MSWG Meeting #15, 27-Oct-2017

Present: S. Albright, F. Asvesta, H. Bartosik, N. Biancacci, M. Carla, K. Cornelis, H. Damerau, G-P. Di Giovanni, V. Forte, M. Fraser, B. Mikulec, A. Gerbershagen, G. Guidoboni, S. Hirlander, A. Huschauer, T. Lefevre, G. Papotti

The minutes of the last meeting were approved.

Agenda:

Link to the Indico Event:

- Approval of minutes – Karel Cornelis
- Status of operational beams – Machine supervisors
- Main presentations:
    - LEIR longitudinal Schottky improvements and measurements analysis – Simon Hirlander
- MD updates:
    - SPS slow extraction efficiency measurements: 2016 vs. 2017 – Matthew Fraser

Status of Operational Beams:

LEIR – Nicolos Biancacci

Improved transmission from Linac3 pushed intensity towards 4-4.5e10 charges. The EARLY beam is operating stably at 2E10 charges. Progress made in MD has been propagated to the NOMINAL beam with over 6E10 charges extracted to the PS. Modulated RF capture has increased the intensity by 0.5E10. Resonances are being probed in MD as well as combined multiple RF harmonics to flatten the bunch. The effect using the Ionisation Profile Monitors on the operational beam was discussed and the compensation of the kick imparted on the beam was explained.

K. Cornelis asked if the IPMs age when kept it on. Indeed, they do and they should be turned off when they are not needed: as a safety measure, they are run on an automatic timing and turn off after 2 hours. **H. Bartosik** enquired about the ripple, which is caused by the long cables (25 m) from the power converter. This is a real effect and not an OASIS artefact as was previously speculated. An action is underway to reduce the ripple. **H. Bartosik** suggested that we should try and make IPM operation independent of losses by applying a correction and suggested to to infer the IPM kick from orbit response measurements.

PSB – Gian-Piero Di Giovanni

OP beams running fine. Since TE-EPC intervention to fix the systematic drift in AQN current on BT1.SMV10 with respect to the CCV value last Tuesday no drifting has been observed. During the stop

for RP survey BLMs around BHZ502 were finally connected to investigate R2 hotspot. The additional BLMs were added to the PSB BLM application and first measurements indicate losses starting at injection for about 50 ms. The losses disappear when disabling the R2 vertical correctors.

Special INDIV beams have been set-up including the 4b VdM at 1.3E11 ppb and EH/EV = 1.5/2.0 µm and a request for LHC Roman Pot tests for INDIV 8-10E10 ppp with as low emittance as possible: < 1 µm.

PS – Matthew Fraser

OP beams OK. Both LHC special run beams played in the PS with VdM extracted at about EH = 2.5 µm and the Roman Pot INDIV at 0.7 µm. A first set-up of the LHC NOMINAL ion Xe beam (2b, 100 ns) has been carried out and is available for the SPS at about 6E10 charges. Setting up of the high intensity MTE beam is ongoing for further tests foreseen next week as the extraction losses have changed since last week, to be understood. WR transmission of the B-train for POPS regulation has been updated and since Tuesday no missing cycles of POPS have been observed. In addition, the new B-train measurement propagated on WR was also tested on several clones of operational users with success. An issue on the setting of the TFixLoop parameter of the TFB is causing confusion for operators and MD users as every trim decreases the value of the setting by 2 ns: BE-RF have been informed. Very promising tests of the BGI were being carried out today, comparing to the wire-scanner and checking the minimum integration period needed vs. intensity.

SPS – Hannes Bartosik

North Area fixed target physics has moved to ions with the beam momentum currently at 358 Z GeV/c, the highest of 6 energies requested. Spill quality is a challenge but on-going improvements are being made and progress is good. Unfortunately, there are no diagnostics capable of measuring the 50 Hz ripple on the ion beam to permit correction. Improvements have been found by increasing chromaticity and increasing the rate of the tune sweep. Yesterday the VdM beam was sent to the LHC successfully for first tests. First test of the MTE beam permitted over 4E13 ppp to be accelerated through transition and horizontal aperture studies show a strongly asymmetric momentum acceptance, possibly due to the design of the MBB-QD vacuum flange transition.

Main presentations:

A new approach to longitudinal Schottky characterization at LEIR – Simon Hirlander

The LEIR longitudinal Schottky signal throughout the entire cycle was used to motivate the usefulness of such a diagnostic tool and the improvements that have been made recently, including signal quality and resolution, analysis techniques and software. Information on the injection efficiency, beam quality from Linac3 and space-charge effects can all be gleaned from the plot. An important step of extracting the beam intensity from the Schottky spectrum was made, allowing beam losses and cooling to be understood at different times in the cycle with multiple injections. An operational tool was developed to analyse the Schottky signals online, quickly with a single acquisition and on a cycle-by-cycle basis.

A first application of the tool was to the analyse the beam scraping and injection quality for the multiple injection process. A good agreement with the measured intensity using the BCT could be attained. The

tool gives more information than the BCT as the energy of the particles lost can be measured and "loss spectra" produced.

A second application was demonstrated with a measurement of the cooling performance by observing the momentum spread of the beam along the cycle. The cooling time could be extracted on a cycle-by-cycle basis. The longitudinal Schottky software tool promises many future applications.

Discussion:

H. Bartosik is looking forward to an application capable of monitoring the quality of the injection performance and cooling performance online. **S. Hirlander** explained that they are waiting for a proper FESA class for the Schottky; first a python tool will used to demonstrate the principle before a proper Java operational tool is developed. **V. Forte** asked if this was the same device used to measure the chromaticity. **H. Bartosik** explained this was the case using the Schottky to measure the mean energy of the beam with cooling as the mean beam energy changed, along with the tune change: this could be done with a coasting beam. It would be interesting to pursue this to measure the chromaticity in a single-shot measurement.

MD updates:

SPS slow extraction efficiency measurements: 2016 vs. 2017 – Matthew Fraser

The large systematic calibration errors on the Secondary Emission Monitors (SEMs otherwise known as the BSIs) in the North Area used for the measurement of the DC slow-extracted beam intensity make directly measuring the extraction efficiency impossible. To quantify the calibration error of the BSIs and to estimate the slow extraction efficiency, an indirect technique was employed based on calibrating the measured loss signal on the BLMs with the ring BCT. The BLM signal is sensitive to even small changes in the extracted intensity. The technique was recapped: ZS is voluntarily misaligned to change the extraction efficiency and the correlation of the loss vs. extracted intensity measured and calibrated against the ring BCT.

As a result of similar measurements made in 2016 the BSI foils in 210279 (upstream TED in TT20) were exchanged with new foils. The measurements made in 2017 showed that the new foil (BSIA) has a 12.5% higher Secondary Emission Yield compared to the old foil last year. There are two foils at this location and the downstream foil, BSIB, measures 14.7% higher than the upstream foil BSIA. This phenomenon was reported by **F. Roncarolo** at the SLAWG on the foils inserted in TT10 and needs further investigation. **M. Fraser** added in the discussion that the difference measured between the foils in TT10 changed over time. The calibration error in 2017 of the BSIA foil was measured at 21.6% and BSIB at 6.9%.

The extraction inefficiency was measured at 3.4%, an improvement of 21% on 2016, consistent with the measured 25% reduction in the normalised losses between the two years. The large systematic error in such an indirect measurement indicate caution should be taken when quoting the absolute extraction efficiency. Nevertheless, the number is in the right ballpark as a little less than 2% inefficiency is expected in simulations usng a ZS septum with effective thickness of 200 μm.

The large linear extrapolation is susceptible to large systematic errors in the estimation of the extraction efficiency. One major contributor is the difference in the BLM loss profile as the position of

the ZS is skewed. Missing losses on the BLM would result in an over-estimation of the extraction inefficiency: the 3.4% is probably an upper limit and the true value somewhat lower.

Discussion:

T. Lefevre suggested a continuous BLM based on fiber would improve the longitudinal BLM coverage. **M. Fraser** pointed out that the large range of linearity measured at AGS, Brookhaven, was achieved using a continuous coaxial type BLM system as **T. Lefevre** suggests.

K. Cornelis highlighted just how important it is to improve the instrumentation in the North Area, especially when such efforts are now needed just to understand calibration issues and the extraction efficiency. A BCT was used in the past in the West Area with faster extractions to help calibrate SEMs and it is recommended to revive such a system, or with activation foils, in the North Area. **M. Fraser** points out that we can fast extract to the North Area as proven in the past by **F. Velotti** although half-integer fast-slow extraction is no longer possible. As a final point **M. Fraser** also pointed out that the missing 25% of beam (calculated by comparing the ring BCT value to the sum of the intensity measured on the BSIs at the targets) is either being lost in the NA or is being wrongly counted by the BSI calibration. This has a significant role in the number of protons that need to be slow extracted for a given POT requested, impacting the activation levels in LSS2.