

# Start of Fill RF MDs in 2012

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# Start of Fill (SOF) MD

- ▶ There is **not much we can do** in the RF with **End of fill**: we have high intensity beam and almost full bucket. Playing with this type of beam is not recommended
- ▶ There are **many RF MDs** that can be **conducted at 450 GeV**, with **nominal batch injection** and **nothing changed in the rest of the machine**. In that situation a 2–4 hours timeslot with the machine at injection settings could be used very effectively for short SOF MDs
- ▶ The MD beam would then be **dumped** and the machine proceeds with physics fill.

# Good candidates SOF RF MDs (1)

- ▶ **Longitudinal stability for batch (RFStabBatch\_2012).** Only changes with respect to physics fills are the **LHC capture voltage**, the **SPS longitudinal emittance** and the **filling pattern**
- ▶ **Longitudinal blow-up studies (RFBlowUp\_2012).** At least the batch per batch blow-up at injection (potential reduction of the transverse emittance growth caused by IBS) can be tested with a **series of nominal batches injected**. (Of course the blow-up in the ramp needs a formal MD)
- ▶ **Longitudinal damper (RFLongDamp\_2012)** is active at injection only. Must be commissioned with **nominal batch at injection**.

# Good candidates SOF RF MDs (2)

- ▶ **Voltage modulation around 1 turn** (RFVoltageMod\_2012). Its final implementation will make it active after the filling is complete. But we must first (MP concerns) **test it at injection** with 2 or more nominal batches.
- ▶ **RF feedback optimization with circulating beam** (RFFdbkOptimWithBeam\_2012). Again the first tests should be done **with 1 or few nominal batches at injection** (MP concerns). Would later be used in ramp and physics also.

# Limits on SOF MD

- ▶ We must define limits on the accepted deviation from nominal parameters so that it does not take ages to rollback to injection for physics...
- ▶ I suspect that BT, BI and ADT can also benefit from SOF MDs

# 25 ns MD. RF request

- ▶ The RF will keep on making observations/adjustments with the 25 ns beam
- ▶ With the present scheme (constant field over one turn) the **beam loading depends on the beam current averaged over ~3 microsec**
- ▶ With 72b batch we do not reach peak value
- ▶ We want to **ramp at least 1 batch with 288 b**

# Additional material

# Longitudinal and RF MDs 2012

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# Longitudinal studies

- ▶ **Loss of Landau damping during ramp** Leftover 2011
  - ▶ Single-bunch, different long. emittances, ramp
  - ▶ Measurements of longitudinal dipole and quadrupole oscillations. Measurements of transverse emittance evolution in parallel
  - ▶ 6 h
- ▶ **Measurement of longitudinal broad-band impedance**
  - ▶ Single-bunch, different intensities, 450 GeV
  - ▶ Measurement of dipole and quadrupole oscillation frequencies to derive impedance [REDACTED]
  - ▶ 6 h
- ▶ **Longitudinal stability for batch**
  - ▶ Several batches, vary long. emittance/capture voltage, 450 GeV
    - ▶ Measure damping of dipole oscillations at injection Leftover 2011
  - ▶ Increase cavity impedance at fundamental (reduce fdbk gain)
    - ▶ Measure the onset of coupled-bunch instabilities Road to higher intensity
  - ▶ 2 x 8 h

# Improvements of present operation

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- ▶ **Longitudinal blow-up** studies

- ▶ 2 or more equally spaced batches, 144b, ramp
- ▶ Alternative longitudinal blow-up & batch per batch blow-up at injection
- ▶ 2 x 8h

Reduced heating?

Effects of IBS during filling reduced

- ▶ Commissioning of the **longitudinal damper** acting via the main accelerating cavities

- ▶ Batch(es) 144 b, 450 GeV
- ▶ 2 x 8h

Reduced capture losses (25 ns)

Damps dipole oscillations at injection?  
(enough BW?)



# The road to higher intensity

## ▶ Voltage modulation around one-turn

- ▶ Few batches | 44b, 450 GeV then ramp
- ▶ Modulation of the voltage phase set point at  $f_{rev}$  to follow transient beam loading and minimize klystron power
- ▶ 2 x 8h

Required to reach nominal current with 25 ns. First test required before LSI

## ▶ RF feedback optimization with circulating beam

- ▶ Few batches, 450 GeV then ramp
- ▶ inject RF noise with zero power spectral density on the Synchrotron Sidebands to measure RF fdbk response (close loop) with circulating beam
- ▶ 4h

Required for stable operation with nominal current .  
First test required before LSI

# p-Pb preparation

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- ▶ Commissioning of the **p-Pb rephasing** using p
  - ▶ 1 batch 32b p in each ring, 450 GeV
  - ▶ Automate the rephasing to get collisions in the detectors
  - ▶ 2 x 4h

Best scheduled in the second half of 2012... but at least 2 months before the p-Pb run