RF MD requests for the LHC in 2016

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MD249 Voltage phase modulation

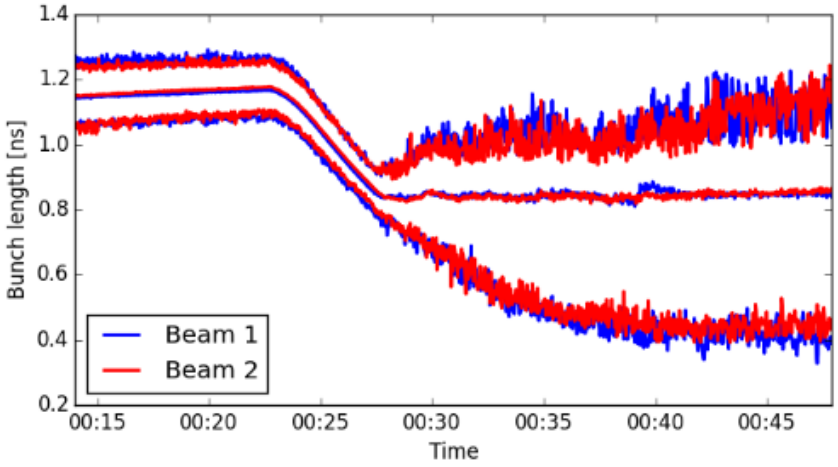
Aim: allow operation of the existing ACS system above nominal beam current by reducing the power “wasted” in compensation of transient beam loading

- Proposed in 1991, implemented in PEPII, presented for the LHC “above nominal” in 2011
- First tested in 2012 (see ATS-Note-2013-013 MD)
- “Consolidation” required this year as intensity is planned to be increased

MD1087 Controlled long. emittance blow-up with short bunches

Aim: understand bifurcation of bunch lengths observed in some cases for the controlled longitudinal emittance blow-up

- Emittance blow-up is a MUST for operation; bifurcation observed during MDs e.g. when spread in bunch length of injected batch was large $\Rightarrow$ operating at the limit!
- Test intensity dependence and dependence on number of bunches

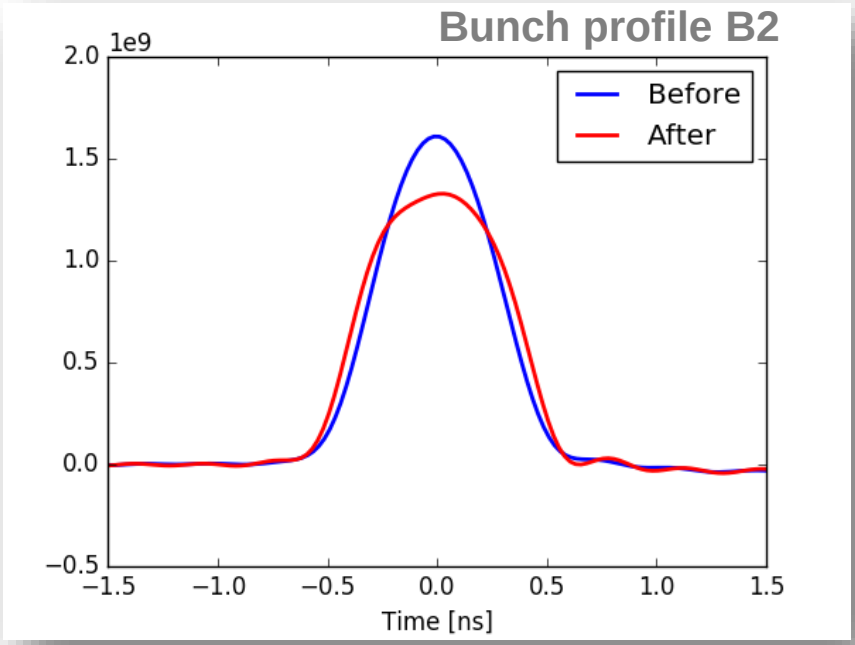


LHC MD August 2015

MD373 Bunch profile shaping

Aim: how close to the stability limit can bunch flattening be performed, how much margin is needed?

- Bunch flattening successfully demonstrated in 2015, but need to answer the above question before it can be applied in stable beams
- Operation, commissioning, or MD time?



Measured on 28th October 2015 at the end of a physics fill

Coupled-bunch instability

MD376

Aim: determine the threshold of longitudinal coupled-bunch stability excited at the fundamental RF cavity impedance

- Gives a better understanding of CBI and the margins of the feedback system for the HL-LHC era
- Was supposed to take place in MD block 3 in 2015, got cancelled

MD652

Aim: determine the threshold of longitudinal coupled-bunch stability excited by the full machine impedance

- Measured with emittances smaller than nominal to probe parameters comparable to the HL-LHC regime

MD232 Impedance evaluation

Aim: determine the LHC longitudinal machine impedance

- Using different methods that do not require making the bunches unstable
- ImZ/n from synchrotron frequency shift:

  Phase modulation (flat bottom)

  Peak-detected Schottky (flat top)
- ReZ from synchronous phase shift

MD1009 LLRF optimisation w/ beam

Aim: optimise of LLRF loops with beam

- Presently, loops are optimised at machine restart w/o beam and with cavities on tune. With beam the cavities are detuned and settings are not optimal anymore
- Interest for the HL-LHC era
- Method: optimisation of feedback response via noise injection into the LLRF loops, but with zero noise Power Spectral Density on the synchrotron sidebands to avoid longitudinal emittance growth

MD240 Longitudinal damper

Aim: demonstrate damping with the longitudinal damper using the ACS cavities (RF phase modulation, ~300 kHz BW)

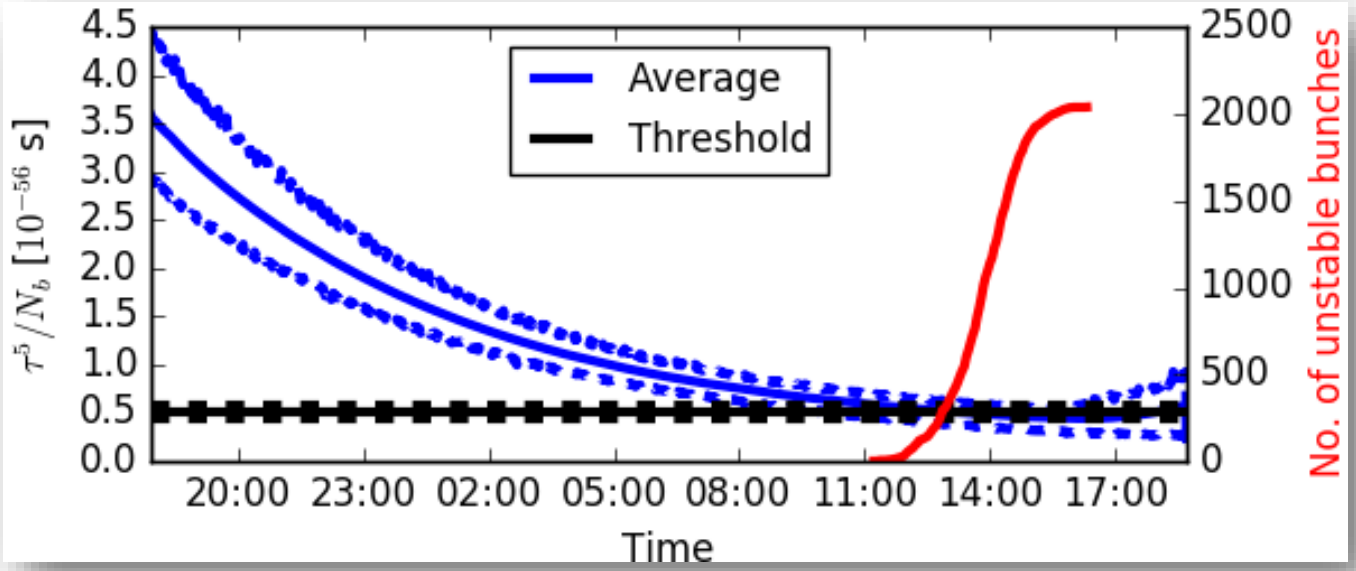
- Can damp injection oscillations, reduce capture losses, and damp longitudinal coupled-bunch instabilities of low order modes
- First test in 2013 was inconclusive

MD472 Single-bunch stability

Aim: determine the dependence of the single-bunch stability thresholds on the particle distribution (Gaussian vs flat)

- Threshold accurately determined in 2015 for Gaussian bunches
- Flattening will change the threshold

  Operation with shorter bunches would require frequent flattening



Loss of Landau damping in the longest fill of 2015.

Single-bunch threshold obtained in MDs.

MD1076 400 MHz Cavity HOM Measurements

Aim: measure HOM power from cavities as a function of beam current and orbit offsets

- Longitudinal higher order mode (HOM) power in the cavities as a function of beam current
- Transverse HOM measurements and its effects on beam to experimentally determine the maximum tolerable orbit offsets in the cavities

- First parasitic measurements during commissioning to check sensitivity (no. of bunches required)
- Potential as diagnostics for dipole mode