

# Bunch parameters of the 50 ns LHC type beam for the Q26 and Q20 optics in 2012

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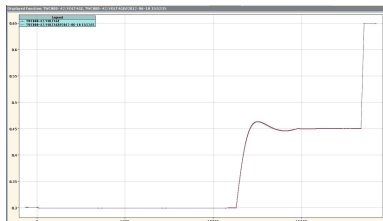
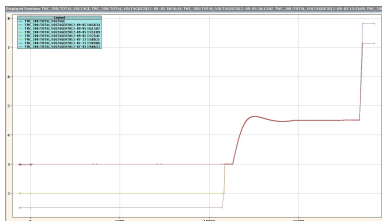
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# Introduction

- ▶ difficulties
- ▶ BCT, BQM data, 50 ns LHC type beam (4 batches of 36 bunches)
- ▶ 2012-07-13 - 2012-09-16: Q26, LHC BP INJPHYS, SPS LHC\_50NS\_D\_2011 (ID: 387)
- ▶ 2012-09-24 - 2012-12-05: Q20, LHC BP INJPHYS, SPS LHCMD\_50NS\_D\_Q20\_2011\_V1 (ID: 768)
- ▶ further selection criteria
  - ▶ LHC request
  - ▶ no. of bunches at flat top exactly 144
  - ▶ BQM flag OK
- ▶ Q26: 118 cycles, Q20: 186 cycles

# RF Voltage Programmes I

RF voltage for cycle LHC\_50NS\_D\_2011\_V1

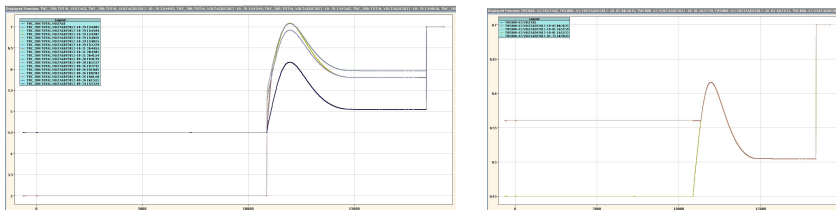


**Figure:** RF voltage for cycle LHC\_50NS\_D\_2011\_V1 (2012-07-13 till 2012-09-16). 200 MHz voltage (left), usually 3 MV at flat bottom and 7.1 MV at flat top. The voltage was below 3.0 MV at the flat bottom only between 2012-09-05 15:25 and 16:12. The higher voltage at flat top was used 2012-07-21 between 15:03 and 15:09. 800 MHz voltage (right), always 650 kV at flat top.



## RF Voltage Programmes II

RF voltage for cycle LHCMD\_50NS\_D\_Q20\_2011\_V1



**Figure:** RF voltage for cycle LHCMD\_50NS\_D\_Q20\_2011\_V1 (2012-09-24 till 2012-12-05). 200 MHz voltage (left), usually 4.5 MV at flat bottom and 7.0 MV at flat top. The 800 MHz voltage (right) was 560 kV at flat bottom till 2012-10-05 08:26 and then 450 kV. The 800 MHz voltage was always 700 kV at flat top.

## RF Voltage Programmes III

Date	200 MHz Voltage	
	Flat Bottom [MV]	Ramp Max [MV]
2012-09-24 13:52	4.5	6.2
2012-09-26 19:01	3.0	6.2
2012-09-26 19:07	4.5	6.2
2012-09-26 19:10	3.0	6.2
2012-09-26 19:27	4.5	6.2
2012-09-28 18:57	3.0	6.2
2012-09-28 19:41	4.5	6.2
2012-10-21 19:41	4.5	6.9
2012-10-29 13:40	4.5	6.2
2012-10-29 13:43	4.5	7.2

**Table:** Summary of 200 MHz voltage trims during the 2012 run with the Q20 optics. Ramp Max is the maximum RF voltage during acceleration.

# Data Acquired I

Data acquired per SPS cycle

$N_Q$  average number of charges per bunch at flat top

$\lambda$  bunch length of one bunch

$\lambda_{\min}$  at injection: min. bunch length of all injected bunches of the first batch; at flat top: min. bunch length of all 144 bunches

$\lambda_{\text{mean}}$  at injection: mean bunch length of all injected bunches of the first batch; at flat top: mean bunch length of all 144 bunches

$\lambda_{\max}$  at injection: max. bunch length of all injected bunches of the first batch; at flat top: max. bunch length of all 144 bunches

$\sigma$  standard deviation

## Data Acquired II

Data plotted are those of one LHC fill ( $\mathcal{O}(25)$  cycles), one LHC period of Beam Process INJPHYS

$\langle N_Q \rangle$  mean of  $N_Q$

$\langle \lambda_{\min} \rangle$  mean of  $\lambda_{\min}$

$\langle \lambda_{\text{mean}} \rangle$  mean of  $\lambda_{\text{mean}}$

$\langle \lambda_{\max} \rangle$  mean of  $\lambda_{\max}$

$\langle \sigma \rangle$  mean of standard deviation

## Data Acquired III

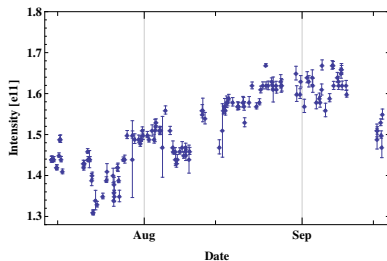
Longitudinal emittance at flat top

- ▶ Q26 cycle: 200 MHz RF voltage of 7.1 MV, 800 MHz RF voltage of 650 kV
- ▶ Q20 cycle: 200 MHz RF voltage of 7.0 MV, 800 MHz RF voltage of 700 kV

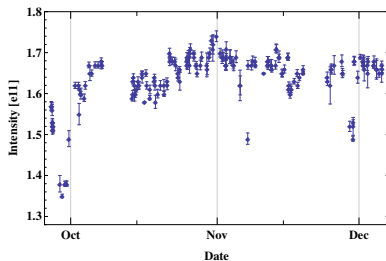
# Time Series I

$\langle N_Q \rangle$  at flat top as function of time

analysis\_20130820.nb v00.01; 2013-08-22 17:32:35; #f94714  
varName: bct



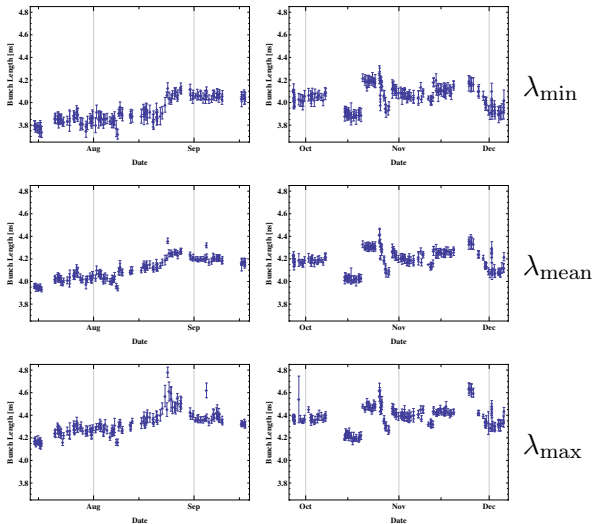
analysis\_20130820.nb v00.01; 2013-08-22 17:35:29; #f94727  
varName: bct



- ▶ intensity step 2012-10-29
- ▶ at about the same time: 200 MHz RF voltage during ramp increased by about 10%

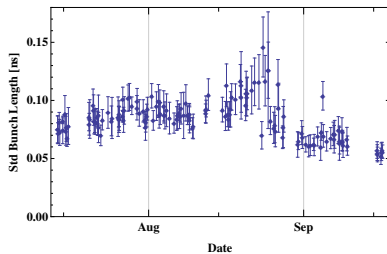
# Time Series II

$\langle \lambda \rangle$  at injection as function of time



# Time Series III

analysis\_20130820.nb v00.01; 2013-08-22 17:34:08; #f94722  
varName: LengthInjStdDev



analysis\_20130820.nb v00.01; 2013-08-22 17:37:22; #f94731  
varName: LengthInjStdDev

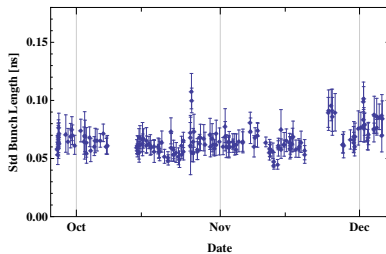
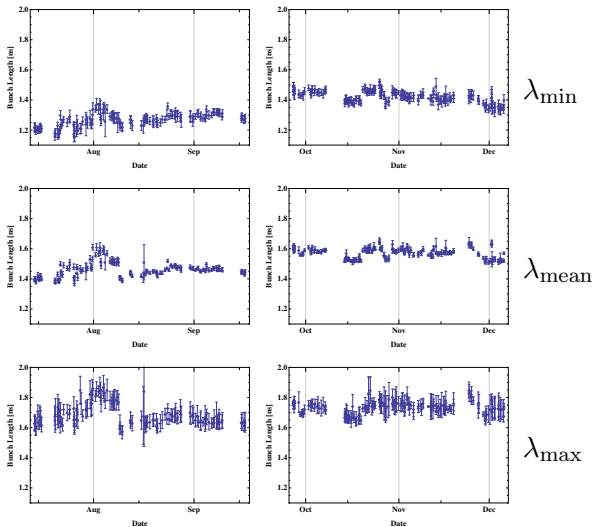


Figure:  $\langle \sigma(\lambda) \rangle$  at injection as function of time.



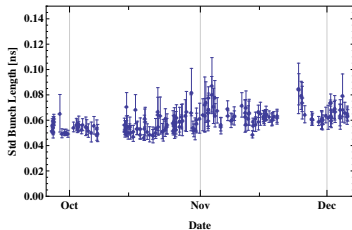
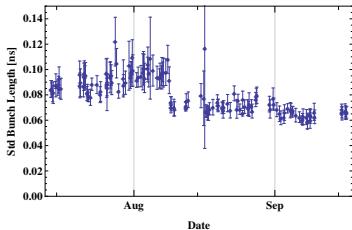
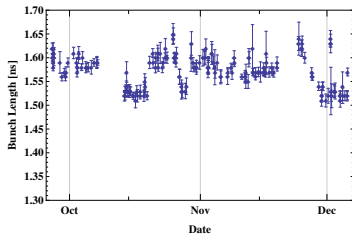
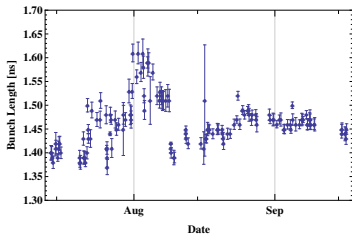
# Time Series IV

$\langle \lambda \rangle$  at flat top as function of time



# Time Series V

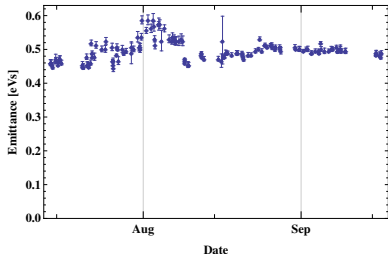
$\langle \lambda_{\text{mean}} \rangle$  and  $\langle \sigma(\lambda) \rangle$  at flat top



► 2012-08-08: longitudinal damper adjustment

# Time Series VI

analysis\_20130820.nb v00.02; 2013-08-26 12:49:03; #f94773  
varName: LengthMean/long. emittance



analysis\_20130820.nb v00.02; 2013-08-26 12:48:07; #f94771  
varName: LengthMean/long. emittance

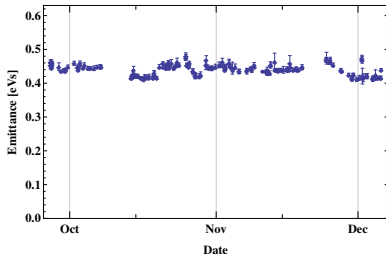


Figure: Longitudinal emittance at flat based on  $\langle \lambda_{\text{mean}} \rangle$  at flat top.

# Correlations I

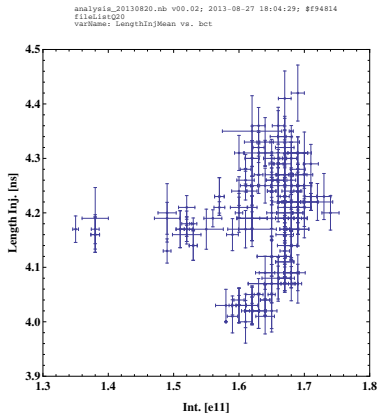
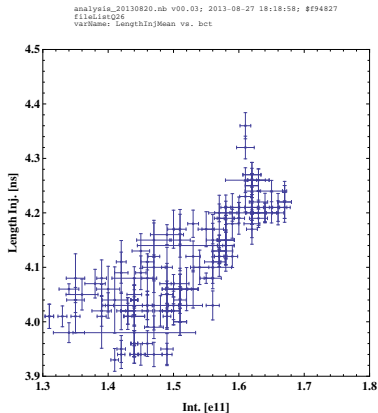


Figure:  $\langle \lambda_{\text{mean}} \rangle$  at injection versus  $N_Q$  at flat top. Q26 (left), Q20 (right).

# Correlations II

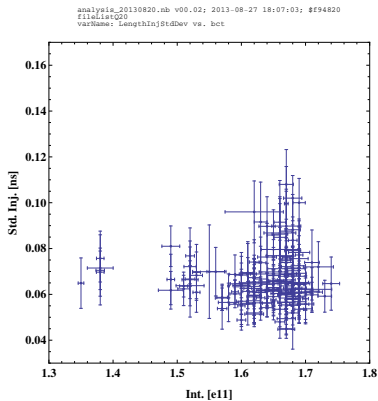
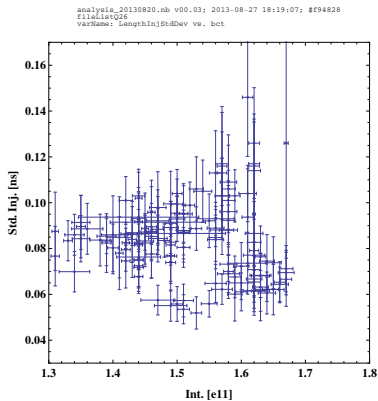


Figure:  $\langle\sigma(\lambda)\rangle$  at injection versus  $N_Q$  at flat top. Q26 (left), Q20 (right).

# Correlations III

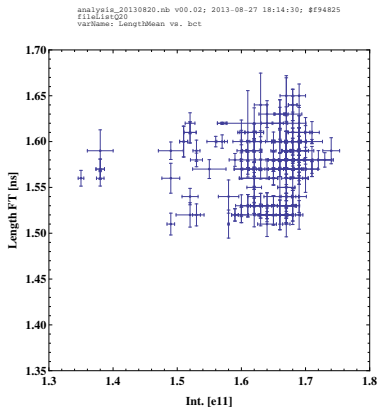
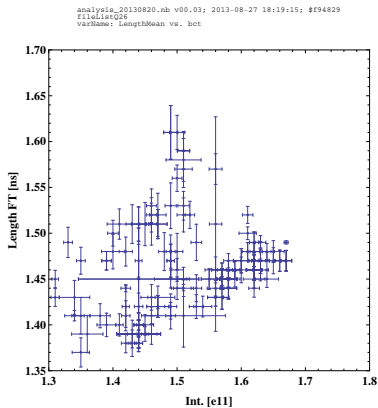


Figure:  $\langle \lambda_{\text{mean}} \rangle$  at flat top versus  $N_Q$  at flat top. Q26 (left), Q20 (right).

# Correlations IV

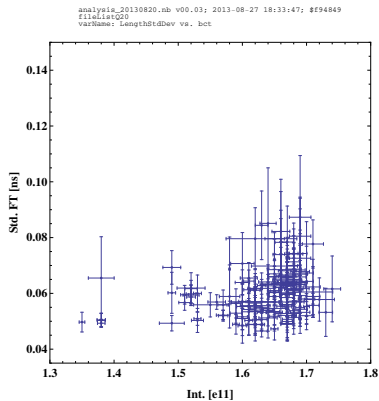
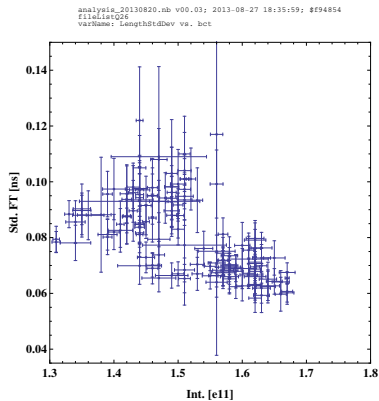


Figure:  $\langle \sigma(\lambda) \rangle$  at flat top  $N_Q$  at flat top. Q26 (left), Q20 (right).

# Correlations V

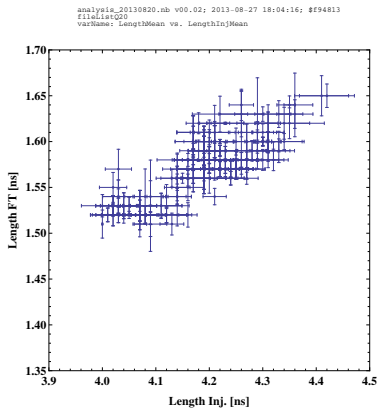
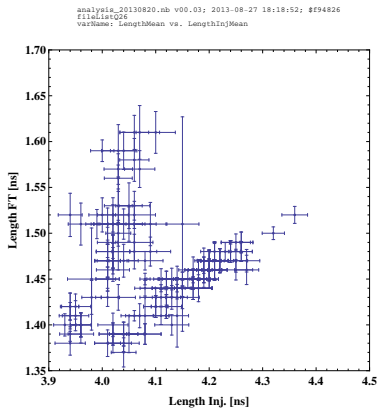


Figure:  $\langle \lambda_{\text{mean}} \rangle$  at flat top versus  $\langle \lambda_{\text{mean}} \rangle$  at injection. Q26 (left), Q20 (right).



# Correlations VI

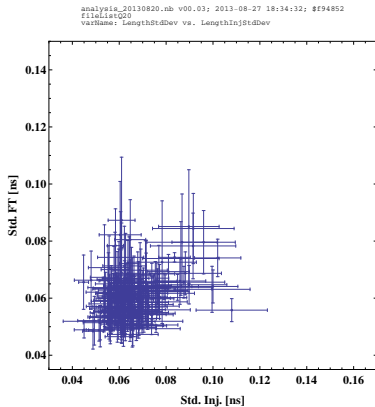
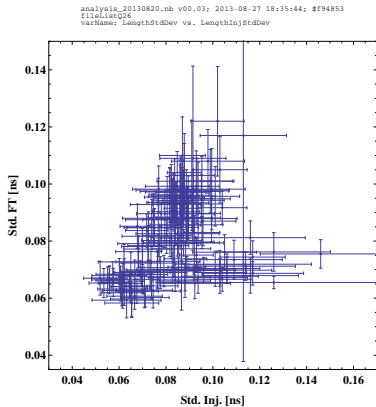


Figure:  $\langle\sigma(\lambda)\rangle$  at flat top versus  $\langle\sigma(\lambda)\rangle$  at injection. Q26 (left), Q20 (right).