Coupled-bunch Instability Studies at DELTA

D. Teytelman, et al.

Dimtel, Inc., San Jose, CA, 95124, USA

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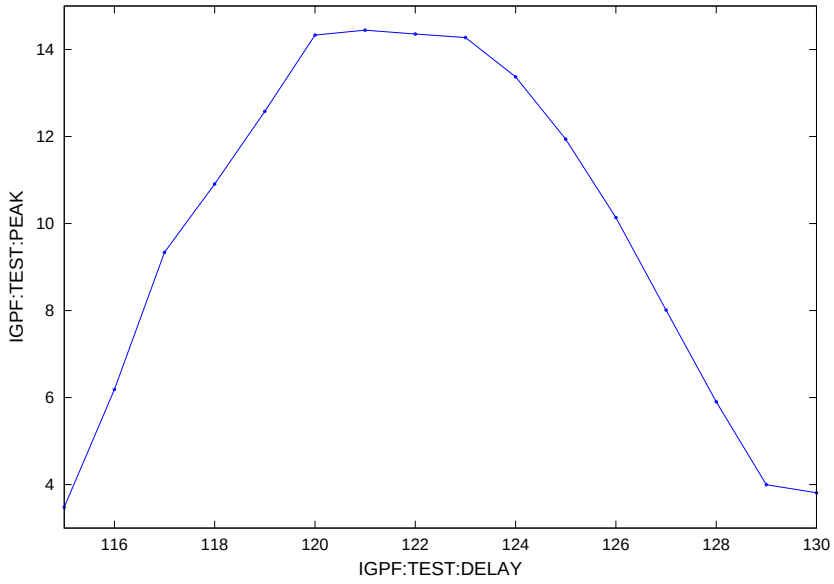
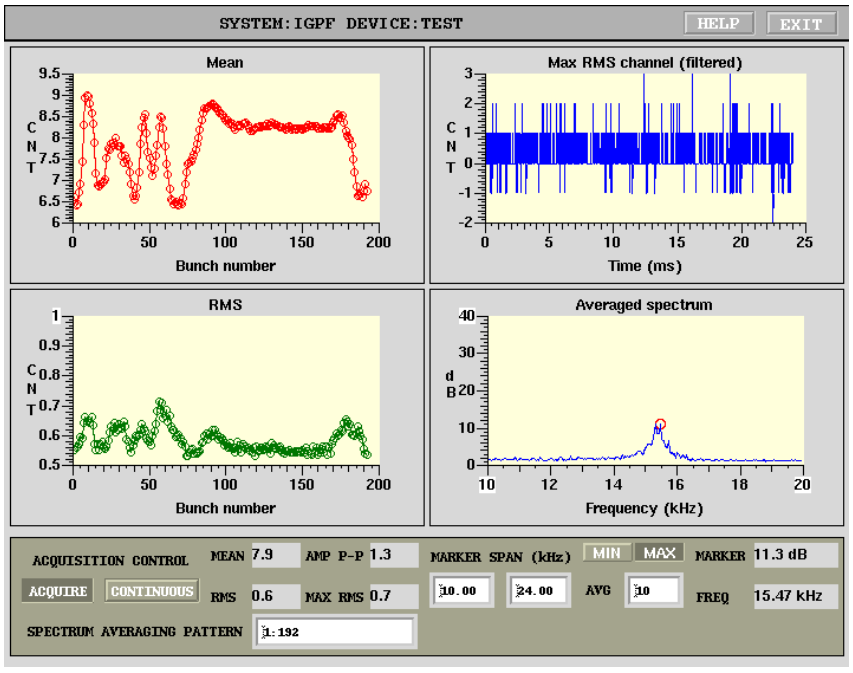
Back-end Timing



- Start with tiny (0.0 mA on DCM) fill of 8 bunches;
- Adjust drive frequency, back-end phase and pattern to obtain 13 dB difference between on/off states;
- Sweep output delay in 2 ns steps, recording driven peak amplitude;
- Set timing at 121.5.

Low-current behavior



- Next we started filling the ring in normal fill pattern;
- At 5 mA we started to see the effect of the feedback in:
- Negative feedback;
- Open loop;
- Positive feedback.

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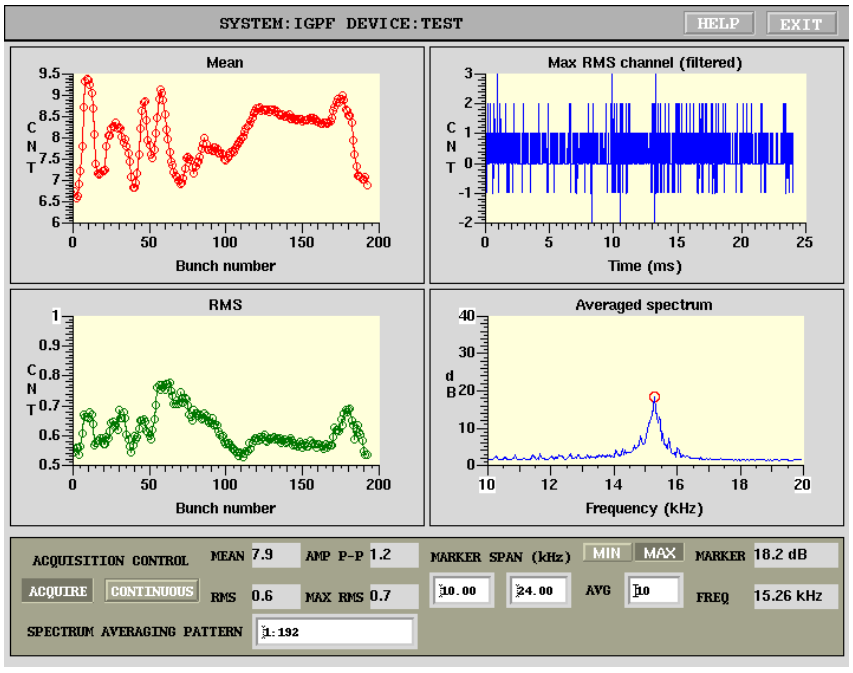

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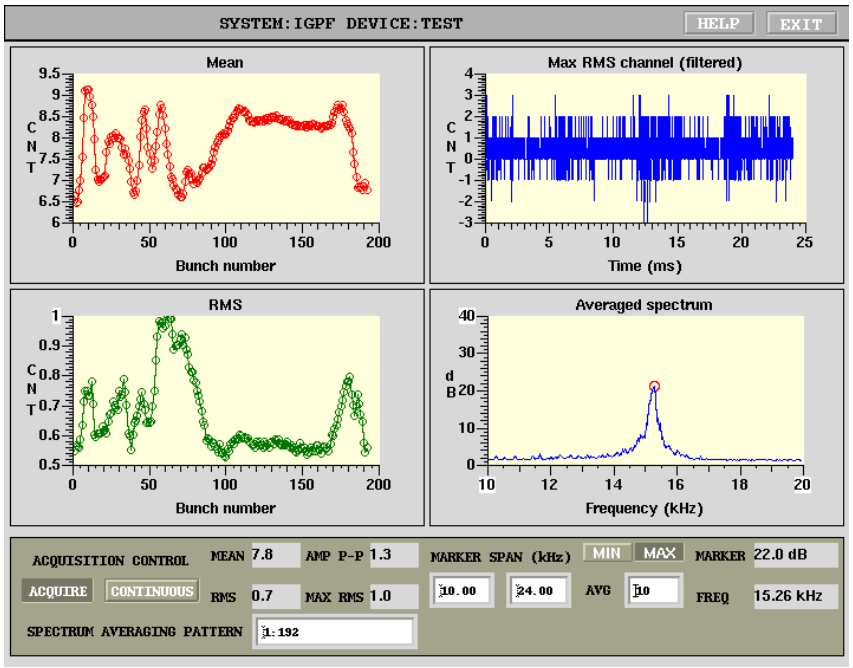

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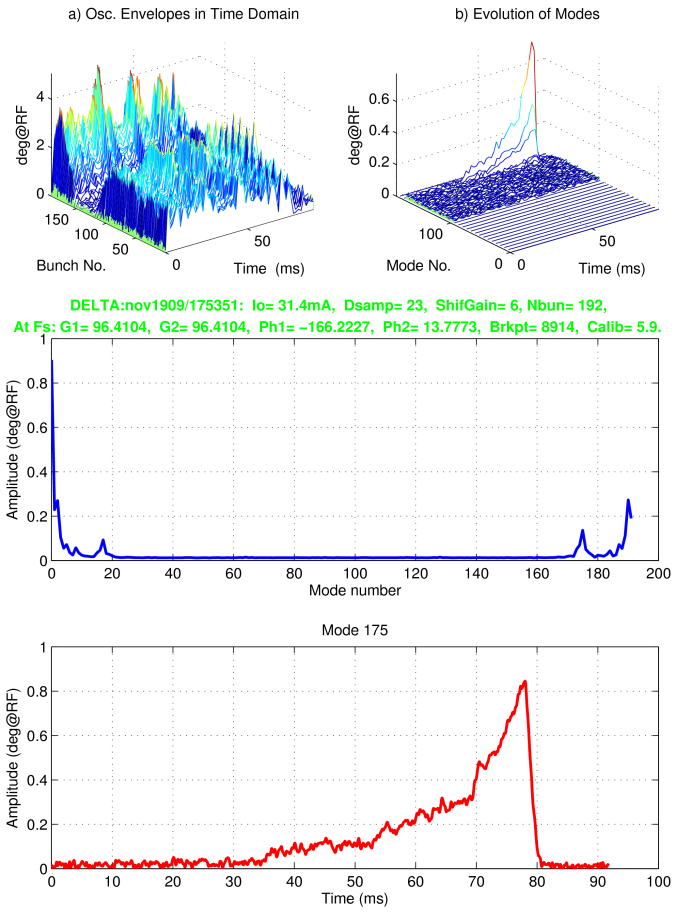
A Successful Drive/Damp



- At 31.4 mA we finally get a successful drive/damp;
- That is, an eigenmode (175) is driven unstable by the positive feedback;
- Why 175 - it is near the peak of the stripline response - highest gain.

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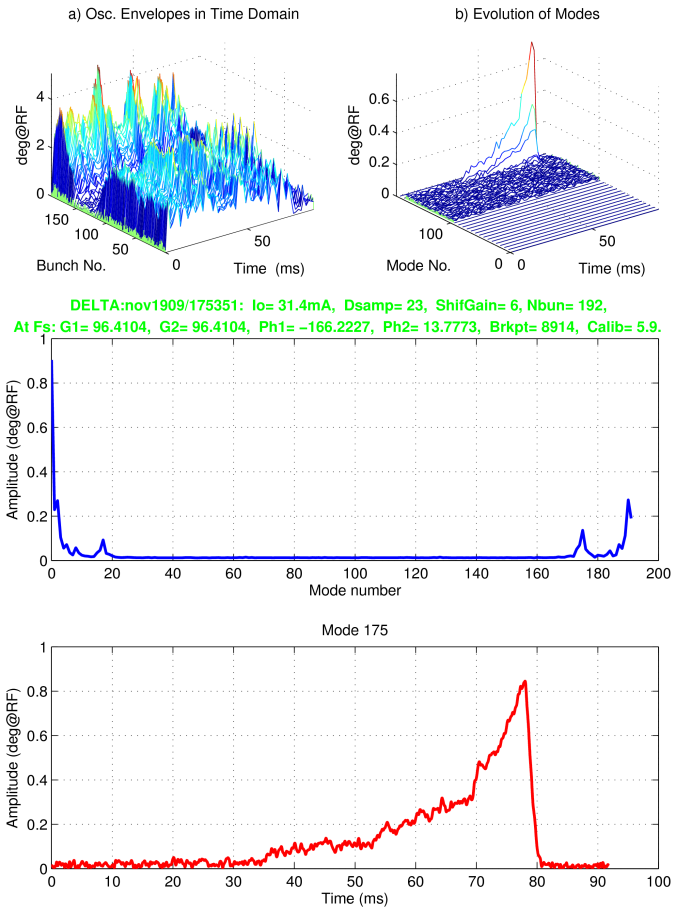

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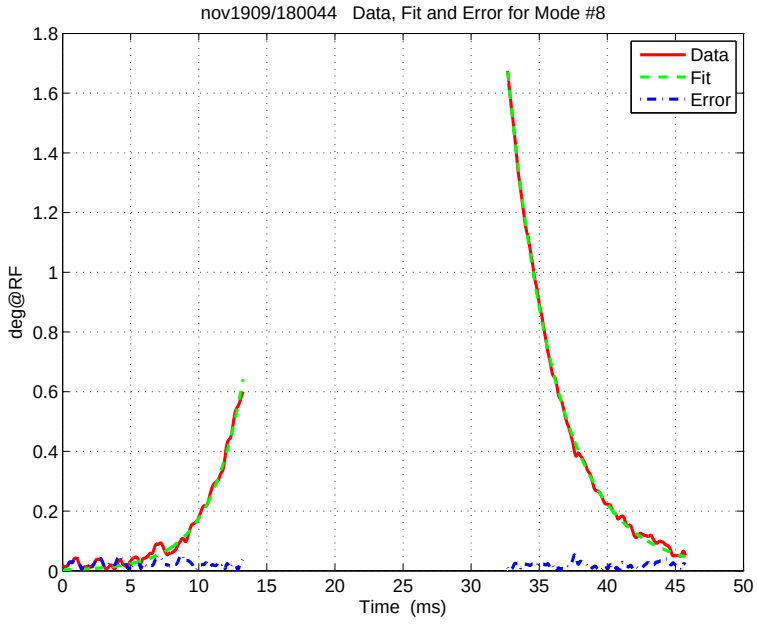
Open/Closed Loop Damping



- At 42 mA compare open-loop damping (0.275 ms^{-1});
- And closed-loop (1.01 ms^{-1})

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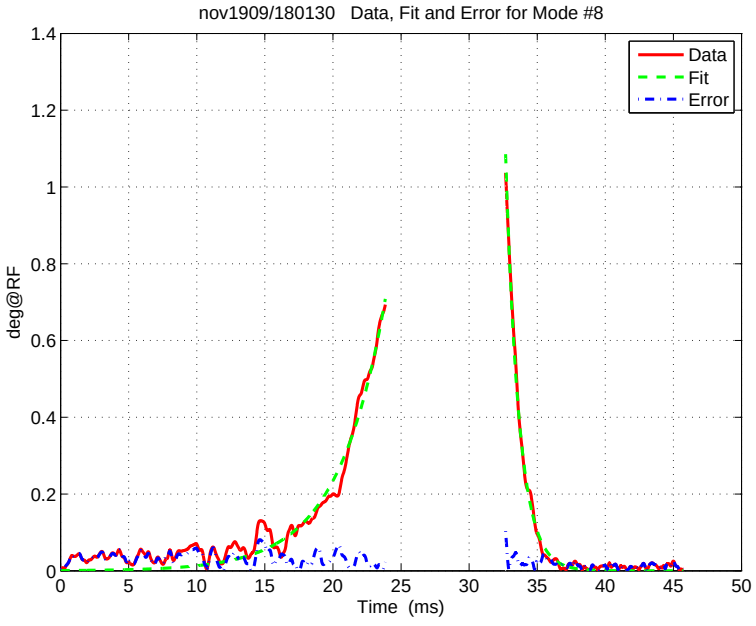

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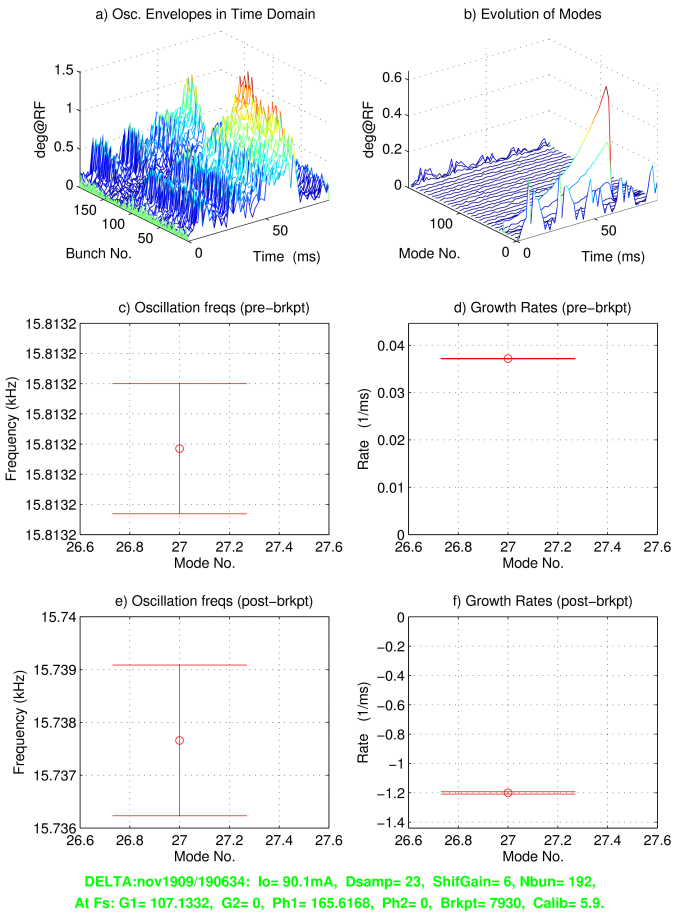

- At 87.1 mA we see the first grow/damp data with unstable mode growing.
- Here is a measurement at 90.1 mA;
- Mode 27 grows and damps.

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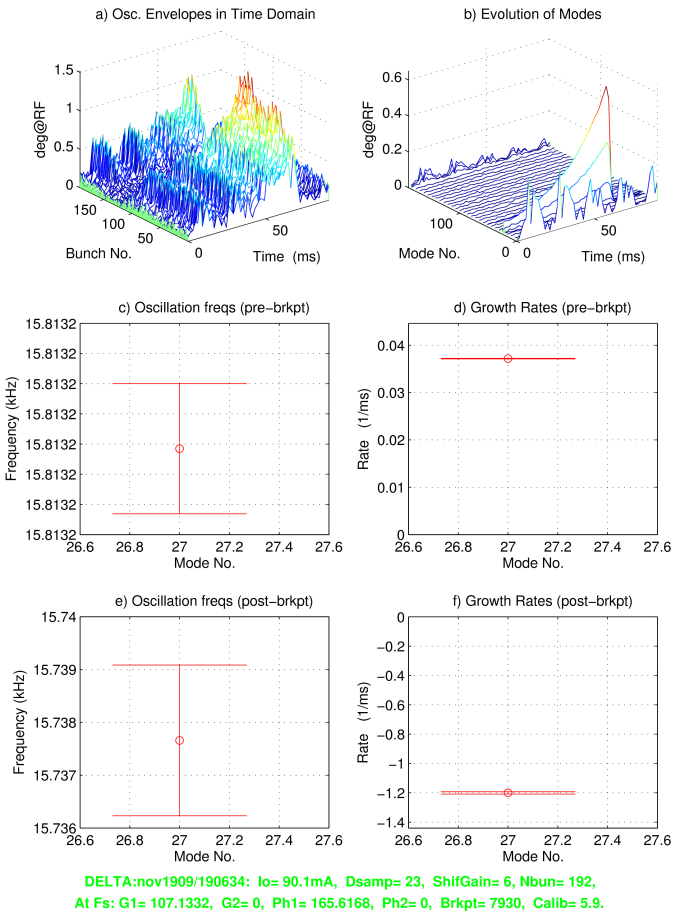

DELTA:nov1909/190634: Io= 90.1mA, Dsamp= 23, ShifGain= 6, Nbun= 192,
At Fs: G1= 107.1332, G2= 0, Ph1= 165.6168, Ph2= 0, Brkpt= 7930, Calib= 5.9.

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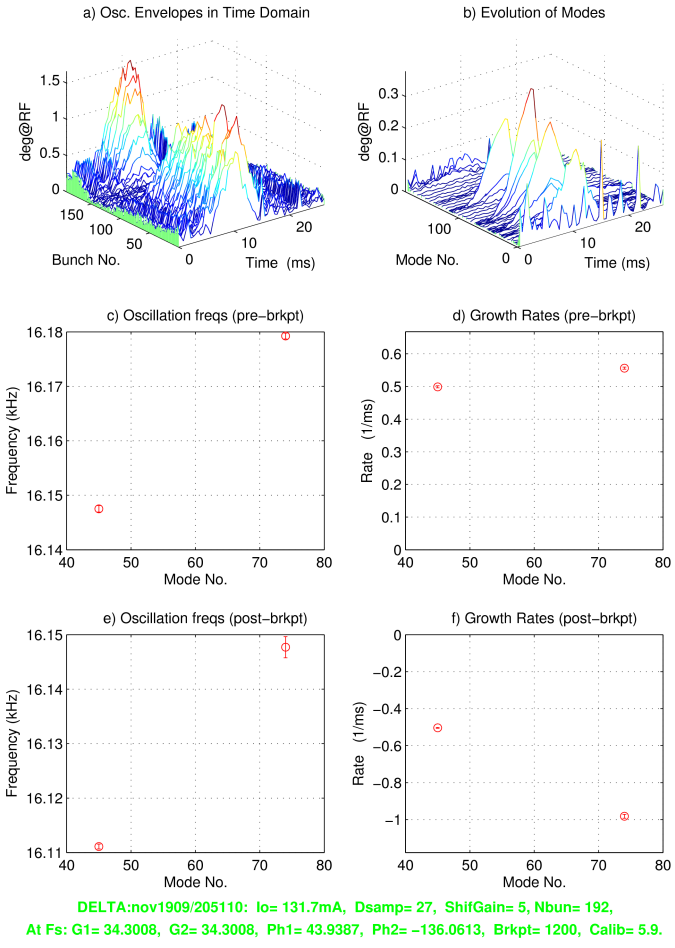
Going All the Way



DELTA:nov1909/205110: Io= 131.7mA, Dsamp= 27, ShifGain= 5, Nbun= 192,
At Fs: G1= 34.3008, G2= 34.3008, Ph1= 43.9387, Ph2= −136.0613, Brkpt= 1200, Calib= 5.9.

- We reach (with feedback control) 132 mA!
- A measurement at 131.7 mA;
- Modes 45 and 74 are dominant;
- Overall see many active modes, main actors are 27, 45, 54, 74.

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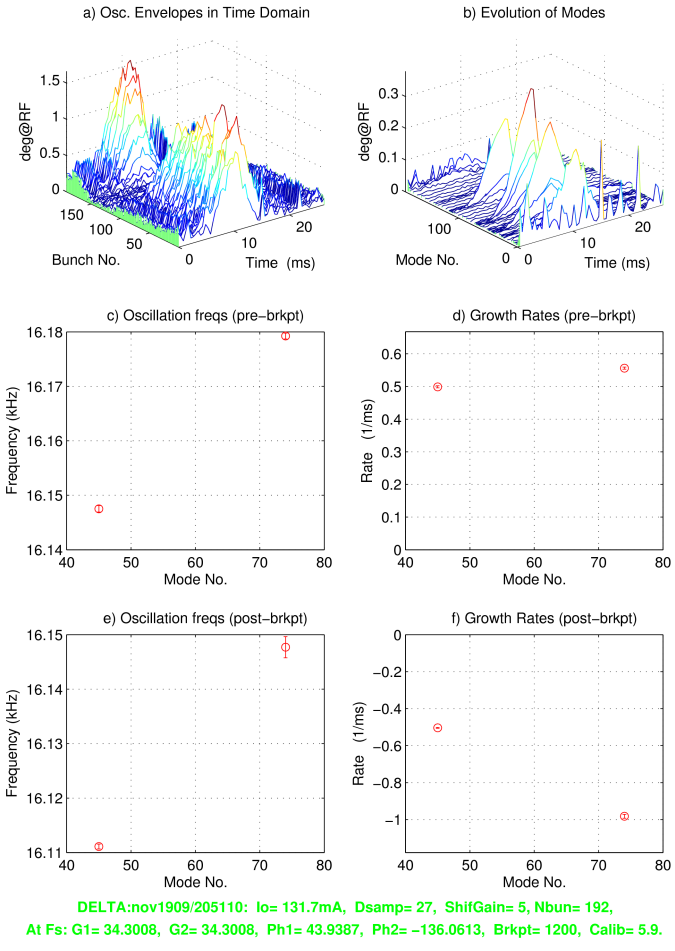

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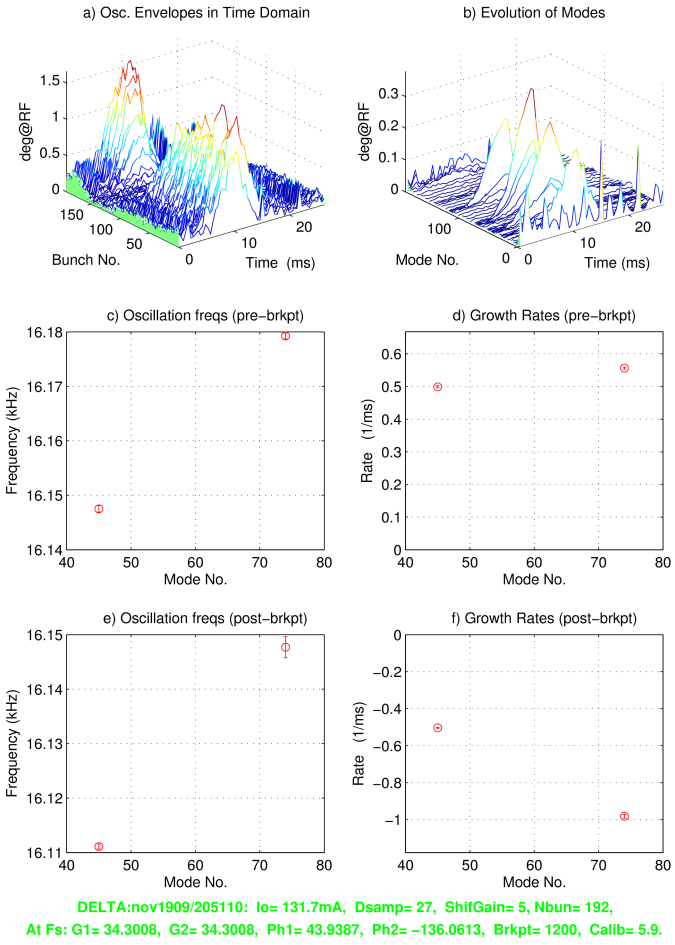

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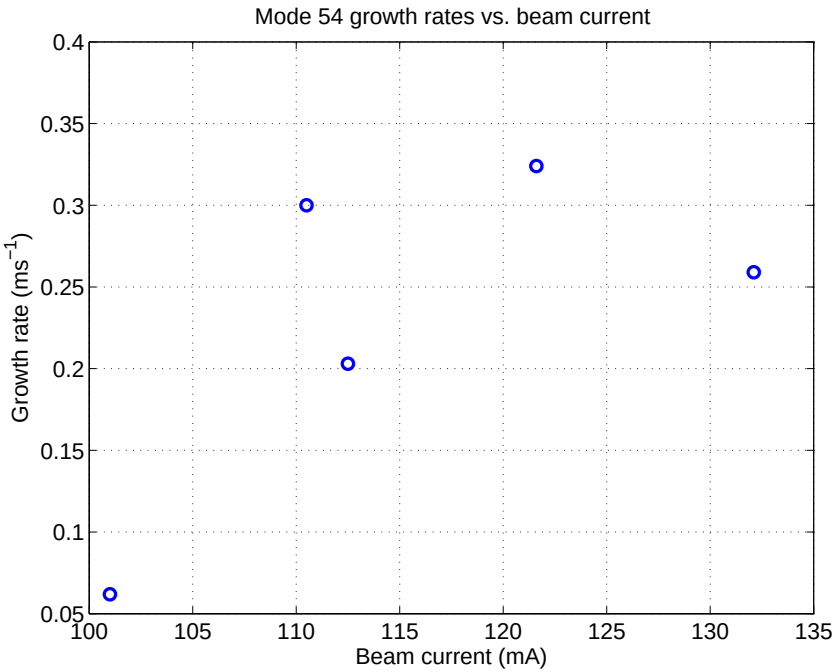
Growth Rates vs. Beam Current



- Very basic plot, a few points;
- Have 40 data sets acquired above the threshold;
- Multiple modes in many of these transients.

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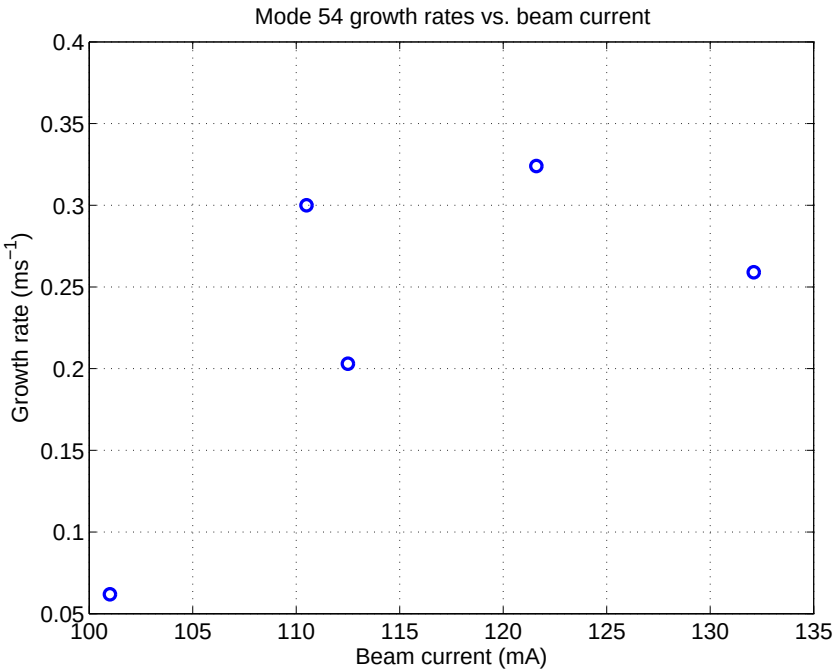

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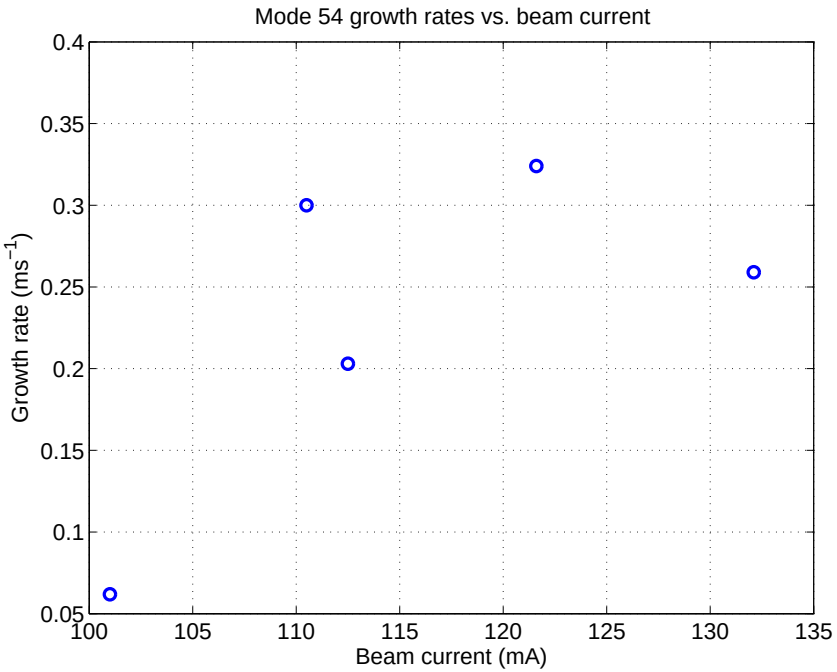

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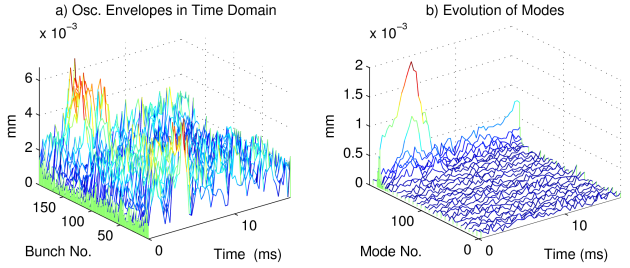
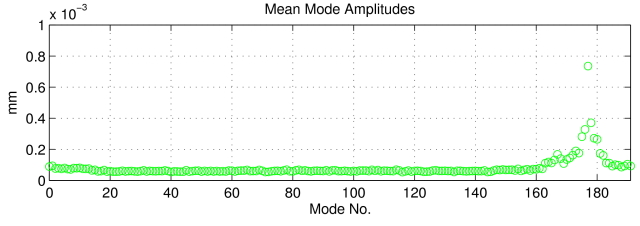
Transverse Motion



DELTA:nov1909/205342: Io= 131.3mA, Dsamp= 1, ShifGain= 5, Nbun= 192,
At Fs: G1= 21.9814, G2= 21.9814, Ph1= 51.6106, Ph2= –128.3894, Brkpt= 679, Calib= 80.4.



- Recorded 16 ms of beam motion at 131.3 mA;
- Vertical spectrum centers around mode 178;
- Most likely an HOM, not resistive wall;
- Horizontal spectrum has several peaks: 146, and strong modes 187 and 188;
- Unlikely to be resistive wall as well.

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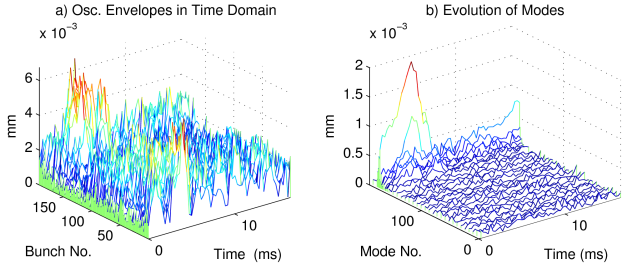

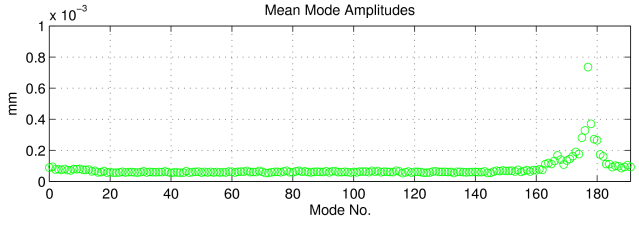

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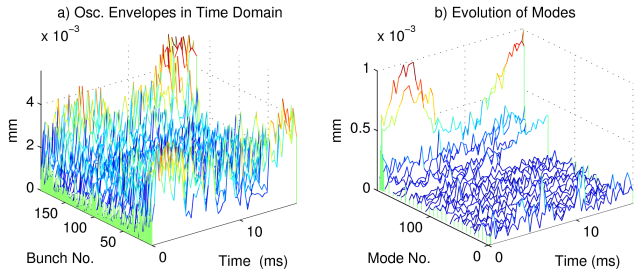

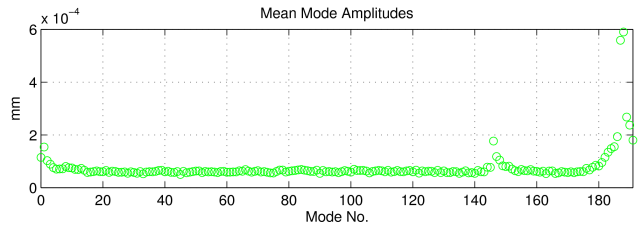

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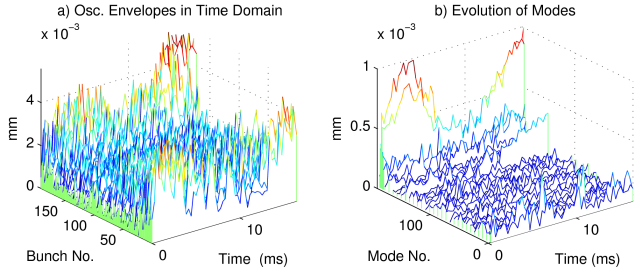

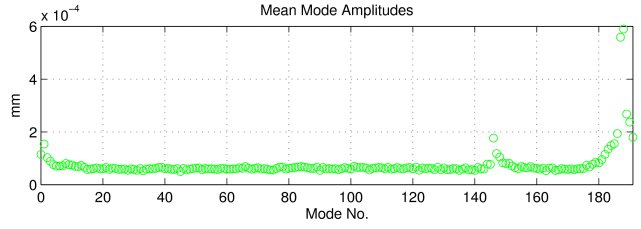

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- We had a very successful day;
- Stripline kicker performed much better than expected;
- Longitudinal stability was achieved to the highest current;
- A lot of data still to be analyzed;
- $2 \times f_s$ excitation was very useful to recapture feedback control at high currents.

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