# Minutes of the

# PyHEADTAIL Development Meeting #01

**Attendees:**

H. Bartosik, S. Hegglin, G. Iadarola, K. Li, L. Mether, E. Metral, A. Oeftiger, A. Passarelli, G. Rumolo, M. Schenk

**Matters arising:**

Round table collecting ongoing major activities:

- G. Iadarola: benchmarking between HEADTAIL and PyHEADTAIL for e-cloud studies is mostly completed. Simulation of the quadrupoles has begun and different modelling of the e-cloud are being investigated (uniform vs. imported distributions, tune footprints). A submission script was written that allows the creation and handling of chain jobs which has proven very useful.
- A. Oeftiger: a lot of progress has been made for the longitudinal space charge modelling. In particular, the longitudinal matching for multi-harmonic RF systems in the presence of space charge has been heavily optimised. The main results will be presented at the Space charge workshop in Oxford (https://eventbooking.stfc.ac.uk/uploads/spacecharge15/oeftiger-pyheadtail.pdf).
- S. Hegglin: unittesting is nearly completed. Work for the matching section will begin soon.
- L. Mether: nothing particular to report.
- A. Passarelli: nothing particular to report.
- E. Metral: lots of work required especially for LHC and HL-LHC. The impact of the current impedance model on beam stability needs to be further assessed, in particular with benchmarks against NHTVS and DELPHI. The crab cavities foreseen for HL-LHC need detailed studies as they seem to be highly detrimental for beam stability.
- M. Schenk: a new monitor to analyse headtail modes has been developed. This so-called pizza slice monitor discretises the longitudinal phase space in accordance with the decomposition done analytically to study transverse instabilities via the Vlasov equation. An SVD on the output data should give a deeper insight on the mode contents of the different instabilities observed in the simulations. Multi-turn wakes have been implemented and have passed first benchmarks against HEADTAIL. More benchmarks will be done in the near future. The simulations for the PSB will be one of the first applications that are likely to require multi-turn wakes.
- G. Rumolo: Nothing particular to report.

- H. Bartosik: nothing particular to report.
- K. Li: preparation of the low-beta wakes for studying the PS injection oscillations have been completed. Details can be found in the talk.

**Agenda:**

1. **Good title (A. Oeftiger)**
   The RF bucket has been generalised to enable matching to buckets with an arbitrary number of SFP and UFP. Moreover, longitudinal space charge has been added to the RF bucket which enables a first step of matching with intensity effects.
2. **Low beta wakes and dispersion in PyHEADTAIL (K. Li)**
   Simulation of the PSB in the past have not given any conclusive results. A first step to tackle the inconstistencies with measurements and with theory was to check the numerical modelling in particular of the low beta wakes. For this, a study done earlier with HEADTAIL was used as a model case. This case involved the investigation of the injection oscillation in the presence of indirect space charge in the PS.
   - HEADTAIL and PyHEADTAIL did not agree at the first iteration.
   - Corrupted interpolation of the wakefield in front of the bunch was found in HEADTAIL and corrected.
   - HEADTAIL and PyHEADTAIL still did not agree at the next iteration
   - Dispersion was not taken into account for the wake field computation in HEADTAIL. This was also corrected in HEADTAIL.
   - HEADTAIL and PyHEADTAIL are in perfect agreement at the final iteration.
   - This now gives confidence in both the modelling of the low beta wakes and the implementation of dispersion in PyHEADTAIL. The next step would be to run simulations for the PSB at 1.4 GeV and check the results against measurements and theory.

**AOB:**

Nothing

KL 20/04/2015