Coupled-bunch Instability Studies at ANKA

D. Teytelman, et al.

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

November 24, 2009

System Setup

- Started around 14:00 on Sunday (22/11);
- Configured the system for vertical feedback;
- Output used 50 W amplifier (specified to 220 MHz) driving one stripline;
- Within 2 hours started taking grow/damp data;
- Stability range was very narrow, system quite touchy;
- In spite of these problems reached 240 mA, lost beam trying to ramp up.

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Power Amplifier Investigation

- Measured the amplifier on a network analyzer;
- Phase response is extremely nonlinear;
- Peak-to-peak deviation from linear phase (constant delay) is 105 degrees in the 5–250 MHz range;
- Switched to a 10 W Kalmus amplifier, specified for 0.5–525 MHz range;
- Much better phase delay linearity, 9 degree variation;
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Ramping Summary

- On Sunday we tried to ramp at 240 mA and 210 mA, beam was lost;
- Adjusted the feedback controller phasing to support tune changes during the ramp;
- Successfully ramped at 80 mA;
- On Monday tried to ramp at 220 mA in the new setup, lost the beam partway through the ramp;
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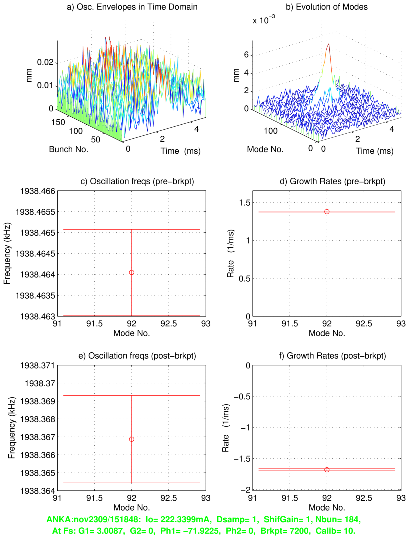
Vertical Grow/Damp



- Grow/damp measurement at 222 mA, mode 92;
- Saw modes 91 and 92 in the measurements;
- Frequency shift between open and closed loop - controller is offset to handle tune changes during ramping;
- Often saw large tune shift with amplitude, hard to extract open-loop oscillation frequency.

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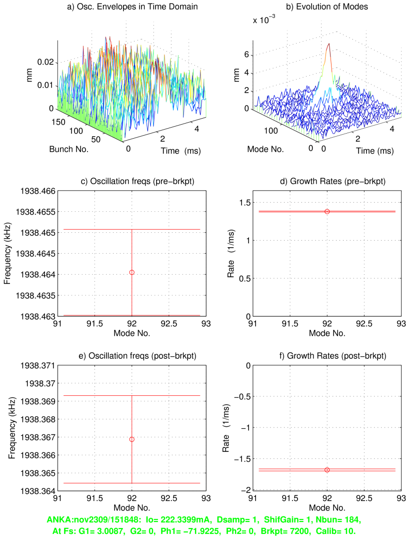

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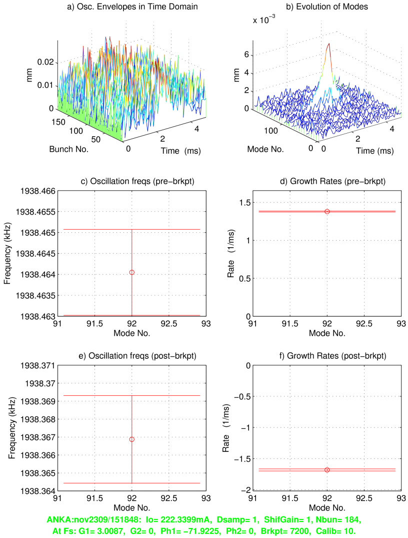

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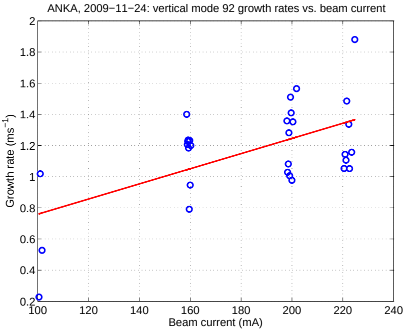
Vertical Growth Rates vs. Beam Current



- Multiple grow/damp measurements;
- Significant growth rate variation shot-to-shot;
- Damping rates roughly equal to growth rates;
- Feedback output really low in steady-state;
- Suspect filter phasing as the limiting factor for ramping.

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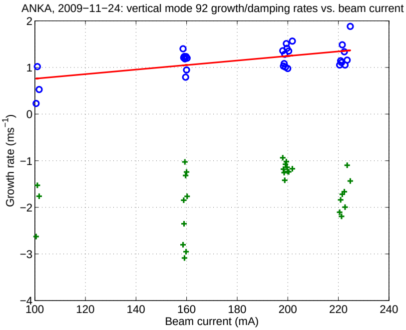

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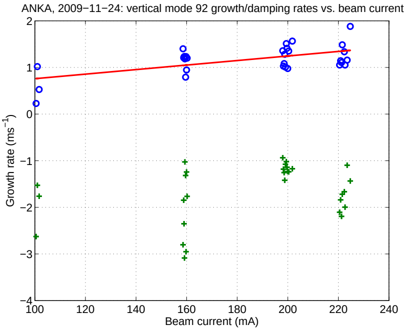

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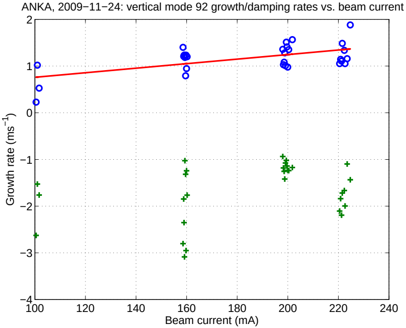

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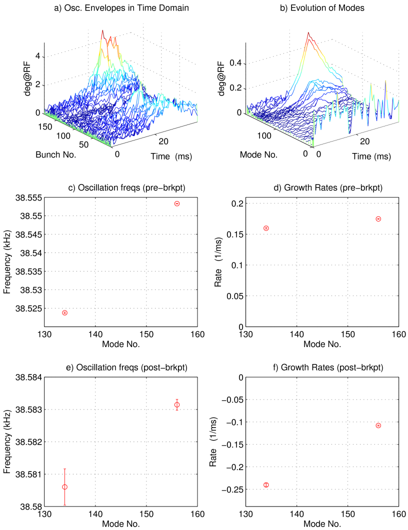
Longitudinal Grow/Damp



ANKA:nov2309/182444: Io= 9.9mA, Dsamp= 20, ShifGain= 2, Nbun= 184,
At Fs: G1= 2.6679, G2= 0, Ph1= 67.3911, Ph2= 0, Brkpt= 4200, Calib= 34.252.

- Switched to longitudinal plane using the same amplifier and stripline kicker;
- Input from the sum signal;
- Modes 134 and 156;
- At 10 mA beam goes vertically unstable when the longitudinal feedback is turned on;
- Studies were limited to under 10 mA.

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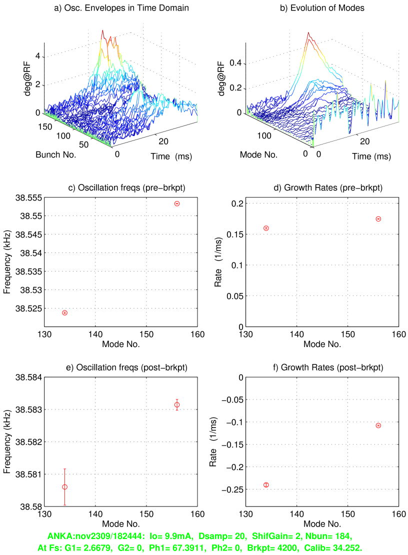

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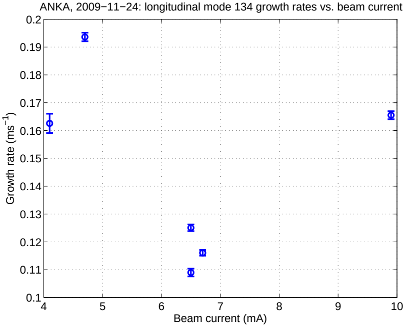

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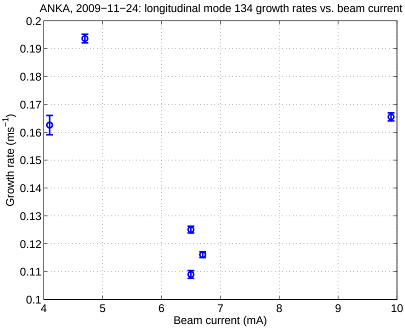

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Summary

- We had a very successful study;
- With appropriate power amplifier it is relatively straightforward to stabilize the ring;
- Further parameter optimization is necessary to get reliable ramping with vertical feedback;
- Longitudinal oscillations without feedback reach amplitudes of 15 degrees at RF;
- Suppression of longitudinal motion increases growth rates of the transverse instabilities (as expected);
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