ALICE solenoid ramp down at 6.8 TeV – in stable beams

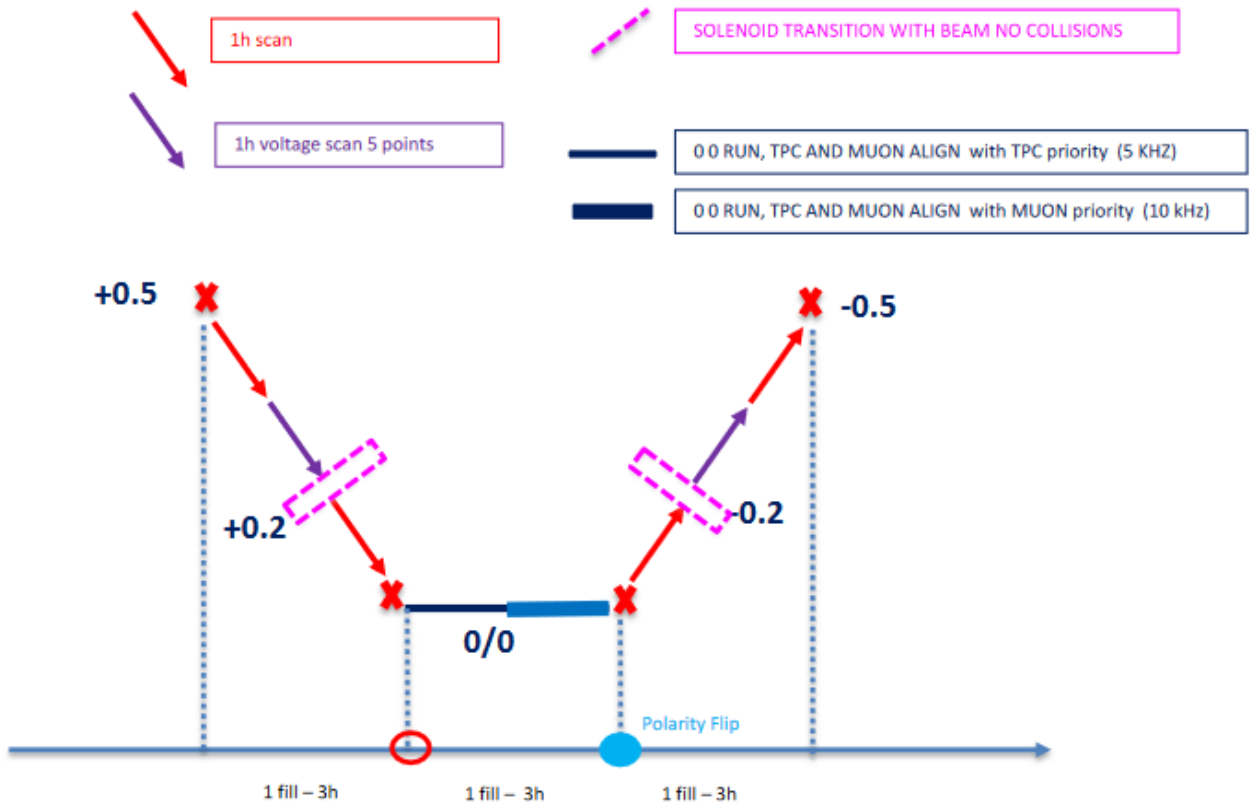
J. Wenninger

18 / 03 / 2022

ALICE special test request

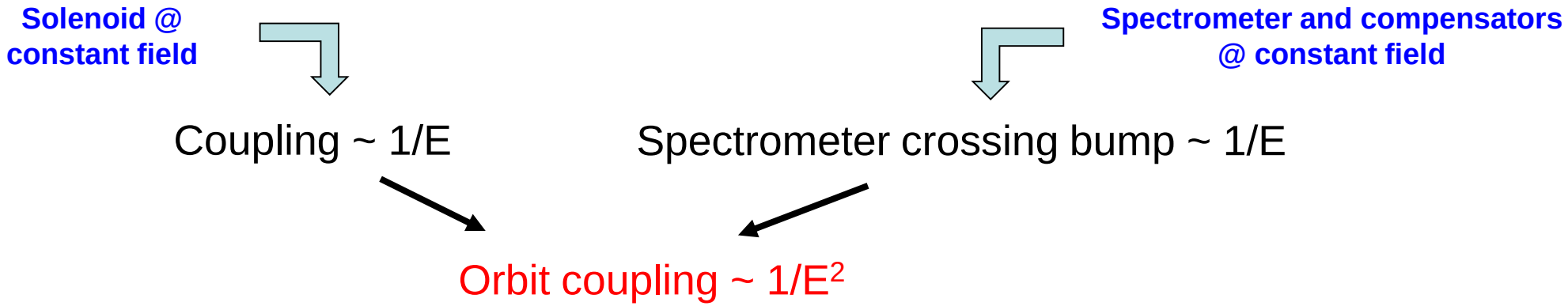
- Request for 3 fills with polarity +, polarity - and with spectrometer & solenoid off.
  - **Plus: ramp down solenoid from 30kA to 12kA during the fill** (+ and -).
- Test to be performed during the 75b intensity ramp up step (0 field operation to be avoided with e-cloud !).

- If the ramp is considered no possible 5 fills will be needed.



ALICE solenoid impact on orbit

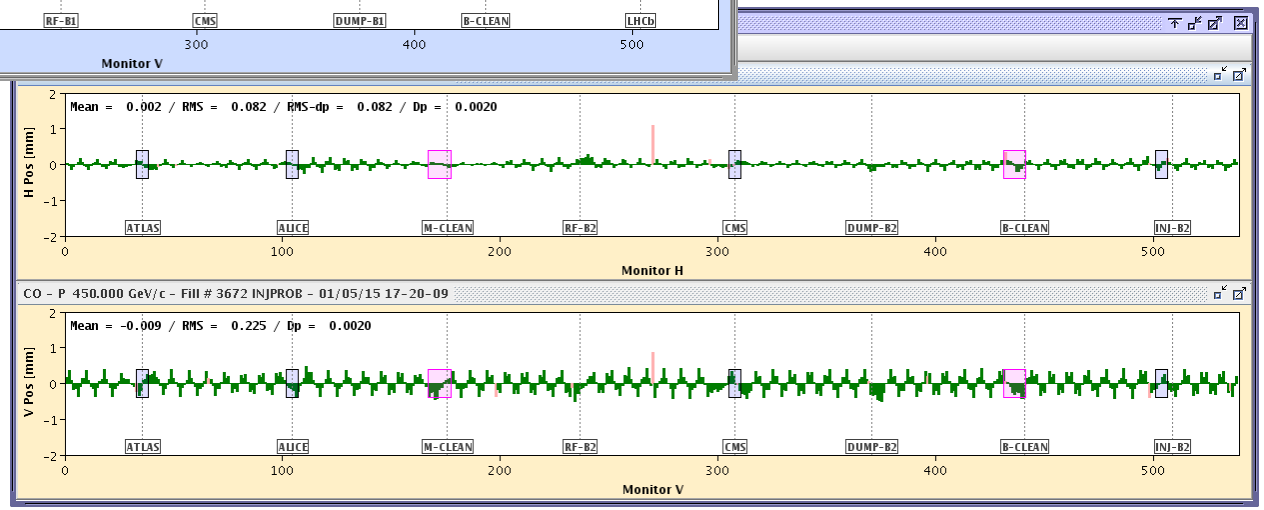
- The ALICE solenoid generates very small (‘negligible’) coupling on the beams.
- In the presence of an orbit bump at the IP – in particular of the crossing/separation bumps – the solenoid **couples part of each bump** (near IP) into the other plane as an open closed orbit oscillation (over the entire ring).
  - At injection the effect is by far largest due to the large internal crossing angle (ALICE spectrometer) and larger solenoid impact due to the low energy.
  - **Scaling with energy** of spectrometer bump contribution:



  - **Scaling with energy** of separation and crossing bump contribution ~ 1/E
    - Crossing angle: 170 → 200 μrad, separation: 3.5 to 1 mm.

ALICE coupling at injection energy

- Orbit change during the ramp of the ALICE solenoid from 0 to 30 kA for positive polarity and external crossing bump of -170 μrad (B1) : **typically ~ 0.2 mm rms**



r.m.s. orbit change ~0.2 mm

ALICE solenoid ramp at 6.8 TeV

- Beside energy increase, there are **two other differences** for the requested test at 6.8 TeV compared to the example shown for injection:
  - Only ~ ½ field change,
  - No separation bump since ~ in collision (even with beams slightly re-separated).
- We can therefore expect that the impact on the orbit is **more than 30 x smaller at 6.8 TeV** → at the level of **10 micron rms maximum**.
  - Such a small orbit change should not represent a problem – natural orbit drifts are larger (but also slower).
  - Can test a ramp down at the end of one of the late commissioning fills (or one of the first ramp up fills).

ALICE solenoid ramp at 6.8 TeV (2)

- Normally we would perform such a magnet ramp in ADJUST, and go back to STABLE BEAMS afterwards. But ALICE indicated transiting through ADJUST is not possible because of the important change in detector state when moving to ADJUST.
- **Procedure as requested by ALICE** :
  - Separate beams to have ~ 0 luminosity.
  - Call ALICE to prepare for the solenoid ramp down. ALICE puts its detectors in a special safe mode for magnet field changes.
  - When ALICE ready, ramp from 30 kA to 12 kA.
  - Bring beams back into collision, carry on with fill.

Recommendation - OP

- Based on the very small orbit changes expected during the ramp down, **no obstacles from OP side** to perform the solenoid ramp with beams at 6.8 TeV.
  - Moving to ADJUST or not should not have an impact.
- We should **test the procedure at the end of a fill**, either during the commissioning of during the 3b/12b intensity step.
- Comment on polarity flip / operation at 0 field:
  - We will only validate one (the default) polarity of ALICE for the ramp up.
  - With careful orbit correction the impact of the polarity flip on the orbit can be kept safely small.
    - But there is of course an important local change between Q1.L and Q1.R in the crossing (V) plane.
  - Because of the required orbit correction, no changes in the middle of the night… The timing of the fills will be constrained !