

Supercycles in the SPS - towards "full" ppm operation and impact on the equipment

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for the SPS-OP & CO-AP controls gang

BE-OP

SPS Settings Organization

- The SPS settings are so far strictly organized by super-cycle (SC), and the settings are managed with LSA.
 - *Even tough the SC is composed of individual cycles (with independent settings), those cycles cannot be played in isolation or de-coupled from the SC – see next slides.*
 - *This situation was inherited from the 'past' when the SPS controls was moved to LSA in 2006 ('do one thing at a time').*
- When a new SC is required with a (even slight) modification of the cycle composition, completely new settings must be generated for the entire SC.
 - *Copy tools are available to import trims from existing cycles, or re-synchronize settings of various SCs. The copy is done on a cycle (in fact even beam-process) basis.*

Many super-cycles, even more cycles

● = CNGS cycle

Example of 4 SCs used in 2008.

- Each CNGS cycle has independent settings.
>> 12 complete cycle settings (ring + TLs).

Issue:

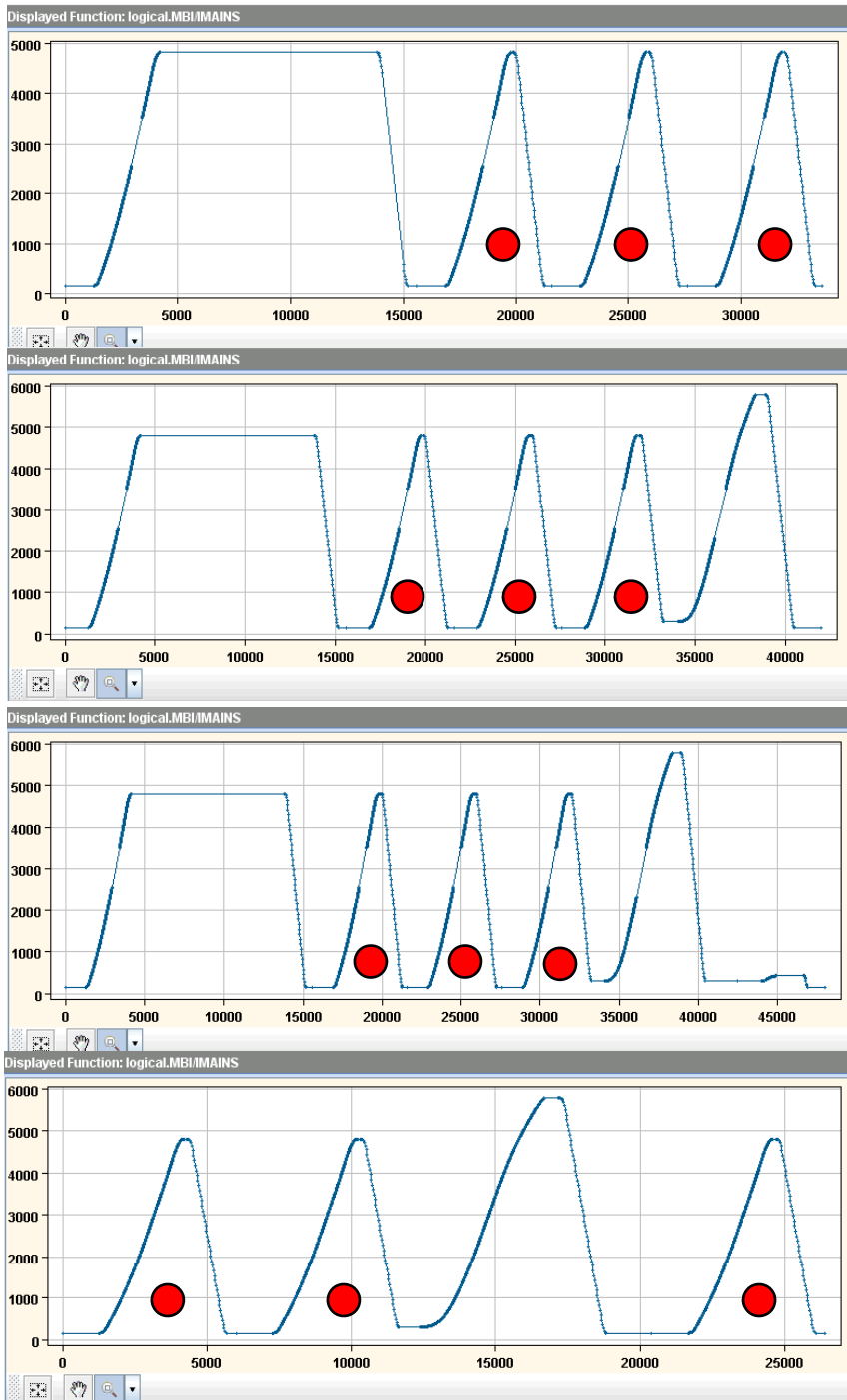
- Every time a cycle is tuned, one has to synchronize the settings of the other SCs (when they are used again).

>> *Tedious work!*

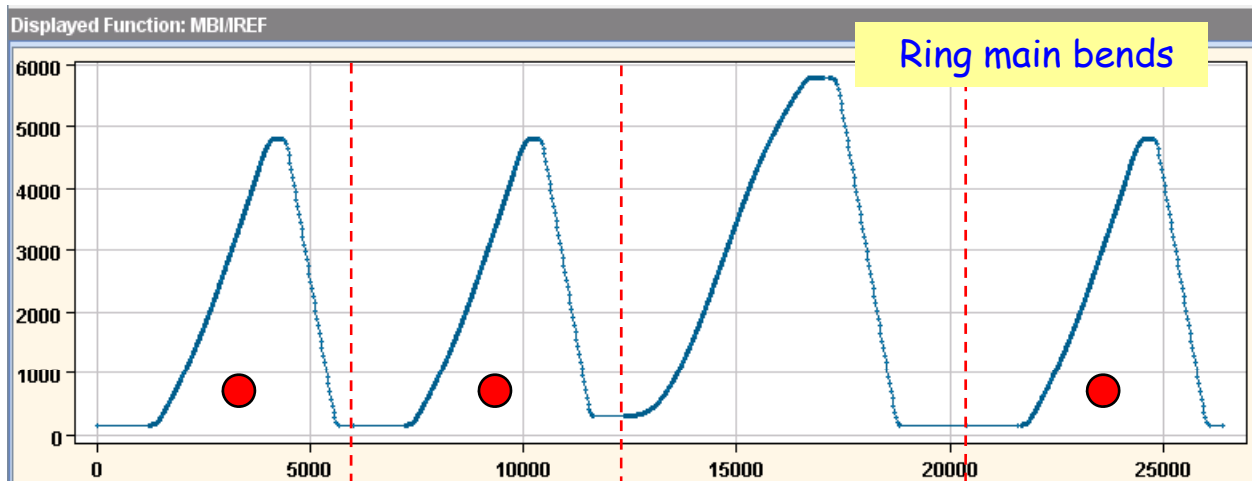
>> *In fact 2 or 3 re-usable CNGS cycle settings should be sufficient (hysteresis).*

For more flexibility...

- Remove the link between SC and cycle.
- Ensure cycles can be interchanged using a standard setting at start and end.

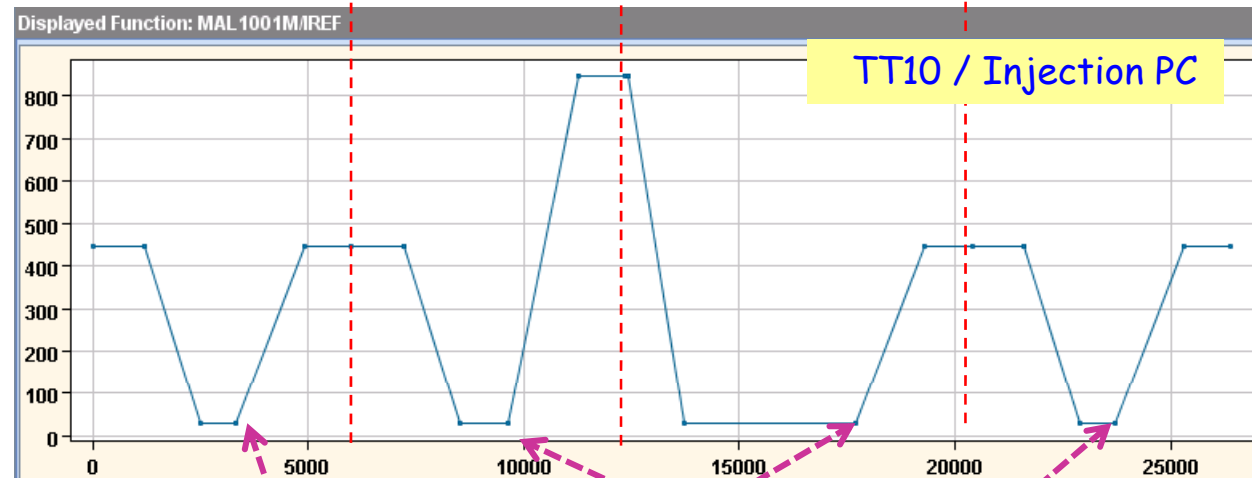


Present settings



- SPS settings are 'frozen' into the super-cycle.
- Order of the cycles is fixed – cannot be changed.

Injection levels are not equal!



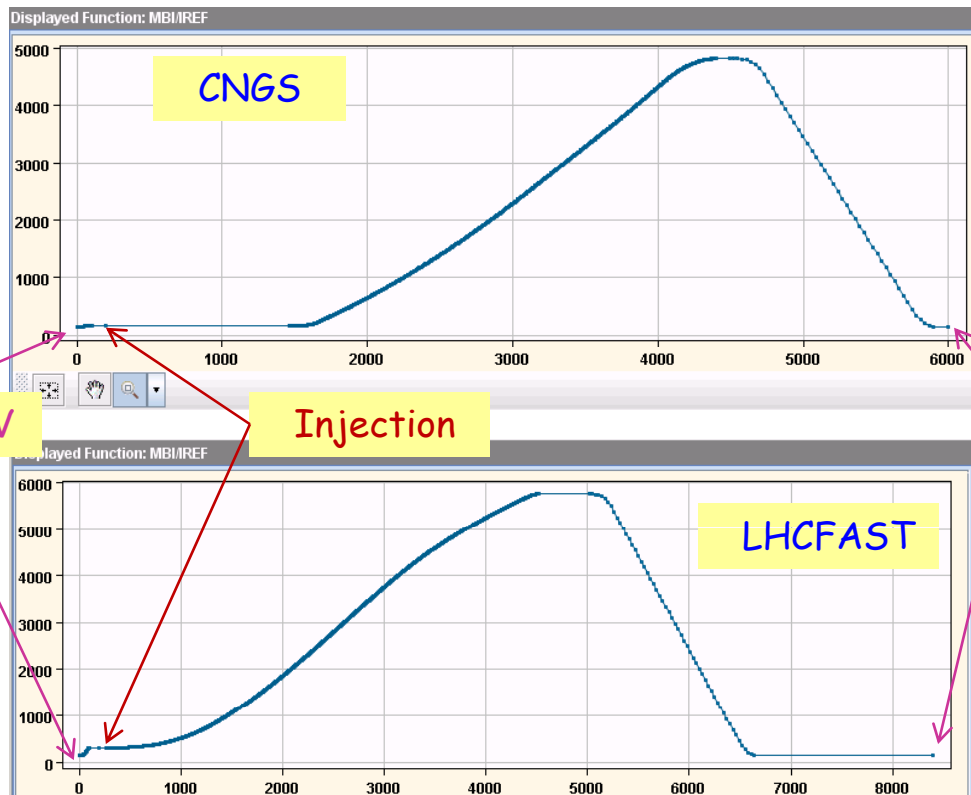
Due to the boundary conditions from the PS basic period, some SPS cycles are 'super-optimized' to just about fit into the time... see CNGS.

PC ramp is (must be !) initiated in the preceding cycle

Settings by cycle

To organize settings by cycle and [be able to combine cycles in any order](#) every PC function must have the same value at the start and end of each cycle.

- >> the ring will use a fixed base momentum of [13.5 GeV](#) (time constraints for CNGS !!!).
- >> injection no longer coincides with time = 0 for FT and CNGS beams.
- >> TT10 PC functions must be started in advance (~ 2000 ms) → CTRV programming.
- >> extraction lines are not an issue – settings are constant or come back to Imin.



Example for SPS mains bends settings in cycle based schema.

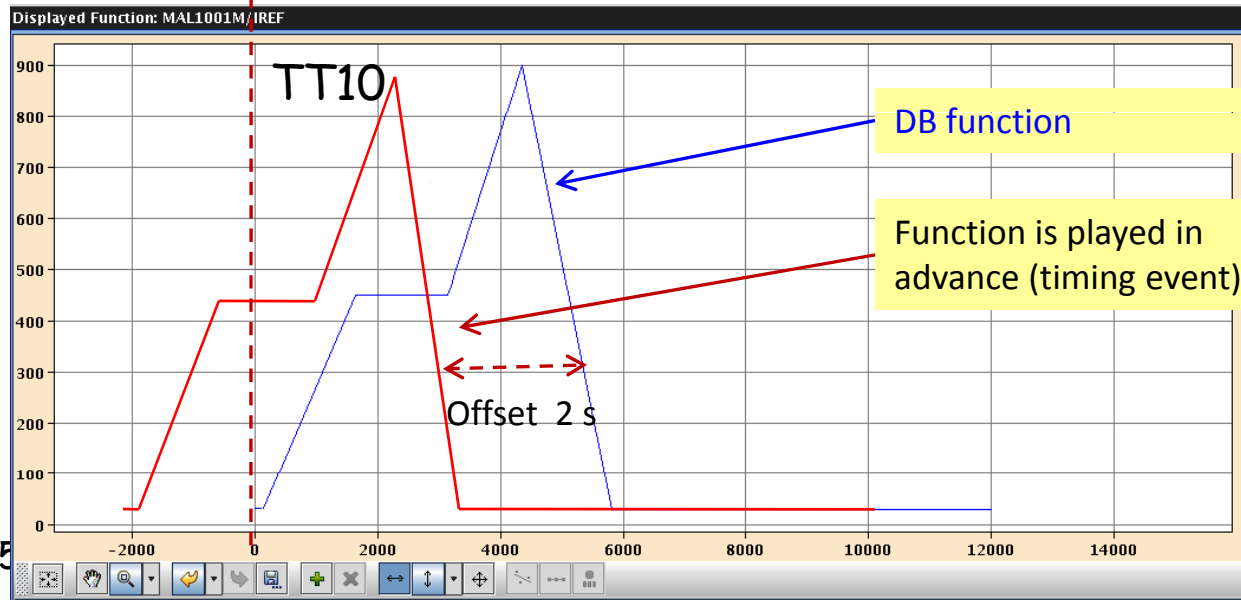
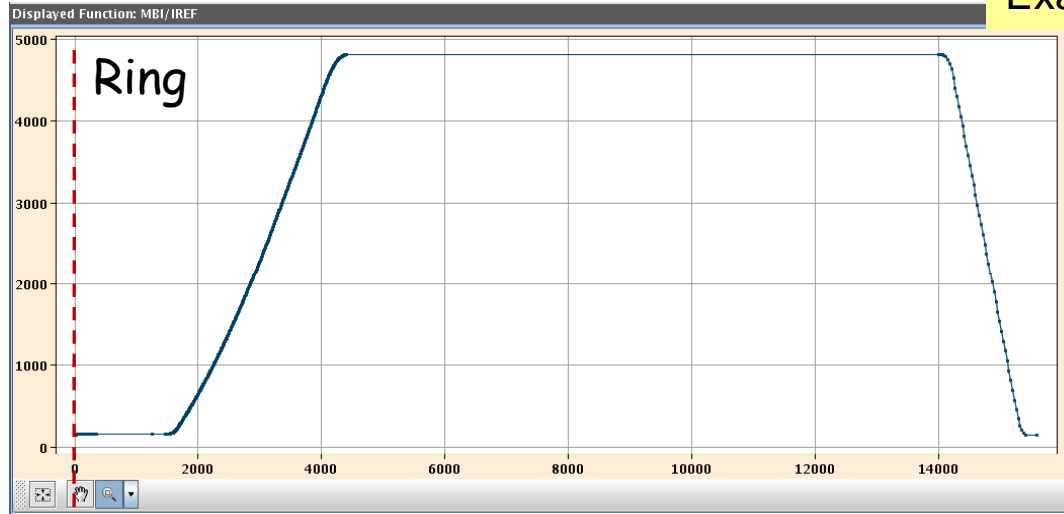
13.5 GeV

Injection

13.5 GeV

TT10 injection line

Example for FT cycle



DB function

Function is played in advance (timing event)

Offset 2 s

DB function is 'artificially' shifted (No negative time !!!!)

Summary

- ❑ The SPS settings will be re-organized to decouple the settings from the super-cycle. The super-cycle will only exist in the timing system. Main gain is simplified settings management for OP, possibly faster setting up of super-cycles (tbc !).

Almost all changes are made within the control system/DB (OP & CO).

The TT10 PC crate has to be triggered on a different timing event.

Transparent to other equipment as far as we can judge.

- ❑ Timing:

The injection time of the beams will change.

The machine offset between CPS and SPS has to be changed by -200 ms

We need a new timing event ~ -2000 ms (wrt start of cycle).

- ❑ SPS – page1 will look (almost) exactly as before...

The basic SC structures will remain the same, but the SC will only 'exist' at the level the timing system and no longer in the DB.

Cooling power and target intensity limitations remain – limits the flexibility.

- ❑ Changing back and forth between new and old settings organization is possible, but not 'on the fly'.

Machine offset between CPS and SPS, interlock and SW configurations...