Bunch-by-bunch Feedback Commissioning at the MLS

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November 19, 2010

Outline

Commissioning Goals

- Update and configure three bunch-by-bunch feedback units (iGp12);
- Create a front-end hybrid network to generate Δx, Δy, and Σ signals;
- Time feedback channels to the beam, demonstrate stabilization in three planes at 629 MeV;
- Demonstrate bunch cleaning, study fill pattern control;
- Train MLS staff in system setup and operation.

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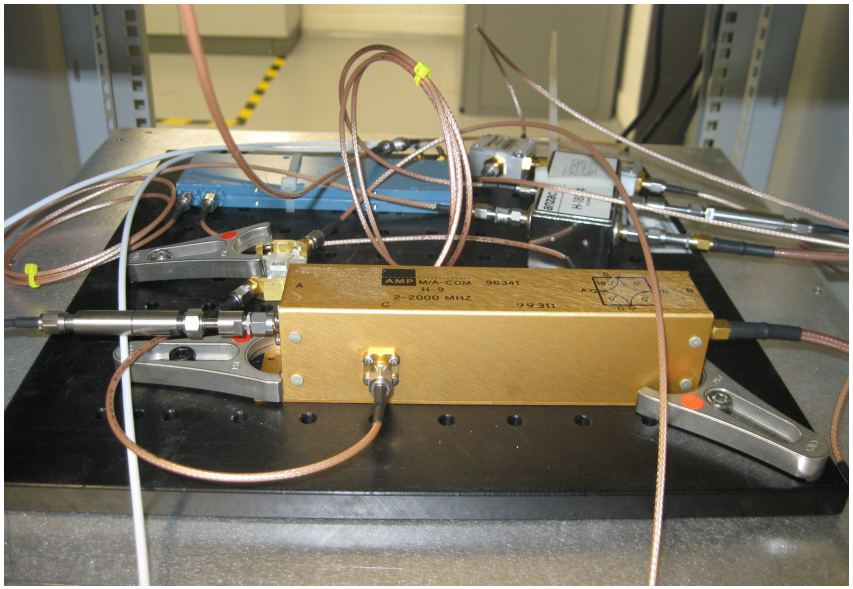
Hybrid Network



- Button BPM - low sensitivity at 1.5 GHz - transitioned to 3 GHz striplines;
- Hybrid network composed of Anzac H-9 and H-183-4, Merrimac HJM-4R-9.5;
- H-9 inverts its outputs - used Mini-Circuits ATDL2-18/TB-94A for Σ output.

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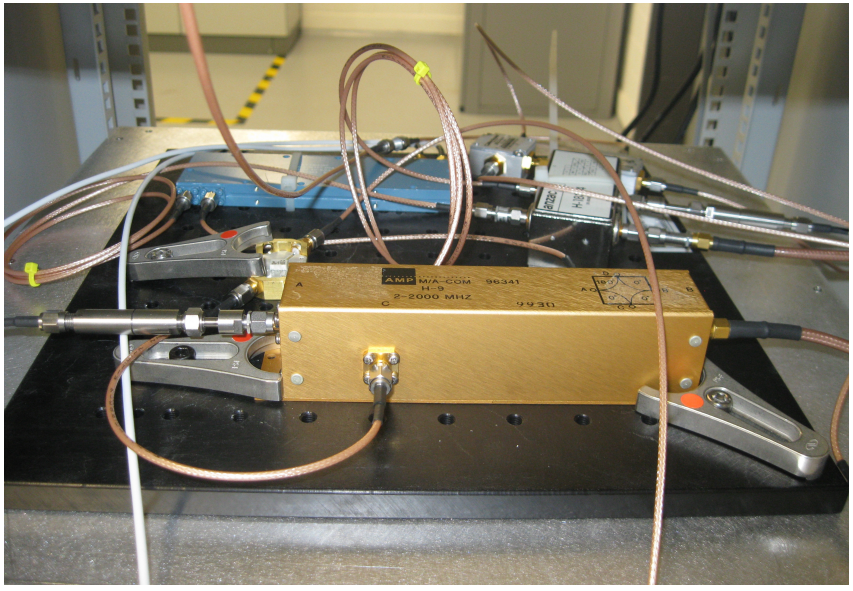

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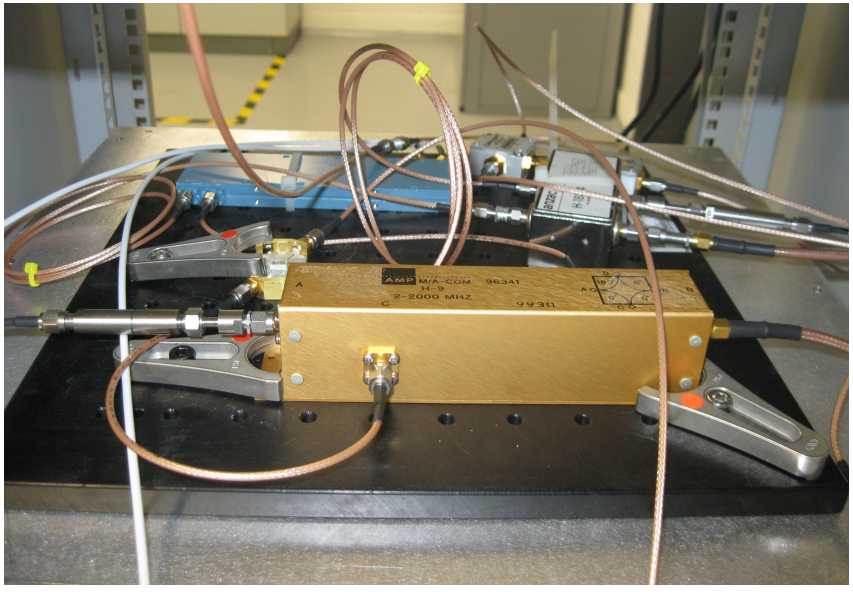

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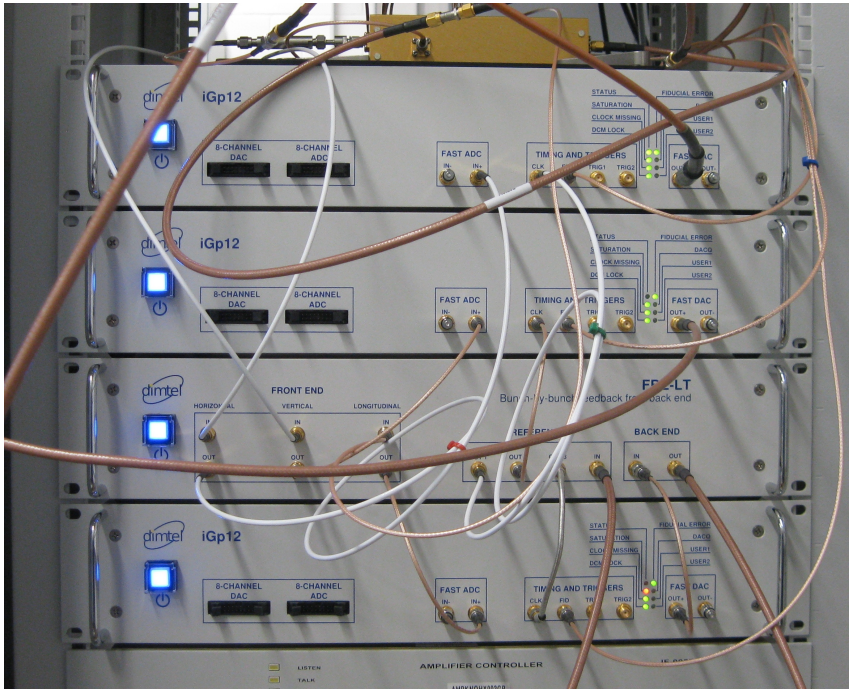

- Three baseband processors (still to be mounted);
- Combined front/back-end.

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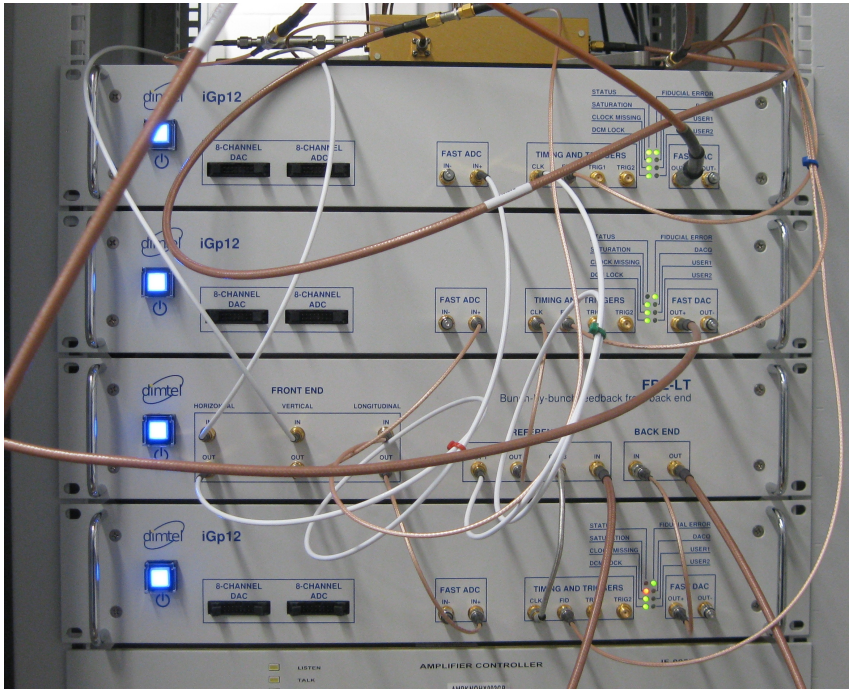

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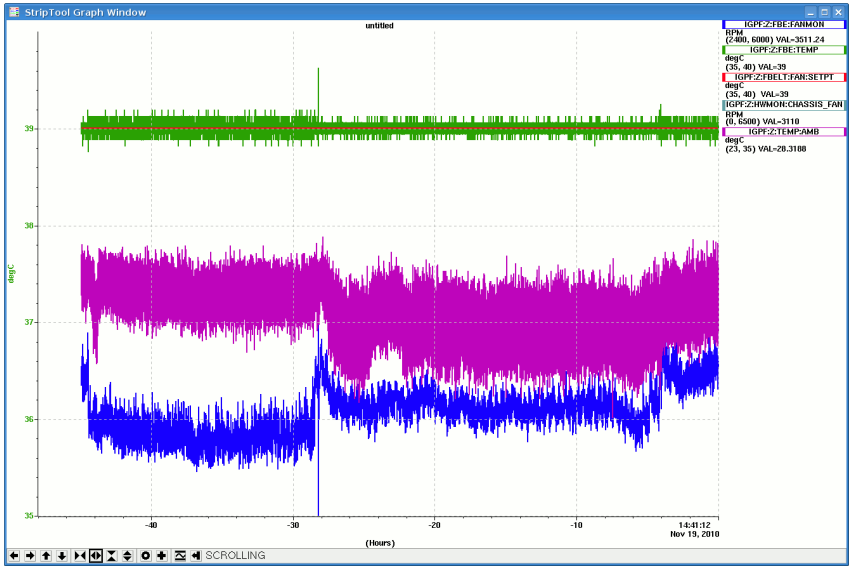
Outline

Temperature Stabilization in FBE-LT



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- EPICS feedback loop is used to control the temperature;
- Improves phase and amplitude stability.

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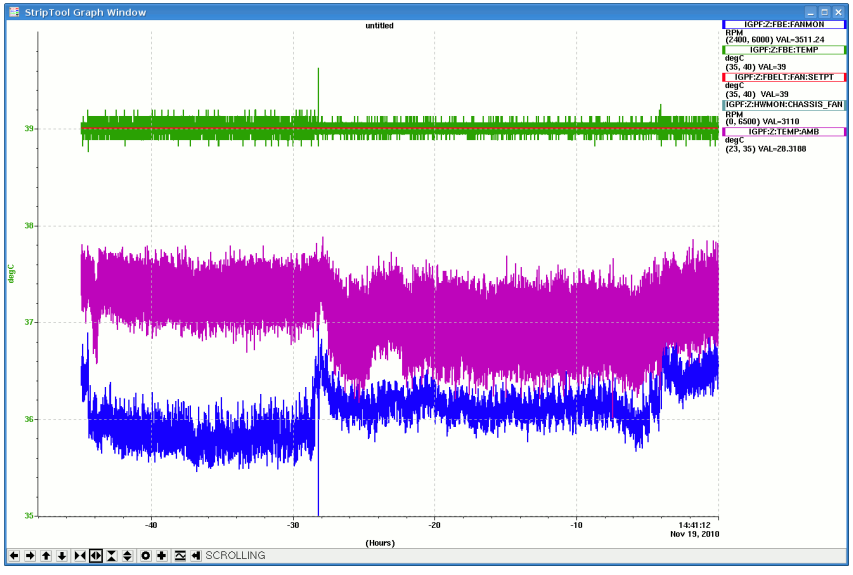

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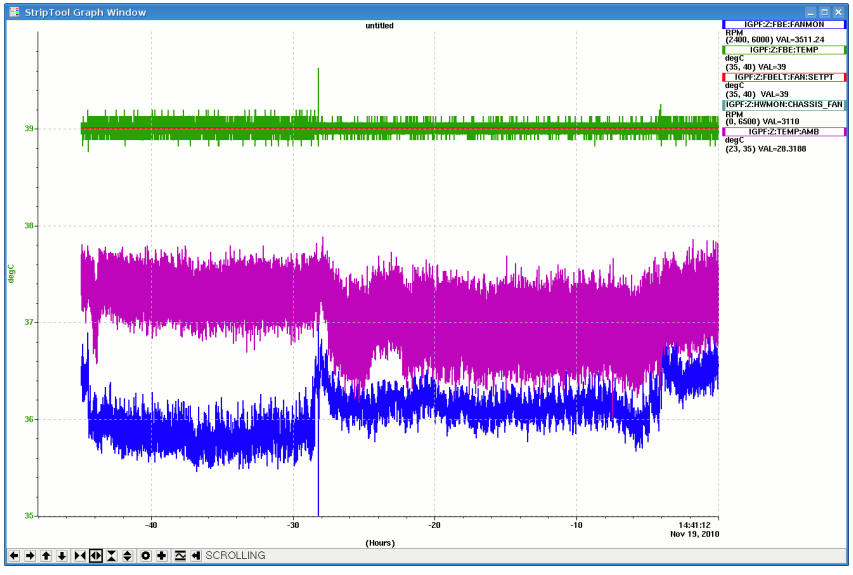

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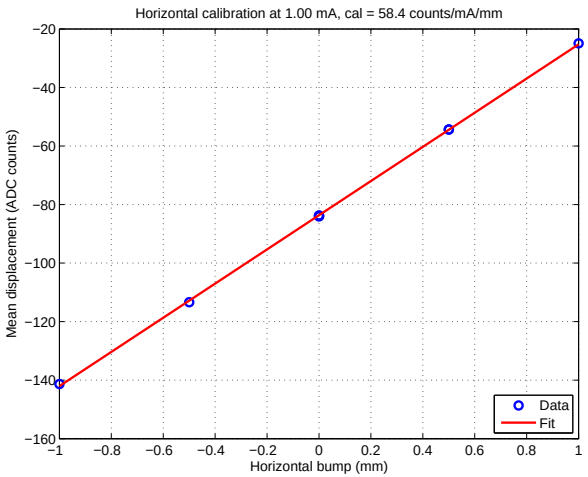
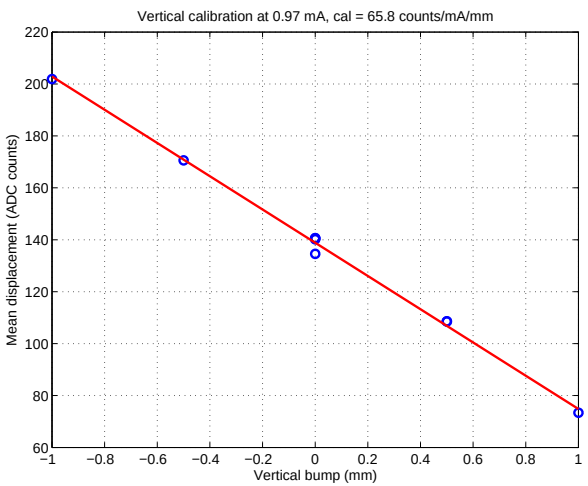
Front-end Calibration: Transverse Plane





- Set up controlled orbit bumps in X and Y;
- Measure bunch signal displacement in ADC counts;
- At 2 mA per bunch ADC LSB corresponds to 8.6 and 7.6 μm in X and Y respectively.

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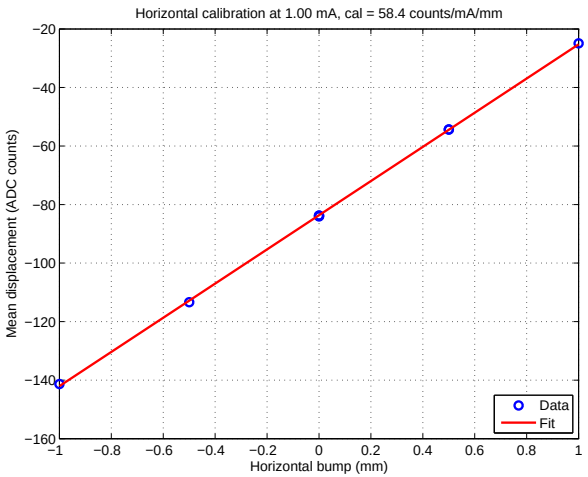

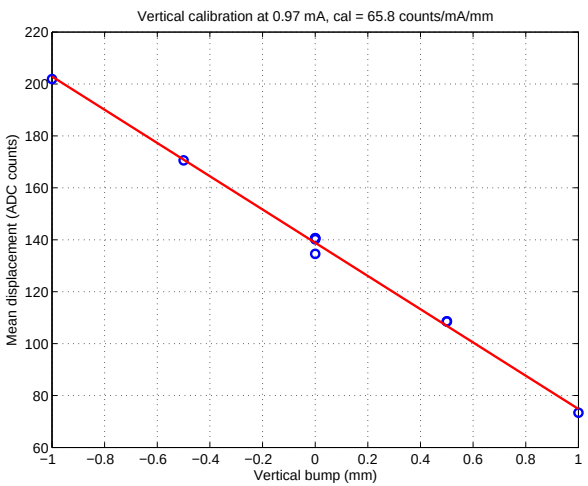

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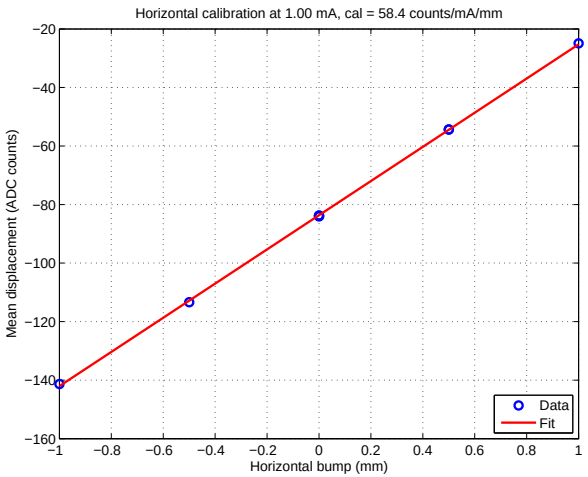

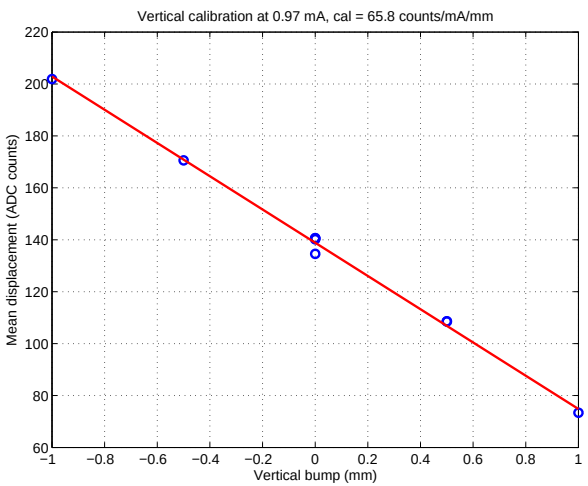

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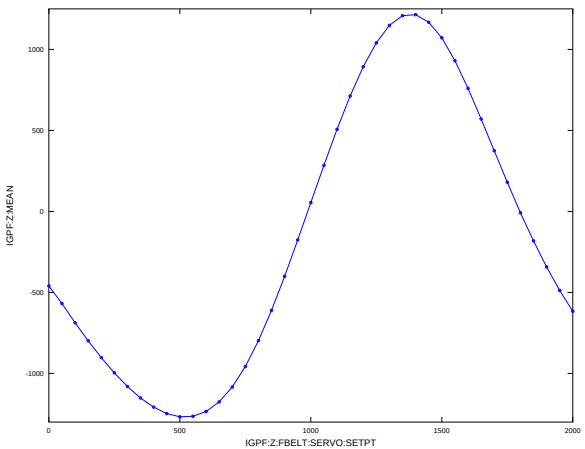

- Sweep phase shifter over 360°;
- Record bunch signal (average);
- Calibration factor of 62.5 counts/mA/degree;
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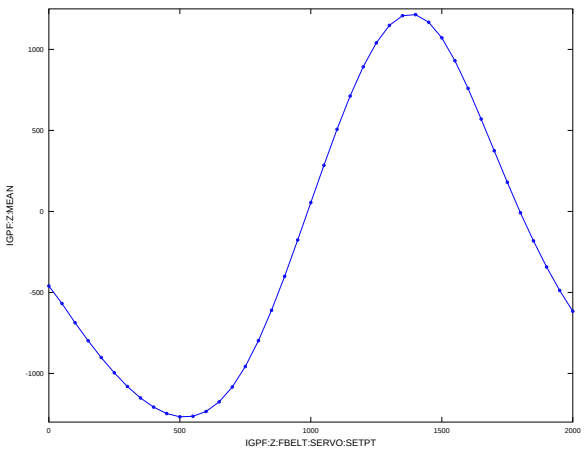

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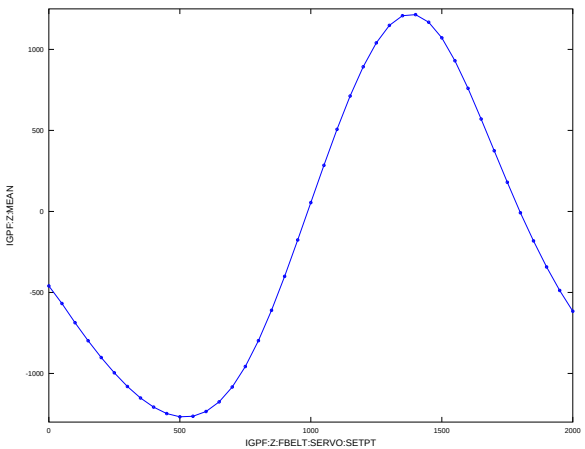

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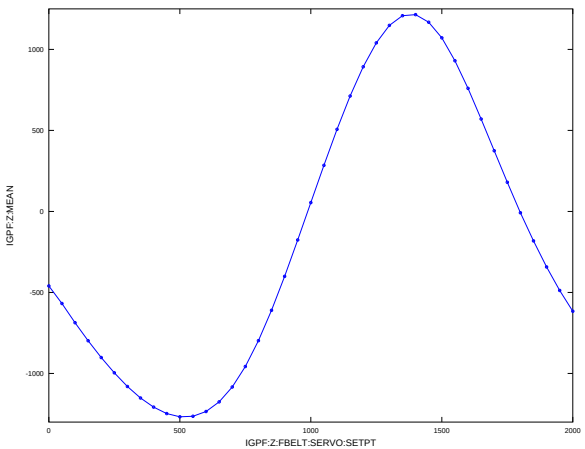

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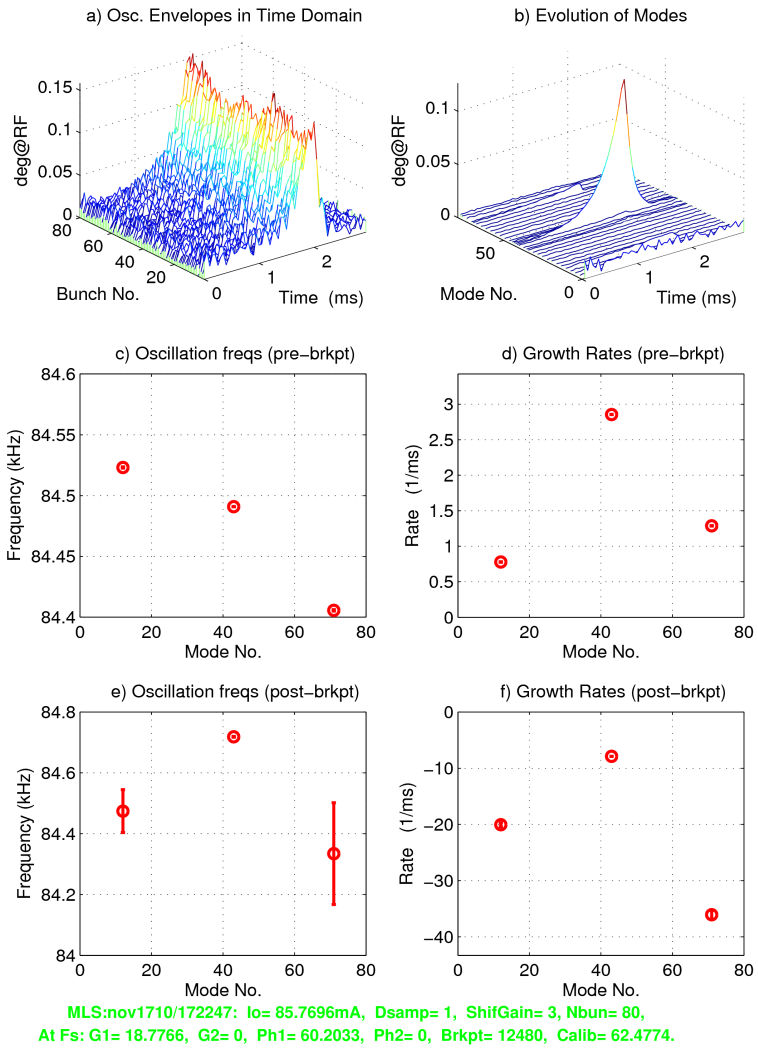
Longitudinal Grow/Damp Measurement



MLS:nov1710/172247: Io= 85.7696mA, Dsamp= 1, ShifGain= 3, Nbun= 80,
At Fs: G1= 18.7766, G2= 0, Ph1= 60.2033, Ph2= 0, Brkpt= 12480, Calib= 62.4774.

- Open-loop growth at 86 mA shows modes 43, 71, and 12;
- Very fast feedback damping;
- Resistive - minimal tune shift.

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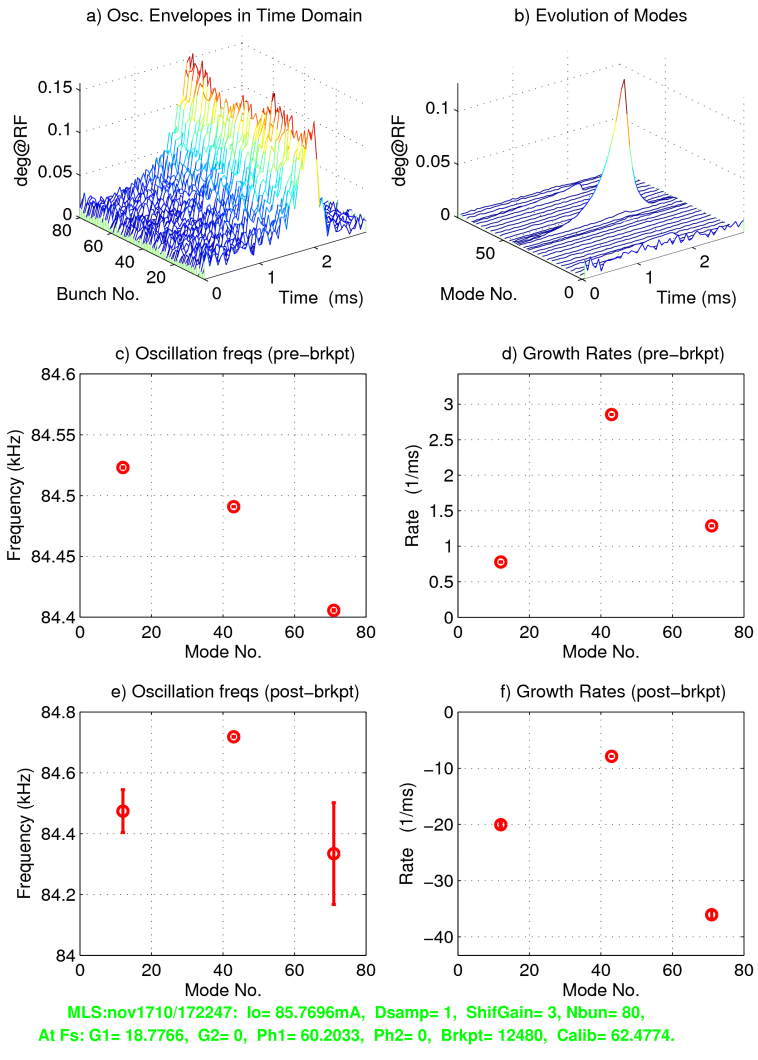

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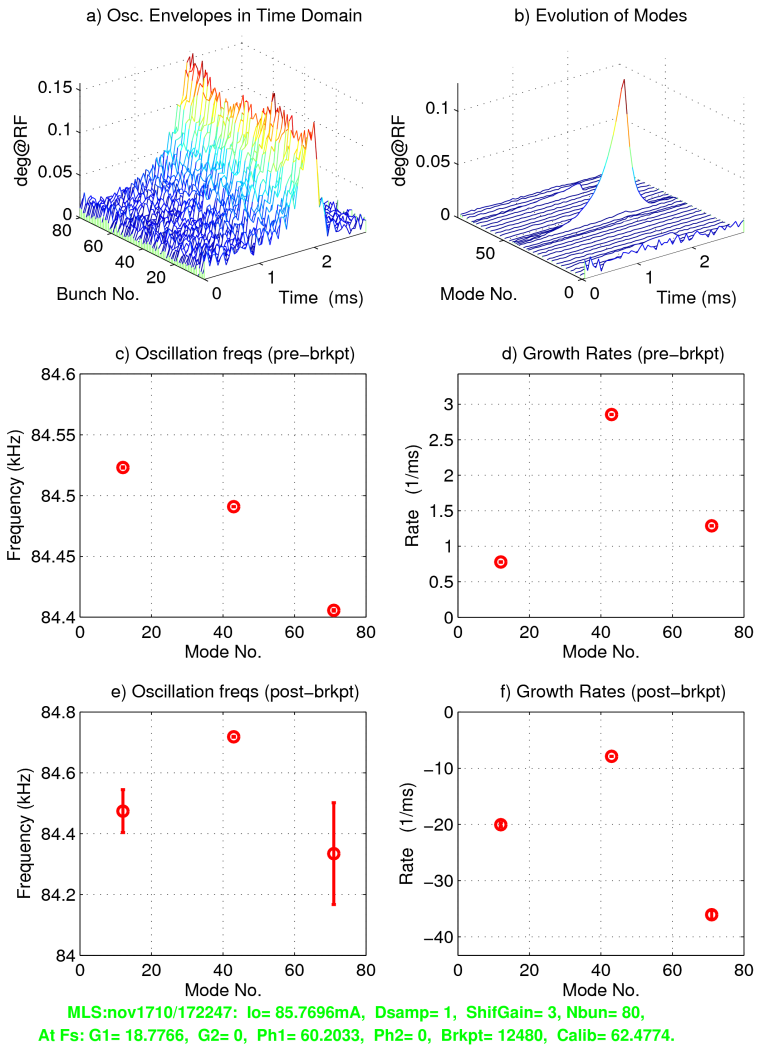

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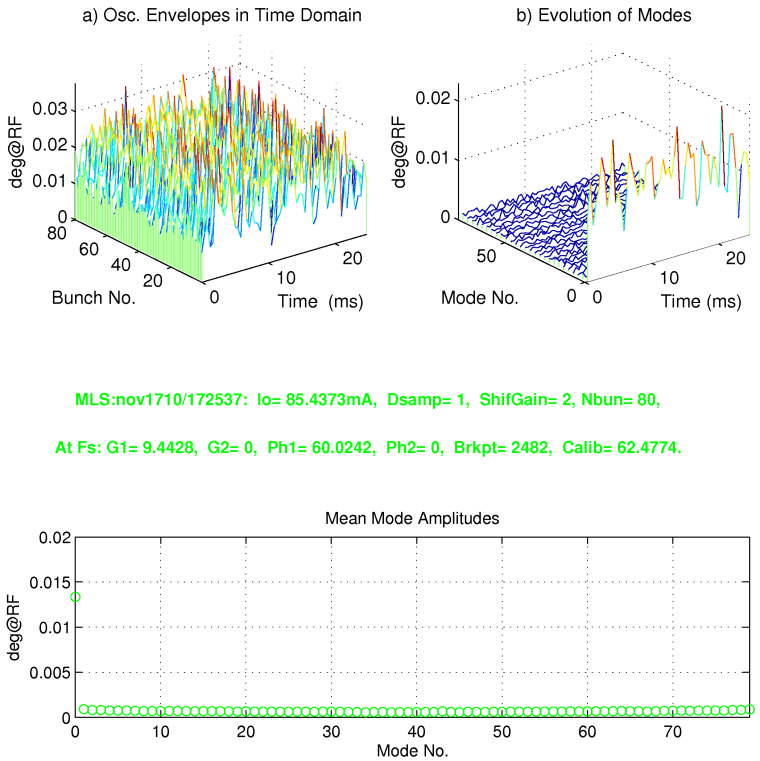
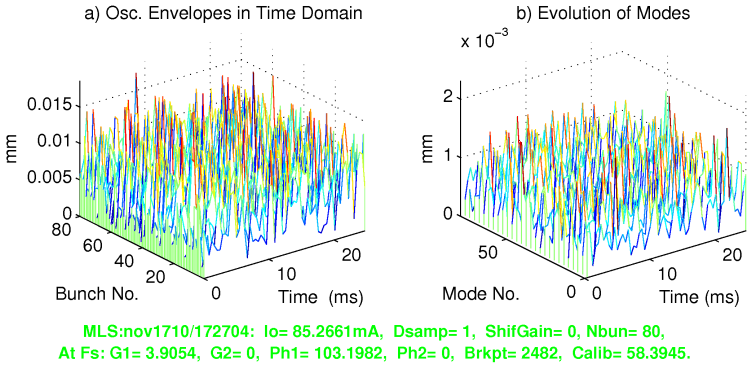
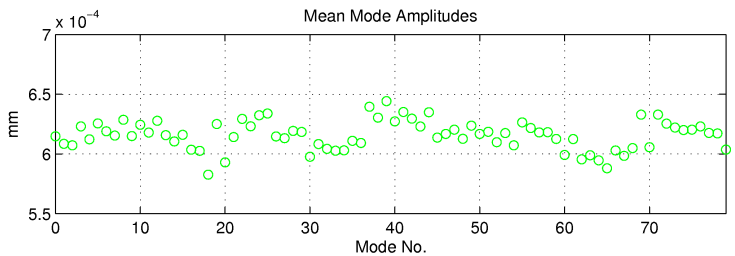
Longitudinal Steady-State Record



- Steady-state data from the longitudinal plane;
- Bunch signals filtered in 70–102 kHz range;
- Mode 0 is driven by RF noise, others are at the noise floor;
- Average oscillation amplitude is 14.4 milli-degrees (80 fs).

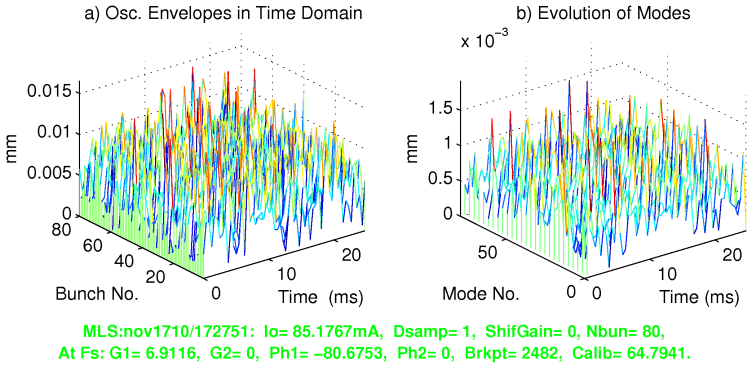
Horizontal Steady-State Record

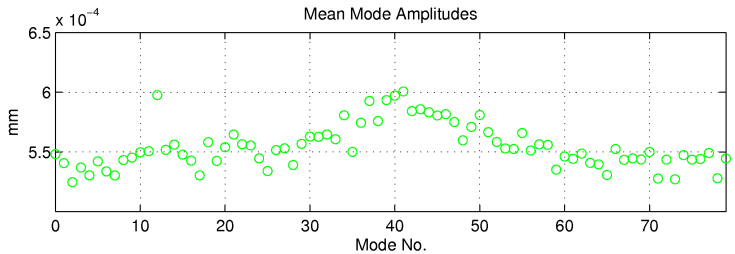




- Steady-state data from the horizontal plane;
- Filtered in 1120–1170 kHz range;
- All motion is at the noise floor;
- Average oscillation amplitude is 5.5 μm.

Vertical Steady-State Record





- Steady-state data from the vertical plane;
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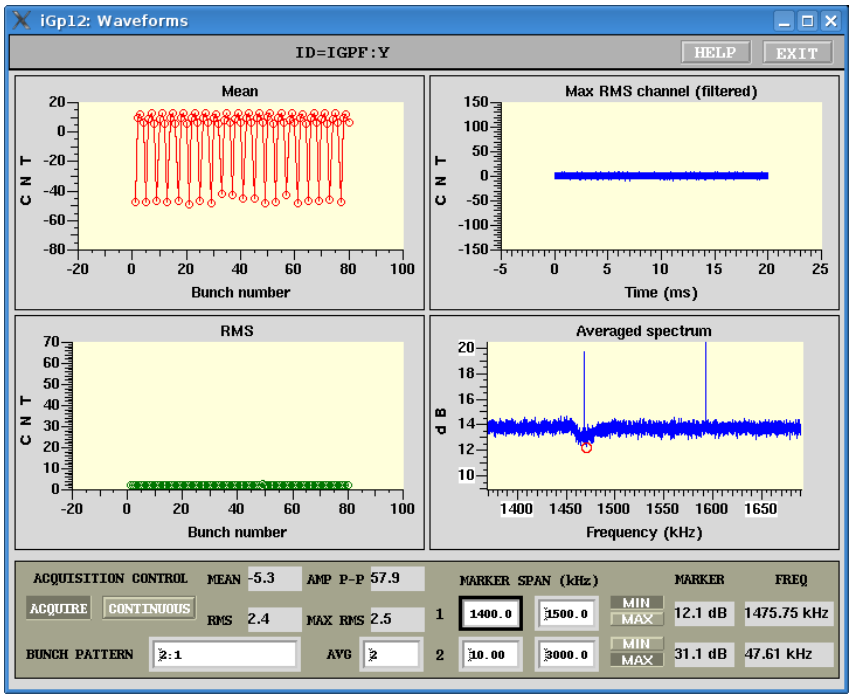
Every Fourth Bunch



- Vertical plane - excite the unwanted bunches, keep others under feedback control;
- Successfully used to create single bunch as well as other fill patterns;
- Somewhat touchy due to high bunch-to-bunch coupling in the back-end;
- Traced to the response of the power amplifiers.

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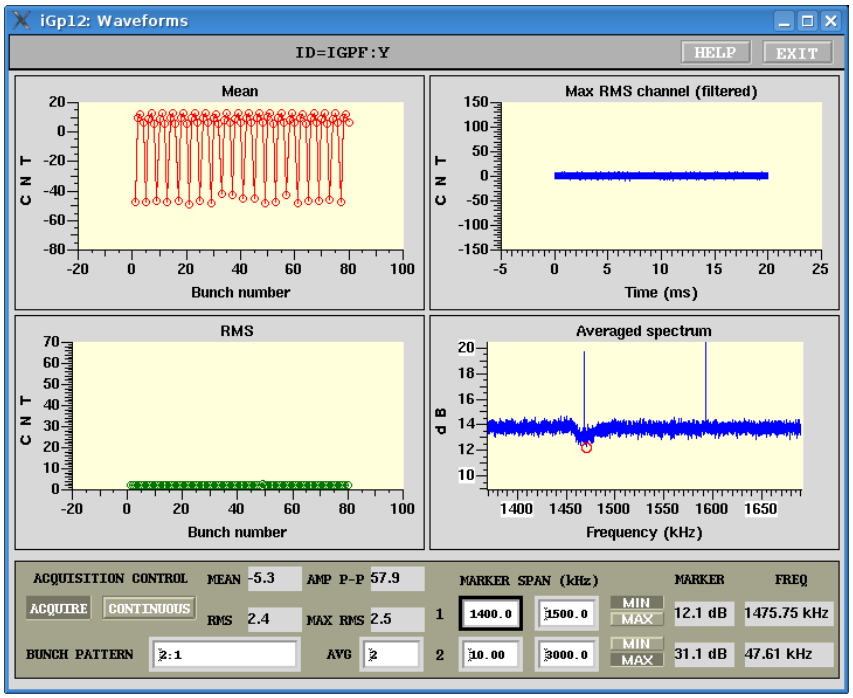

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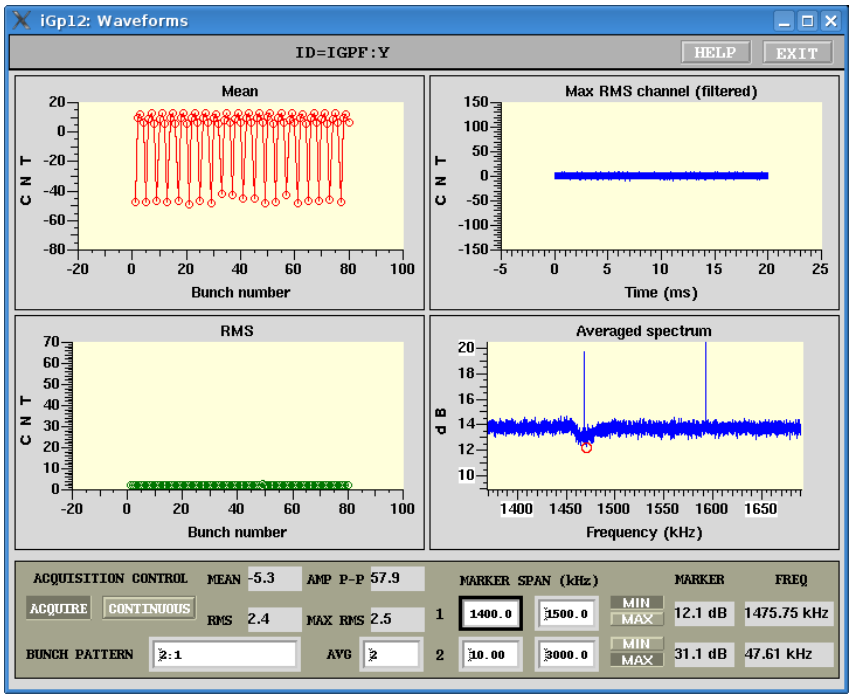

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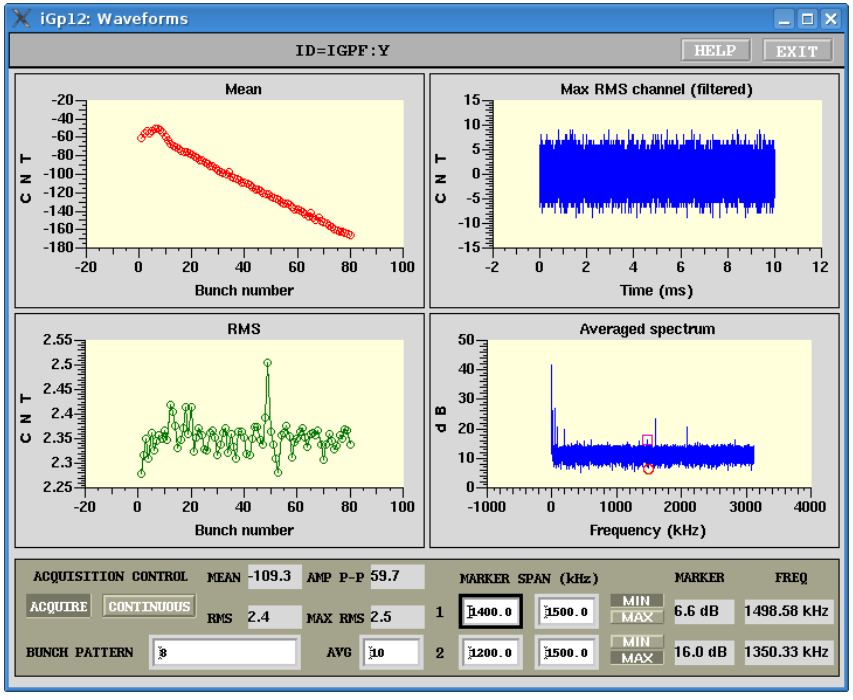

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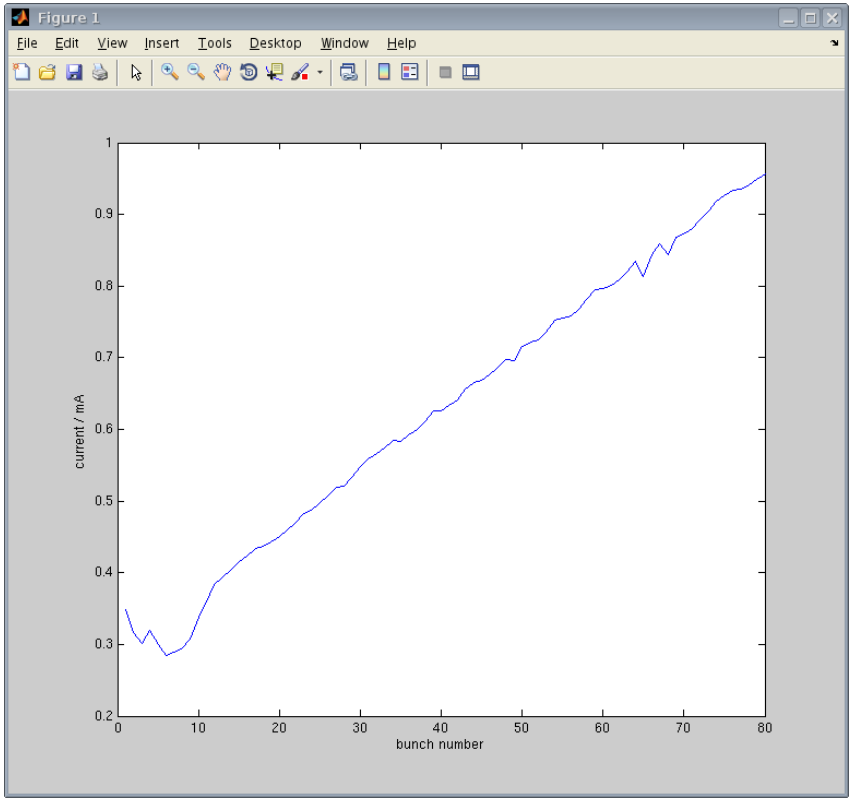

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