# Minutes of the LIU-PS BD WG #33 on the 08th of August 2019

***Agenda (***https://indico.cern.ch/event/838902/*)*

1. *Update on BGI data analysis activities*
2. *AOB*

**Present:**

Denis Cotte, Matthew Fraser, Klaus Hanke, Alexander Huschauer, Salim Ogur, Alexandre Lasheen, Branko Popovic, Hampus Sandberg, James Storey, Frank Tecker.

## 1. Update on BGI data analysis activities (H. Sandberg, pdf)

Hampus Sandberg presented the latest status of the data analysis for profiles acquired with the BGI. PS-BGI advances the SPS-BGI regarding more direct analysis i.e. no conversion steps thanks to counting in the hybrid pixel detector than integrating. Counting statistics assumes independent event counting, where an event is defined as the ionization electron count per pixel for one integration period or so. Then the count in each bin follows Poisson distribution.

The new analysis also makes use of a toy Monte Carlo method to validate and understand the process affecting the result by comparison with the real data. The MC model removes the unresponsive pixels (previously called honeycomb) in order to make the generated data look as real data. Alexander, Slide 14: Honey comb to what to what does it correspond on the right? Hampus: Low event count value on the left is excluded by cutting pixels with a count below the 2-sigma limit.

Salim: how is the data resorted on Slide #16? Hampus: just putting the unresponsive pixels under the honeycomb on the top in order to exclude them from the analysis. These unresponsive pixels are not included when calculating the beam profile by taking the sum of events in each column.

Matthew: How much data is lost because of the honeycomb exclusion? Hampus: 20%

Frank: Is the position of the honeycomb structure fixed? Hampus: We assume it is fixed, the mask to remove the honeycomb bins is evaluated once and used for the rest of the data analysis. Frank: why not excluding the honeycombs manually in the beginning? Hampus: they may not be fixed, we need to check.

Hampus continued his presentation by pointing out a comparison between the old and new processing. The new processing showed a cleaner beam profile measurement with less dips compared with the old one.

Alexander: fit looks shifted to the right on Slide #21. Hampus: due to the plot, indeed we need to figure out why.

Hampus also discussed that the analysis can be done either by likelihood fit or rms calculation yet emphasizing on the discontinuity in the data due to gaps between the detectors. Goodness of the fit is evaluated in simulations (no simple formula), shown on slide #23.

Matthew: if you change the binning, the change in the noise will change the goodness of the fit? Hampus: Shown in coming slides.

Hampus continued with the rms determination method which is to be used when the goodness of fit fails or Gaussian distribution does not make sense. Another important discussion in the analysis is the sample size. Hampus verified that the accuracy and precision of determination is improved when the sample size is above 1000 on slide #26 and #27. Similar to fit method, the rms method also demonstrated almost the same accuracy and precision in beam profile measurements.

Hampus also simulated a case with the dynamic beam width and position (which is very realistic case for the PS), and calculated the accuracy and precision for that. Furthermore, he validated their analysis with measurements in the PS. Turn-by-turn (t-b-t) measurements at injection required the pressure bump by sublimating the ion pump at SS82. The fit to t-b-t acquired by the BGI agrees well with t-b-t data and its analysis by the SEM grid. The BGI horizontal beam width oscillates with a frequency of 0.186 ± 0.008 oscillations per turn, compared with the value Matthew measured, which was 0.188 (https://indico.cern.ch/event/825325/).

Matthew, slide # 35: interesting, beam size is growing even without the SEM grid in, this is the kind of measurements we are looking for. Matt implied that the horizontal beam size blow-up may not only be due to scattering from the SEM Grid but caused by blow-up due to poor injection steering. Hampus also verified the fractional tune measurement on the SEM grid using the beam position oscillation which was calculated to be 0.219 ± 0.002 oscillations per turn.

Alexander recommended to look at the time stamp to know whether it was a bad shot (i.e. with large oscillations) for the slide #37 and by comparing to logged BPM positions.

Hampus concluded his talk by showing the measurements for different beam intensities which are in good agreement with wire scanner measurements on slide #44.

Matthew: expected change in dp/p as a function of intensity referring to slide #42 and on? Alexandre: should not be very large.

Alexandre: any noise filtering for rms calculation (e.g. noise on measured data on slide 19). Hampus: The data is centered and a window is applied to remove the noisy tails that can spoil the rms calculation. Alexandre: any filter applied? Hampus: no filter applied, that would be an issue with the counting statistics, prefer to use the raw data and users can apply their own filters.

Matthew: a priority list for future studies needs to be set up. He also wondered about the feasibility of acquiring more than 30 turns in PS with the BGI. James Storey: looks feasible regarding the chips capacity to record 80 million events before saturating.

Alexander: implementation for the start-up? Hampus and James: The offline data processing framework is all in a docker container.

Further discussions to be planned on gas injection. Matthew underlines that the results presented demonstrated the feasibility of using the BGI as a turn-by-turn device to compliment the SEM grid data acquisition and will be useful for the commissioning.

## 2. AOB

- Alexander commented that thanks to this analysis, we can attribute sigma, i.e. error/precision, to the calculated beam size and position measurements. He asked for the feasibility of using this detector and analysis at the start-up, and he asked to clean up the data recorded with the detector (i.e. remove the beam loss).
- Hampus: around 10 mins for a full cycle of data, faster if a smaller window of the cycle is recorded. e.g. first 10 ms of the cycle. Alexander, this is still useful considering the WS which saturates early.
- Alexander: Need to set a priority list on next steps till commissioning both for the hardware requirements (gas injection or sublimation of the pump) and software to be used for online measurements for the commissioning.

*Minutes by S. Ogur and A. Lasheen*