
LHC Fast Timing Commissioning

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Reminder

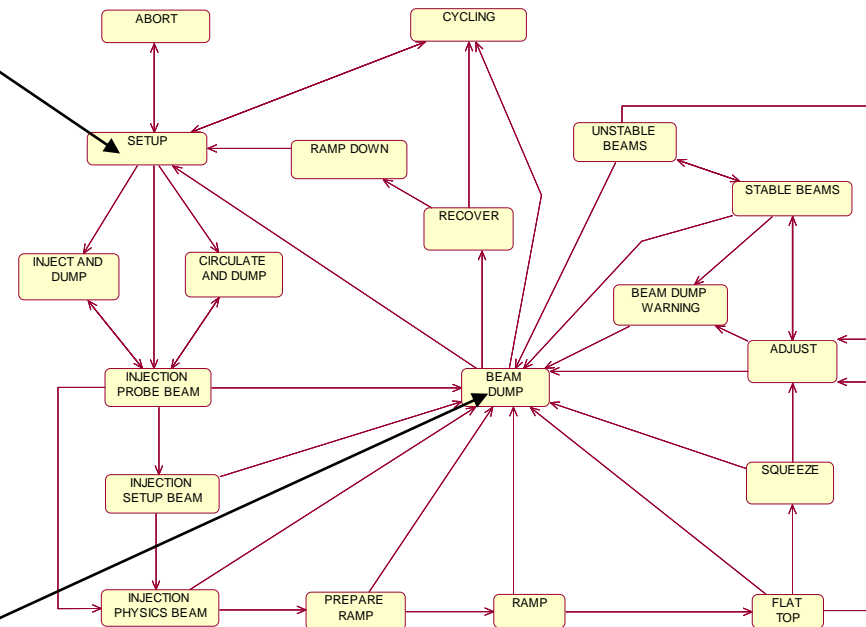
- **BC1** and **BC2**: For each ring the Bunch Clock is a square wave at the RF frequency divided by 10. Its rising edge has a fixed delay w.r.t. bunch passage. This delay is reproducible from run to run. When present BCx is **always locked to the corresponding beam**.
- **Orbit1** and **Orbit2**: For each ring the Orbit is a train of 5 ns long pulses at the Revolution Frequency. The pulse has a fixed delay w.r.t. passage of a bunch in bucket 1. This delay is reproducible from run to run. When present Orbitx is **always locked to the corresponding beam**.
- For each ring, **bucket 1** is the first bucket after the 3 μ s long abort gap (defined from bucket 34442 to 35640)
- Two bunches in **buckets 1** of the two rings **collide in IP1** (and IP5)

Reminder (cont'd)

- **BCref**: The reference bunch clock is a square wave at a **fixed frequency** equal to the collision RF frequency divided by 10.
 - It is locked to the beam **during collisions only**
 - During collision its rising edge has a fixed delay w.r.t. bunch passage.
 - But the equipment to rephase the beam to the reference clock is **not operational yet**. In the meantime **use BC1** or **BC2**...
 - OP wishes to fine-tune the reference frequency during physics to compensate for very slow drift in machine circumference (effect of tides,...). This will be done very smoothly (< 1 Hz/s)

The final system...

- During SETUP mode
 - All RF fcts are ramped to injection values (including the Frequency Program)
 - Synchro loop is closed to lock RF onto the Frequency Program
 - **Bunch Clock and Orbit Signal are re-synchronized** (for the relevant beam plus BCref). This causes an interruption in the signals for < 1 ms
 - Injection set-up: Machine must go through INJECTION PROBE BEAM and INJECTION SETUP BEAM (pilot, intermediate, dump, pilot) and then finally INJECTION PHYSICS BEAM (>30 min)
 - We then move through INJECTION PHYSICS BEAM, PREPARE RAMP, RAMP, ...
 - **Signals are OK until after BEAMDUMP**



Reproduced from LHC Modes, LHC-OP-ES-0005

The final system

- In general, after BEAM DUMP, the signals will still be there but **it is not excluded** that an intervention on the RF equipment interrupts them. They will then be re-started during the following SETUP mode.

The way it was

- BCref
 - Was at a fixed 40.078 900 MHz **not related to the beam frequency**
 - Was (almost) never resynchronized. Only when rebooting the VME crate
 - Was derived from a commercial Signal Generator at 400.789 MHz driving the Divider-by-10

The way it was

- BC1 and BC2

- Were always at the same frequency (except when one loop would unlock...).
 - First 40.078 878 MHz
 - Then 40.078 893 MHz from Sept 10, 19:30
 - Then 40.078 896 MHz from Sept 11, 22:00 Capture beam 2, -0.4 mm
- Were **re-synchronized when needed**: after re-boot, after opening synchro loop or for test.
- Should have been **locked with the beam**...

- Orbit1 and Orbit2

- Were always at the same frequency
- Were re-synchronized when needed
- Should have been locked with the beam

FAQ

- Q: Will BCref be in phase with the beam in the following days?
- A: The RF equipment to phase the beam with BCref is **not operational yet**. In the meantime BC1 or BC2 will stay in phase with the beams during collision. Recommended...

- Q: Are BC1 and BC2 synchronous for the moment?
- A: Yes, and they will **always be synchronous during physics**. They may be **asynchronous during filling and ramping** for MD modes or when only one ring is used. If you wish to observe the beam in such situations you should use BC1 to track beam 1 and BC2 to track beam 2.

If physics is intended they would be synchronous from injection on but this decision could be reviewed.

FAQ

- Q: What signals are going to disappear for 1 ms before runs?
- A: All 5 signals, including BCref, are re-synchronized during the SETUP mode