

# *LHC Operation*

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- ❑ After LS1 we restarted beam operation (since there was no period that one can decently call a check-out...) with the experience and the controls tools inherited from run 1.
  
- ❑ Most core persons of run1 were fortunately still available for the commissioning.
  
- ❑ Some spices were added to the excellent starting conditions:
  - *Loss of people active in controls, some projects had to be taken over without sufficient time to understand all details.*
  - *At the level of details, many issues due to the controls changes (FESA, CMW, HW platforms) all over the controls boulevard. The quasi-absence of check out did not help.*
  
- ❑ Yet the restart from scratch was remarkably smooth and fast.
  - *60 days from first injection to stable beams !*
  - *... even if some commissioning activities were not completed.*



- ❑ One can/could clearly feel less ‘enthusiasm’ for the beam commissioning as compared to run1.
  - *It is no longer the brand new and exciting machine of 2009-10.*
  - *Many repetitions of what was done in run1.*
  
- ❑ The reduced level of ‘enthusiasm’ is also observed in the many nights that we filled with ‘OP measurements’.
  - *Many people that worked 200% on LHC in 2009/2010 are now involved in many other activities.*
  - *Commissioning was not as efficient as it could have been.*



- ❑ During the commissioning conditions evolved rapidly and it was difficult to keep for example an up to date sequence.
  - *Often parallel commissioning threads require different 'task combinations'. For example: tricky with collimation settings – to be considered for the future.*
- ❑ Some phases, in particular for the squeeze commissioning, were quite delicate with many ad-hoc instructions – over now.
- ❑ In the last 2 weeks the dust has settled, and the sequences to drive both low and medium beta have converged well.
  - *With another 2-3 weeks of regular operation (not scrubbing) all shift crews should have seen all phases of the cycle.*
- ❑ From the point of the view of the overall cycle operation the situation is quite good, and **there are no evident stoppers for increasing the intensity.**

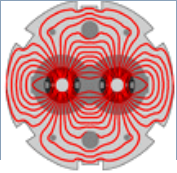




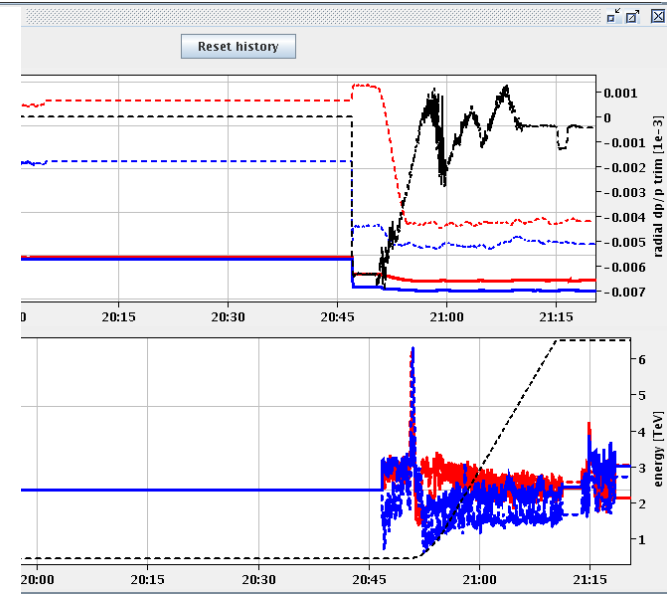
- ❑ Daily and careful work on injection has so far been left 'aside', the intensities or course were almost always safe.
  - *Basic steering and alignment done, but no systematic daily corrections.*
  - *Issue with probe-nominal difference did not help.*
- ❑ As a direct consequence IQC is very frequently false... and ignored.
  - *Errors are mainly due to losses and steering (trajectory excursions).*
- ❑ For the intensity increase **the steering of the lines has to be monitored and corrected more systematically.**
- ❑ The losses will also have to be checked regularly.
  - *Scraping in the SPS, tails...*
- ❑ ... and IQC will take to be taken seriously (and be reliable).



- ❑ Decay of persistent currents and their impact on beam parameters are a special feature of injection.
  - *We observe for the first time orbit decay (and snapback) – not a problem → orbit FB.*
  - *The tune and b3 decays are larger than before. Many measurements have been performed and fed back.*
- ❑ Q and b3 decay modelling are converging, the FIDEL software deserves a bit of consolidation (in progress).
  - *Dependence on powering history – tricky.*
- ❑ Overall injection is OK from the ring side, key items that require integration are **abort gap and injection cleaning**.



- Settings, cycles and sequences are in good shape. Care was taken to make **good quality feed-forward of the real-time trims.**
  - *Prepare for the day when the tune FB may become unusable.*
  - *Cycle is very reproducible (RT trims for orbit & tune, but also Q') – good sign.*



- Both OFB and QFB are now stable from the controls point of view.
- QFB performance is directly correlated to the tune signal quality.
  - *For probes and nominal bunches – OK !*
  - *Special ADT low gain region ('witness gain') works rather well in combination with gated BBQ.*
  - *For higher intensity the quality degrades already for 6b, we may have to change the spectrum filtering philosophy.*
  - *Wait and see...*



- ❑ So far no problems going into collisions.
- ❑ To improve the beam stability, IR1 and IR5 collide first for low beta cycle.
- ❑ The octupoles have already been pushed to  $> 550$  A, and the ADT is on at its maximum strength.
  - *Some issues with stability, but no problem for MPS.*
  - *Brute force approach – no fine tuning.*
- ❑ New : we have observed significant orbit drifts ( $\pm 0.2$  mm [ $1\sigma$ ] rms) that seem to be driven by the IR8 triplet (IR8).
  - *The drifts can be easily counteracted – autopilot.*
  - *If they are too large (peak orbit reaches  $\pm 0.6$  mm in arcs) SIS will dump on orbit excursion.*





- ❑ From the point of view of operation the machine seems ready for an intensity ramp up.
  - *With some items to the integrated (injection and abort gap cleaning).*
  
- ❑ There are many small items to clean & fix, but nothing that is a real stopper.
  
- ❑ When we come out of TS1, a number of MPS checks have to be performed / re-qualified and some items need completion. This will require quite some time and shorten the 50 ns ramp up period further. We should take the time and do it properly.
  - *That is what we usually say and then...*