Proposal for high intensity MDs(6&7) in the SPS with Crab Cavities

Abstract:
At present the safe beam limit is 6e12 at 26 GeV and 3e11 at 270 GeV. For the final two crab cavity MDs we would like to increase the intensity upto a maximum of 4-batches (288 bunches nominal):

1. To study strong beam loading effects
2. Cryogenic heat loads due to beam induced effects
3. Cavity performance and stability with high beam current
4. Higher order mode power w.r.t estimated limits

For MD6 the proposal to inject batches at 26 GeV. The following will outline the intended steps in accordance with MPP.

MD6

Pre-requisites:
The BA3-BA6 frequency synchro hardware installed and functioning such that it is masked during injection and interlocked immediately after the synchro
~~Check that the 26 GeV crab cycle allows 4 injections~~ - **DONE**
RF on timing set to 100 ms after the synchro between BA3-BA6 established. In the case of upto 4-batches, synchro & RF on after the 4th injection.

Cycle Information:

PSB: MD3811_LHC25_72b_A_2018
MD3811_LHC25_72b_B_2018

PS: MD3811_LHC25#72b

SPS: MD_CRAB_26_L26400_Q26_2018_V1

Settings for PS splitting can be found in the PSMD logbook on 10/07/18 at 12:02. Different settings are needed between 2e10 and 1e11 ppb. Screenshots in the logbook should be able to allow the beam to be reproduced.

Steps to take during the MD:

- Setup 26 GeV with single bunches 2e10 and 1e11. Check new interlock with beam for rephasing by turning off BA3-BA6 synchro during 26 GeV flattop. Check coarse phase scan for crabbing phase
- Measurement of RF off interlock to BIS for validation of IOT1 & 2 in series ? Check the BPM signal & Cavity Antenna signal on fast scope for reaction time. Back up option to use only one cavity at a time
- Increase the number of bunches to 72 bunches of 2e10 ppb (total int of 1.44e12 = safe beam). Transverse damper setup

- Cavity phase scan and orbit bumps upto +/- 3mm (?) with 72 bunches (safe beam), in parallel a3 measurements
- Perform orbit bumps for electrical centering with cavities off
- When ready to start increasing intensity. Switch PS splitting settings and take more intensity from the PSB. Start with only 1 PSB ring to ensure settings still remain safe while beam quality is optimised.
- Set crabbing phase & set point voltage (1MV each cavity) & increase in steps of 12 nominal bunches up to 60 (safe beam) and then to 72 bunches. No change in Wait and observe.
- Revoke RBAC rights, leave everything alone, don't touch anything.
- Come back to 12 nominals and add second/third/fourth injections for batched beams
- Increase the # of bunches within the batch sequentially from 12, 24, 48, 72
- ….
- Collimation loss maps (?) - with LHC collimator moving in with and w/o CC - check with safe beam, including time profile
- End of MD - with safe beam (2 nominals), ramp to 270 GeV and check RF synchro hardware. Setup transverse damper & RF on sequence for MD7

MD#7 Additional topics for discussion

- Repeat batched beams in steps of 12, 24, 48, 72 at 270 GeV
- 450 GeV with single bunch SFTPRO2 for measurement of HOMs with bunch length
- Coast with high emittance and tail population measurement with wire scans / collimation
- Awake cycle 1-4 bunches, for short bunch length - HOMS
- Coast with higher voltage ?