

# MSWG Meeting #9, 21-July-2017

---

**Present:** M.E. Angoletta, F. Avesta, H. Bartosik, N. Biancacci, K. Cornelis, V. Forte, M. Fraser, S. Hancock, V. Kain, T. Lefevre, B. Mikulec, G. Papotti, A. Saa Hernandez, L. Soby, F. Tecker, F. Velotti, P. Zisopoulos

The MSWG minutes of the last meeting were approved.

## **Agenda:**

### [Link to the Indico Event:](#)

- Approval of minutes – Karel Cornelis
- Main presentations:
  - Commissioning of new BPMs in ITE (LEIR) – Michele Bozzolan
- MD updates:
  - Recent SHiP/BDF MD's – Matthew Fraser

## Status of Operational Beams:

### [PSB – Vincenzo Forte on behalf of Alan Findlay](#)

All operational beams are in specification. An LHC25 BCMS variant with larger longitudinal emittance (1.5 eVs) has been produced and sent to PS for tests: a blow-up was observed at injection. The LHCINDIV van der Meer (VdM) beam has been setup along with a variant making it possible to vary the emittance. The new turn-by-turn BPM system is now agreeing with beam based measurements. An issue with the calibration of the Ring 3 vertical WS as a function of speed 15 vs. 10 m/s. A hotspot in BHZ502 has been identified. Finemet MD's have permitted a record intensity of  $> 1000e10$  ppp!

**B. Mikulec** explained that the hotspot was identified from the RP survey, which doesn't distinguish between rings. It's a factor 3 higher than in the YETS and 10 higher from TS1 to TS2, although it is not the hottest region in the ring. **G. Di Giovanni** explained to **H. Bartosik** that it was not possible to identify higher losses on any given ring with beam-based methods: the BLMs are not well situated for this location and steering didn't give any clear change. The hotspot is upstream of the bending where the scrapers are so they might be vertical losses.

### [PS – Matthew Fraser](#)

All operational beams are in specification. LHC VdM beam checked. LHC50 beam already sent to SPS for setting-up and to be used by LHC to help diagnose cause of 16L2 problem. Transmission of the ion beam solved by properly adjusting the settings of the PS extraction equipment. It is not clear why the Pb cycle has the extraction settings it does, to be followed up. The extra BGI trim circuit was successful in removing the deflection imparted on the beam, a trim difference of 6.25% was needed. MTE TPS15 shadowing of SMH16 is to be followed up by OP, studies to be continued over the summer: SPS intensity ramp-up deadline is in mind. A list of MD's was presented.

## [LEIR – Nicolo Biancacci](#)

EARLY Xe were beams delivered to the PS and SPS for setting up. Work is on-going on the NOMINAL beam with 7 injections and 6E10 charges accumulated with further optimisation needed to improve the injection efficiency as a function of the number of batches injected. A detailed list of follow-up studies was presented.

## [SPS – Verena Kain](#)

For LHC beams, the damper has been set-up on the doublet beam, Q22 used for high-bandwidth feedback MDs and LHC50 set-up is on-going. HiRadMat BTV investigations and suggested improvements (see last MSWG meeting) have yielded consistent spot sizes with those expected from optics

For SFTPRO beams, glitches on the QF's have been detected and are being followed-up, normalised losses (per proton) at the ZS are stable (logging problem being investigated) and the angle through the splitters needs to be optimised systematically. Transmission is up at 96% and the BGI was used to check for movement of the beam during the spill.

Xe beams injected with close to 100% transmission from the PS and currently being accelerated through transition.

**K. Cornelis** is interested to use the BGI on the flat-top of the operational LHC cycle. The BGI magnet is only ramped at end of cycle, and tests were made at different currents, it is certainly a possibility. **T. Lefevre** explained that it was planned to first check the BGI functionalities, then throughout the year develop the software with an aim to put it in operation by the end of the year. SPS-OP highlight it as a very useful diagnostic tool: if it works it might be even better than the BSRT to check beam quality. **T. Lefevre** warns that calibration checks are still needed to quantify the resolution. **K. Cornelis** stated that OP are often more interested in changes rather than absolute numbers.

## Main presentations:

### [LEIR injection PU commissioning – Michele Bozzolan](#)

The two new electrostatic dual-plane pick-ups installed in the ITE line were described, with 7 more to be installed in the YETS. The aim of commissioning was to validate the BPM sensitivity. The response of the pick-ups showed some deviation from that expected, probably because of (i) scraping of the beam on the vacuum pipe, (ii) residual gas ionisation and possibly (iii) different charge states. Before upgrades (DC bias voltage and/or Helmholtz coils) installed in TS2, the response of the BPMs was shown to be linear with an applied bump. PU1 and PU2 showed different behaviours with applied fields. Both showed improved signals with just 3V of bias voltage applied and PU2 was not sensitive to an applied magnetic field. The computed position of H on PU1 changed dramatically with applied magnetic field. It is still to be decided if coils are installed on all PU's because of the challenges of integration. Further validation/calibration measurements are needed, as well as optics measurements, e.g. kick response, and the FESA class is still under development.

## *Discussion:*

**H. Bartosik** asked if the calibration issue is understood, but it isn't yet. It is possible that the normalised quadrupole strengths used in machine and in YASP differed when the taking the measurements of the BPMs. Further checks are needed. The variation of the H position along pulse from the Linac3 is already a sign of dispersion and the energy ramping of the linac. Other artefacts along the pulse are not expected in the instrumentation although **M. Bozzolan** cannot rule out effects if the beam touches the beam pipe. This could easily be tested with constant phase along Linac3 (no energy ramping). The asymmetry of the effect on the two PU's could be indicative of mismatch of dispersion before the achromatic bend or in the achromat itself.

**K. Cornelis** asked about the combination of bias and solenoid: PU1 is sensitive to both, when combined? In PU1 one has to apply both fields to achieve same effect as 3V.

**L. Soby** explained that the integration of the solenoids is challenging and today they have to be wound on the bellows, which is not ideal. He suggests that we install the clearing electrodes for the next PU's and if they do not work then we add solenoids to those that require them. The effect of the additional fields on the beam was checked by **R. Scrivens**.

**M. Bozzolan** explained that the prospects for the FESA class look good. At least a version exists now to give raw data but algorithms need writing to extract the position. This will be done when possible but it will take at least a few weeks.

MD updates:

#### [Recent SHiP/Beam Dump Facility \(BDF\) MD's – Matthew Fraser](#)

Two recent MD's were outlined in which the BDF cycle (short 7.2 s version of SFTPRO with 1.2 s flat-top) was introduced into the super-cycle and a new North Area transfer line optics in TT20 and T6 was applied to transport the beam through the splitter (MSSB) dipole aperture, without splitting. The optics was also tested in view of a future BDF prototype test proposal in front of T6 next year (beam requirements to be presented at a future MSWG meeting) requiring input on possible beam sizes. All the beam on the cycle could be extracted on the shorter flat-top by reducing the chromaticity during extraction to -0.5 units and without serious consequences to the spill quality. Spill quality data was provided by NA62 who kindly took data during the MD. A low intensity of  $2E12$  ppp was extracted. For a short while the beam intensity was pushed to  $7E12$  ppp with two injections from the PS and the cycle behaved well. The beam intensity will not exceed  $2E12$  ppp in future MD's until the thermomechanical behaviour of the TT20 TED is investigated by EN-STI. It was promising to see the same normalised extraction losses (per proton in LSS2) as for the present operational SFTPRO beam at  $3E13$  ppp. The new TT20 optics showed good transmission although more investigations are needed to account for some of the missing intensity. No correlation was observed between transmission and BLMs located at the splitters, and it is thought that the steering at the end of the line near T6 can be improved. The NA instrumentation limited the quality of the optics measurements that could be carried out, although from what could be attained the agreement between model and measurement was impressive. The instrumentation needs for now and the future are being followed up in the SLAWG. An outline for the future and planned MDs was outlined.

*Discussion:*

**T. Lefevre** was surprised to see a significant 200 MHz time structure in the transfer line that could in fact be used for non-interceptive measurements using pick-ups. **M. Fraser** explained that this is due to the momentum-type extraction in which slices of momentum are extracted and from which the projection of the time structure stays present for longer. In the ring the different momentum slices overlap and mask the time structure during de-bunching much quicker.

**A. Saa Hernandez** asked why the chromaticity needs to be so large. **M. Fraser** explained that momentum-based extractions are typically done to improve spill quality such that the tune of the extracted particles crosses the resonance quickly. **F. Velotti's** recent visit to J-PARC showed the problems with amplitude-based extractions with very small chromaticity where the tune is swept across the emittance of the beam (amplitude dependent tune). In this case the tune sweep variation is lower, feed-down effects are smaller, but the extraction is far more sensitive to power supply ripple. In this case excitation by the damper is important to improve spill quality. It is thought that such an extraction is better for losses as feed-down effects caused by sweeping the machine tune and moving the separatrix at the ZS are less important, but that is yet to be demonstrated in the SPS: a future MD proposal.

A brief discussion was made on the instrumentation and the need to improve the diagnostic tools in the future.