

MD1737: Uncaptured Beam Data of 2016-08-02

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Introduction

Main parameters of the measurements

- ▶ MD1737: Transmission of pLHC Beam at Flat Bottom and Intermediate Flat Top (H. Bartosik)
- ▶ 1 batch of 48 bunches of BCMS 25 ns beam, $N_Q = 1.30 \times 10^{11}$ at injection
- ▶ 200 MHz beam component, SA with zero span, BW: 3 MHz
- ▶ date: 2016-08-02

Overview

Observation of the 200 MHz beam component throughout the cycle. For the two following movies a kick had been applied with the tune kicker at $t = 2000$ ms:

- ▶ acquisition without amplifier (download [avi] and use Windows Media Player)
- ▶ acquisition with amplifier (download [avi] and use Windows Media Player); the amplifier gain was 8.9

Analysis of Frames

Overview

The same data as shown in the movies was analysed frame by frame. The 200 MHz beam component was determined for two regions:

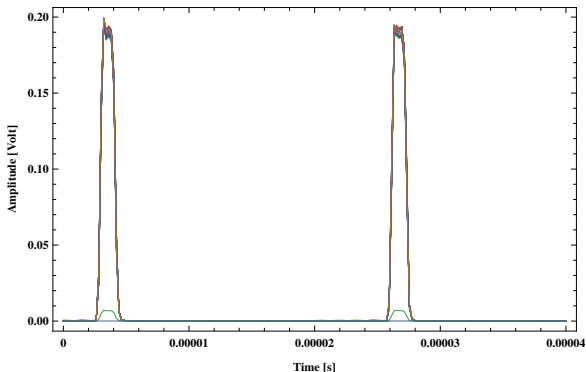
- ▶ Region 1: where mainly the captured beam is located
 - ▶ $3.1 \mu s < t < 4.0 \mu s$
- ▶ Region 2: where mainly the uncaptured beam is located
 - ▶ $5.1 \mu s < t < 24.7 \mu s$

Analysis of Frames

Overview

- ▶ movie frames (w/o amplifier) covering Region 1 and Region 2
- ▶ full scale settings: not possible to see the uncaptured beam escaping from the batch, traces of the frames mainly overlap

Region 1 and Region 2



Analysis of Frames

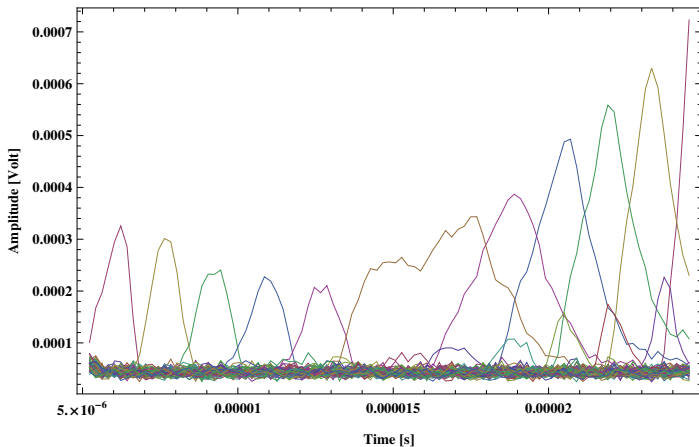
Overview

The following Figure covers only Region 2 and shows frames of the movie (without amplification) with a higher amplitude resolution. The vertical scale is only a fraction of the vertical scale used to show the data of Region 1 and of Region 2. There is a larger fraction of the uncaptured beam moving from the right towards the centre and a smaller part moving from the left towards the centre. At the moment both fractions meet, at about $t = 2$ s, the tune kicker eliminated most of the uncaptured beam (see movie). From then on, no uncaptured beam is seen during the rest of the flat bottom. Then there is short ramp to the Intermediate Flat Top (IFT). After the beam has arrived at the IFT, there is again beam moving out of the buckets as can be seen on the right panel. Now, of course, the amplitude of the beam escaping towards the left is much smaller.

Analysis of Frames

Overview

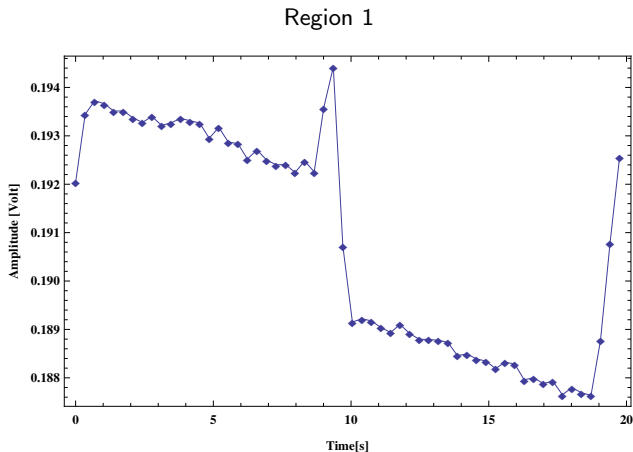
Region 2



Analysis of Frames

Average Amplitude

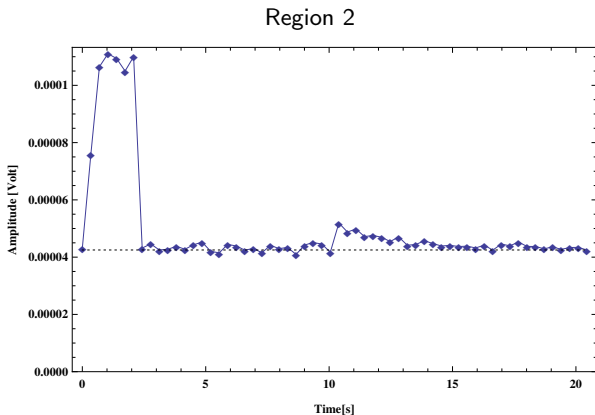
Signal average amplitude for each region plotted versus time. For the Region 1 signal, the average loss rate along the flat bottom and along the IFT is about 0.1%/s with respect to the mean value.



Analysis of Frames

Average Amplitude

Region 2 signal (without amplification) shows the cleaning of the tune kicker at about 2 s. It shows also that at the beginning of the IFT there is again beam escaping the bucket. The dotted line in the Region 2 plot corresponds to the approximate noise level.

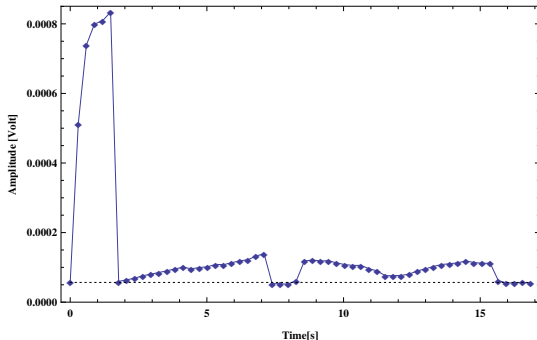


Analysis of Frames

Average Amplitude

Region 2 signal with amplification shows the cleaning of the tune kicker at about 2 s, in addition also the increase of the amount of uncaptured beam in Region 2 along the flat bottom. The amount of uncaptured beam disappears with the acceleration ramp. At the beginning of the IFT there is again beam escaping the bucket.

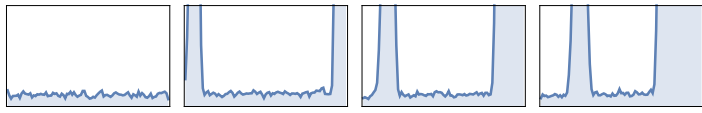
Region 2



Analysis of Frames

Frame by Frame Analysis: Flat Bottom

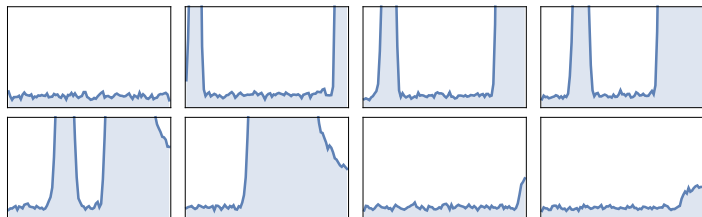
Plots of each data acquisition frame (Region 2) along the flat bottom with amplification (fixed horizontal and vertical scale).
Frame 1: Region 2 is empty, injection (Fig: F1-F4)



Analysis of Frames

Frame by Frame Analysis: Flat Bottom

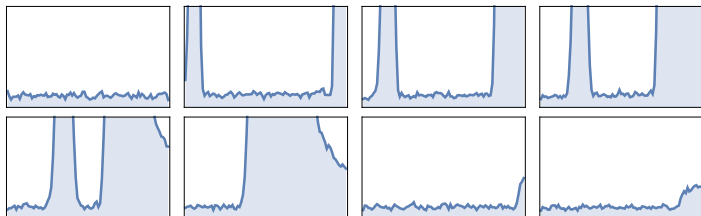
Frames 2-5: beam moving from right and from the left moving towards the centre of Region 2; the part coming in from the right is of larger amplitude than the part coming from the left; in both cases it is much larger than the full scale (Fig: F1-F8)



Analysis of Frames

Frame by Frame Analysis: Flat Bottom

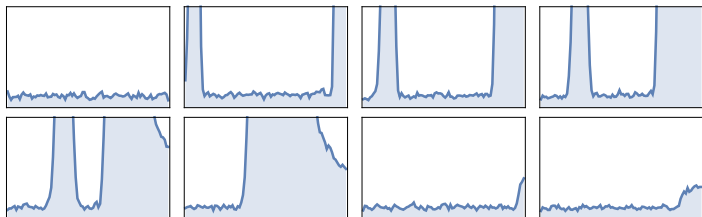
Frame 6: the part coming from the left meets the part coming from the right (Fig: F1-F8)



Analysis of Frames

Frame by Frame Analysis: Flat Bottom

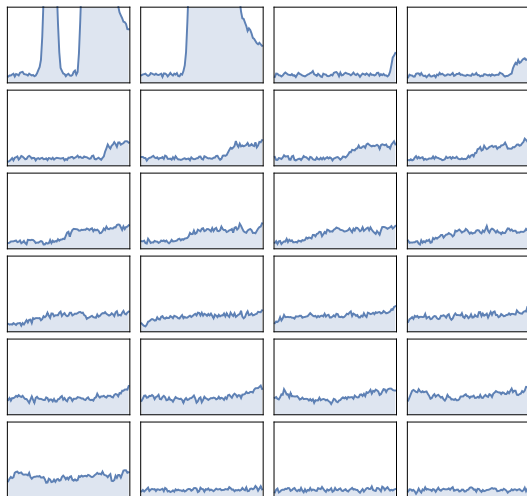
Frame 7: as soon as the parts form the right and the left meet, they are eliminated by the the tune kicker, but there is still beam escaping from the beam and appearing at the right; the part coming from the left is too small to be seen (or not present) (Fig: F1-F8)



Analysis of Frames

Frame by Frame Analysis: Flat Bottom

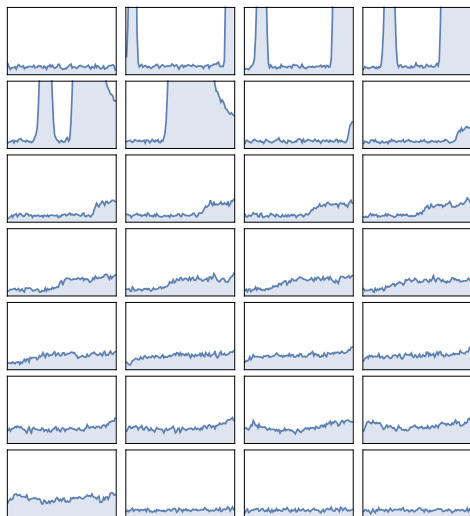
Frame 8-25: Region 2 is filling-up (Fig: F5-F28)



Analysis of Frames

Frame by Frame Analysis: Ramp 1

Frame 26-28: due to acceleration, Region 2 is empty (Fig: F1-F28)

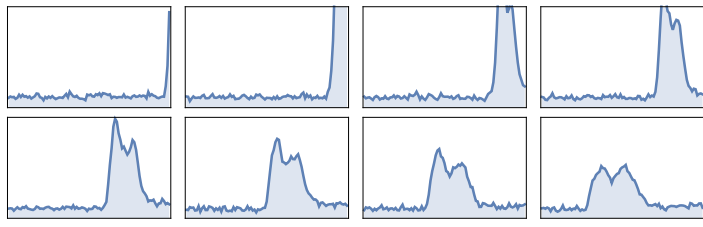


Analysis of Frames

Frame by Frame Analysis: IFT and Ramp 2

Now each data acquisition frame (Region 2) along the IFT (same fixed horizontal and vertical scale as previously).

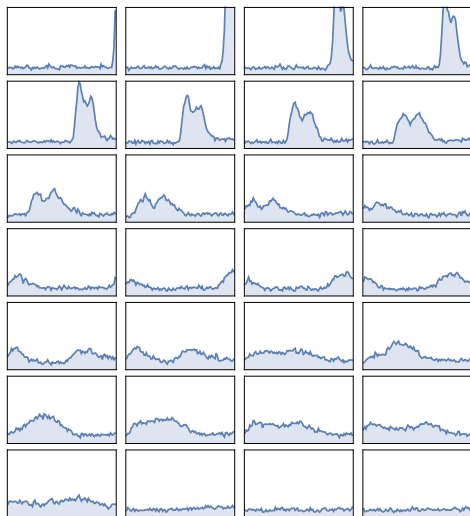
Frame 1: beginning of IFT, beam is moving from the right into the empty Region 2 (Fig: F1-F4)



Analysis of Frames

Frame by Frame Analysis: IFT and Ramp 2

Frames 2-25: Region 2 is filling up (Fig: F1-F28)



Analysis of Frames

Frame by Frame Analysis: Ramp 2

Frames 26-28: Region 2 is emptied by acceleration (Fig: F1-F28)

