Status of the machine studies

APC, 14/09/07

1) Non-liner chromaticity measurement in the SPS (R. Tomas, 23/08)

- Acquired enough data to measure nonlinear chromaticity for the full LHC cycle from BBQ and PLL.
- Next step: correction tests.

2) BBLR-wire (U. Dorda, 27/08)

- No initial settings for the BBLR were set in the trim editor. This caused problems, which could be solved but cost some time (this should be fixed in the software).
- Wire results at 55GeV, current, distance and chromaticity scans.
- Next step: Data evaluation, tune scan.
- Requirement: Still to rotate the BBLR at next possible time => Certainly not this year!

3) 75 ns LHC variant (S. Hancock, 23/08)

- Pb: The beam was shaved due to a severe mis-steering at injection then Linac 2 went off, so we only worked in the afternoon.
- PA.GSPC20 was commissioned and four bunches of near-nominal intensity were ejected inside spec (longitudinally, at least).
- Next step: The fine synchro is not yet active. Also, stability is marginal when more than one Booster ring is injected. Work needs to be done to turn on the CBI feedback (this will be the first time on h=14).
- New requirement: No new beam requirements, but sharing the available time slots for parasitic work may be an issue.

4) Beam stability in a double RF system (E. Chapochnikova, 27/08)

- Pb: Could not have high intensity back at the end of MD after working with lower intensity.
- Single bunch was stable during coast at high intensity in all regimes. It had un-damped oscillations at lower intensity in bunch lengthening mode. In general bunch was more stable in bunch shortening mode than in bunch lengthening mode, but comparison with case of 800 MHz off is less clear.
- Next step: To have more than one bunch in the coast and continue studies with a single bunch on the flat bottom (could be done on parasitic cycle if available).

5) Investigation of C04 cavity behaviour with high intensity H1 MERIT type beams (A. Findlay, 29/08)

- Could confirm that the C04 system does not have the power or cooling required to maintain the voltage on the extraction flat top with a high intensity (more than 600 E10 protons accelerated per ring) beam.
- Next step: To quantify the limitations due the C04 on bunch length and emittance for the required intensities.
- New requirement: Further tests should be done during normal setting up sessions with the beam in the PSB, so no further dedicated MD sessions presently required.

6) Slow extraction sectupoles in SS1 instead of SS3 (R. Steerenberg, 29/08)

- Pb: The MD time came with short notice in the shadow of SPS magnet repairs. Therefore the total time was a little short.
- Reasonable extraction efficiencies (I was told ~ 90%?). Experiment crew satisfied, but we need to try to optimize the extraction efficiency over the next week(s).
- Next step: Optimize extraction efficiency and reduce losses.
- New requirement: Not really if successful, if not then access to re-cable XSE in SS3.

7) LEIR to PS matching (C. Carli, 29/08)

- A large horizontal betatron mismatch (90% so-called geometric mismatch, which would lead to 22% rms emittance blow-up) was found. Some (not dramatic) dispersion mismatch was measured as well.
- A rather small vertical mismatch was found.
- When we switched to the very first transfer line setting (before the first measurement), we found very large mismatches (just from the application program).
- A new setting of the LEIR to PS transfer line based on these last measurements exists. However, the observed mismatch may be at the limit where such iterative procedures to improve matching do not work any more.
- People are working to improve the Secondary Emission Profile monitors in the ETL line. Hopefully, this will allow understanding better the transfer from LEIR ejection to a location just upstream from the PS field.

- If time is available next week, some measurements can be redone. Parasitic measurements in the ETL line should be performed first and, possibly, find a setting which yields the design Twiss functions there. At a later date, we would like to measure PS injection matching with different transfer line settings in one MD (to disentangle changes of the setting of the line from possible other effects).

8) TMCI at SPS injection (G. Arduini, 27/08)

- Some data taken for 3 intensities in parallel to Elena's MD. The threshold is between 4x 10^10 and 8x 10^10 p/b.
- What is strange is that the instability seems to develop first in the H-plane.

=> To be looked at in detail.

9) Cancellation of the next (first) dedicated ion MD (initially foreseen on TU 04/09)

- After several discussions with Django, Christian, Paul, Christoph etc…, the next (first) ion dedicated MD of 8 hours, initially foreseen on 04/09 has been cancelled (the 8 hours are lost).

10) Nominal LHC beam in the SPS (22/08)

- MKDV is out gassing with 4 times 72 (nominal) bunches, which dumps the beam just before 450 GeV/c => We decreased the intensity per bunch (the limit for the MKDV was ~ 700E10 p / PS batch) and then after few minutes due to the beam dump TIDVG, which is also out gassing, the beam was cut (there is an interlock on the MKP's vacuum) => Laurent Ducimetiere, Etienne Carlier and Jan Borburgh informed.
- Idea of GA: Make a horizontal bump (using MDH11407 and MDH11832) at the MKDV which is at 117 => Effect still to be analyzed.
- 5 TSTLHC25 in the PS => Rms pb with the 8 loop (it cuts the beam even with 4 TSTLHC only, due to the other EAST beams in the supercycle) => To be redone another time.
- An instrumentation timing is needed when the beam is in COAST, otherwise many types of equipment do not work (BCT, FBCT, scrapers, orbit, beam loss… However, wire scanners do work!) => Jorg will follow-up this issue to be ready for the next SPS Long MD.

11) QKE16CT in the PS (S. Gilardoni, 23/08)

- The CT losses have been displaced from SS09 to ~ SS75 using the QKE16CT as foreseen from simulations and the PS is now operating like this => Perfect (no loss anymore in SS09)! We are waiting now for the measurements from RP (movable monitor installed…), but already congratulations!

12) IPMs in the SPS (I. Koopman, 20/08)

- As we had no signal we went with Jan to the point 5 and found that the camera was dead. As there is no spare, we need to buy another one and it may take 2-3 months... meaning 2008. I asked Jan to clearly look at it in detail and keep me inform if the camera is really dead and if we cannot have one before the end of the run…

13) Ions (D. Manglunki => Ion meeting on 22/08)

- Good news:
  - Beam on d3.
  - Beneficial effect of the radial loop as expected (~ 20-30 % of losses now compared to ~ 50-60 % last year).
  - Limitation on the power supply at 20 A is not HW but software => Solved and it can be decreased to 12 A.
- Bad news:
  - Stripper too slow => Tech. Stop.
  - ABS not ready in TT2 for ions.
- Long SPS MD foreseen in week 43 on SA => week 45 on TH => This has been approved.
- 3 cycles required (the supercycle length will be 16.8 s):
  - MD parallel => 17 protons equivalent at injection, flat-bottom of 2.4 s + 60 ms (for the RF) to have 2 injections and then go to the highest energy.
  - Early (up to 4 bunches) => Reduced injection plateau (7.2 s) and "fast" ramp to 450 GeV/c.
  - MD for collimator: coastable at 270 GeV/c.

14) 5-current mode for the PFWs in the PS (23/08)

- The PS is operating in 5-current mode since TH 23/08 => Congratulations to all the people involved (OP, PO, ABP…).
- DIRAC now claims that the 5-CM is better than the 3-CM.

- Still some pbs, less critical, to be solved.
- Measure matrices in parallel MDs.

16) Setting-up of the "LHC pilot beam" in the SPS MD cycle with 72 bunches (K. Cornelis, weeks 33&34)

- Succeeded to accelerate the 72 bunches up to 450 GeV/c with ~ half nominal intensity.
- Fast BCT shown in the Logbook (24/08) at top energy with 3E10 p/b.

17) Achieving nominal longitudinal beam parameters + Beam quality checks (T. Bohl, 22/08)

- We had for some time acceptable beam.

- The main problem was that we could not have 4 batches of nominal intensity for more than a few cycles due to MKP outgassing.

- Setting-up of h/w went fine. In view of a beam quality monitor, a lot of bunch profile measurements were made which have to be analyzed. New h/w for longitudinal emittance blow-up was used for the first time during an acceleration ramp. Initial results look promising, further analysis is ongoing. Data concerning losses at flat bottom and beginning of the ramp were acquired. Thanks to Elias who let us continue our MD longer than originally foreseen.

18) Optics measurements of AD beam in TT2, with QKE58 ON and OFF (E. Benedetto, 30/08)

- The orbit is ok now and the extraction without QKE58 from the PS is successful.

- Need the help of an RF expert in the Central Building to manually adjust the synchro when varying the beam energy during the dispersion-measurements (as usual). Saving the SEM-grids/fils profiles is not at all automatic, but it is done manually, shot by shot.

- Dx (QKE58 on) ~3m, Dx (QKE58 off) ~ 3.8m @ beginning TT2, as for the measurements with LHC beam of LAST YEAR. Twiss parametes: to be completed

- Matching of TT2-FTA for the extraction w/o QKE58.

- Try the new optics in the CCC.

19) Optics and Dispersion measurements of LHC beam in TT2-TT10 and 1st turn SPS, with optics 2007 (QKE58 off) (E. Benedetto, 30-31/07)

- MD4 beam from PS, booster ring #3, I=~12e10, 1-4 bunches. Two sets of measurements with and without bunch rotation. Need to locally tune the 40MHz cavities for low intensity beam and remove the protection in order to be able to vary their frequency in a range of ~ 2kHz.

- Pbs: 1) the Excel application Passerelle for the Dispersion measurements was getting no more than 2-3 acquisitions of the SPS BPMs, before loosing synchronization with the passage of the bunch (needed to start different sets of measurements and then put them together "by hand"); 2) Couplers in TT2-TT10 sometimes do not acquire (needed to discard some measurements "by hand").

- Follow-up MDs 17Jul'07 and Nov'06: measurements with LHC-type beam (MD4 from PS), but with the new optics 2007, matched for QKE58 off. 1) Couplers calibration and beam response -> to be analyzed; 2) Dispersion measurements -with and w/o bunch rotation- -> preliminary results show dispersion mismatch in the ring and an horizontal dispersion at beginning TT2 of ~3m only (the line has been matched for a dispersion of ~3.8m, according to Nov.06 measurements); Profile measurements with OTR and SEM -> to be analyzed
- Next step: Continue the data analysis and understand if/why the horizontal dispersion at beginning TT2 is now only ~3m, with QKE58 off, while it was ~4m measured last year. Wait for the results of BPM response in TT2-TT10.

20) Optics meas. by Simone and Elena on TU 04/09 from 14:00 to 16:00

- Simone and Elena told me that on 04/09 at 16h22 that they took their meas. It seems that they have a ~ 20% beta-beat, due to the measurement as they don not have too many TVs as the beam is not sent to the SPS.
- Elena should compute the optics for tomorrow and Simone will install it on Friday. Then, we will let it for next week (no AD beam I think…) and the beginning of the next for confirmation from AD and then the QKE58 can be removed!!!
- Simone told me on 04/09 that he could not do the MD of meas. of the nonlinear chromaticity on MTE as the Qmeas does not work (probably they put a filter for the high intensity and now it does not work for low-intensity bunch => Simone will check with Marek tomorrow…)

21) LHC baseline Q' measurement using dp/p = 1e-5 modulation, tune-width measurement using side-exciter and diode-based head-tail phase shift measurements (R. Steinhagen, 27/08)

- Beam parameters were ok

- a) Due a missing/disabled timing event, most beam and RF instrumentation did not work during coast which made a systematic quantitative measurements difficult. b) Slow sinusoidal RF modulation did not work -> fall-back: step functions using the RF radial loop were used.
- It was demonstrated that the base-band-tune metre (BBQ) and attached tune-PLL can be tuned to resolve tune changes in the order of 1e-6 and below with an for the LHC adequate tracking speed. In combination with dp/p step function changes in the order of 1e-5 it was possible to derive the linear chromaticity down to a resolution of 1 unit. The diode based head-tail Q'-phase-shift method was tested and yielded inconclusive results. We assume that this is due to the chosen (fixed) 1 sigma separation between the sampling points of head and tail seem to be too large. Improvements are on the way....
- Next steps: Further quantitative tests are needed and as well as a functional test that demonstrates that the PLL can track sinusoidal dp/p modulation induced tune changes. The side-exciter based method needs further assessment w.r.t. to the influence of non-linear effects such as amplitude detuning (non-lin. Q') etc. as well as impact on beam emittance and beam life-time.
- New requirements: Same as before with available equivalent "beam-in" timing signal during coast. Check that RF modulation works (during coast).

22) AD optics without QKE58 (S. Gilardoni, 08/09)

- AD antiproton production same as with the QKE58 for the fast extraction. The retuning of the line has been done using in total 5 AD pulses.
- When AD is back, check the beam at the target, if light on the target repaired during the current AD stop.
- New requirements: AD antiproton target camera working.

23) Optics measurements in TT2 of AD beam (E. Benedetto, 04/09)

- Twiss parameters at the beginning of TT2 measured without QKE58. The new matched optics has already been done in the CCC (MD 7/09/07).

24) MD2 with one basic period but without beam (S. Gilardoni, 10/09)

- No resources available for the MD.
- No result => Repeat when time will be available.
- New requirements: The same will be repeated but shrinking the function of the 2bp user on 1bp user like but keeping 2 bp. This is because is not clear if the flat top of the bunch splitting of SFTPRO is needed (h8-h16) also in the MTE case and eventfully the minimum length required to do the splitting.

25) MD2 with one basic period and with beam (S. Gilardoni, 11/09)

- Since the preparation of the magnetic cycle on the 10/09/07 was not possible due to lack of resources, no results.
- Next step: The same will be done but using the 2bp user and shrinking the function to fit a 1bp user

26) Matching monitor in the SPS, LHC beam (E. Benedetto, 11/09)

- BTV1018 is not working -> we will contact S. Burger.
- We can see some mismatch in the SPS (as expected).
- Next step: Analyze the data and quantify the mismatch. Prepare a new optics, according to the initial conditions measured on the 31-07-07.

27) Technical test of scrapers with new application and beam and quick attempt to check tail re-population (H. Burkhardt, 12/09)

- Mostly good conditions.
- Not well known problems and apparently not very stable conditions in coast.
- The new scraper application was successfully tested with beam. We quickly checked on re-population and found evidence for major re-population in both the vertical and horizontal.
- Next step: Proper measurement of scraping efficiency and re-population (coast, 270 GeV).
- New requirements: Different intensity. We had about 1.2e12 which gives poor resolution on BCT3 and is just over saturation of BCT4 (about 7e11). Total intensity either around 1e13 (preferred) or 7e11. Need about 4h and known, stable conditions in coast. Possibility to ramp down rf and transverse feedback.

28) Summary for ions

- Ions have been seen in the SPS for few turns.
- The first 2 dedicated foreseen have been cancelled! => May be all the foreseen programme will not be completed this year => Need for ions in the SPS next year?