MSWG Meeting #8, 7-July-2017

Present: F. Antoniou, F. Avesta, H. Bartosik, K. Cornelis, R. Esposito, V. Forte, M. Fraser, K. Hanke, V. Kain, G. Kotzian, T. Lefevre, B. Mikulec, S. Montesano, A. Perillo, A. Sounas, G. Sterbini, F. Tecker

The MSWG minutes of the last meeting were approved.

Agenda:

Link to the Indico Event:

- Approval of minutes – Karel Cornelis
- Main presentations:
  - First results from crab cavity coast MD's in the SPS – Fanouria Antoniou
- MD updates:
  - News on recent Hews on recent HiRadMat beam size and position measurements – Apostolos Sounas and Stephane Burger

Status of Operational Beams:

PSB – Bettina Mikulec

All operational beams are running within specification with many LHCINDIV MD beams set-up for SPS and LHC. R2 used for some MD's because of C16 issue on R3. Good news from exchange of R3V wire-scanner with the position jitter now gone. **T. Lefevre** stated that the wire was found loose; unexpected as typically it breaks. The correct calibration table needs to be uploaded. Also, found source of vacuum degradation since EYETS in the BT line, located on the BTV that had been moved outside of the septum tank. This has been repaired and leak has gone. A complete list of interventions required for the C16 repair was given with a bad contact being the main culprit. A new calibration has been made for all 4 rings, and is being adjusted now with the beam. An offset observed in dispersion measurements of new BTMS system needs investigation.

PS – Klaus Hanke

Operational beams in a good state. MTE limited to 1.7e13 ppp at present, above which losses at extraction become unacceptable. **K. Cornelis** does not expect the intensity to be increased until the end of the summer. Investigations are being carried out to understand why the emittance of the LHC25 standard beam is 3 mm mrad and not closer to 2.5 mm mrad. The wire-scanner has been occasionally blocked, **T. Lefevre** explained that if **A. Guerrero** is away from CERN then **F. Roncarolo** should be called.

SPS – Hannes Bartosik

M. Fraser reported that for SFTPRO investigations on losses in LSS2 permitted the loss levels to reduced by about a factor two, with the culprit bring misalignment of the ZS2 cathode touching the extracted beam. Transmission in SPS for SFTPRO up to 96% with 3e13 ppp total intensity injected with MTE. Aperture is now improved after dipole exchange of MBA13370.

B. Mikulec asked if the vertical emittance constraint in the PSB can now be reduced. For the moment only about 6 mm mrad is available for the highest intensity version, and 4 mm mrad cannot be achieved yet (only for the present intensity). **H. Bartosik** stated that any further increase in the vertical emittance will result in a reduction in transmission.

For LHC the BCMS beam has been set-up. The 200 ns batch spacing is now being used operationally without problems. At present, still running without feed-forward on 200 MHz for all LHC beams; investigations by RF experts ongoing today. Provided MD beams last weekend with high brightness INDIV at 2e11 p/b and 1.5um, which was even too bright for the LHC!

Setting up of the RF on the short MD cycle started for the Xe ions.

Main presentations:

First results from crab cavity coast MD's in the SPS – Fanouria Antoniou

Preparations for crab cavity tests with protons in the SPS in 2018 are underway in order to ensure efficient use of the limited MD time next year. The MDs will aim at checking the induced emittance growth from phase jitter of the crab cavities, which is the main concern in the LHC. The work builds on MDs carried out over many years, of which a summary was presented. The plan for studies in 2017 include work on the Head – Tail monitor, closed-orbit correction, collimation studies and studies with shorter bunch length. During the first MD in May 2017 the RF feedback was identified as a source of off-bucket losses (particles lost out of the main circulating bunch) relevant to all coasting beams, which was corrected by turning off the feedback. Problems with the RF carried on into June and sudden jumps in bunch length needs to be understood. Calibration studies were made or the Head – Tail monitor, the BSRT showed promising data and Q20 optics was tested in the last MD slot. A preliminary summary of results was presented. A clear dependence of the emittance growth on the chromaticity was observed and IBS seems to play a role. If the expected effect from IBS is removed, the growth in the two planes tends to become similar. In next MDs systematic scans of the chromaticity will be made in order to define optimal chromaticity settings in both planes, a linear WS multi-scan will be made to verify the dependence on the number of scans and correlations between the vacuum degradation and emittance evolution will be investigated.

Discussion:

G. Kotzian explained to **K. Cornelis** that the transverse damper was off, its power system was on but without the feedback. **K. Cornelis** remarked that the Schottky spectrum in the transverse plane is also an interesting observable. From experience he expects to see lines of 50 Hz right up to 12000 Hz, which can cause significant issues for the beam stability over long periods of time. In the past, special capacitors were used to get rid of these lines when the emittance growth in coast was much better then it is now, when it was used as a collider. The capacitors had to be taken out because of induced voltage on the FT cycle. In addition, when in coast another active feedback circuit was used to filter

out all the noise with longer integration times, perhaps this can be done again in software with new digital control. **K. Cornelis** added that the chromaticity could be applied as low as 0.005. **F. Antoniou** reported that when the beam was taken very close to zero it went unstable. As it must stay positive this should be carefully checked again. At the moment it is not possible to make radial steering trims in coast, to be fixed.

G. Kotzian enquired if there is any indication that the RF feedback can be improved and asked if it is it something to be studied, or will it just remain off**. R. Calaga** stated that it is being studied, not only for this reason, but for now it's not needed and will be left off.

MD updates:

News on recent HiRadMat position measurements – Apostolos Sounas

The alignment and calibration of the BPMs was outlined. The BPMs located at the end of TT66 may suffer from noise induced by backscattering as the beam impacts the target material. Due to strong perturbations in the past, the electronics were moved to a more protected area but some noise is still observed, especially when using high-Z target. The affected bunches along the train are consistent with the time-of-flight that the first bunch takes to impact the target and the returning shower to reach the BPM electronics. The first bunch readings that are unaffected can still be used to understand the orbit of the first part of the train. Interestingly, the PS batch pattern along the SPS bunch train can be observed on the BPM signals.

Discussion:

T. Lefevre explained that the software for these BLMs was originally set-up and calibrated for single-bunches, where as the calibration is dependent on the length of the train. This is not systematically adjusted and if done when LHC is filling could result in strange results. **V. Kain** said that OP are aware of this issue and is easily taken care of. Sometimes it might be forgotten but it is very easy to identify the issue and correct quickly.

At present the average bunch position over an entire train is provided in logging for users. This has the problem that the backscattering corrupts the average and gives confusing data. The bunch-by-bunch data is also logged but the user needs to post-process this data to include only the first bunches in the computation of the average.

V. Kain pointed out that as the single bunch calibration is different to trains, could the kicker gaps in between the batches make the first bunch in every batch appear like the first and hence creating the periodic signal showing the PS batch length. **T. Lefevre** would rather expect this is actually a physical offset. **V. Kain** and **H. Bartosik** reported a similar phenomenon was reported at injection to the LHC and requires further follow-up to investigate the cause. The effect of dispersion causing such offsets (bunches with slightly different energies) is being investigated. **G. Kotzian** enquired if the structure seen on batch could be this correlated to intensity along the batch. **T. Lefevre** stated that the normalisation of the position is independent of intensity. **T. Lefevre** requested a test with only the first and last batches, which is in principle feasible.

T. Lefevre explained to **S. Montesano** that the BPM system as it is now cannot measure the bunch position for every bunch in the batch, but only the first ones. This is a present limitation induced by backscattering.

T. Lefevre also explained to **A. Perillo** that it is important to calibrate the BPM for either single bunches or trains, but with the target retracted.

News on recent HiRadMat beam size measurements – Stephane Burger (presented by Thibault Lefevre)

A new BTV was installed at the end of experimental Table A, in-vacuum to avoid Cherenkov parasitic light, with the objective of measuring the beam sizes for trains of up to 288 bunches. The details of the setup were outlined with the new feature that the camera is placed in a shielded location in the adjacent TT61 tunnel, with a long optical line linking it to the screen. At some point during measurements with beam tails were observed, making the beam size far larger than what was expected with large tails; investigations showed another source of light creating "satellites" probably coming from "reflections." Indeed, investigations during the ITS2 found the SiC screen was broken, which is a likely culprit for the observation of tails coming from forward OTR scattering on the crack. A thin carbon foil was also installed to stop the forward OTR from the BTV vacuum tank window.

Discussion:

T. Lefevre stated that the crack was probably caused by mechanical forces arising from the clamping that appeared rather tight, although we can't exclude that it was broken by the beam. **K. Cornelis** suggests that this is further investigated to see when the tails appeared and what intensity was put on the BTV at that point.

The performance of the modified system will be checked as soon as possible with the next HiRadMat run.