Status of the machine studies

APC meeting, 28/09/07

1) Study for the LHC BLM (B. Holzer, 11/09)

- There were rather frequent intermittent losses, but that is (most likely) not a problem.
- Currently unexplained partial loss of signal in different channels. Hence it is (most likely) not possible to get the IC to SEM response ratio from the data taken.
- Most system tests were successful (BLM data buffers, communication between BLM system to collimators, setting of thresholds, logging of data and threshold in database...). Frequency spectra taken, need to be analyzed.
- Before the next MD the problem with the loss of signal needs to be solved! Then, repeat from last MD the response ration IC to SEM, and continue with the second part of the MD (threshold settings, conversion factors Gy to bits, test the functioning of the beam abort trigger when loss level above threshold, take data for beam kicked into the collimator jaw - thesis project).

2) Collimation studies for ions in SPS: loss maps with injected beam (since it is not yet possible to do RF capture) using LHC Collimator with as a test of our ability to predict ion loss maps in the LHC (J. Jowett, 19-20/09)

- Yes (in the sense that this MD was a compromise planned at short notice, we would greatly prefer to do it with stored beam when that becomes available). A lot of work was done at the beginning of the MD to provide good injection trajectory and conditions (G. Arduini).
- Short down-time of ion source at start of MD. Behaviour of both Beam Loss Monitor (BLM) systems is not well understood: the SPS BLMs displayed negative values and the sign of losses could change from one injection to the next, particularly in Sextant 2. Nevertheless difference measurements showed the pattern expected from simulations in Sextant 5 (downstream from the LHC collimator). It was verified that the negative values are already in the data coming from the Front-Ends so are not an artefact of the application program. Apparently such effects have not been seen before with proton beams. The LHC-type BLMs in the SPS also gave strange data, in some cases, no data. Similar effects are seen with protons. The experts were present and are investigating.
- Wire scanner showed clean beam profiles in the vertical; apparent wide tails in horizontal are very probably due to the injection oscillations. Difference loss maps downstream of the LHC collimators seem to show the patterns predicted made by Roderik Bruce using the ICOSIM program (although these were for higher energy lead-ion beams). This includes a prominent peak at QD523 which is characteristic of certain ion fragments and is not seen with protons. As it was not possible to measure the closed orbit with the debunching injected beam, the collimator jaws were centred by symmetrizing losses from the individual left and right jaws. This worked better using the BCT rather than BLMs and the orbit displacement was established to be about 6 mm. A variety of collimator position and angle scans were carried out and data will be analysed. Closing the collimator completely was also done, essentially stopping the beam.
- The LHC ion beam commissioning and studies in the SPS are behind schedule because of hardware delays and operational mishaps. We hope to have captured beam soon so the next MD will likely be on the properties of the stored beam (IBS, space-charge, etc.). Further collimation studies on the stored beam are also very high priority and should provide a clearer test of the methods used to predict losses in the LHC.
- It is important to understand and correct the behaviour of both the LHC and SPS BLM systems for future MDs. It is also important to know how we can use the data we already have from the SPS BLMs. It is clear that they have very useful physical content but a clear recipe for how to transform them into strictly positive loss rates is needed.

3) MTE: capture optimization (S. Gilardoni, 21/09)

- 400e10 from booster instead of 600e10 max.
- Capture with very small losses
- Next steps: Continue MTE studies. Either going to higher intesities, or more booster rings, or to one bp.

4) LSS4/6 and TT40/60 high intensity LHC beam commissioning (B. Goddard, 26-27/09)

- It took some more time than expected to set up the LHC pilot beam on the LHC cycles
- 3 trips of main SPS quadrupoles, some minor issues with applications controlling the SPS extraction kickers.
- Half nominal intensity LHC beams extracted to TT40 and T60 TEDs, individually and in an interleaved way. Interlocks tested, MKE kicker waveforms measured.
- Next steps: None for 2007. In 2008 more work is needed in the sequencing and control of the cycles for the interleaved extraction, especially concerning the user-destination concepts; in addition OP should regularly

make practise LHC filling scenarios with extraction of pilots and intermediate beam onto the upstream TL TEDs.

- New requirements: Some minor things noted concerning interlocking, cycling and applications.
- Email from Brennan (27/09): “Hi all, The tests yesterday worked very well, with the TT60 high intensity commissioning and half nominal intensity beam extracted in an interleaved way to TT40 and TT60 in a simulated LHC filling sequence... We've worked on the conception, design, construction and commissioning of these systems for over 10 years, and yesterday it all came together - many thanks to all involved, for the hard work and great results! There will be a debriefing meeting sometime next week - with a small celebration top of the agenda.”

5) Study for the LHC BLMs (B. Holzer, 26/09)

- Email from Bernd on 24/09: **”**Concerning the BLM system problems of the SPS and LHC system
    1. SPS system: the negative vales are not seen with protons, it is a new feature. It could be due to a subtraction of offset in the front end crate. (Lars Jensen and Franco Ferioli will try to find the cause of it).
    2. LHC system: the effect was reproduced in the LAB using long cables. Further understanding is needed to implement a solution.**”**
- There was not enough time to diagnose and improve the LHC BLM system after problems have been discovered in the MDs in week 37 and 38. Therefore, most of the time (including an access to the tunnel) was spent on diagnosis and improvement of the system (which was at least partly successful). Other problems: SPS BLMs showed similar problems as with ions in week 38 "the SPS BLMs displayed negative values and the sign of losses could change from one injection to the next, particularly in Sextant 2". The BPMs did not work in coast.
- 3 out of 4 tasks were completed. The first two were taking data for system diagnosis: The high voltage applied to the chambers seems to be one origin of the missing signals. Crosstalk is another possible cause, which needs to be further investigated. Task 3 was data taking for the SEM during scraping with the collimators. It was not possible to take data with SEM and IC at the same time - but it was possible to take them after each other. That is hopefully sufficient. The last task could not be done due to lack of time: Kicking the beam completely into the collimator (as opposed to scraping).
- Next steps: Diagnosis and debugging of the LHC BLM system needed. Analysis of the data taken, lab tests, hardware changes will require machine access.
- New requirements: After the hardware changes we would need beam time (~4h) to verify the system. That could be in parallel with any MD that causes losses at the LHC collimators (ion).

6) MTE studies (S. Gilardoni, ??/09)

- Capture succeeded with 4 bunches (multi-bunch beam splitting realised for the first time!) with very few losses but at relatively low intensity.

7) Fine synchronization for the LHC75 beam (S. Hancock, 28/09)

- The last outstanding issue of fine synchronization for the LHC75 beam has been resolved using parallel beam time. Consequently, for next week, we would like to modify our time slot on Friday 05/10 to look at bunch rotation on TSTLHC25 using a double voltage step. In addition, we would be very keen to participate during the long ion MD but taking MDION for our own purposes while Django continues to work with the early beam on LHCION.

8) Discussion with the Physics coordinator (on TU 18/09):

- OK with the MD blocks.
- We both agreed that one should try and improve the fast switching between physics and MDs…
- No problem if we want to add few days here and there between the blocks (if we use only 2 of the 3 days).
- We also both agreed that one should try to clearly state on the schedule the time when physics is stopped => But in this case this will include the MD time + time of switching and recovering...

9) Accesses (on WE 19/09):

- Accesses in TT2 to check the magnets polarity, in BA4 (for wire scanner) and 5 (for IPM), and for the transmitters TRX:
- Conclusion of the meas. in TT2 of the magnets polarity => The QDE207 was indeed inverted and was changed! After inversion of the QDE207 the profiles are nice on the SEM-wires => We just have to centre the beam… However, they disappeared after few shots => This still has to be understood… However, then Django made a manual steering (ABS is not working as we have a bad optics) and then OK again.

- For the IPMs, Jan said that the 2 cameras are good (i.e. they are not dead) => 2 connection boxes were dead. He repaired one and he will see for the second. On 25/09, Jan Koopman came with Virginia Prietto to look at one of the IPM together. The 2 cameras worked in the tunnel but only one works upstairs! And it is not the electronics as when he swapped the 2 cables only one camera still works! We will continue on MO 01/01.

10) Correction of the Laslett tune shifts in the SPS when injecting several batches (on 20/09):

- Jorg added a menu in the multiq using the Mathematica Notebook from Gianluigi. Go in the 'Tools' menu (main program toolbar) and check the box 'Show LHC beam "Injection Q"....'. This will make the appropriate menu/DV plot appear/disappear."

11) Study of the effect of energy (and transverse beam emittances) on the electron cloud vertical fast instability at 55 GeV/c (25/09):

- Transverse emittances (rms, norm.) meas. in the PS:
    - Inj (C180) => 2.2 (H) and 2.5 (V).
    - Before ext. => 3.5 (H) and 3.2 (V), i.e. there is a huge blow-up!

=> Might explain why the ecloud fast vertical instability is less critical this year in the SPS??? (but this is the effect we wanted to check!!!). It's a pity because one might not be able to perform other MDs this year and because we allocated some parallel MD time to check it the day before.

- Note that the transverse tunes were inverted in the PS (Qh ~ 6.25 and Qv ~ 6.22)!
- Email from Rende (26/09) => It seemed to be the transition that caused the transverse blow-up. He managed to improve it by changing the transition timing. The values measured after the change the afternoon were 2.8 in both planes, which are still larger than we had last year (~ 2.5). This is because of the PFW's, which we do not yet control fully due to the lack of matrices.

12) MD planning for week 40:

- MO 01/10 and TU 02/10: Increase intensity of CNGS in the PS.
- WE 03/10 (08:00) - WE 04/10 (08:00): SPS dedicated ion MD (to be defined at Django's meeting on Monday 01/10 at 15:00 in the CCC glass box 874/R-018).
- WE 03/10 (08:00 - 18:00): MDION (priority) and MTE-related studies.
- TH 04/10 (08:00 - 12:00): Radiation tests in the PS (with the QKE16CT ON, to compare to last year's results)

Beam conditions:

- Supercycle length = 33 BP = 39.6 s
- 14 CNGS at 2E13 p/p + 2 SFTPRO at 1.5E13 p/p (beam sent to the SPS physics users) => To have a proton flux equivalent to last year, i.e. ~ 0.8E13 p / s
- No beam will be sent to the other users during the morning!

- TH 04/10 (14:00 - 18:00): MTE-related studies (priority) or continue to increase the intensity of CNGS in the PS.
- FR 05/10 (08:00 - 18:00): Bunch rotation on TSTLHC25 using a double voltage step.