Bunch-by-bunch feedback commissioning in Solaris

D. Teytelman

Dimtel, Inc., San Jose, CA, USA

December 20, 2024

Demonstration Summary

- Monday, December 16:
  - Connected all RF signals, adjusted button delays (A-C diagonal);
  - Set up the power amplifiers (A-C diagonal);
  - Placed iGp12 on the network, installed client software on AlmaLinux;
  - Set up transverse feedback in Y, then X (1.5 GeV).
- Tuesday, December 17:
  - Verified feedback operation at full 400 mA;
  - Explored bunch cleaning — demonstrated at 1 GeV and below;
  - Tried to establish single-bunch at 1.5 GeV, losses during ramping;
  - Configured tune tracking, explored amplitude-dependent tune shifts.
- Wednesday, December 18:
  - Exploration of single-bunch transfer functions;
  - Introduction to control panels;
  - Training session (part 1).
- Thursday, December 19:
  - Training session (part 2);
  - Client software installation cleanup;
  - Minor iGp12 software updates, frequency counter calibration.

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- Front/back-end, baseband processor, and power amplifiers;
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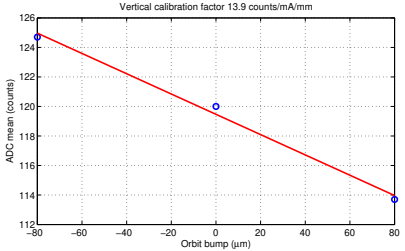

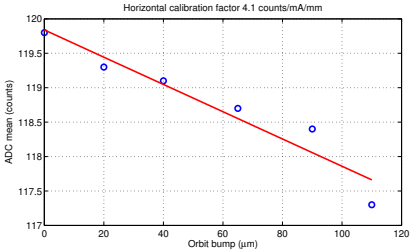

- Local orbit bumps in X and Y;
- Much higher sensitivity in the vertical plane;
- Some envisioned hardware changes to improve this by 6–20 dB.

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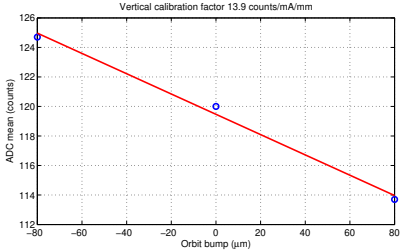

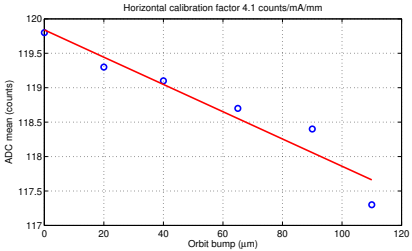

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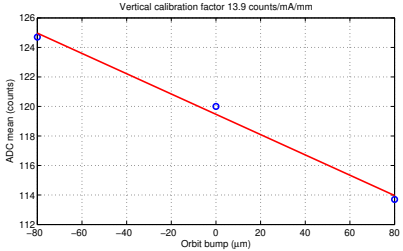

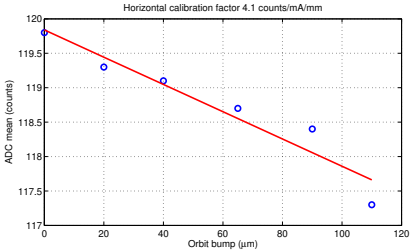

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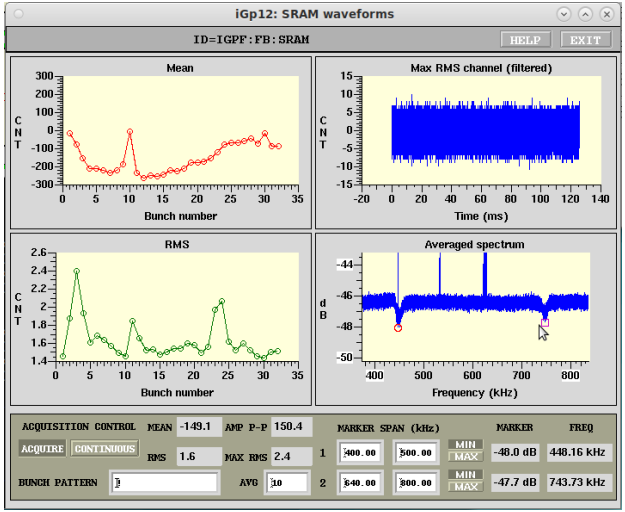
Steady-state at Full Energy



- Closed-loop operation after ramping;
- Bunches 1, 10, and 30 have been cleaned at injection energy;
- Notches at X and Y tunes;
- Camshaft pattern, December 20, 2024.

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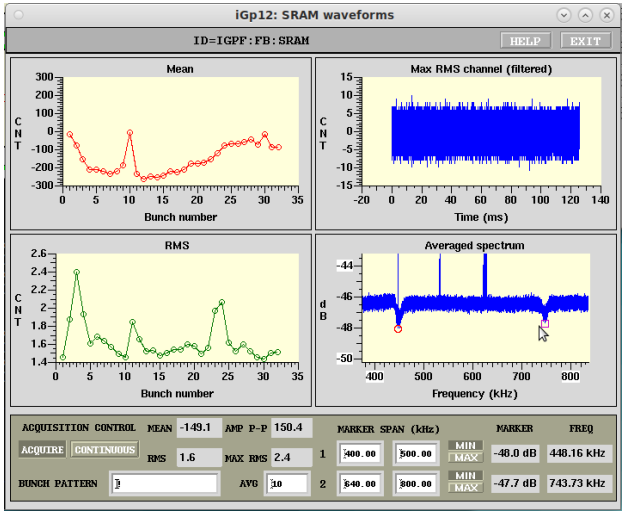

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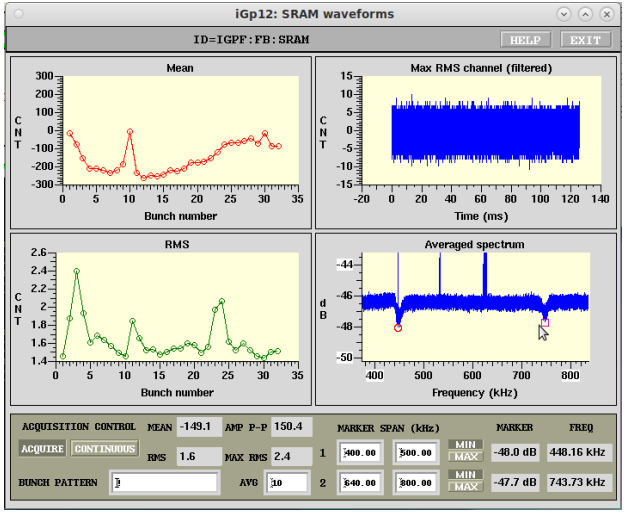

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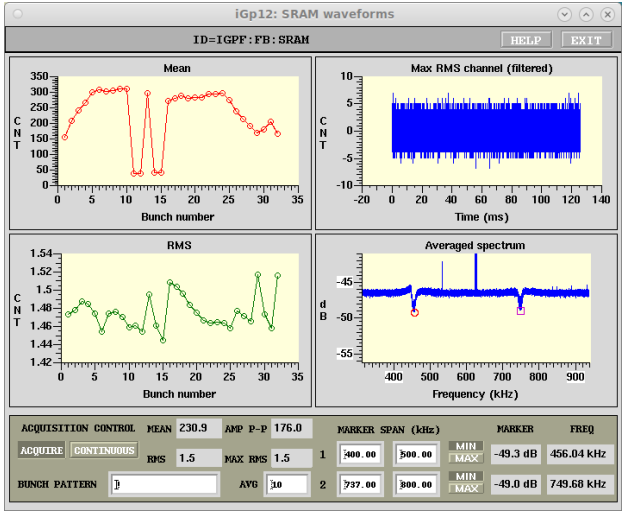

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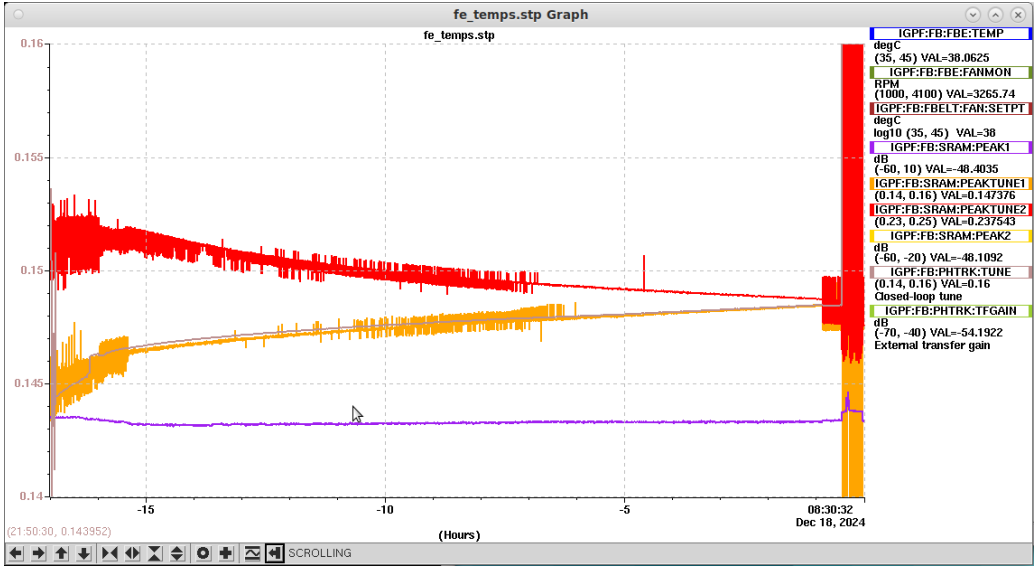
Tune vs. Beam Current: StripTool



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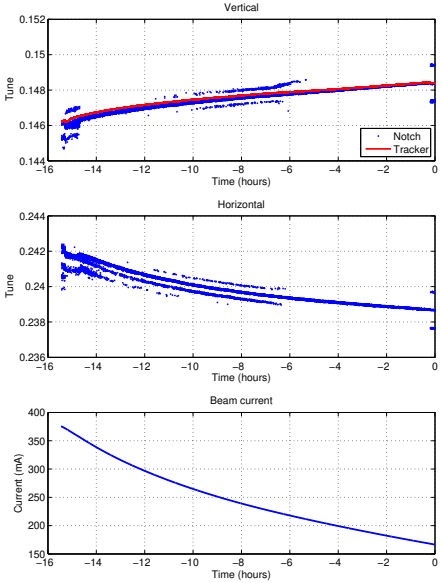

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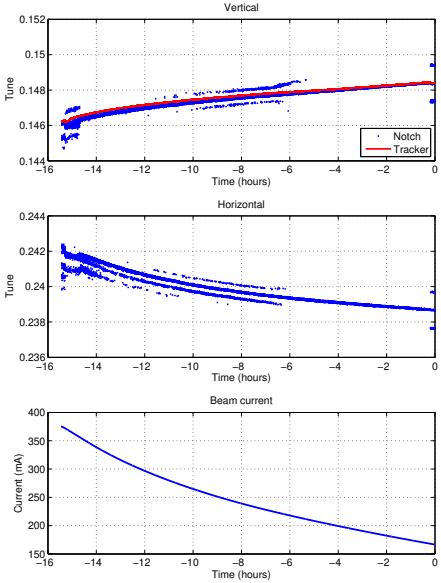

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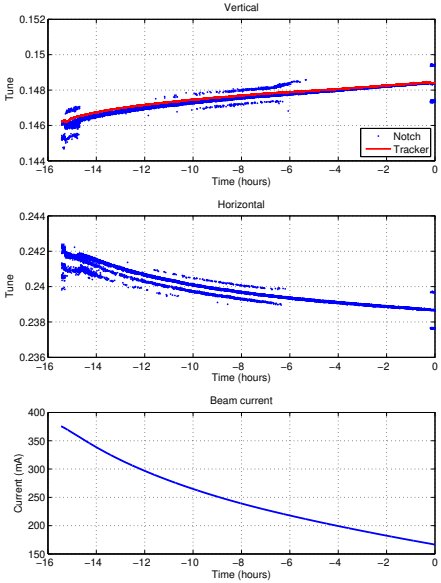

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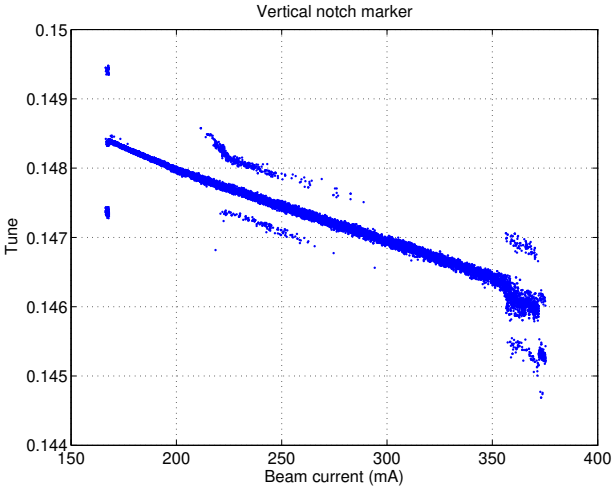

- Plot data vs. beam current;
- Linear fit;
- Removing highest-current data (orbit correction moving the tune?);
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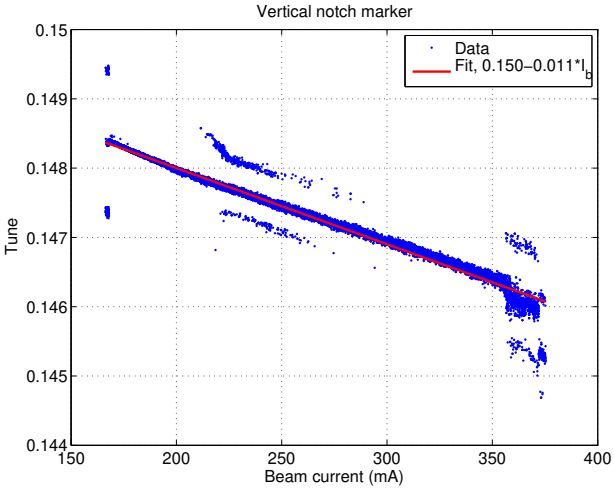

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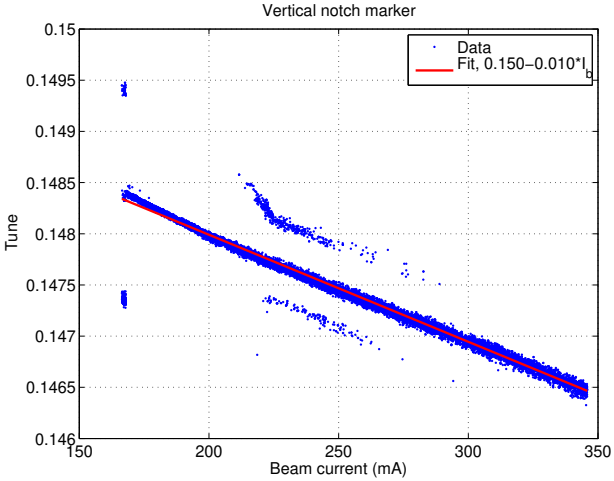

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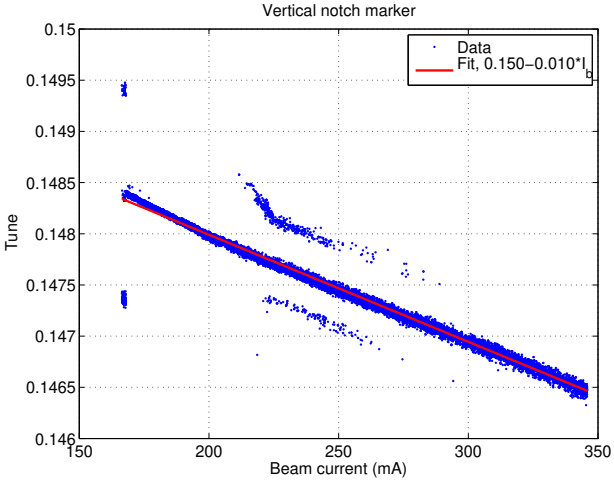

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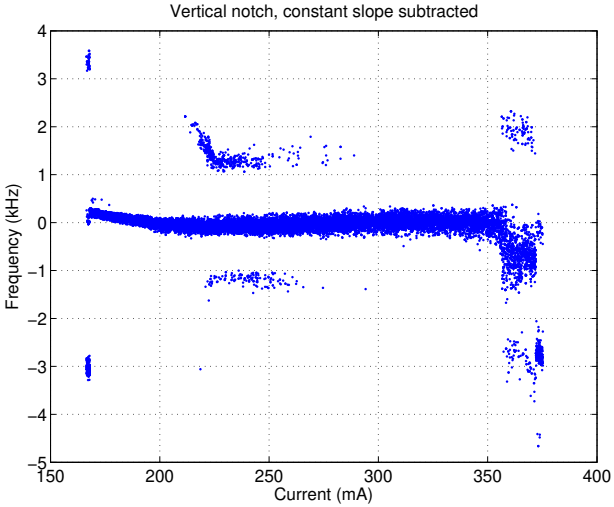

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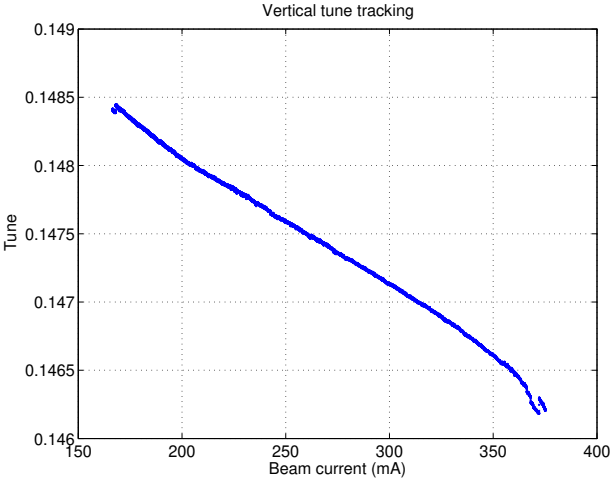

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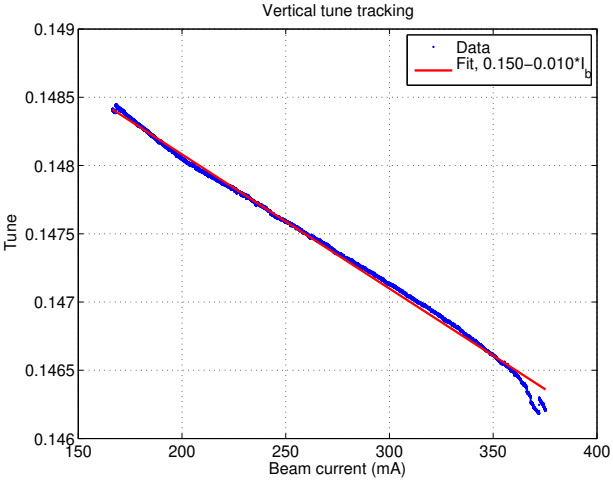

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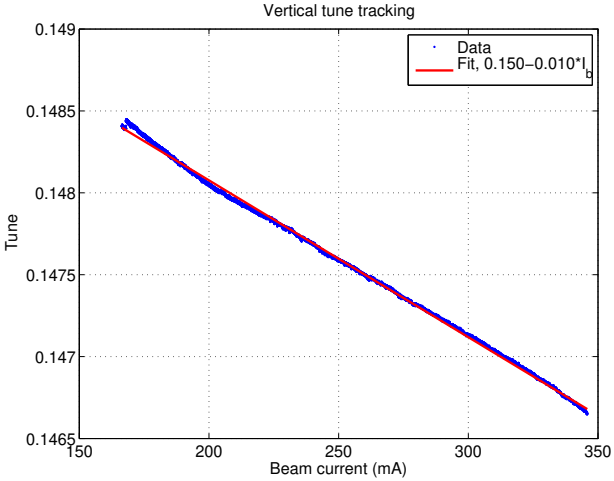

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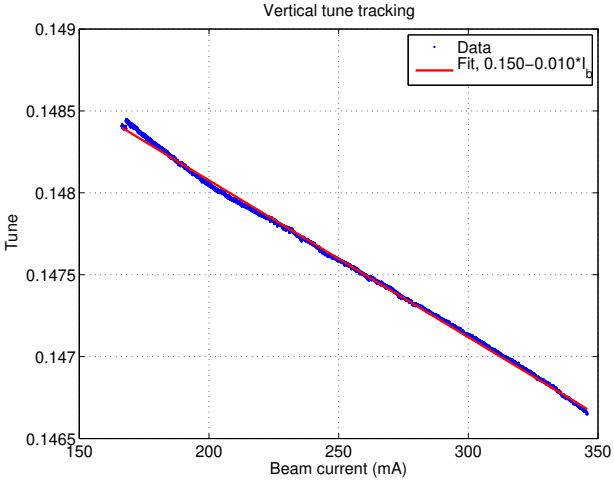

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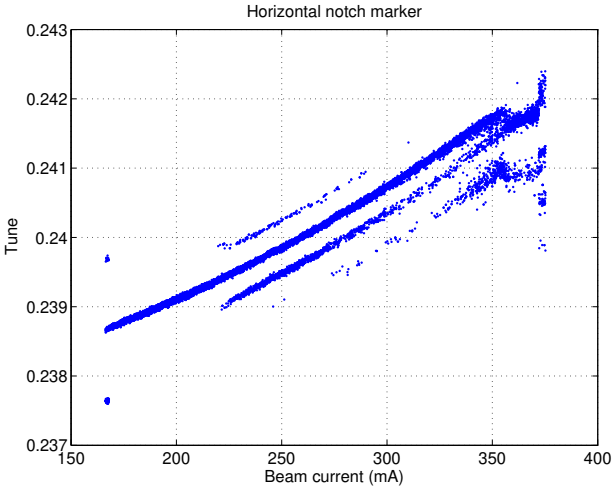

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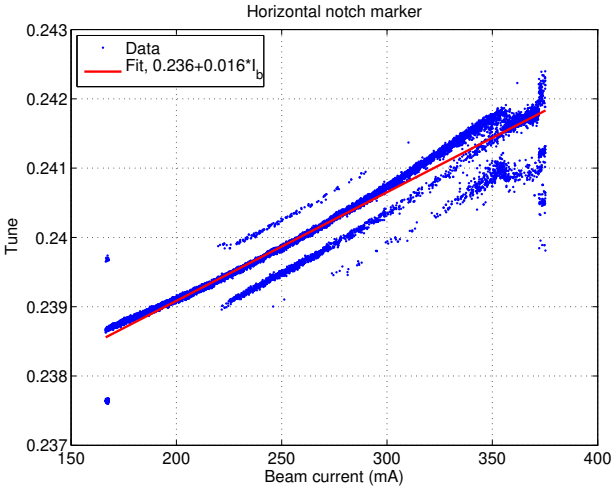

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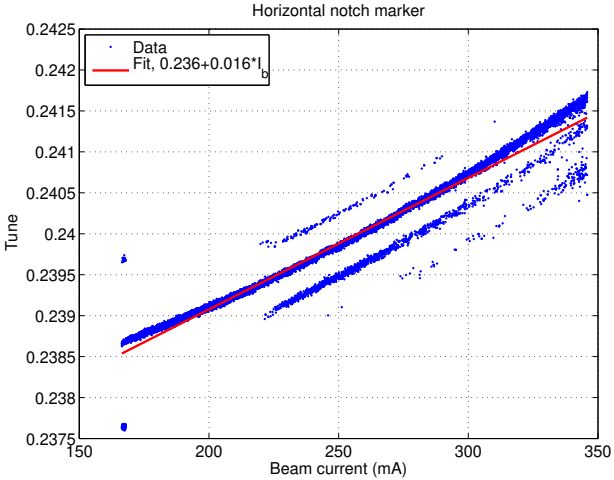

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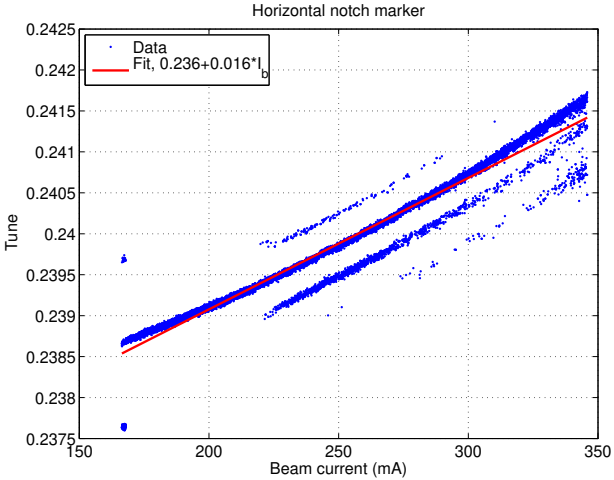

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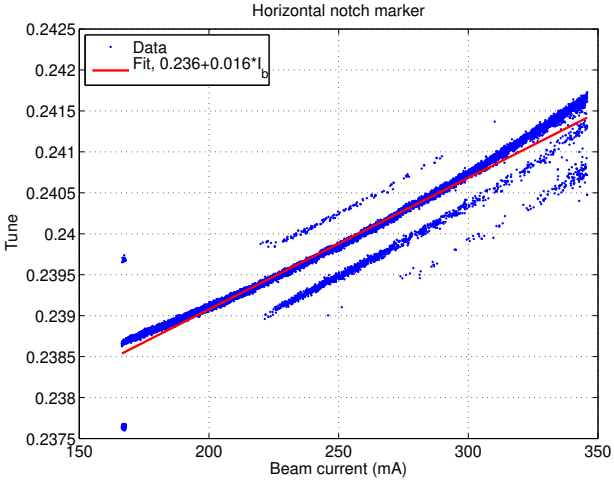

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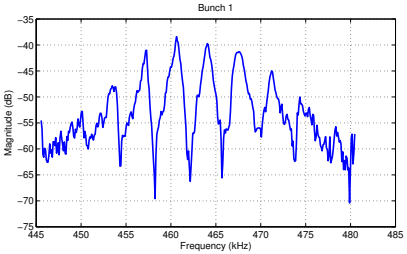

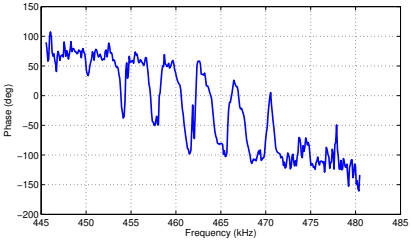

- Single-bunch transfer function, swept sinewave excitation;
- Single resonance fit;
- With first synchro-betatron sidebands included;
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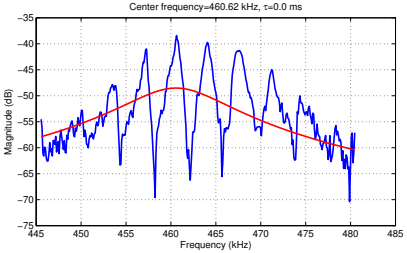

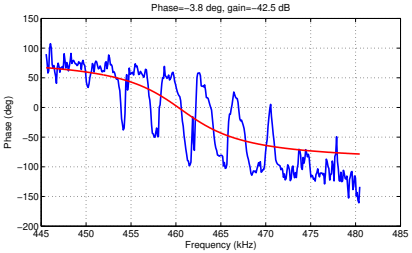

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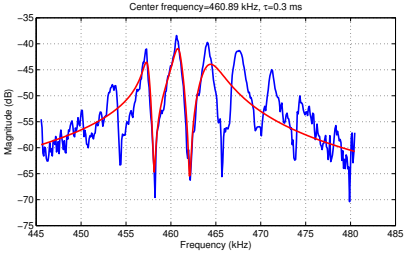

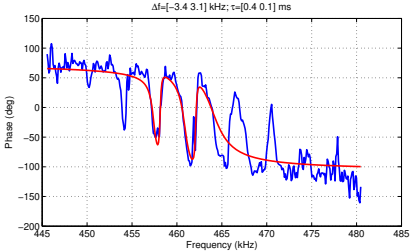

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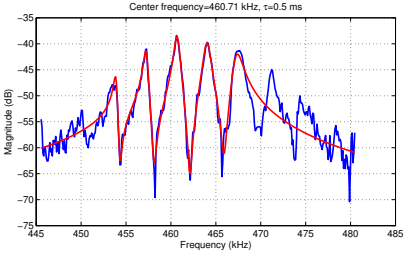

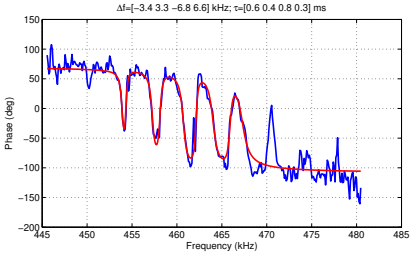

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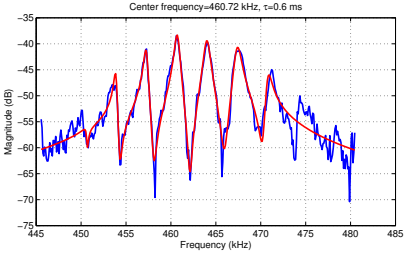

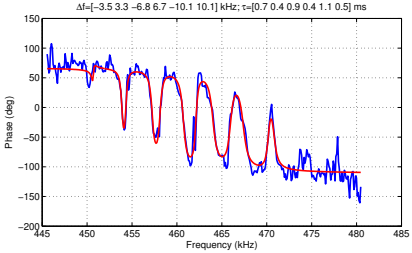

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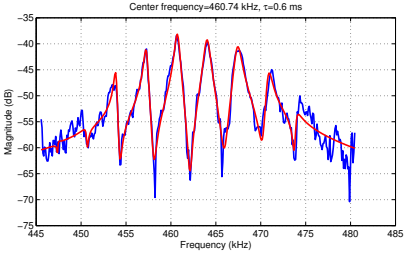
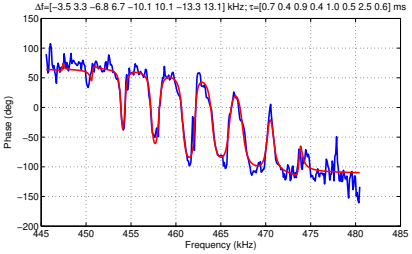
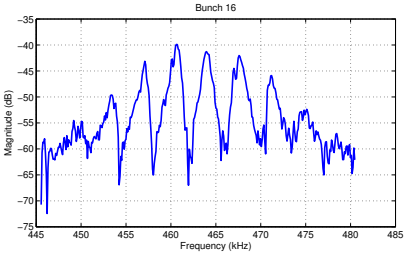
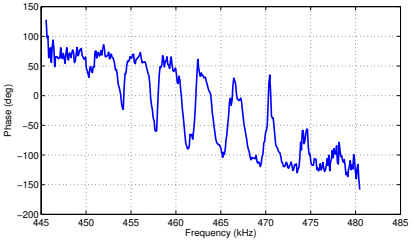




- Single-bunch transfer function, swept sinewave excitation;
- Single resonance fit;
- With first synchro-betatron sidebands included;
- Up to second synchro-betatron sidebands;
- Up to third synchro-betatron sidebands;
- Up to fourth synchro-betatron sidebands.

Single Bunch Transfer Function: Bunch 16





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- Up to second synchro-betatron sidebands;
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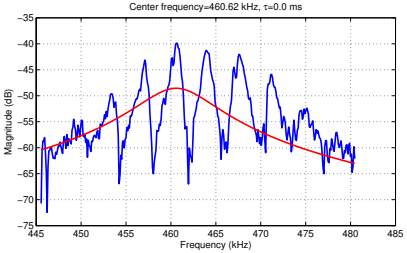
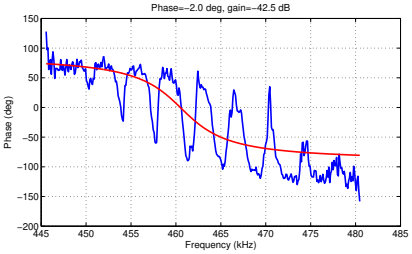
Single Bunch Transfer Function: Bunch 16





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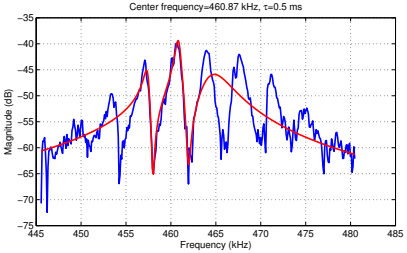

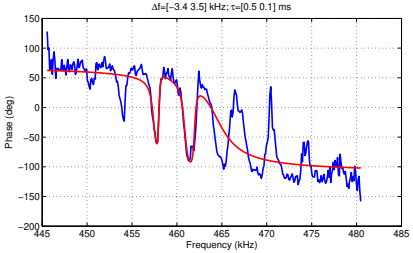

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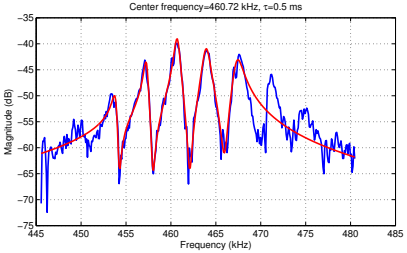

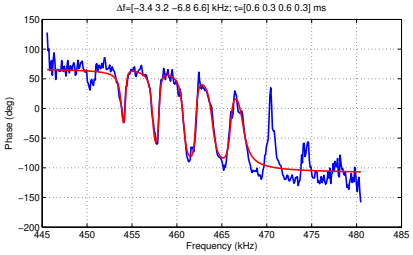

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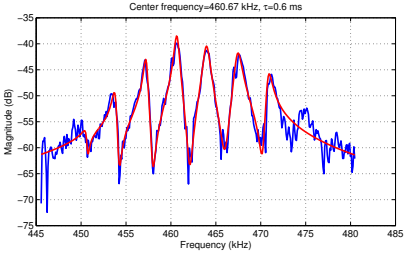

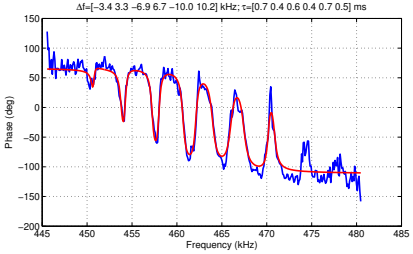

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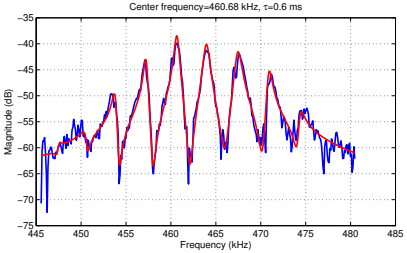

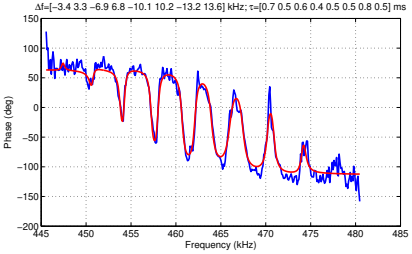

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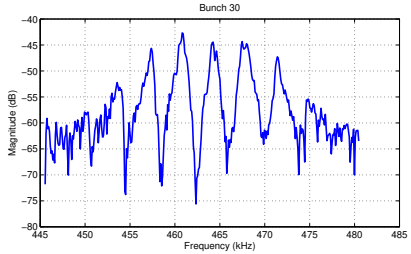
Single Bunch Transfer Function: Bunch 30



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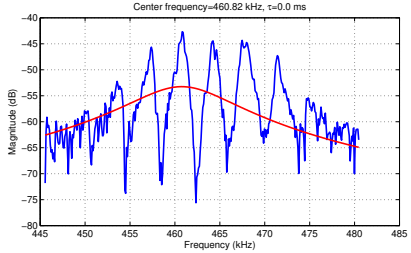

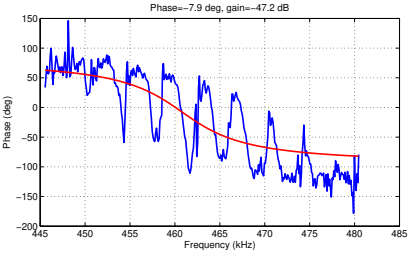

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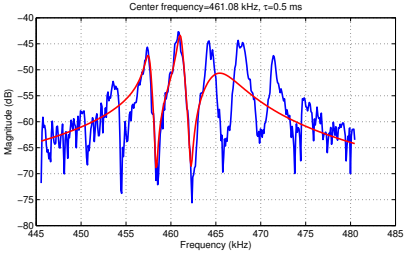

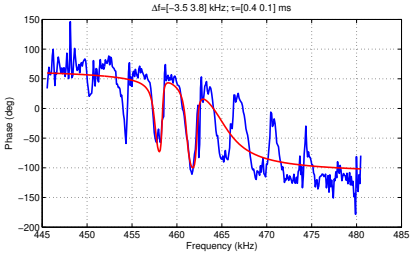

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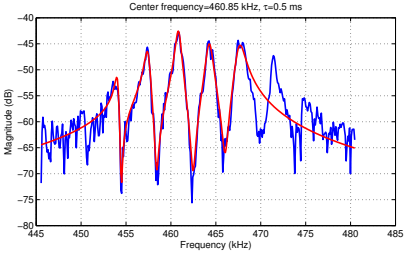

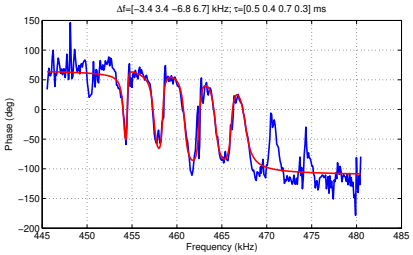

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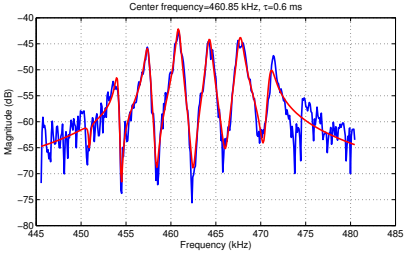

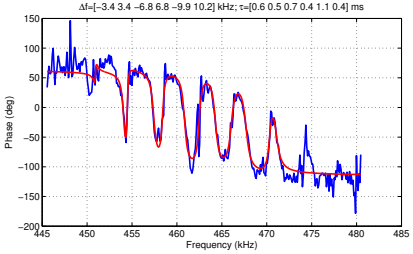

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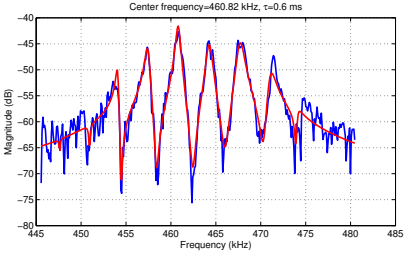

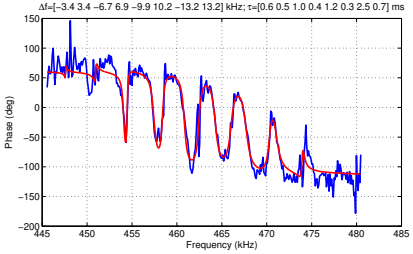

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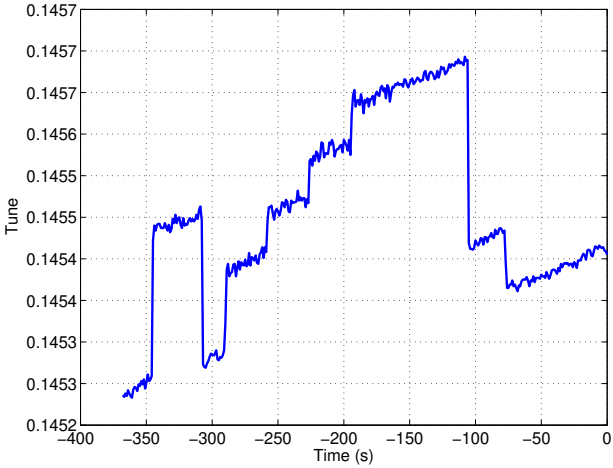
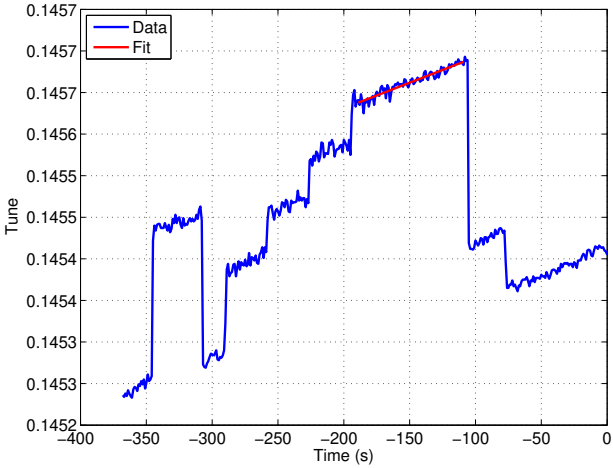
Tune vs. Amplitude, Vertical



- Bunch 13 (camshaft) tracked by tune tracking in Y;
- Linear fit to the current decay slope;
- Compensate for the current decay component;
- Plot versus oscillation amplitude;
- Fourth order fit to guide the eye.

Tune vs. Amplitude, Vertical



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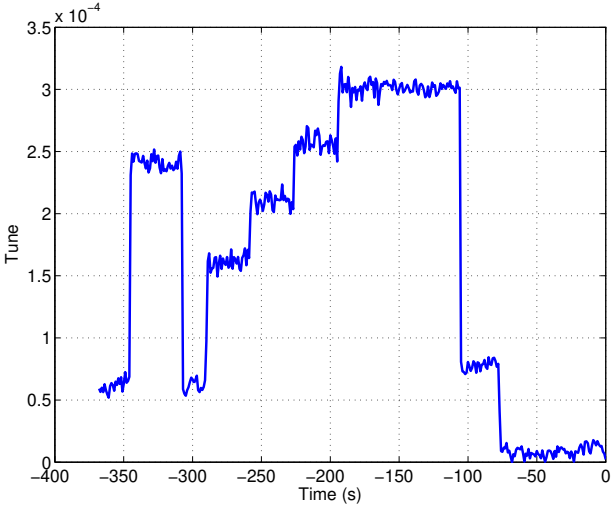

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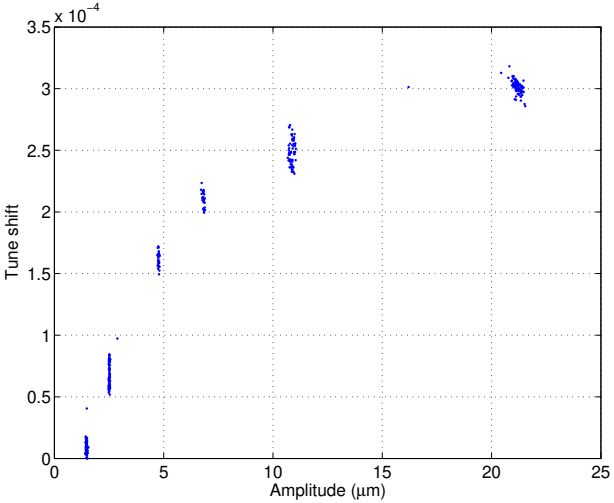

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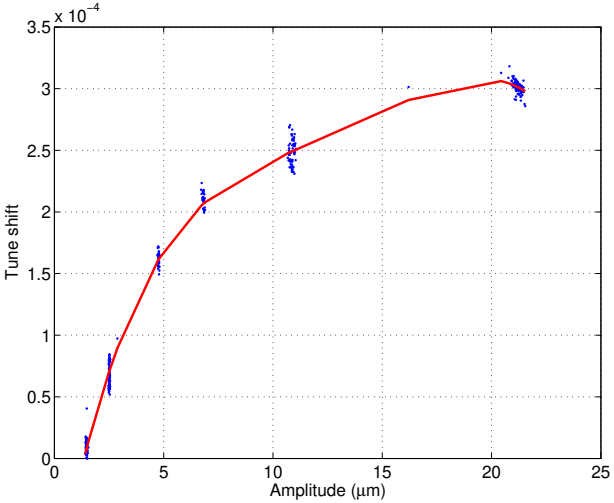

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- Linear fit to the current decay slope;
- Compensate for the current decay component;
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Summary

- Initial commissioning is complete;
- Bunch cleaning works up to 1 GeV;
- Propose borrowing an amplifier to check the three stripline drive configuration: 0.5 kick in X, 1.5 kick in Y;
- Some preliminary measurements of current-dependent tune shift;
- Explored single-bunch transfer functions;
- Next — gather some operational experience with user beam.

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