Bare lattice vertical tune measurement

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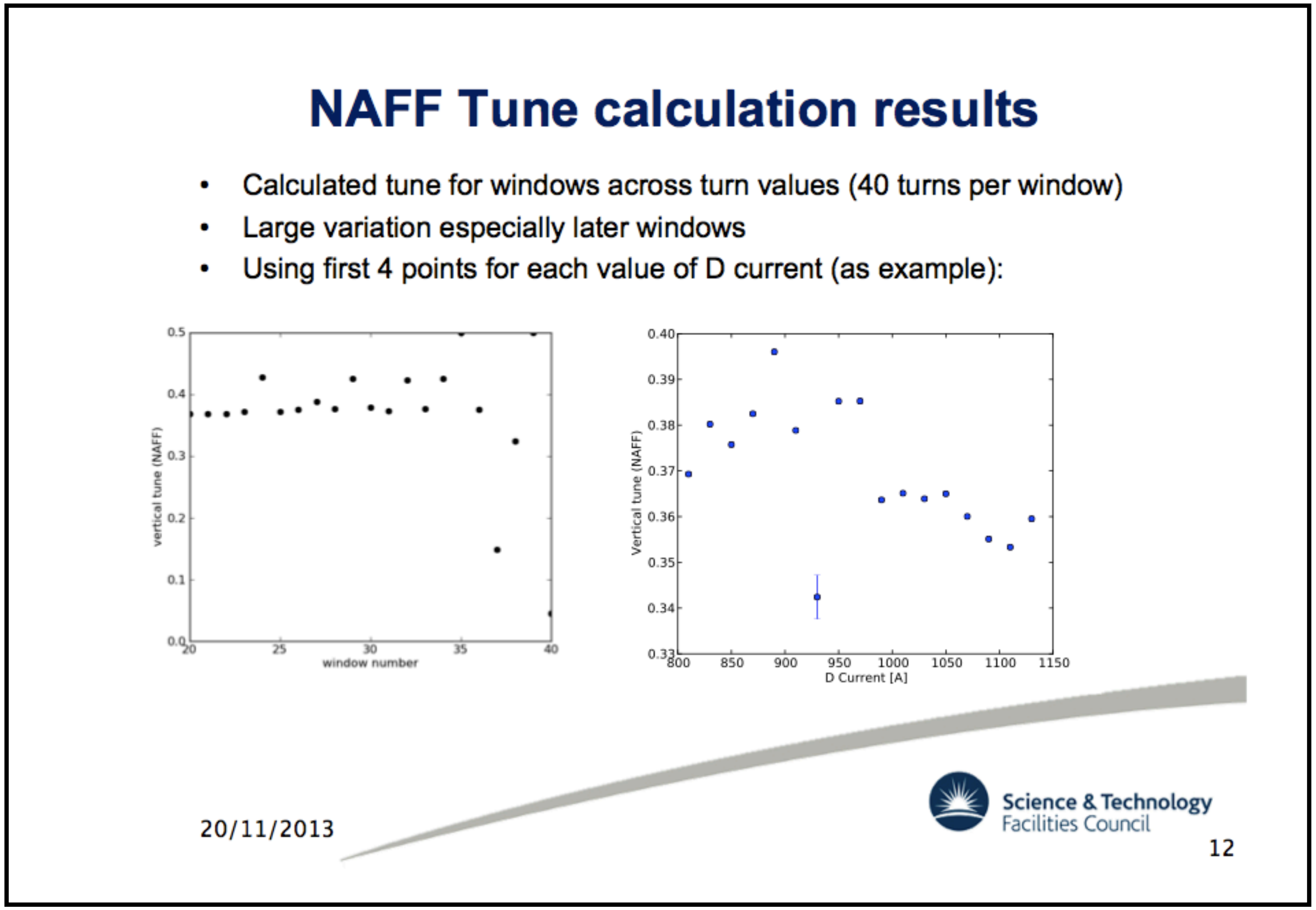
Preliminary analysis by Suzie



NAFF Tune calculation results

- Calculated tune for windows across turn values (40 turns per window)
- Large variation especially later windows
- Using first 4 points for each value of D current (as example):

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12

Vertical tune does not change much with D-mag current. Is it true?

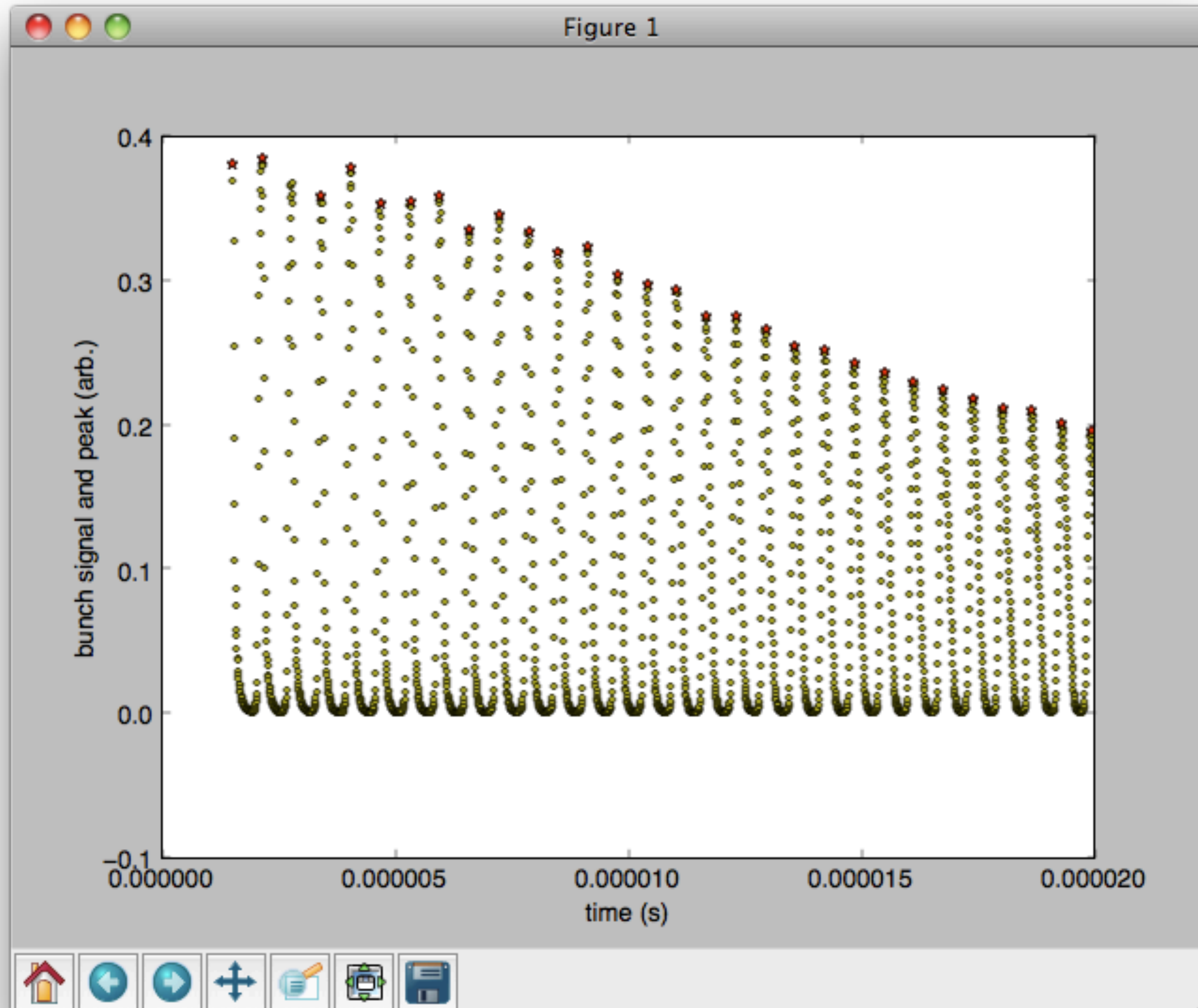
Conditions

- Data on 13 November 2013.
- No rf cavity.
- Small vertical offset at injection.
- F-mag current is fixed at 813.15 A. D-mag is varied from 810 to 1130 A.
- Use double (hebi,巳) and single (inu,戌) bunch monitors.

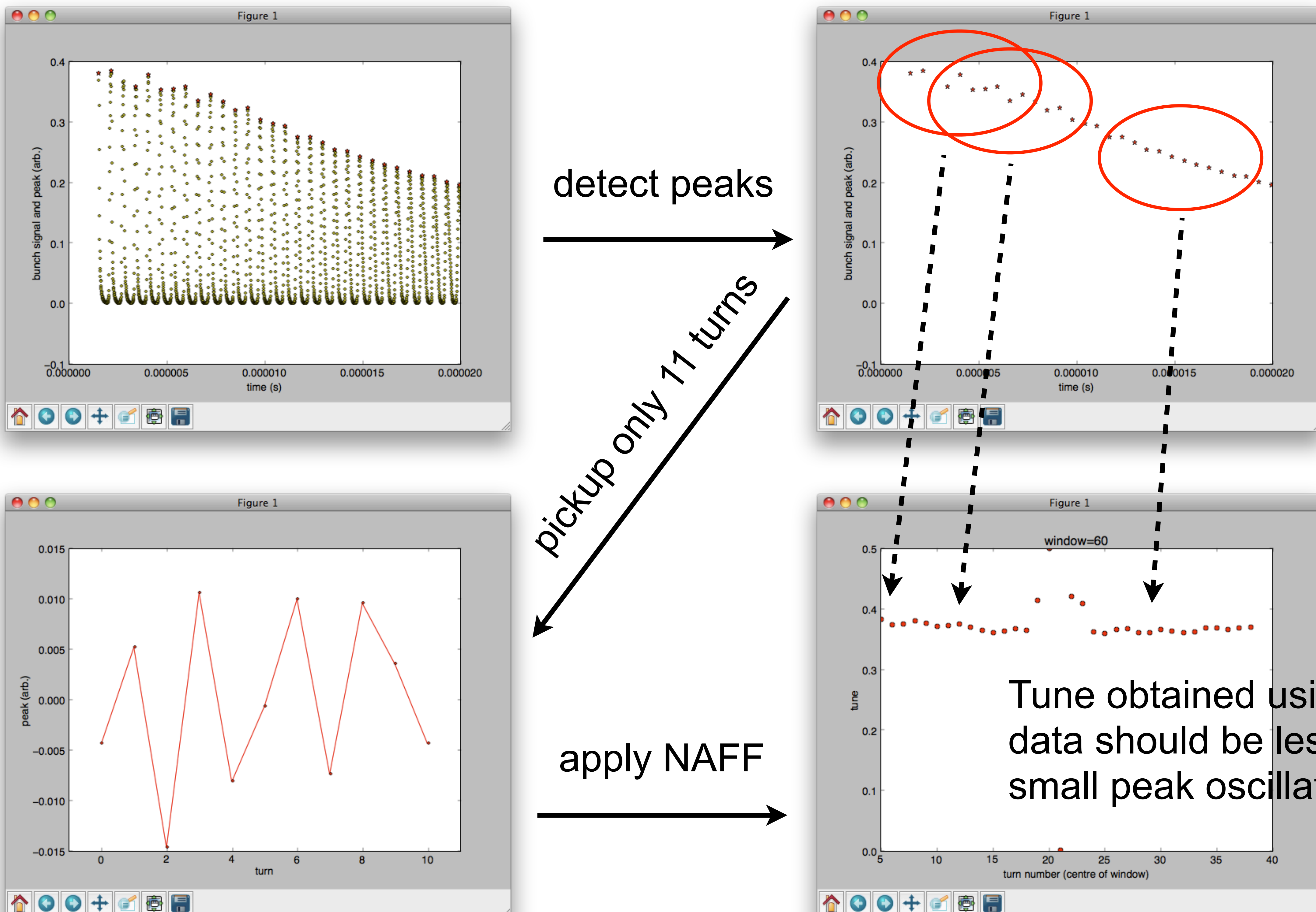
- More details can be found in a spread sheet by Suzie.

Bunch monitor single

- (Baseline is forced to be zero.)
- Peak height decays due to bunch broadening.
- Some oscillations of the peak height for the first 10~20 turns. Assume this s due to vertical betatron oscillations.



Data analysis



Tune obtained using later 11 turns data should be less accurate due to small peak oscillations.

NAFF algorithm

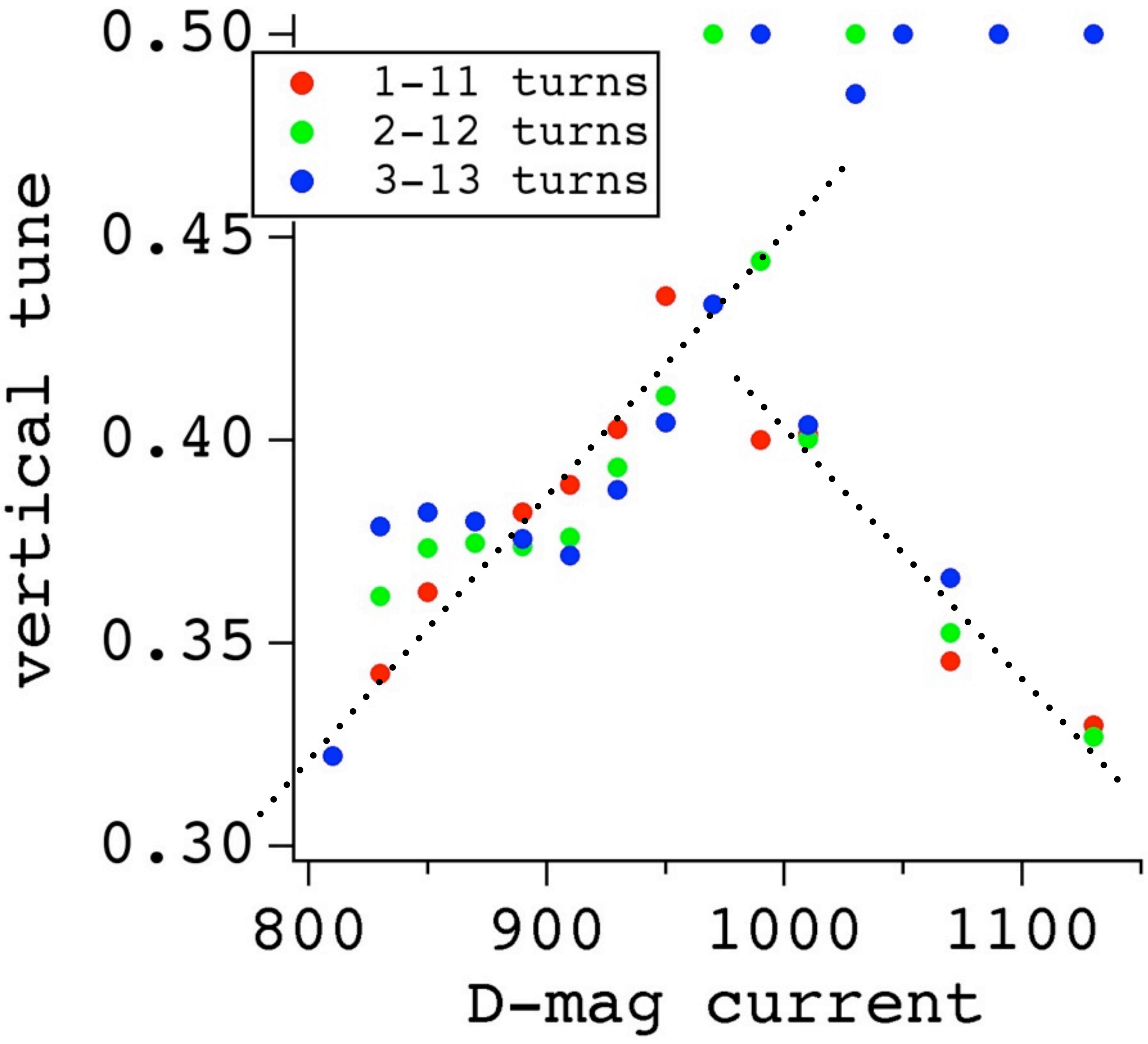
- Numerical Analysis of Fundamental Frequency.
- Find numerically the frequency ν which maximise $\phi(\nu)$

$$\phi(\nu) = \frac{1}{N} \sum_{n=0}^{N} z(n) exp(-2\pi i \nu n)$$

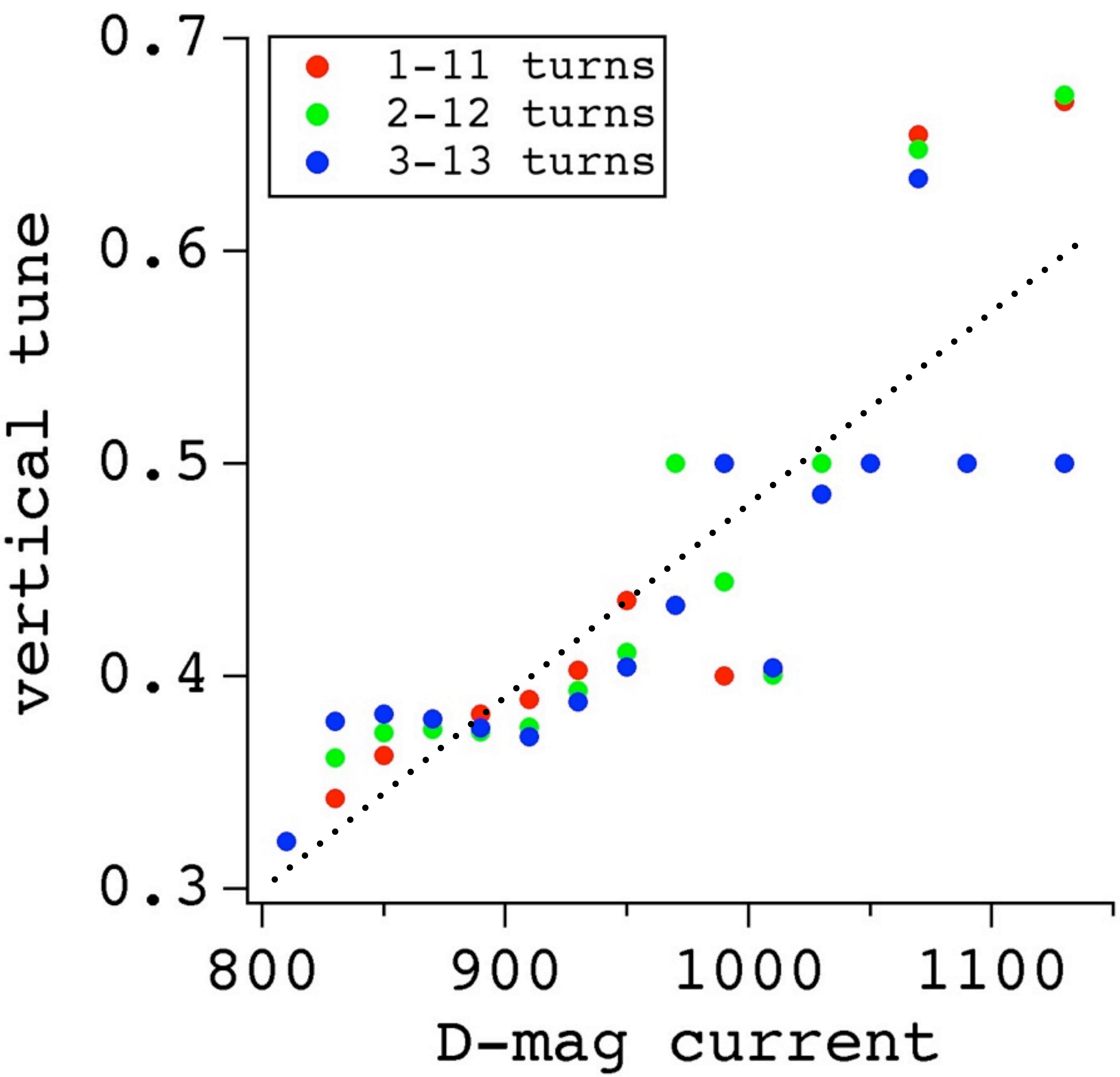
$z(n)$: data set to be analysed.

1. R. Bartolini, Particle Accelerators **52** 147 (1996).
2. J. Laskar, Physica D **67** 257 (1993).

Results of single bunch monitor



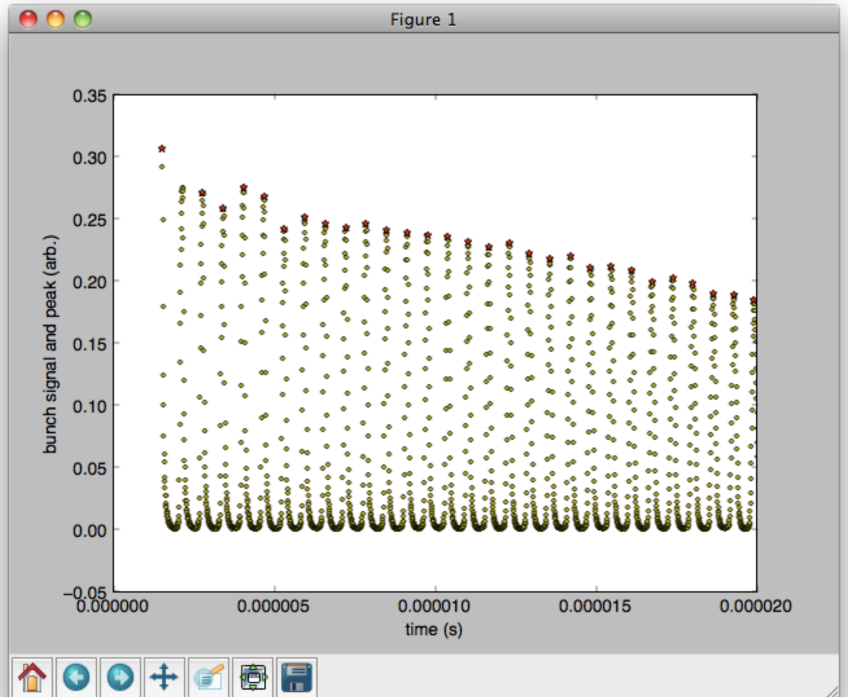
Results of single bunch monitor (some flipped)



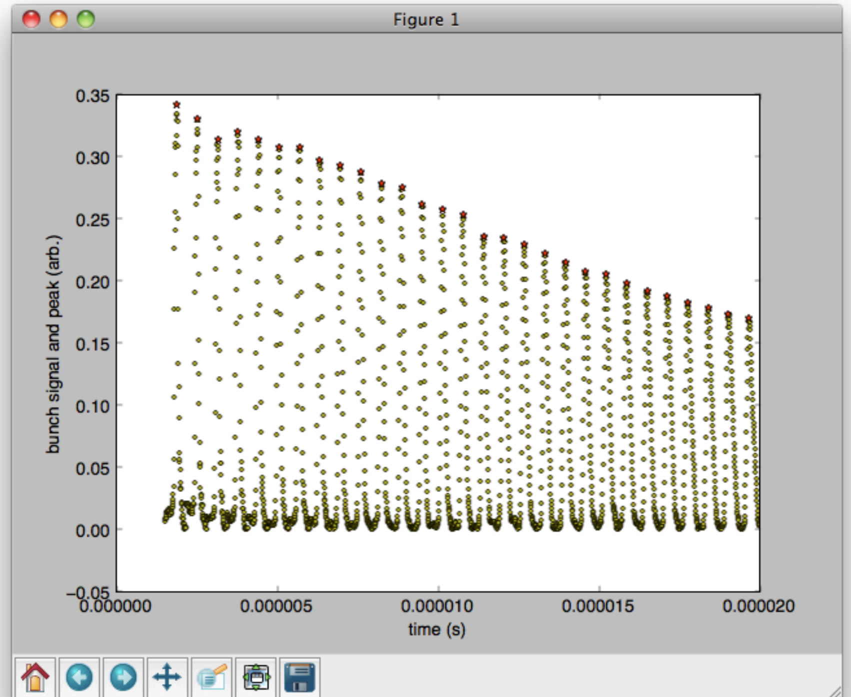
Should be checked by simulation if it is reasonable.

Bunch shape

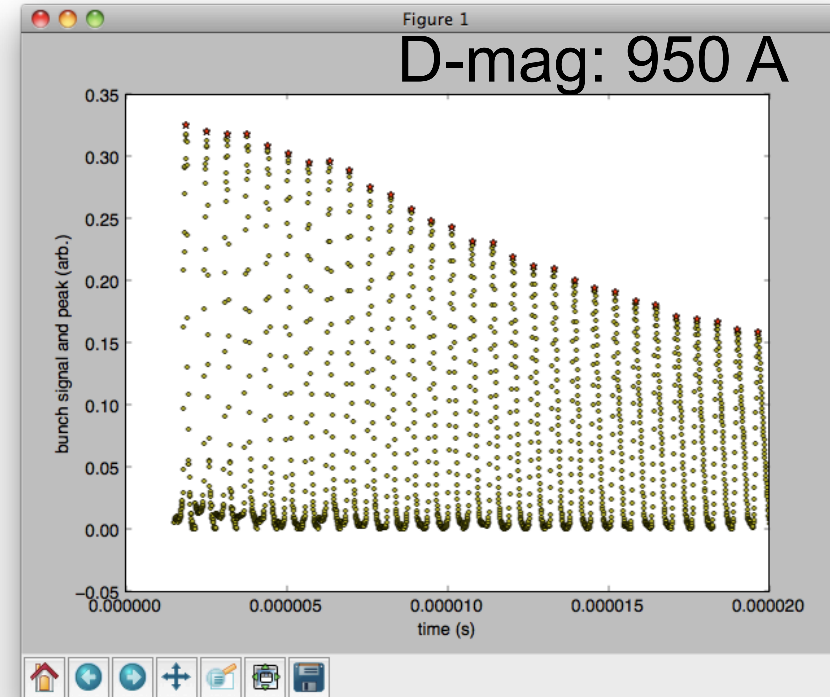
D-mag: 830 A



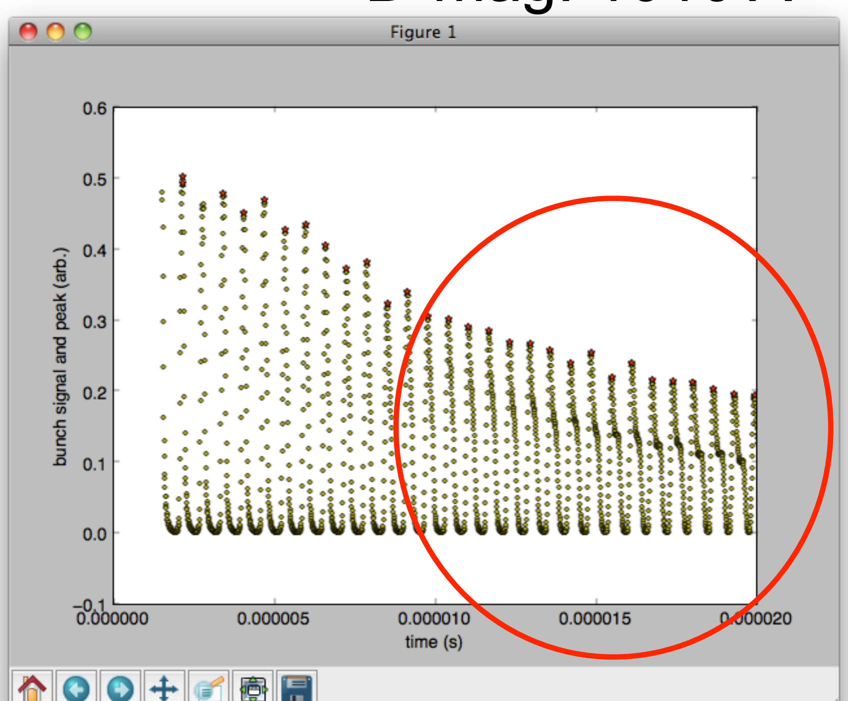
D-mag: 890 A



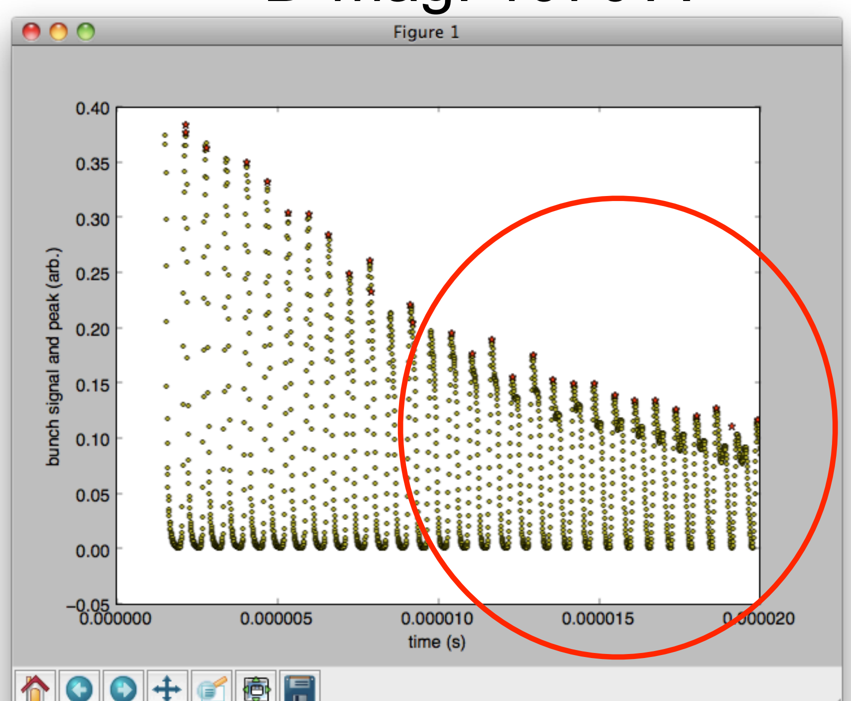
D-mag: 950 A



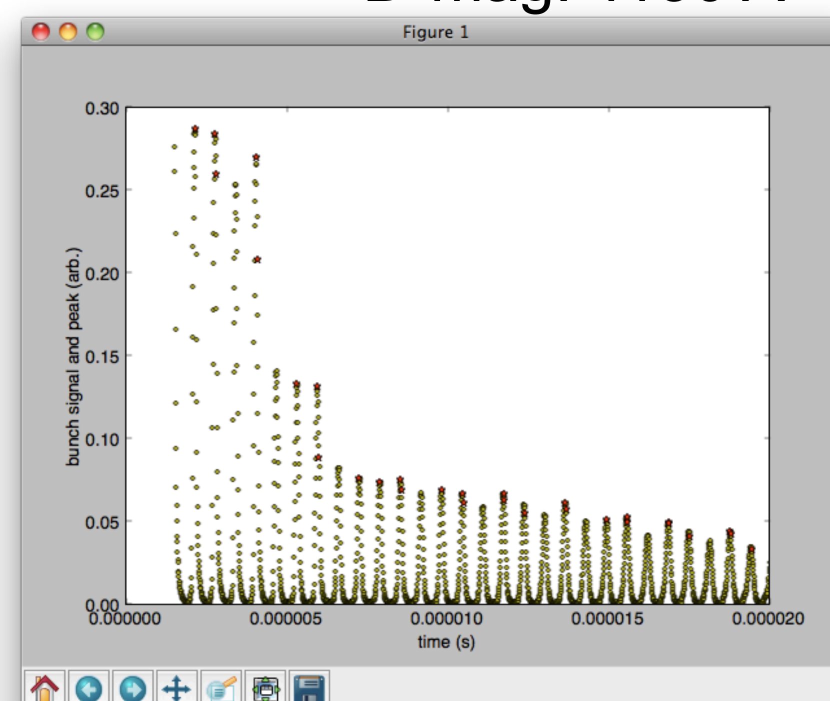
D-mag: 1010 A



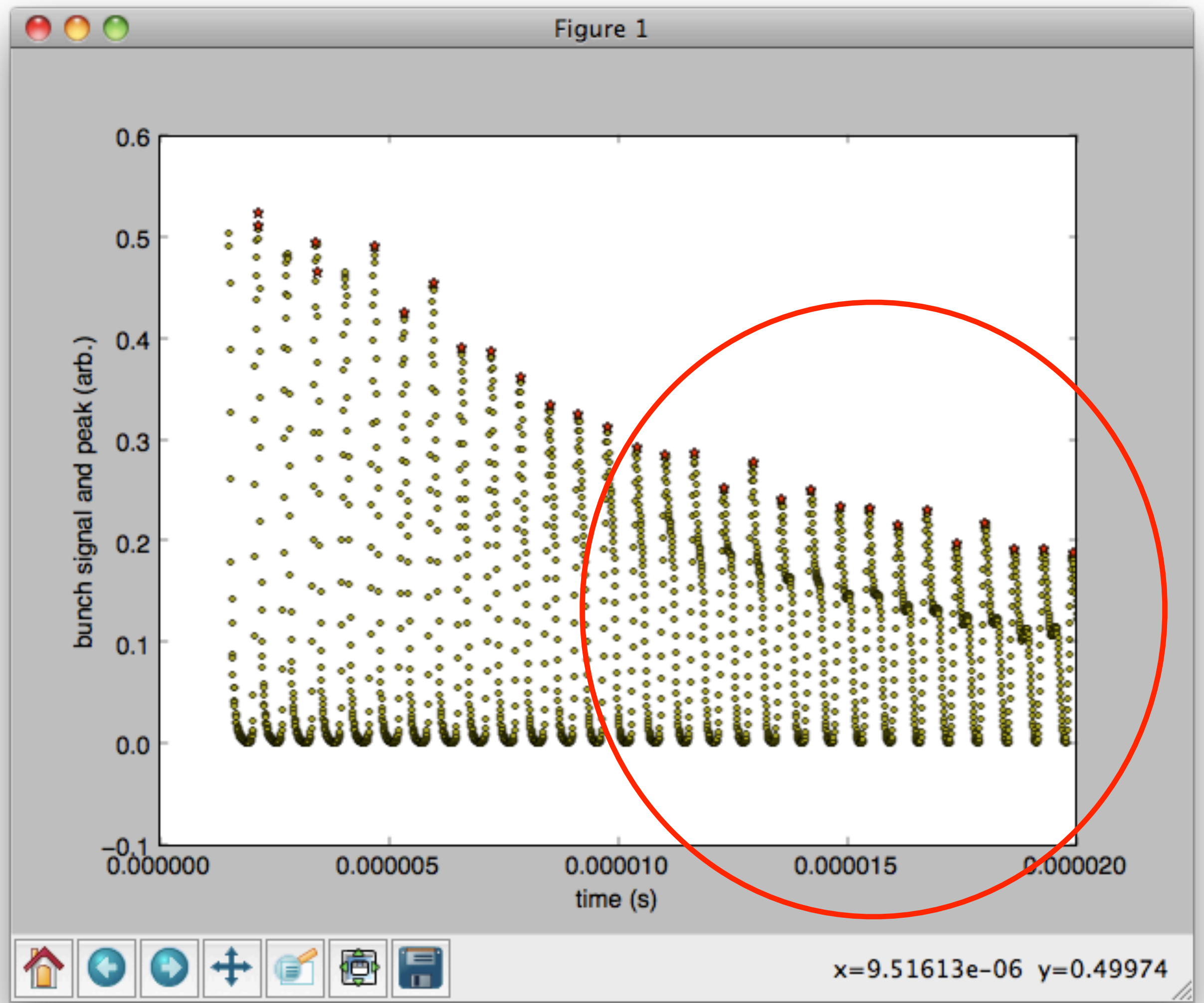
D-mag: 1070 A



D-mag: 1130 A



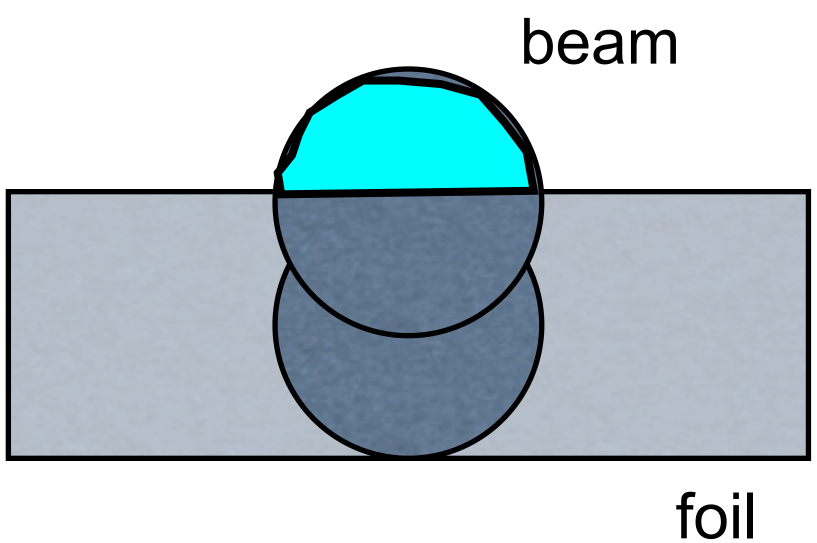
Double peaks



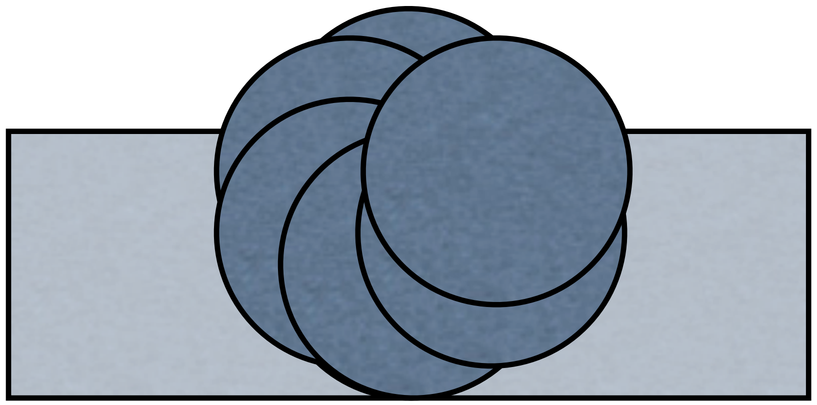
- Only developed around D-mag=1030 A.
- Second peak corresponds to lower momentum.
- If the tune measurement is correct, it occurs around a half integer tune.

Possible explanation

at half integer



at other tune



At half integer tune, some part of a beam can avoid foil hitting every other turn which makes two separate momentum evolution of a beam.