setting-up & Studies

Injector technical stops and scheduled MD take place during LHC technical stops

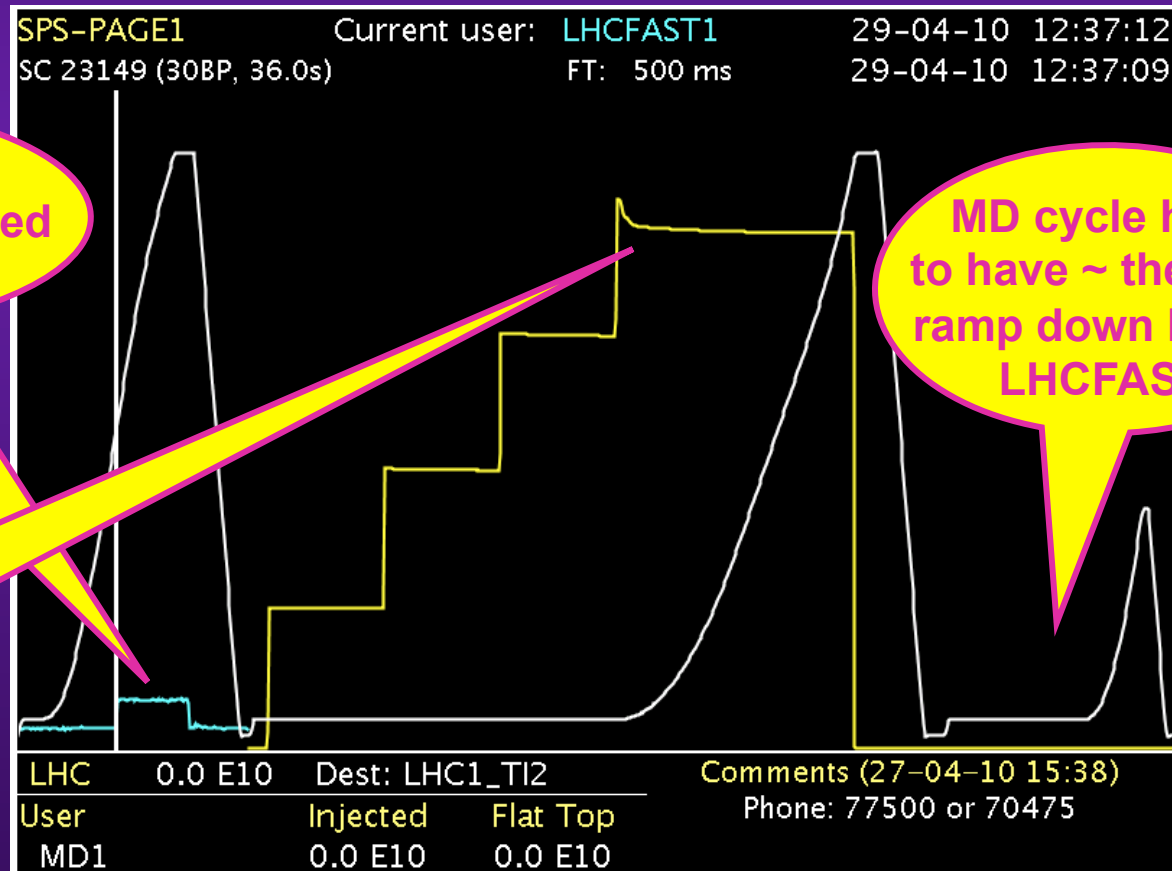
2010 INJECTOR ACCELERATOR SCHEDULE vs. 2009 (4/5)

◆ The “Technical stops” issue

- Initially only 3 slots of 8 h (i.e. **24 h in total**) were scheduled
- In the current planning, there is a total of **144 h** foreseen, i.e. 6 times more!
- **Week22 => 48h required to repair the PS septum**
- **RF power maintenance > 6 × 12 h: Week (14)-22-26-30-35-41-46**
- **Some margin in week 35**
 - **Other machines’ accesses**
 - **Some time could be used in particular for the installation of a Multi-Slit Emittance Measurement inside the present LTE, separate measurement line**
- ◆ **The old dedicated “Wednesday MDs” => Floating MDs with LHC in // (which has priority)**
- ◆ **UA9 => Will finally be done during dedicated MD time (coasts)**

2010 INJECTOR ACCELERATOR SCHEDULE vs. 2009 (5/5)

- ◆ => MD time is missing except if one can do MDs on the Thursdays (of the weeks with MD Injector blocks): Dedicated vs. physics EXCEPT LHC
- ◆ This operation mode was anticipated and checked during the 1st MD block of week 17 => It works and will therefore be used in the future

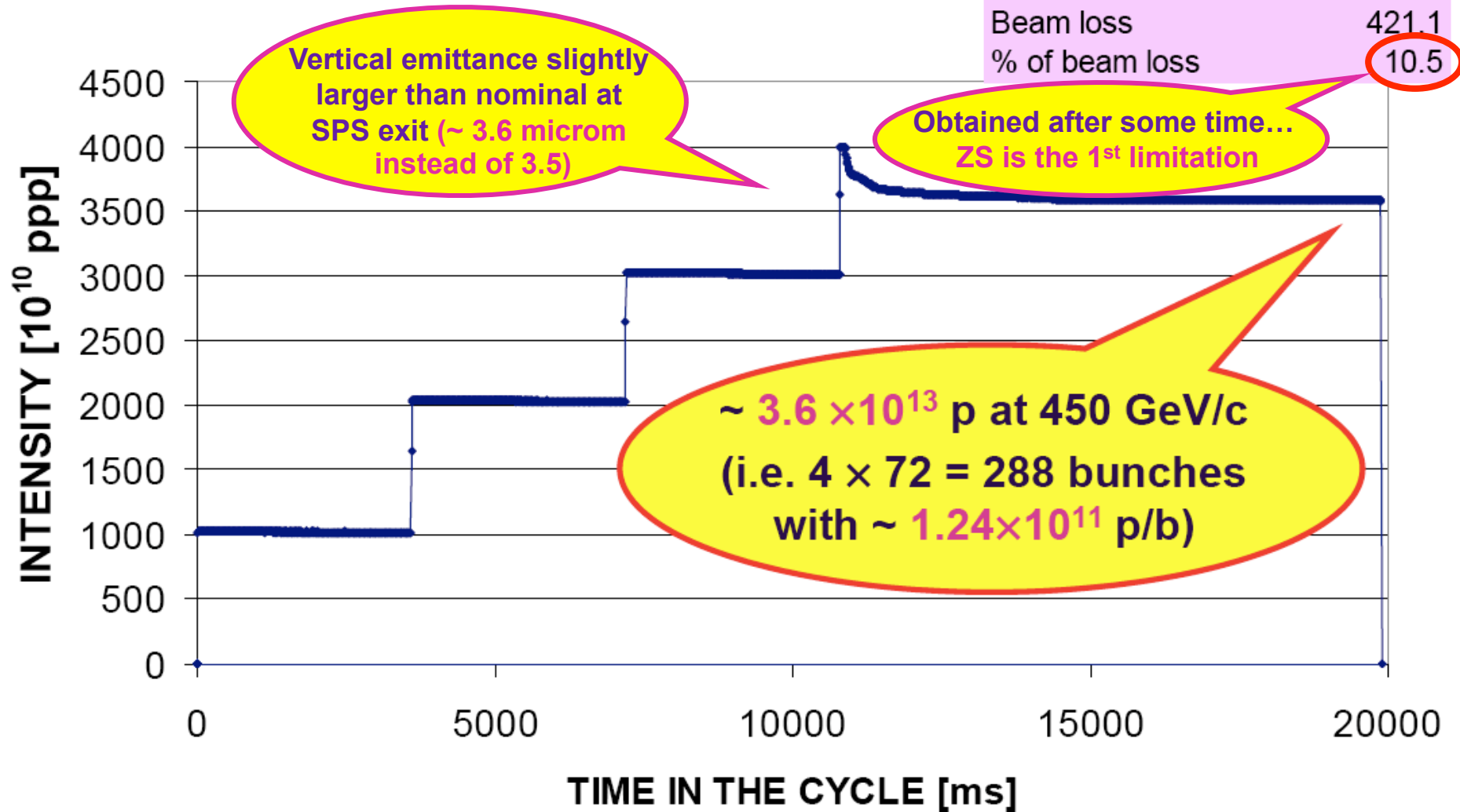


REMINDER: NOMINAL LHC25 BEAM IN THE INJECTORS

In 2006

SPS BCT

| | |
|------------------|--------|
| Total injected | 3995.3 |
| Total at the end | 3574.2 |
| Beam loss | 421.1 |
| % of beam loss | 10.5 |



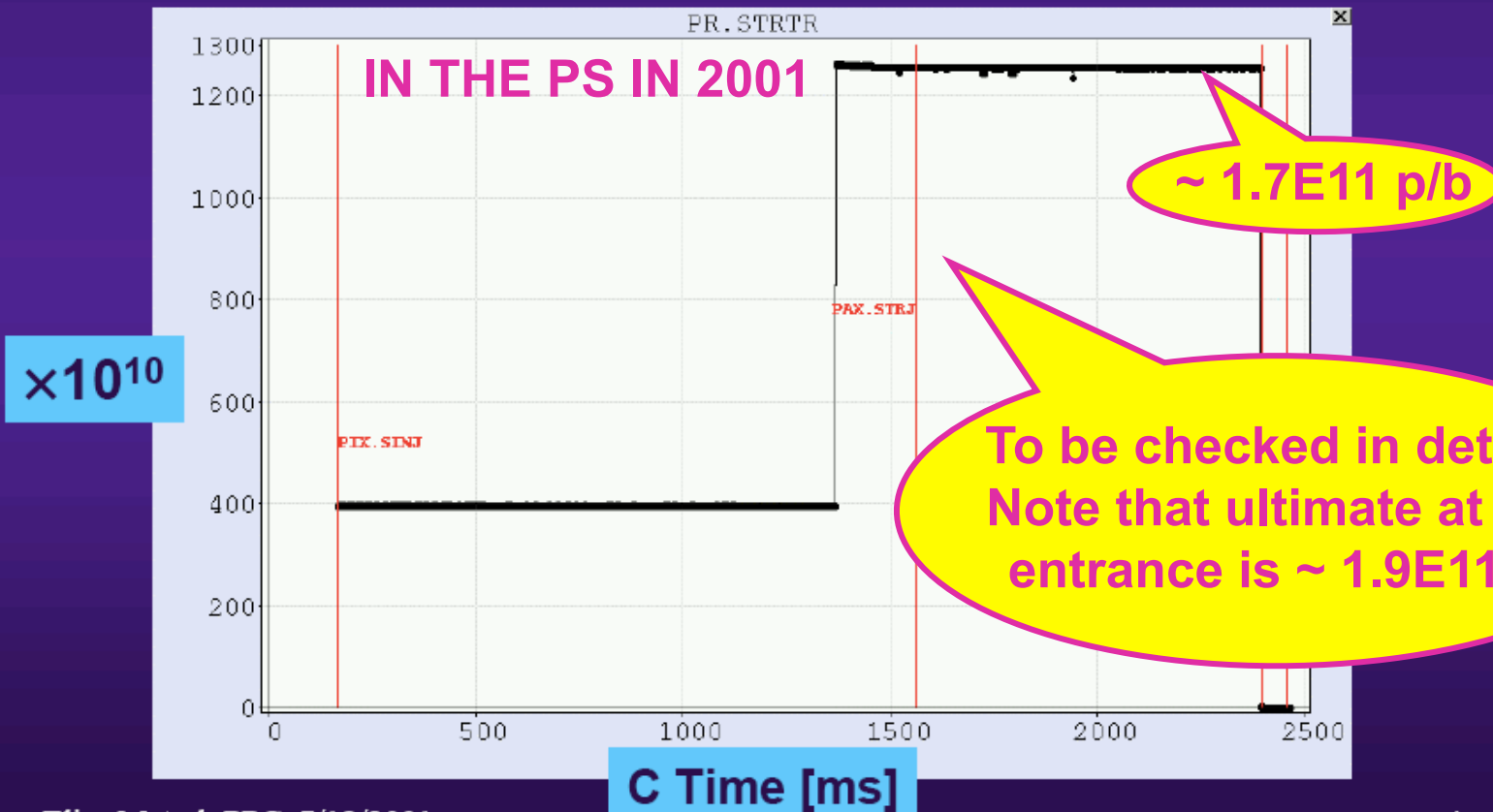
REMINDER: ULTIMATE LHC25 BEAM IN THE INJECTORS

INTRODUCTION (3/4)

Ultimate LHC beam

- Done with a remarkable transmission
- The transverse and longitudinal emittances need to be optimised (slightly too large : $\sim 4 \mu\text{m}$ in transverse and 4.5 ns bunch length, instead of 3 and 4)

Normalised rms emittances



Elias Métral, PPC, 7/12/2001

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REMINDER: LHC50 BEAM IN THE INJECTORS

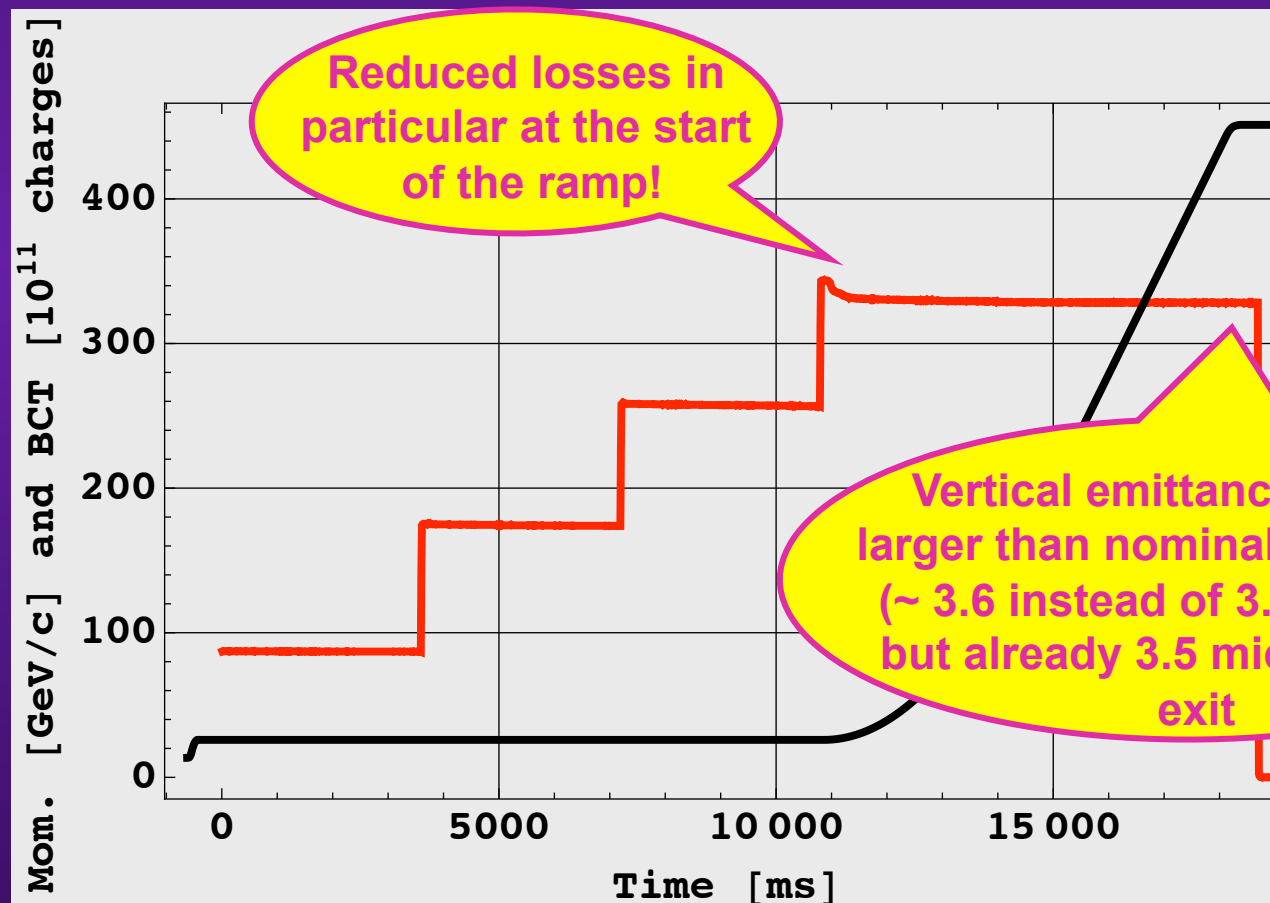
- ◆ **2-batch injection scheme (< 2009):** The transverse rms. norm. emittances for the 50 ns beam with nominal intensity / bunch were measured to be ~ 1.1 microm in X and ~ 1.4 microm in Y at 450 GeV/c (https://espace.cern.ch/acc-tec-sector/Chamonix/Chamx2009/papers/EM_9_04.pdf)
- ◆ **Since 2009 the 50 ns beam is produced in 1 batch** from the PSB and we succeeded to reach at SPS top energy slightly more than the nominal intensity / bunch with transverse emittances of ~ 2.5 microm in both planes (very clean beam). Note that these transverse emittances of 2.5 microm were already produced at the exit of the PSB, meaning that they were \sim preserved during the whole injector chain!
=> Where is the LHC50 intensity limit (as we have some margin in transverse emittances)?
=> What about LHC25 with larger PSB transverse emittances?

THE 1st MD BLOCK OF WEEK 17 (1/2)

- ◆ **MD started only on TU afternoon (i.e. more than 1 day lost) due to**
 - Exchange of dipole MBB.30090 (vacuum leak observed the Friday before)
 - An intervention in the TI12 and TI18 lines, which had to be finalized to protect the SPS in case of LHC helium leak
 - DSO tests for the NA
- ◆ **Main results:**
 - **The ZS experts participated to this MD and found a better adjustment. Up to now the procedure, during high-intensity studies with LHC beams, was:**
 - 1) ZS RETRACTED
 - 2) HV to 0 kV => HV to – 7 kV this time (for better clearing from ion traps)
 - 3) ION TRAPS ON

THE 1st MD BLOCK OF WEEK 17 (2/2)

- ~ nominal intensity / bunch was reached with ~ 5% of beam losses only, which is one of the best result ever obtained, and this during the 1st MD!
- The evolution of the beam losses vs. time could not be studied...



THE 2nd MD BLOCK OF WEEK 22

- ◆ **Between weeks 18 and 21, the PSB will finalize the preparation (in //) of an ~ ultimate intensity LHC cycle (with larger transverse emittances than nominal) and then the PS will study it in detail (still in //) => <https://ab-mgt-md-users.web.cern.ch/ab-mgt-md-users/2010/pmd18to21.htm>**
- ◆ **This cycle will be used for SPS studies during the next Long Injector MD of week 22 (from WE 02/06 08:00 to FR 04/06 08:00)**
- ◆ **The study of max. intensity with LHC25 in 1 batch and LHC50 will be performed after**

THE 2 REQUESTS FROM M. FERRO-LUZZI, FOR ALICE, (1/2)

- ◆ Endorsed by LMC28 (https://espace.cern.ch/lhc-machine-committee/Minutes/1/lmc_28.pdf) and already planned with S. Hancock (150 ns bunch spacing production in the PS)
- ◆ See MD report of 09/10/09 => https://ab-mgt-md-users.web.cern.ch/ab-mgt-md-users/2009/StatusOfMDs/StatusOfTheMachineStudies_09-10-09.pdf
 - Selection of the phases
 - Replace a usual train by a particular train (for the LHC filling) and in particular a train of bunches spaced by ≥ 100 ns, with $\sim 1/3$ or $1/2$ of nominal bunch intensity

THE 2 REQUESTS FROM M. FERRO-LUZZI, FOR ALICE, (2/2)

- ◆ **Reminder on the > 100 ns bunch spacing production in the PS (discussed in the past with S. Hancock and H. Damerau):**

- **18 bunches spaced by 100 ns** (done by injecting 6 PSB bunches on h7 + 3-splitting and then acceleration on h21 without any splitting at top energy) **seem excluded (above which intensity?)** due to the too longitudinal emittance which needs to be accelerated (\Rightarrow Coupled-bunch instability etc.) due to the fact that there is no other splitting at top energy
- **12 bunches spaced by 150 ns seems feasible.** The idea here would be to inject 6 bunches from PSB on h7, then do a rebucketing from h7 to h14 at low energy (instead of triple splitting), accelerate on h14 and then do only 1 splitting at top energy to end up with 12 bunches. Therefore, it is very similar to the 75 ns beam which is also accelerated on h14 (but which has a 2-splitting at low energy)

Finally not feasible like this!

SUMMARY OF REQUIRED BEAMS AND SPS SUPERCYCLES

- ◆ **W17: Nominal LHC25 beam at the SPS entrance => Already done!**
- ◆ **W22: Maximum intensity with LHC25 at SPS entrance (with larger transverse emittances) => > Nominal intensity studies in the SPS**
- ◆ **W24 (Floating MD): Preparation of the coasts**
- ◆ **W26-30-35-41-46: Coasts (but not only!) with in particular UA9 (at 120 GeV/c)**
- ◆ **W41: Ions**

- ◆ **SPS supercycles:**
 - **Nominal LHC cycle (25 ns) => LHC_4Inj_FB10860_FT500_2010_V1 (already prepared taken)**
 - **50 ns cycle => LHC_4Inj_FB7260_FT500_2010_V1**
 - **26 GeV/c flat cycle => For single-bunch high-intensity studies**
 - **120 GeV/c coast => UA9 (request) + BBLR + Diffusion + CrabC**
 - **55 GeV/c coast => BBLR (ideally) + CrabC**
 - **270 GeV/c coast => LHC collimator (ideally) + Diffusion**

APPENDIX

ALL THE REQUESTS (1/25)

◆ LINAC3

- **Desorption studies (E. Mahner) => Potential pressure rises due to heavy ion interactions with a-C surfaces?**
 - **MSWG recommendations (15/01/2010): “The MSWG fully endorses the proposed desorption experiment, as a means to collect valuable data for an informed decision on a-C coating of the SPS surfaces”**

◆ LINAC2

- **Installation and testing of a Multi-Slit Emittance Measurement, for Linac4 (R. Scrivens)**
 - **Installation of a emittance measurement inside the present LTE, separate measurement line**
 - **Installation would take place in a technical stop after summer 2010 that may have to be slightly extended => E.g. on August 30th (36 h of Technical Stop)**
 - **Measurements would then take place over a couple of weeks using ~ 1 / 12 of the beam cycles in Linac2**
 - **Measurements would be in // to operation or other MDs**

ALL THE REQUESTS (2/25)

■ Linac2-PSB stray field compensation study (R. Scrivens)

- A 1st MD (2 h dedicated) is needed to remeasure the trajectory perturbation as a function of PS magnetic field (Dedicated as these measurements require the compensation is inhibited)
- Set-up:
PS Supercycle: ZERO - EASTA(no beam) - ZERO (repeat if required)
PSB Supercycle: ZERO - EASTA(no beam) - NORMGPS - ZERO
The EASTA peak field is ramped up, and the LT-LTB-BI trajectory measured on the NORMGPS cycle
- A 2nd MD (2 h //) is needed to implement and test new trajectory compensation parameters after calculation. Should be at least 1 week later. The user series shown above is needed, but only once per supercycle (and the rest of cycles can be used)

ALL THE REQUESTS (3/25)

◆ PSB

■ Tracking of the PSB transverse narrow-band impedances (A. Blas):

- Motivation: Establish requirements for a new transverse feedback system in the Linac 4 era (doubling of the intensity)
- Conditions: 6×4 h in //. Medium intensity h=2 beam
- Preferred period: From April onwards

■ Head tail instabilities on all rings (D. Quatraro):

- Conditions: 2×4 h in dedicated (need to temporarily short-circuit C04 on R4)

■ Ring 4 instabilities, various measurements (D. Quatraro):

- Conditions: 4×4 h in dedicated

ALL THE REQUESTS (4/25)

◆ PSB

- **Control chromaticity and compensate space charge with multipoles (G. Rumolo):**
 - Preferred periods: Once new multipole controls available (later in the year if at all)
 - Beam: MDPSB, //
 - Particular requirements: Need new multipole controls

- **Continue measurements of resonance lines at 160 MeV and compare to 50 MeV (G. Rumolo):**
 - Motivation: Preparation work for LINAC4
 - Preferred periods: Throughout the year on a // MD cycle
 - Beam: MDPSB and a new beam, to be prepared

- **Measure emittance growth for space charge studies at 160 MeV (G. Rumolo):**
 - Motivation: Preparation work for LINAC4
 - Preferred periods: Throughout the year on a // MD cycle
 - Beam: MDPSB

ALL THE REQUESTS (5/25)

◆ PSB

- **Evaluate automatic injection steering with YASP (B. Mikulec):**
 - Motivation: Deploy YASP on the PSB and beam lines
 - Preferred periods: Throughout the year on a // MD cycle

- **Continue debugging wire scanners (B. Mikulec):**
 - Motivation: There are still some open points
 - Preferred periods: During day time on a // MD cycle (any users)

- **Transverse emittance blow up (A. Findlay):**
 - Motivation: When we produce LHC beams with lower intensities than specified, also the transverse emittance goes down => Possibility to blow it up to nominal in the PSB
 - Preferred periods: Throughout the year on a // MD cycle

- **RF limitations for high intensity (A. Findlay):**
 - Motivation: Find out where the limitations are and how they can be cured, in view of Linac4
 - Preferred periods: //, need an MD user per SC during day time

ALL THE REQUESTS (6/25)

◆ PSB

- **Test and deploy digital beam control on single ring (M.E. Angoletta) => Commissioning planned at the moment for early 2012@latest (see APC 27/02/09)**
 - Motivation: **Needed for Linac4, but the sooner the better**
 - Preferred periods: **//, need an MD user in the SC during day time**
- **Maximum intensity in single batch transfer (A. Findlay)**
=> Joint MD with PS
 - Motivation: **Find out maximum intensity in single batch transfer and possibly deploy this operation mode for the LHC25 beam**
 - Preferred periods: **//, need only an MD user in the SC during day time**

ALL THE REQUESTS (7/25)

◆ PS

- **RF MDs (S. Hancock) => In decreasing order of priority**
 - 1) Single-batch intensity limit at PS injection (Joint PSB/PS MD)
 - 2a) Coupled-bunch instabilities on h=21 (3 × 8 h in //)
 - 2b) Transient beam loading during 10→20MHz splitting (2 × 8 h in //)
 - 2c) Effect of 10MHz cavity detuning on instabilities during acceleration (2 × 8 h in //)
 - 3) Test of new one-turn-delay feedback using C11 (2 × 8 h in dedicated)
 - 4) 10MHz cavity counter phasing to produce low rf voltage (2 × 8 h in //)
 - + the 150 ns bunch spacing production in the PS (new request from ALICE)

- **PS transverse feedback (F. Blas) => Test the new electronic board that should be available in August 2010:**
 - After previous tests with electronic circuits partially adapted to the requirements, test of the PS TFB system in its fully operational version
 - Conditions: 7 × 4 h in //, low intensity, h=8 beam for a first session (after August). The following sessions would test the system on all the high intensity beams

ALL THE REQUESTS (8/25)

◆ PS

- **Optimize the beam parameters of the 5 BP long LHC super-cycle and 2 BP SFTPRO like cycle in case of failure of the rotating machine (Y. Papaphilippou):**
 - In 2009, the 2 cycles were set-up. For the LHC type beam we managed to deliver almost 50% of the nominal intensity. Working point optimization is needed for the full intensity
 - The SFTPRO/CNGS type cycle the magnetic cycle has to be prolonged to reduce the Bdot. The magnetic cycle is set up but measurements are needed for optimization (transverse and longitudinal)
 - Conditions: **1 × 8 h in // + 1 × 8 h in dedicated. For the LHC type, special SC with 14 BP and only 1 long LHC 5BP cycle. Physics (or other beams cannot be guaranteed (rms current). For the other beam, any cycle is good, with 2 BP space for this cycle**
 - Preferred period: **End of May**

ALL THE REQUESTS (9/25)

◆ PS

- **Instability @ transition crossing in the PS (S. Aumon)**
 - Continuation of the studies performed last year, //

- **Studies at PS injection: tune shift measurements (S. Aumon)**
 - In 2009, we noticed slow losses during the 100 first turns on the TOF beam after injection
 - Conditions: 2 × 4 h in //

- **Studies at Injection in the PS (S. Aumon)**
 - New stray field model of the magnet41 during the shutdown => The optics of the end of the line changed, as the result the new optics to match PSB and PS is changing as well. Our last MD in December 2009 did not give any good results since the SEMfil were not working properly
 - Preferred periods: **During spring or summer (except from May 22 to June 15)**
 - Conditions: 1 × 8 h in dedicated followed by 1 × 8 h in //. SFTPRO or CNGS beam with a lower intensity

ALL THE REQUESTS (10/25)

◆ PS

- **INCA (S. Deghaye) => 2010 will be the year of the deployment**
 - 2 days are required during the **1st MD block of week 17**
 - After these studies, we will know when we will make the real deployment of INCA in the PS:
 - A first test of ~ 6 h, **fully in //**, should be planned during **MDs of week 22 (or 24)** to make the final checks etc. (no user needed)
 - **The real deployment** will then take place **during ~ 6 h, either in week 26, 30 or 35. This will be known only after the studies of week 17**

ALL THE REQUESTS (11/25)

◆ SPS

- **UA9 (CRYSTAL) in the SPS ring, with protons or ions (W. Scandale):** 5 shifts of 24 h => The last shift (week 41) will be done with ions. Same requests as last year (120 GeV/c coast, 4 bunches of ~ 1E11 p/b)
- **Transverse coupled-bunch instabilities in the SPS (N. Mounet):** 1 shift in dedicated with LHC beams (25 and 50 ns) + 1 shift in dedicated with SFTPRO => Not before Summer
- **Single-bunch instability studies (W. Hofle):** Continue our studies for a wide band feedback system in the SPS meant to cure single bunch transverse instabilities. This includes TMCI and e-cloud. For this we would like beam time with a longer flat bottom, grouped in three blocks with ~10 s flat bottom and the possibility of injecting single bunches and multiple LHC batches up to nominal intensity. The long flat bottom is required to do beam response measurements, acceleration would not be needed. I would suggest 3 x 8 h, and prefer to use the MD blocks in weeks 17-22-24-26. Half the eight hours should be with single bunch and half with multiple bunches (25 ns spacing). It might also be useful to do a test this year in the shadow of commissioning LHC if a flat bottom of 26 GeV/c could be prepared while not filling LHC with a single bunch from the PS

ALL THE REQUESTS (12/25)

◆ SPS

■ Measurement of the diffusion speed and of the halo density (W. Scandale):

- Motivation: Investigation of the halo formation mechanisms, also considered useful for the optimal setting of the crystal collimation in the SPS
- Conditions: 5 × 8 h in dedicated (coast at 120 or 270 GeV/c). Single bunch of 1E11 or of several (up to 12) bunches of 1E11 protons
- Particular requirements: UA9 instrumentation and collimators

ALL THE REQUESTS (13/25)

◆ SPS

■ Commissioning of the new SPS BPCE Interlock system (T. Baer):

- MDs, tests and simulations in 2009 underlined and helped understanding the vulnerability of the SPS to fast equipment failures. Currently, final works concerning the BPCE hardware and the software implementation are going on. **In early 2010 the system needs to be tested and commissioned**
- Conditions: **3×10 h in //**, as early as possible to protect the SPS against its vulnerability to fast failures as fast as possible. **The MDs are preferably in intervals of 1-2 weeks**

■ Further setting-up studies of TPSG (B. Goddard):

- Complete studies started in 2009 to verify protection of extraction septa in LSS6 for high intensity LHC beam
- Conditions: **2×8 h in //**, LHC pilot/probe single bunch 450 GeV extracted to TT60 TED

ALL THE REQUESTS (14/25)

◆ SPS

- 1) setup tests with the new “phase 2” LHC collimator in the SPS (in-jaw buttons) and 2) fast collimator controls setup tests (R. Assmann):
 - 3 x 8h in coast at 270 GeV/c, with different intensities (up to full LHC batch)
 - 1 x 8h in coast and pulse for halo (and halo removal) measurements

- **Beam instability in a double RF system (E. Shaposhnikova):**
 - Studies of limitations of a double RF system when used as a Landau system for beam stabilization. Important both for SPS operation and LHC upgrade
 - 3 x 8h dedicated (LHC nominal cycle), variable beam intensity and constant longitudinal parameters, 1 and 4 bunches

ALL THE REQUESTS (15/25)

◆ SPS

■ I-LHC (T. Bohl):

• PART I

- 4 days of // 1-injection cycle (08-18h) MD per week during the 6 weeks of commissioning of I-LHC in 2010

+

- 3 dedicated MDs with the full 4-injection I-LHC cycle of about 10h each, spaced by about 2 weeks during the six weeks of commissioning. It might be that toward the end of the commissioning period we would like to have the // 1-injection cycle be replaced by a // 4-injection cycle

• PART II

- 2 dedicated MDs with the 13-injection I-LHC cycle and nominal beam during the LHC run with the early beam (each about 10h) => MD block of week 41

■ I-LHC (J. Jowett) => Measurements of transverse emittance, lifetime, etc. in the Nominal ion cycle

- Some time should be also reserved for that if not possible to fit it in the RF MDs

ALL THE REQUESTS (16/25)

◆ SPS

- **BI studies (R. Steinhagen) => a) Collimator Diode-BPM prototyping b) Classification and systematic studies of the SPS shoe-box pickups c) Prototyping of a non-perturbative BBQ-based quadrupolar injection mismatch monitoring system**
 - a) The 2009 prototype tests showed promising results w.r.t. resolution and the potential measurement accuracy. Our tests in 2010 are needed to verify the robustness and systematics w.r.t. various beam conditions that may deteriorate the measurement accuracy and in particular to test the local tunnel installation
 - b) These tests are required in view of the planned SPS MOPOS BPM electronics renovation. The main target is to assess the performance, signal levels and quality under operational and various non-standard beam conditions
 - c) The instrumentation is a priori passive and these studies shall assess the sensitivity of the system to injection mismatch and quadrupolar instabilities. **Some dedicated MDs with deliberately mismatched transfer lines/injection may be required**

ALL THE REQUESTS (17/25)

◆ SPS

- **Conditions: 4 x 4h in // + 2 x 3h in dedicated. Various beam types, patterns and bunch intensities => Most of the measurements can/will be done in // to regular operation. Some (as e.g. the injection mismatch) may require dedicated MDs to not perturb regular operation**
- **Particular requirements: We may need some short accesses to the SPS to modify the tunnel installation/cabling in between or before MDs**

ALL THE REQUESTS (18/25)

◆ SPS

■ SPS scraper studies (K. Cornelis and J. Wenninger):

- Tests in the SPS earlier this year were made by Karel with the new jaws (copper jaws of 3 cm replaced by graphite ones of 1 cm)
- Scraping seems to be best done in the ramp
- However, the tests that can be done in the SPS itself are very limited, since the only device (except 'trivial' beam loss) for diagnostics is the wire scanner with rather limited resolution for tails
- Best sensitivity is achieved when the beam is sent to the LHC (loss on collimators) given that even tails of a pilot seem to count

ALL THE REQUESTS (19/25)

◆ SPS

■ SPS studies in view of an installation of a KEK-B crab cavity in the SPS (R. Calaga and E. Métral) => <https://emetral.web.cern.ch/emetral/CCinS/CCinS.htm>

- “To take a final decision (on the usefulness of the SPS measurements with the KEK-B Crab Cavity), MDs are proposed in the SPS in 2010”
- “One of the most important measurements is the effect of the RF noise on the horizontal emittance. To study this, one needs first to have a beam with good “horizontal emittance lifetime” (and not only the usual beam current lifetime). Furthermore, the tilt from the Crab Cavity should be at least of the order of the horizontal beam size to see something (which would ideally mean to use bunches with a horizontal rms. norm. emittance of ~ 2 microm and a beam momentum of 55 GeV/c). Therefore, it is proposed to perform some MDs in 2010 in the SPS to **study the horizontal emittance lifetime in coast (at 55 or 120 GeV/c)**, without a Crab Cavity, with few bunches (first, and then few batches to challenge the RF, introducing transients) spaced by $4 \times 25 = 100$ ns (to be more precise $4 \times 24.95 = 99.8$ ns which is compatible with a frequency of the Crab Cavity of 511 MHz). The good news is that the 100 ns bunch spacing beam will be prepared next year to satisfy a new request from ALICE”
- **In fact only the 150 ns bunch spacing is planned at the moment. Can we do also 100 ns bunch spacing? (still to be discussed with S. Hancock)**

ALL THE REQUESTS (20/25)

◆ SPS

■ SPS impedance and TMCI (B. Salvant)

- TMCI vs. chromaticity and vs. the transverse emittances (between ~ 1 and 5 microms, to modify the space charge), tune shifts, localization (may be at the end of the year?), chromaticity scan with a long bunch (no RF in the SPS)
- Conditions: // MD cycle at $26 \text{ GeV}/c$. Usual “low-emittance” ($\sim 0.2 \text{ eVs}$) bunch used in the past for SPS impedance measurement + nominal LHC bunch ($\sim 0.35 \text{ eVs}$ injected in 2 MV etc.) with highest possible intensity

ALL THE REQUESTS (21/25)

◆ SPS

■ **Fragmented ion beam tests for NA61 (I. Efthymiopoulos)**

- **Schedule: Minimum of 2 x 8 h beam time as North Area ion MD, preferably with a short interval between the two. No other beams to SPS during that period => Week 47 was finally reserved for that (see Schedule)**
- **Primary beam optics: we will run with two optics modes: the "standard" one with the beam focused on T2 target, and a special one with the beam focused few meters downstream at the converter. I can provide the relevant information**
- **Beam conditions: consider three tunes (if time allows) say 20 - 40 - 80(100) GeV/nucleon**
- **Secondary beam: I will take care of all the modifications for instrumentation etc. in collaboration with the experiment.**

ALL THE REQUESTS (22/25)

◆ SPS

- As tentative schedule:

- 1st MD:

- ❖ Test extraction at the highest energy
 - ❖ Test beam focusing on the T2 target and transmission along the line
 - ❖ Test instrumentation and detectors, in particular as the beam will not be debunched
 - ❖ Optimization tests for beam focusing at the experiment
 - ❖ Move focusing to converter and try to select B (or whatever) beam splices using the instrumentation
 - ❖ Studies to optimize selectivity with converter and degrader thickness

- 2nd MD:

- ❖ Repeat same steps at lower energies

ALL THE REQUESTS (23/25)

◆ SPS

- **BBLR (Octavio Dominguez Sanchez De La Blanca) => Beam-beam excitation and compensation studies for: (1) reproducing and compensating 1-2 nominal LHC IPs at the tunes (0.31, 0.32) and (0.31, 0.28); (2) reproducing a beam-wire distance scan from 12 to 7 sigma reproducing 12 long-range encounters at the tunes (0.31, 0.32) and (0.31, 0.28)**

- **Motivation:** In the 2009 beam-beam MDs (120 GeV/c in coast) we observed that the transient beam losses due to the wire excitation last 2-3 minutes. During the transient, the beam losses depend significantly on the tails distribution while the steady state losses are dominated by the wire extraction mechanism itself and the initial distribution plays a minor role. In order to rescale the SPS results to the LHC we can (-1-) collimate the beam tails and (-2-, crucial) have an observation time longer than the transient: **a coastable beam is required. A 55 GeV/c coastable beam has several advantages with respect to the 120 GeV/c one we had last year: easier beam steering, no need of emittance blow up, increased effective strength of the wires, increased precision of the beam-wire separation measurement...** Even if we cannot mimic the beam-beam head-on interactions at the SPS, these MDs can give an important preliminary quantification of the beam losses that the long-range encounters of 1-2 IPs of the nominal LHC are likely to induce. Moreover we can confirm the curing effect of a compensating wire and, regarding the LHC Luminosity Upgrade, scenarios similar to the one of the Early Separation Scheme can be investigated (never done in coast before)

ALL THE REQUESTS (24/25)

◆ SPS

- Conditions: 3 x 8h in dedicated (coast at 55 GeV/c). Nb = 3-8E10 ppb, 4-12 bunches at 25 ns, $\epsilon_n > 1.5$ mm mrad (optimal $\epsilon_n = 2-3$ mm mrad)
- Particular requirement: **Possibility to collimate the beam**

ALL THE REQUESTS (25/25)

◆ SPS

■ SPSU SG and RF Group (E. Shaposhnikova)

Problem with ZS - what can be done before?

(A) LHC beam:

25 ns

- (1) Scrubbing run
- (2) Beam loss studies (flat bottom) - (e-cloud or TMCI?):
 - measurements during scrubbing run and in following MDs with "reference" conditions
 - effect of transverse emittance, chromaticity, working point, voltage
 - compare 25 ns and 50 ns spacing, different number of batches
- (3) ZS and MKDH with ABT Group
- (4) e-cloud studies in coated and uncoated magnets
- (5) maximum emittance blow-up for high intensity beam (RF team)

50 ns bunch spacing
- MKDV

(B) Single bunch (parallel MD cycle when possible):

- (1) Inject maximum longitudinal brightness N/emit and maximum N
Measure the threshold of the TMCI as a function of
 - chromaticity
 - voltage
 - double RF system settings
 - transverse emittance

- (3) Longitudinal instability in a single and double RF system
 - variable intensity, constant other bunch parameters, 5s (or max) long flat bottom

- (C) Maximum single and total intensity possible from injectors (any number of bunches) - joint MD with PS and PSB

The 1st MD block of week 17 is reserved for that + 8h during each "LHC set up Injector MD"

See B. Salvant's MD

3 x 8h dedicated (LHC nominal cycle), variable beam intensity and constant longitudinal parameters, 1 and 4 bunches