

# MD: long bunch length

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# MD scheduled on 25.08.2011

- 18:00
- *Ramp down, cycle*
  
- 20:00
- 450 GeV → 3.5 TeV: Long bunch length – *RF setup at injection, test ramp for losses in IR3, voltage change at flat top*
- **B**
- Thursday
- 04:00
- *Ramp down, cycle*
  
- 06:00
- 450 GeV → 3.5 TeV: Beam Instrumentation

# Motivation

- Nominal longitudinal beam parameters:
  - 450 GeV: 0.5 eVs, 1.5 ns  $\rightarrow$  1.1 ns in LHC (6 MV)
  - 3.5 TeV: (1.1-1.25) ns, (1.8-2.2) eVs (12 MV)
  - 7.0 TeV (DR): 1.05 ns, 2.5 eVs (16 MV)
- Larger longitudinal emittances are better for beam stability (0.8 eVs is sufficient for LD) and IBS growth time (in transverse plane also)
- Shorter bunches have smaller bucket filling factor – better for capture losses and lifetime
- Longer bunches are better for heating and multipacting (e-cloud)
- 4.4 rad (1.75 ns in the 400 MHz bucket) is max  $4\sigma$  Gaussian bunch length without losses

What is optimum for LHC?

# Experimental conditions

## Part I: flat bottom studies

- **filling pattern:** 12+36+36 bunches (50 ns spacing) per ring
- **longitudinal emittance:**
  - nominal (DR) **0.7 eVs** and operational (0.5 eVs)
  - change blow-up in the SPS
  - capture voltage 6 MV
- **transverse emittance:** - nominal, but well controlled, scrapping
- **injected intensity:**  $(1.2-1.4) \times 10^{11}$  /bunch
- other LL/RF settings: as in normal operation
- **Measurements:**
  - bunch length and transverse emittance evolution (~1 hour)
  - capture loss
  - lifetime, debunched beam
  - phase error oscillations

# Experimental conditions

## Part II: flat top studies

- **filling pattern:** 8 bunches/ring (9 equally spaced buckets) + pilot at positions  $401 + (k-1) \cdot 3960$ ,  $k=1, \dots, 8$  (9<sup>th</sup> position 32081 and AGK 31161)
- **longitudinal emittance:**
  - injected: nominal 0.5 eVs,
  - during ramp: controlled blow-up to 1.0 ns
  - **additional controlled blow-up on flat top at  $f_{\text{rev}}$  (modulation along the ring with 1.6 ns max) - need to be tested on the flat bottom before MD (this week)**
- **voltage:**
  - acceleration with the nominal program (6 MV  $\rightarrow$  12 MV)
  - reduction to 6 MV at the end of coast (bypass software **interlock at 8.5 MV**)
- injected intensity:  $(1.2-1.4) \times 10^{11}$
- **transverse emittance:** - nominal, but well controlled
- **Measurements:**
  - bunch length and transverse emittance evolution ( $\sim 1$  hour)
  - lifetime, debunched beam