iGp Commissioning at TLS

Dmitry Teytelman

Dimtel, Inc., San Jose, CA, USA

April 8, 2010

Commissioning Progress

- Started on Tuesday (April 6) from longitudinal feedback work;
- Beam stabilized in 20 minutes;
- Later used low beam currents to time the system;
- Training session: longitudinal feedback setup;
- Continued after midnight (April 7) with transverse feedback;
- In the evening - further transverse studies;
- On Thursday (April 8) added the second AR 250A250A amplifier;
- Demonstrated bunch cleaning (with an orbit bump);
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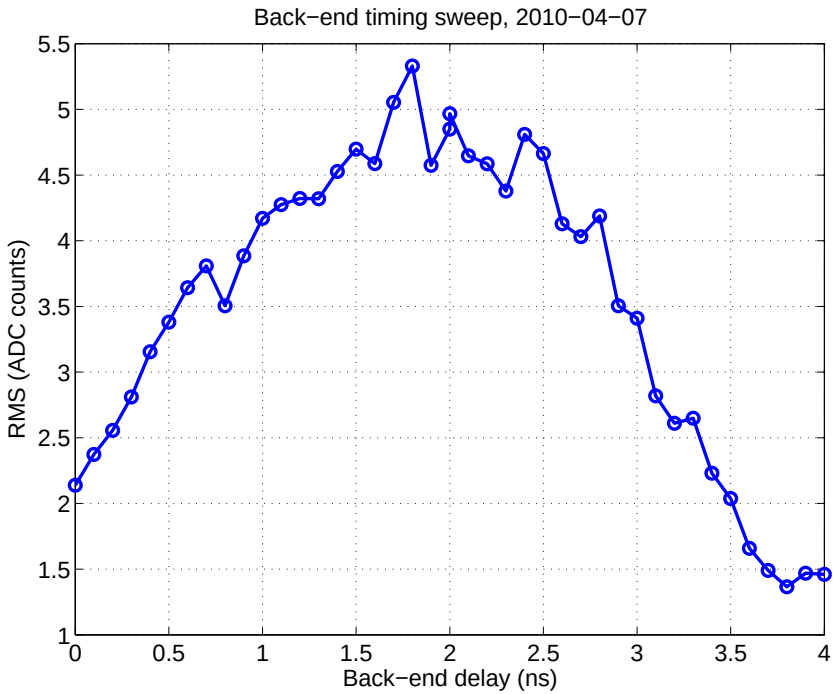
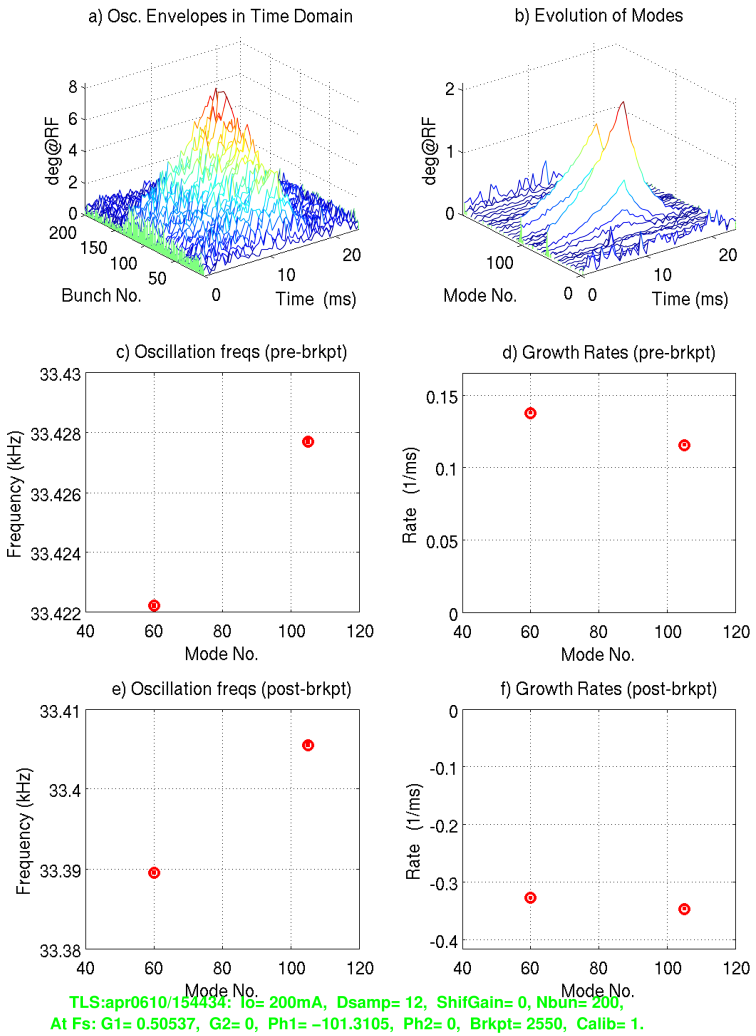
Longitudinal Timing



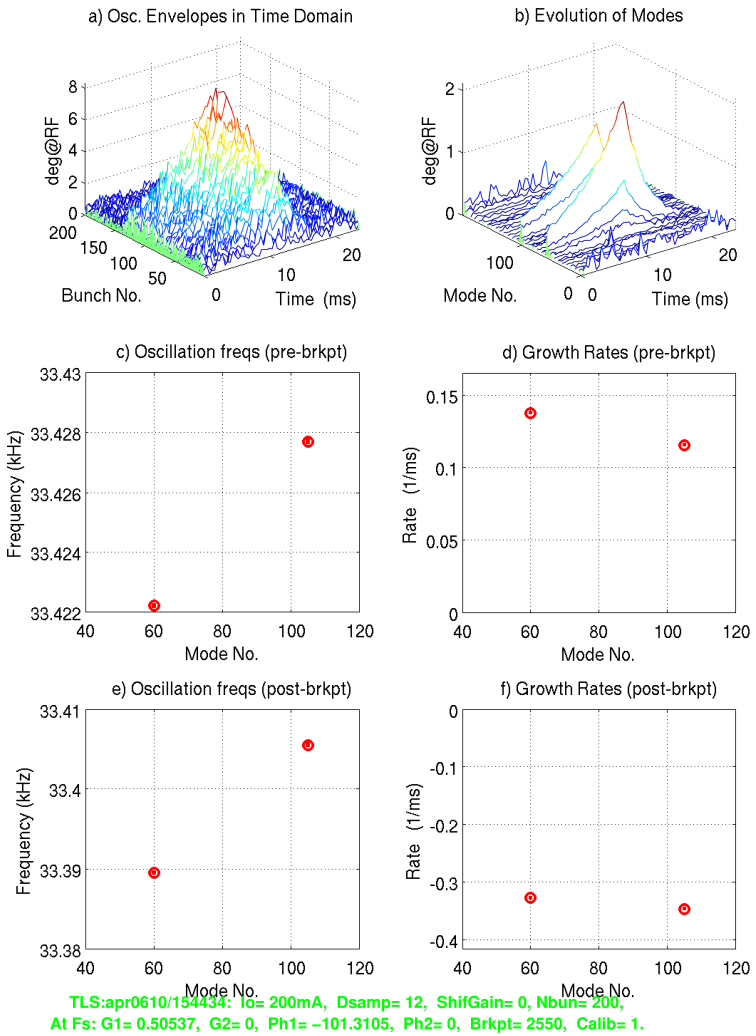
- Longitudinal back-end timing sweep;
- Fine timing, 100 ps steps;
- Adjust DAC delay, record bunch RMS.

Longitudinal Grow/Damp



- Grow/damp transient at 200 mA;
- Low gain configuration;
- Damping rate is twice as fast as the growth rate;
- Roughly 30 Hz tune shift from the feedback.

Longitudinal Grow/Damp



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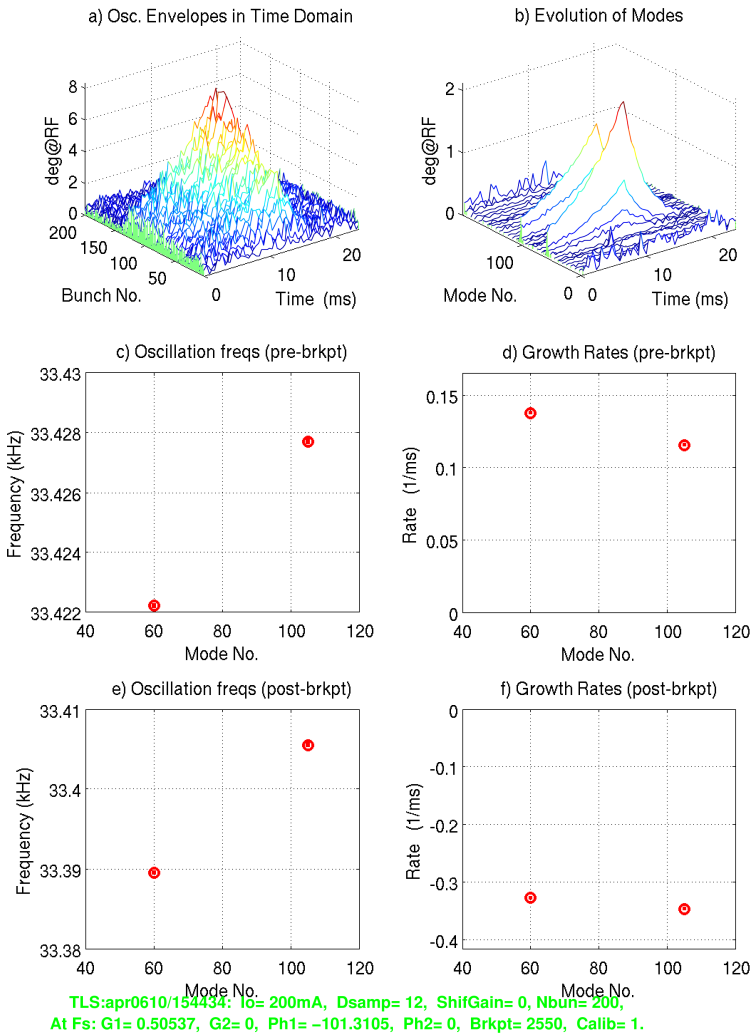

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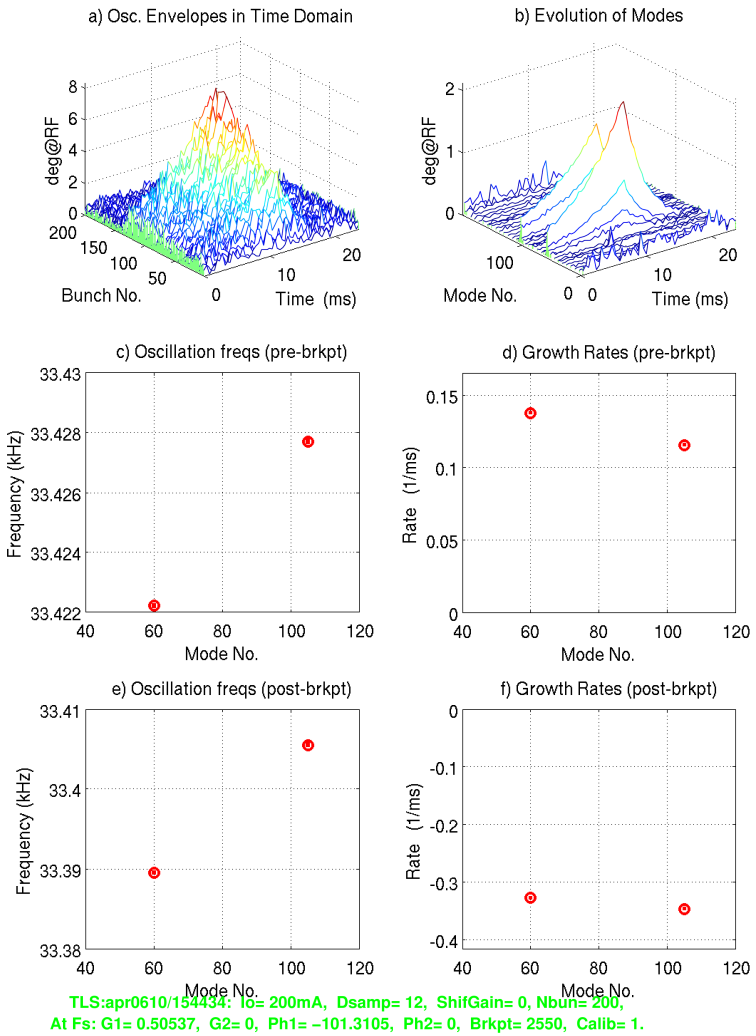

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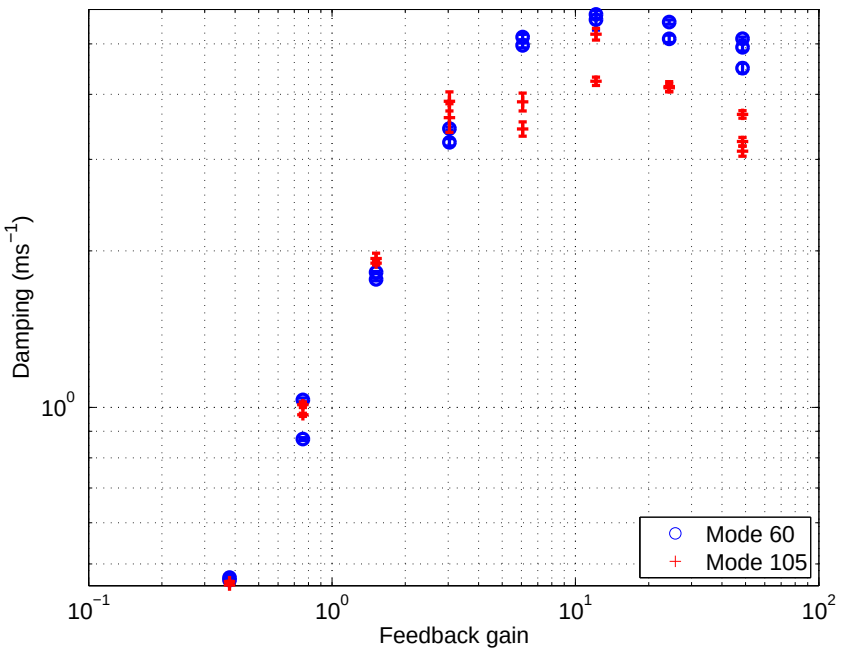
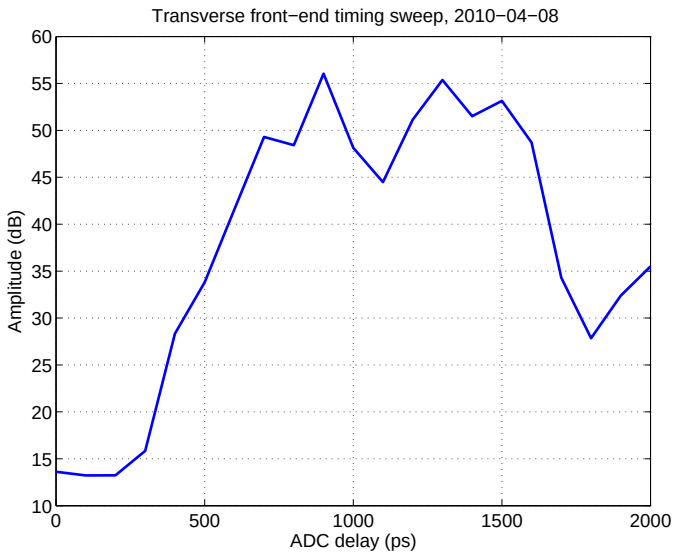
Longitudinal Damping Versus Gain



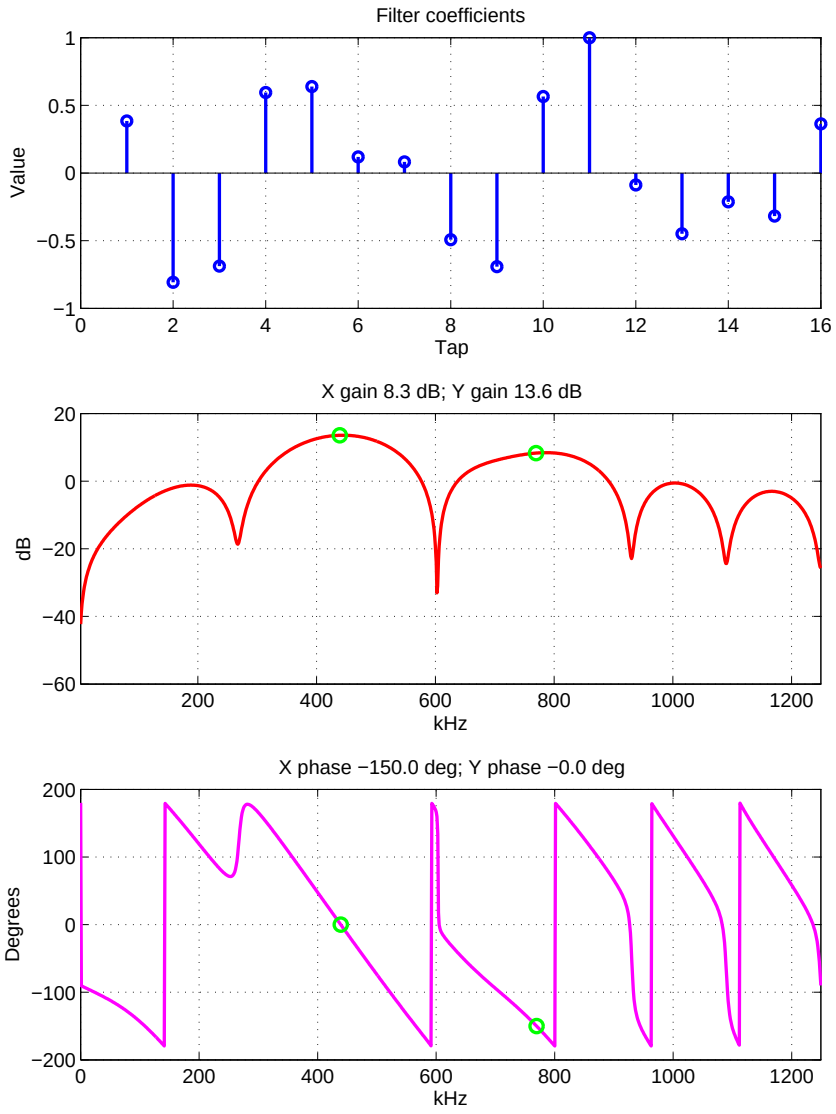
- Plot feedback damping (difference between growth and damping rates) vs. feedback gain;
- Linear increase up to the gain of 3;
- Very high gains lead to reduced damping:
  - Saturation, dynamic limits.

Transverse Setup



- iGp ADC input connected directly to the BPM hybrid output;
- Only possible due to wide (1.3 GHz) bandwidth of the iGp;
- Front-end timing sweep with a single bunch;
- Two peaks around 900 and 1350 ps correspond to positive and negative pulses of the differentiated bunch signal;
- Set timing at 1370 ps.

Transverse Filter Design



- 16-tap FIR filter;
- Matlab filter generator allows independent control of gain and phase for X and Y;
- Lower X gain is intentional - to balance the two loops.

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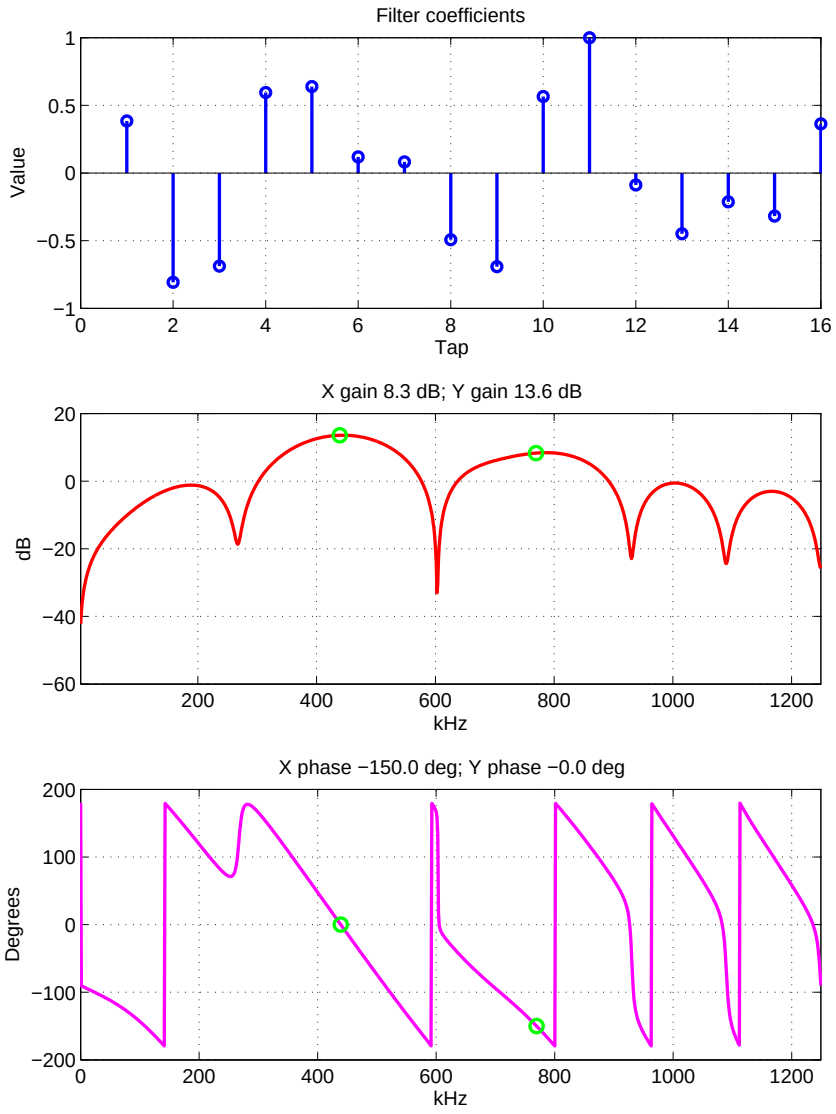

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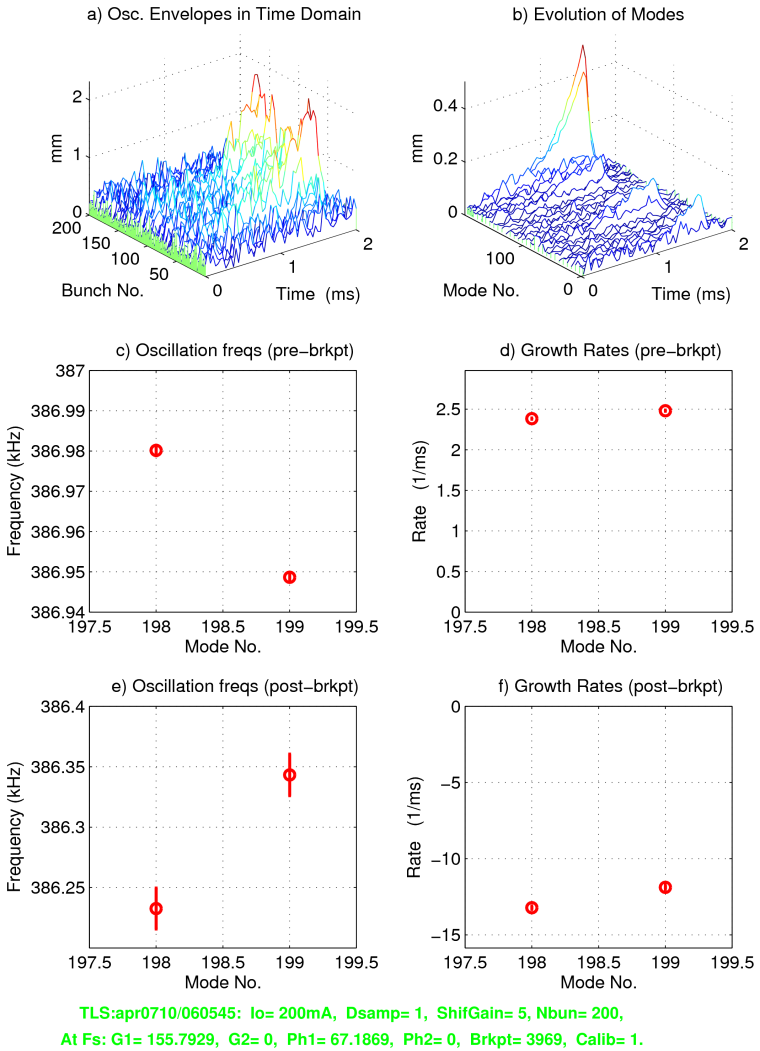
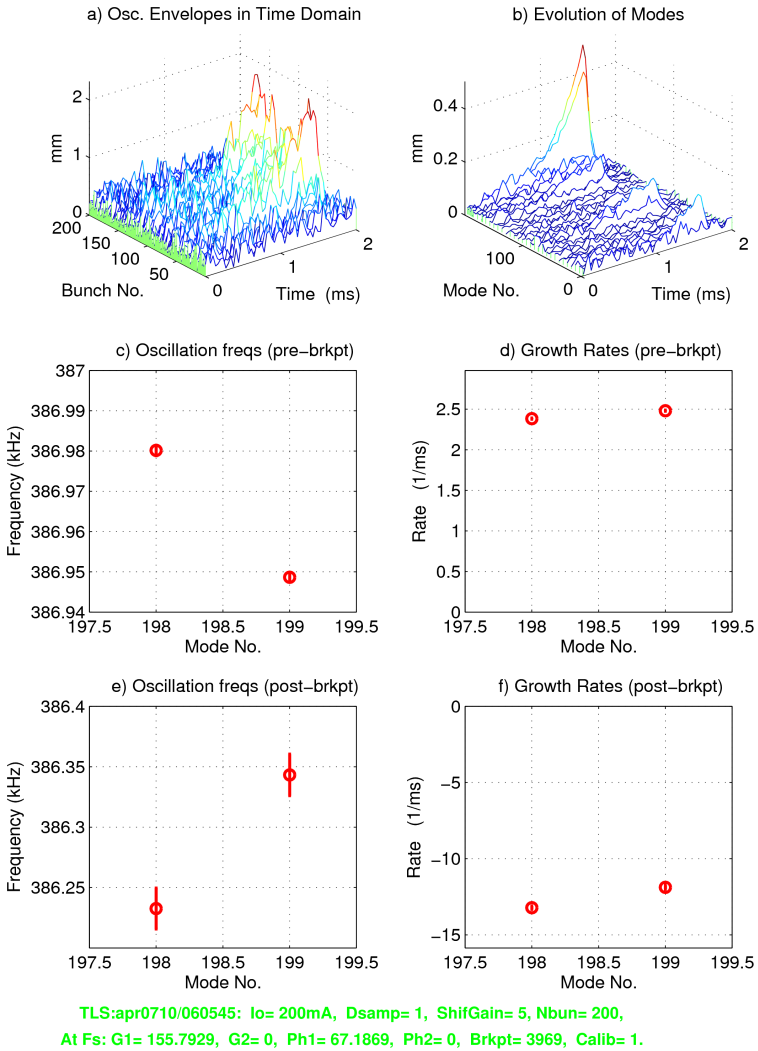


TLS:apr0710/060545: Io= 200mA, Dsamp= 1, ShifGain= 5, Nbun= 200,
At Fs: G1= 155.7929, G2= 0, Ph1= 67.1869, Ph2= 0, Brkpt= 3969, Calib= 1.

- Grow/damp transient at 200 mA;
- Filter bunch signals around the vertical tune;
- Extract growth and damping rates, modes -4 to -1 active;
- Filter bunch signals around the horizontal tune;
- Slower growth rates, similar modal spectrum.

Transverse Grow/Damps



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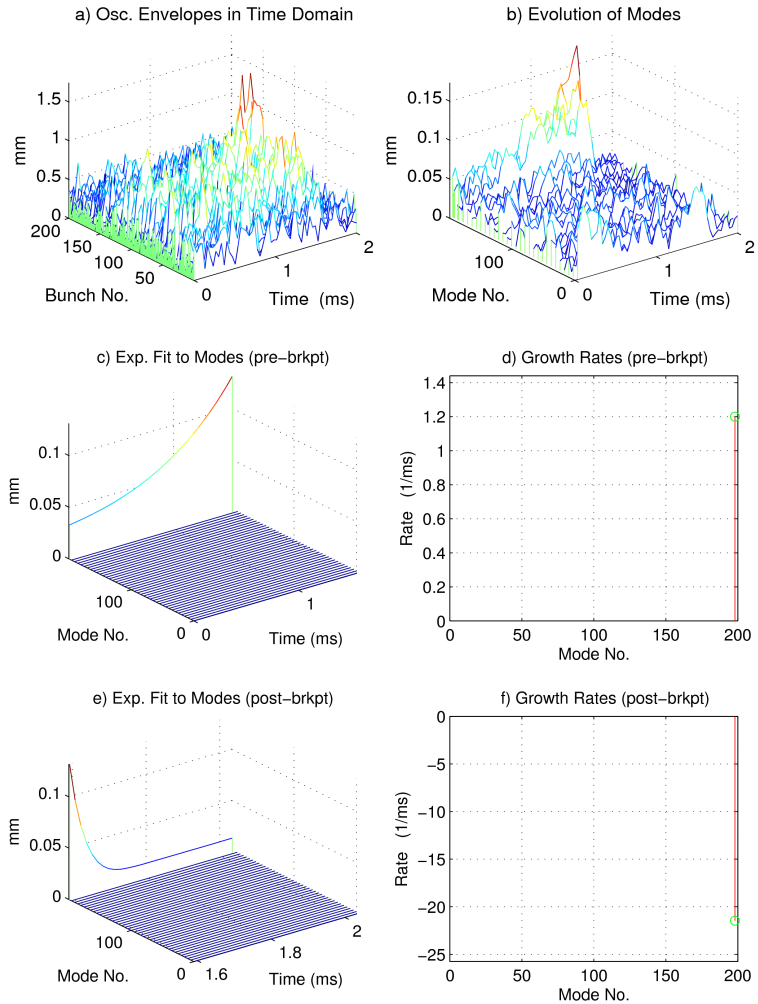

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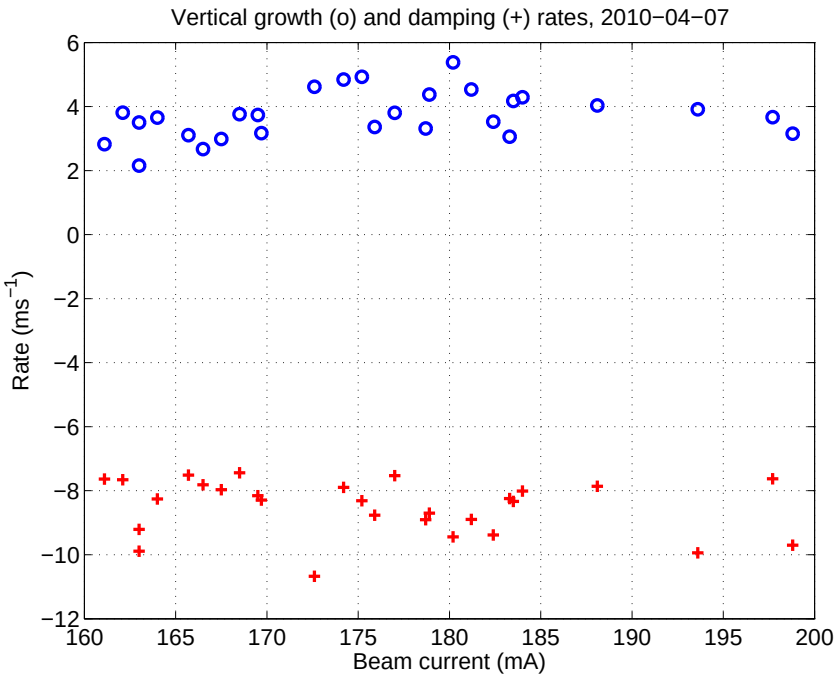
Vertical Growth and Damping Rates Vs. Beam Current



- No change in growth rate vs. beam current;
- Typical for beam-ion instabilities;
- Damping rates are much faster than the growth rates.

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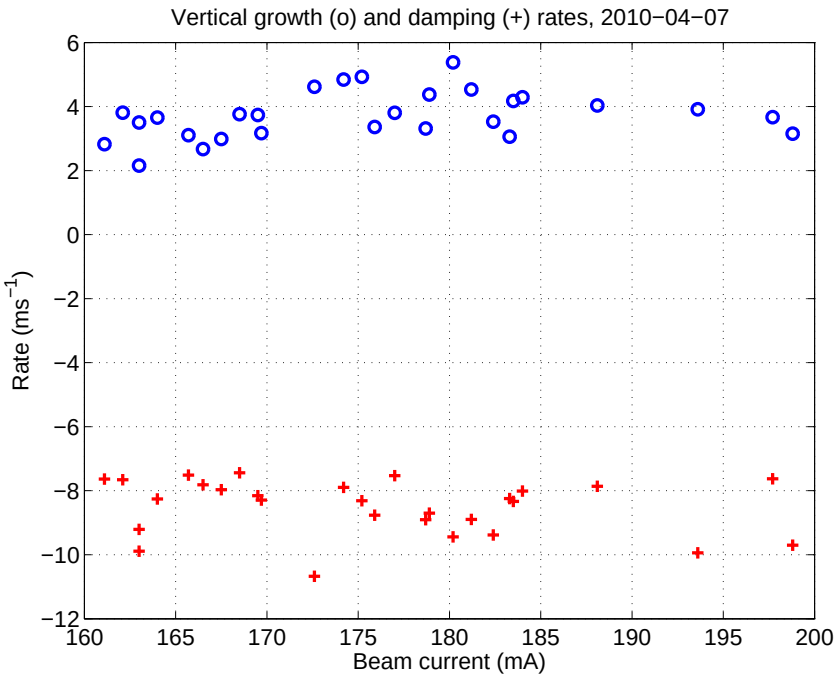

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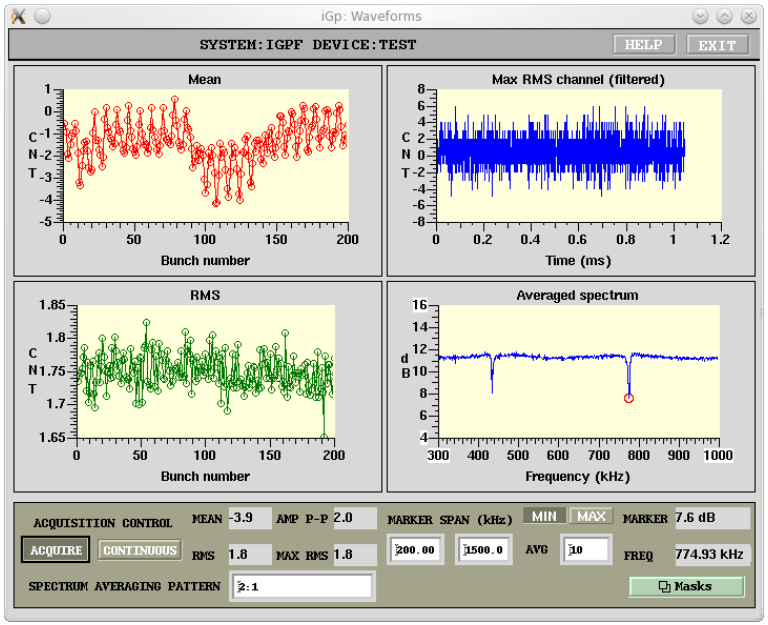
Beam Spectrum and Tune Monitoring



- When feedback loop is closed, bunch spectra exhibit notches in the noise floor;
- These notches are located at the peaks of the beam transfer function, i.e. betatron tunes;
- Depth of the notch is related to the feedback loop gain;
- Search marker automatically reads out the tune at 1 Hz;
- Can fit individual bunch signals off-line to extract bunch-by-bunch tunes.

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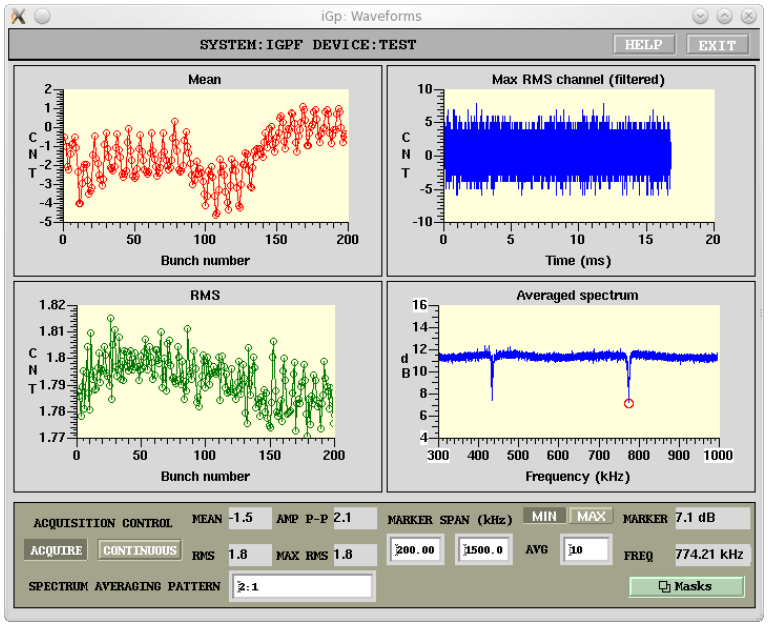

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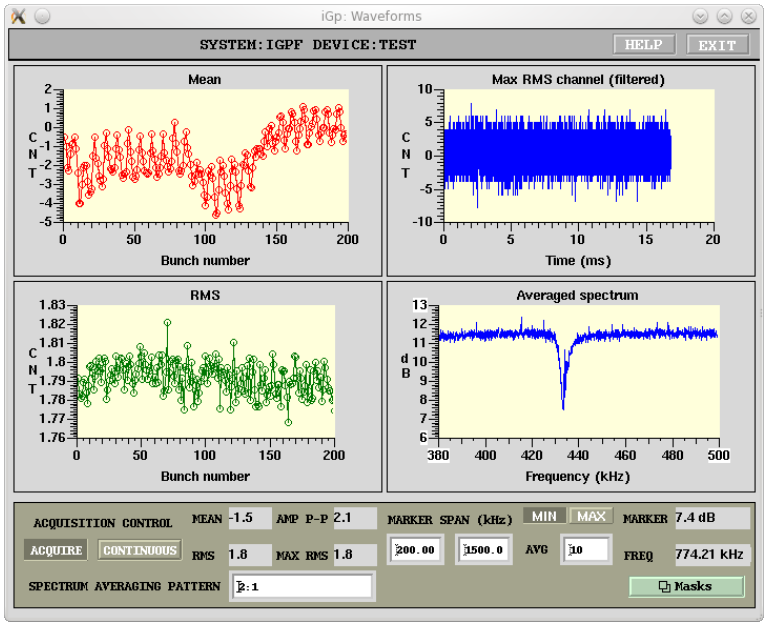

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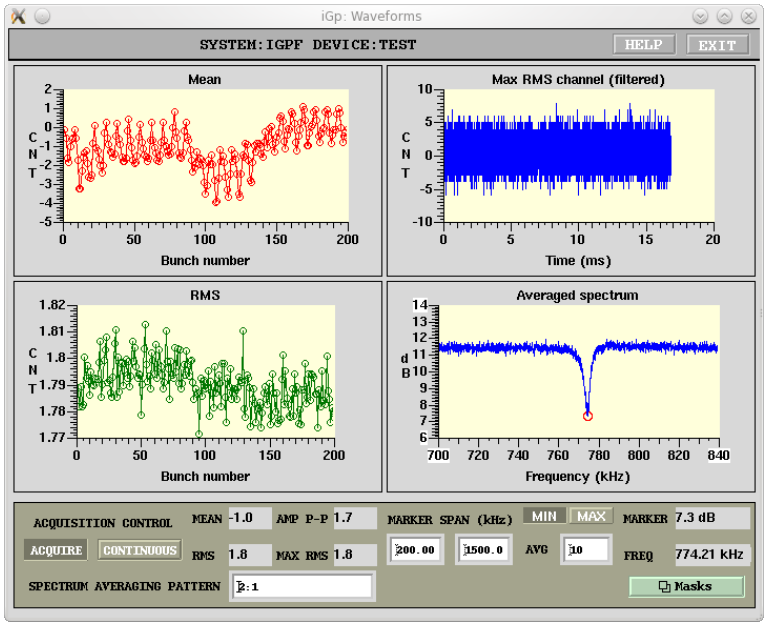

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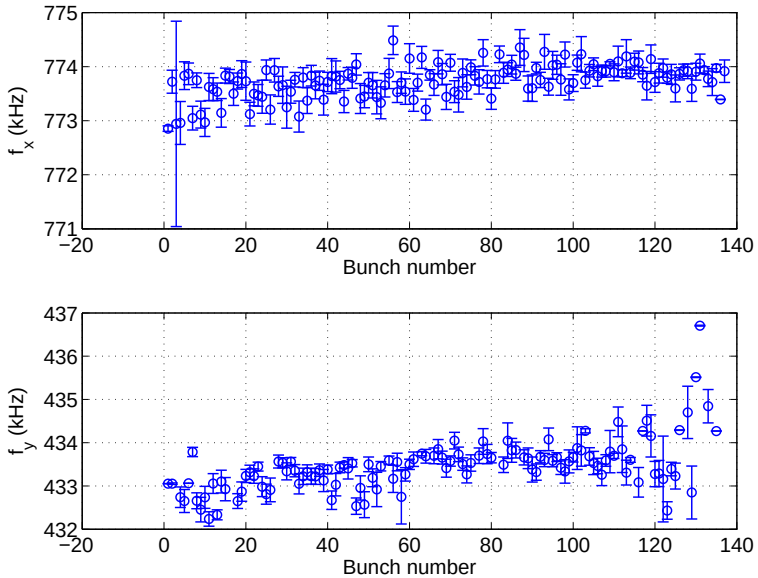

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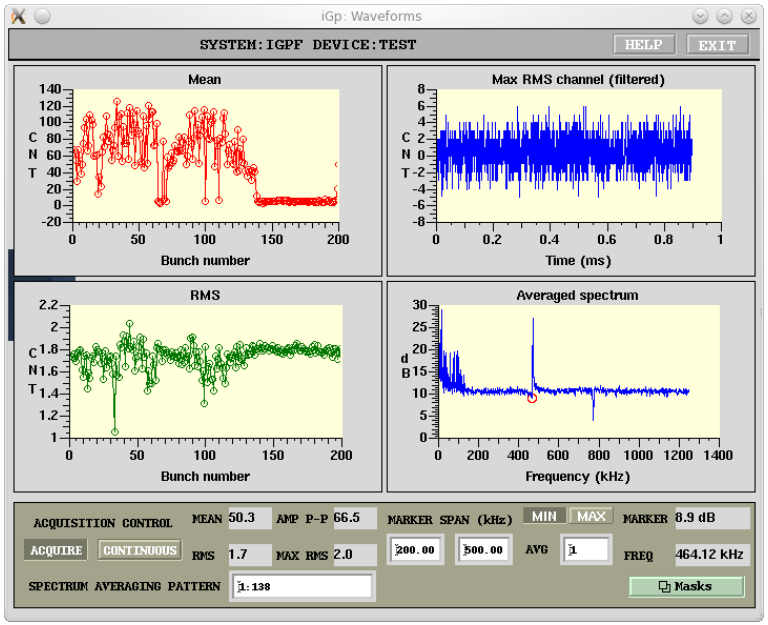

- iGp has integrated functionality for bunch cleaning;
  - We turn off the feedback for bunches to be cleaned and apply excitation at the betatron (vertical) tune;
  - Cleaned out bunches 65–67, 100, 110;
  - Additionally cleaned in the pattern 10:10:200;
  - Cleaned out everything, left one bunch.

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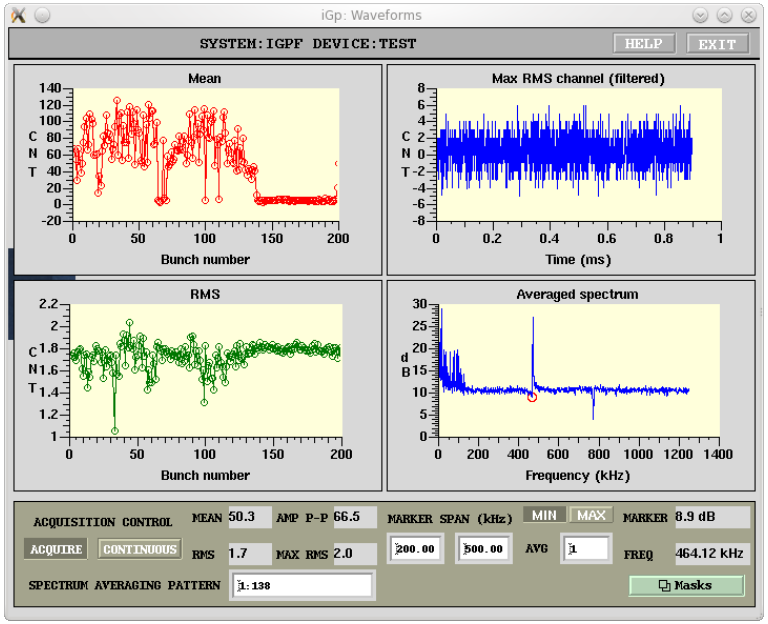

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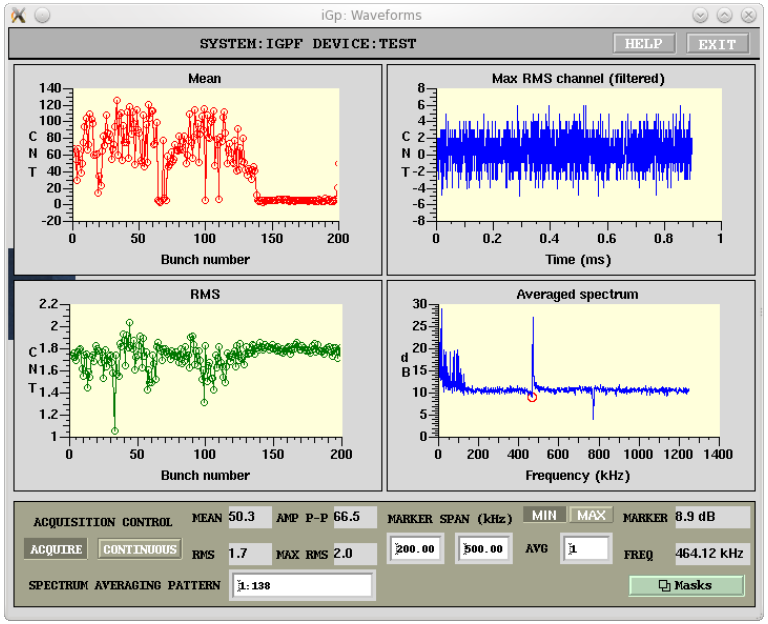

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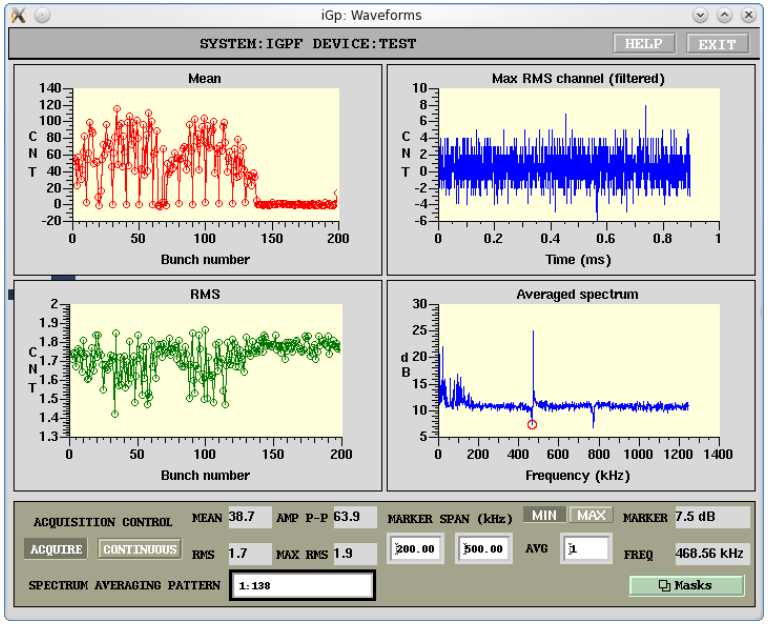

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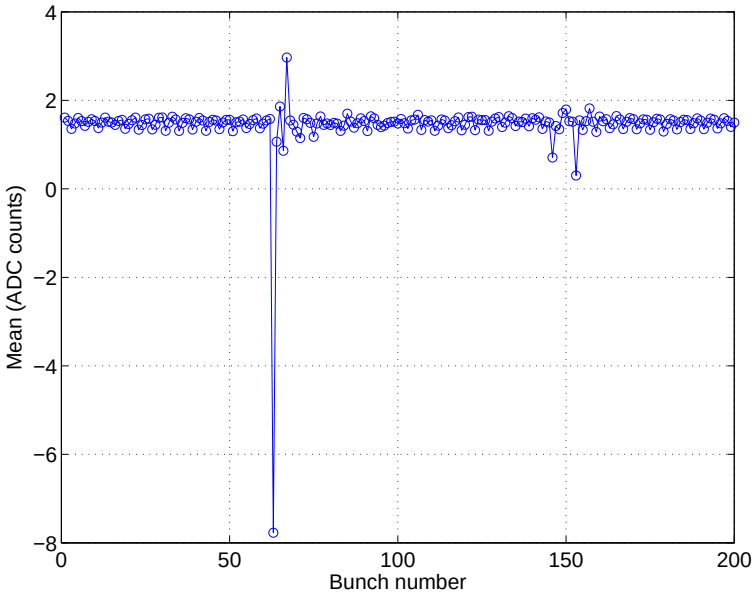

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- Longitudinal SSB modulator needs some attention (large carrier feedthrough).
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