**SNS Bunch Compression Experiment (2025-02-16)**

The purpose of this study is to collect initial data for simulation benchmarking.

To avoid long file names, the study will be divided into "experiments" labeled "Experiment 01”, "Experiment 02", etc. and include descriptions of each experiment will be placed in a README. Similarly, each experiment may have several cases we want to look at, like number of injected turns, which will be labeled "Case 01", "Case 02", etc.

[STATE] = Change machine state

[MEAS] = Perform measurement

[OPT] = Optional

**Outline**

* Experiment 01
  + *Examine the beam evolution with no longitudinal focusing (all cavities shorted).*
  + [STATE] Short all RF cavities.
  + [STATE] Set PWON = nominal.
  + [STATE] Set injected turns = 300.
  + [MEAS] BCM
  + [MEAS] LLRF, beam on
  + [MEAS] LLRF, beam off
* Experiment 02
  + *Inject the beam for a short time, then store the beam for hundreds of turns, all with constant h=1 drive voltage. If the RF voltage is weak, the phase space distribution will not rotate much during injection. Then, during storage at 10 kV rf voltage, we hope for moderate bunch compression in ~500 turns.*
  + [STATE] Un-short only h=1 cavities.
  + [STATE] Set h=1 voltage = 10 kV.
  + Case 01
    - [STATE] Set injected turns = 100.
    - [MEAS] BCM
    - [MEAS] LLRF, beam on
    - [MEAS] LLRF, beam off
  + Case 02
    - [STATE] Set injected turns = 200.
    - [MEAS] BCM
    - [MEAS] LLRF, beam on
    - [MEAS] LLRF, beam off
  + Case 03
    - [STATE] Set injected turns = 300.
    - [MEAS] BCM
    - [MEAS] LLRF, beam on
    - [MEAS] LLRF, beam off
  + …
  + Perform additional measurements for the best case (if time):
    - [OPT] [MEAS] WS
    - [OPT] [MEAS] RIM
    - [OPT] [MEAS] BPM
* Experiment 03
  + *Inject the beam with a ramping h=1 drive voltage, where the ramp starts at injection. This is primarily for benchmarking purposes.*
  + [STATE] Set injected turns = [?].
  + [STATE] Set max drive voltage = [?].
  + [STATE] Delay drive voltage ramp to start at injection.
  + [MEAS] BCM
  + [MEAS] LLRF, beam on
  + [MEAS] LLRF, beam off
* Experiment 04
  + *Inject the store beam with zero drive voltage, then ramp voltage after injection. (We tried this in our last experiment.) To operate the RF cavities in closed-loop (i.e. with feedback), we'll need to reduce the number of injected turns to ~50.*
  + [STATE] Set injected turns = 25-50.
  + [STATE] Short h=2 cavities.
  + [STATE] Delay h=1 ramp to start after injection.
  + [MEAS] BCM
  + [MEAS] LLRF, beam on
  + [MEAS] LLRF, beam off
* [OPT] Experiment 05
  + *Bunch with h=2 instead of h=1.*
* [OPT] Experiment 06
  + *Production settings. (Actually we could just collect BCM data during production.)*

**Notes**