Measurement of betatron tunes

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Outline

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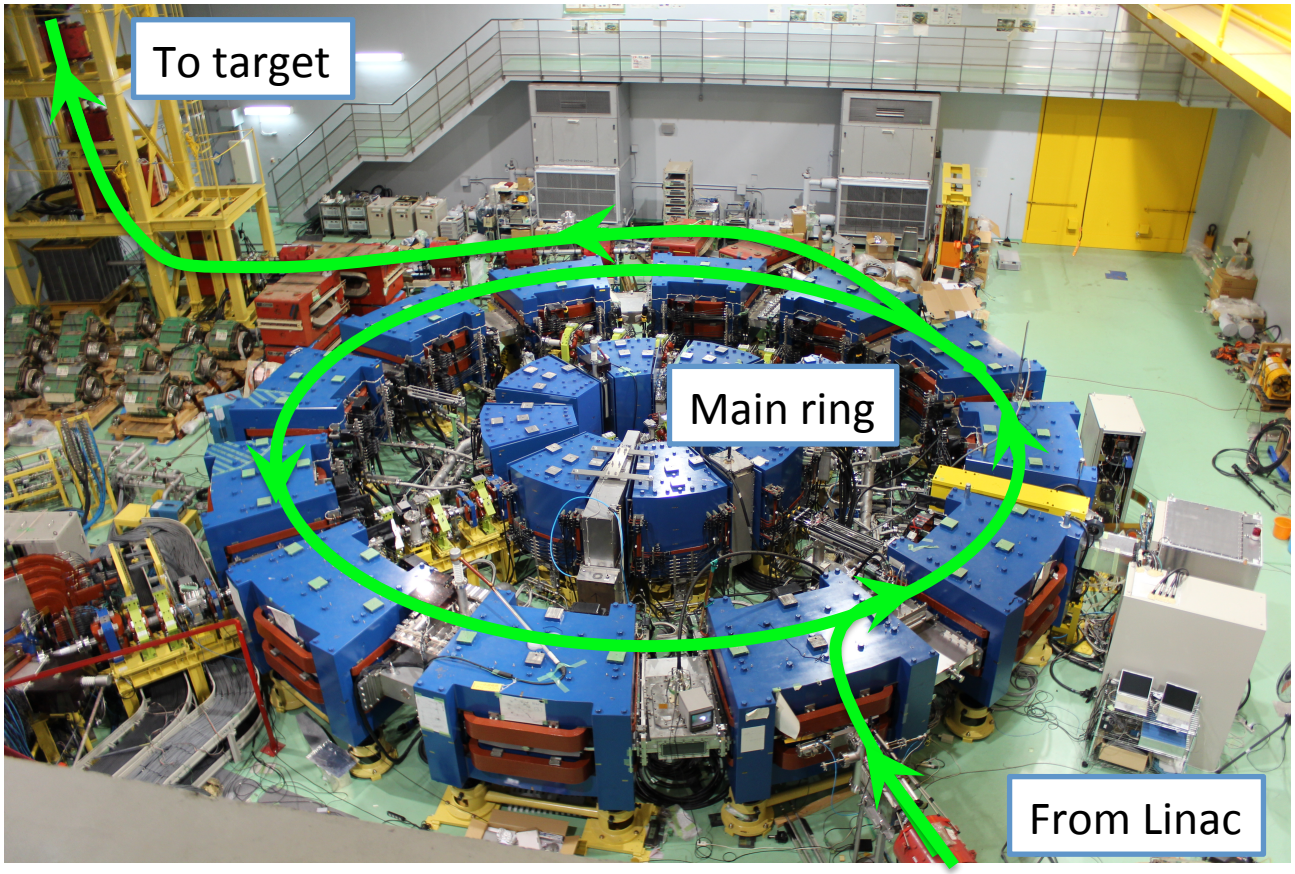
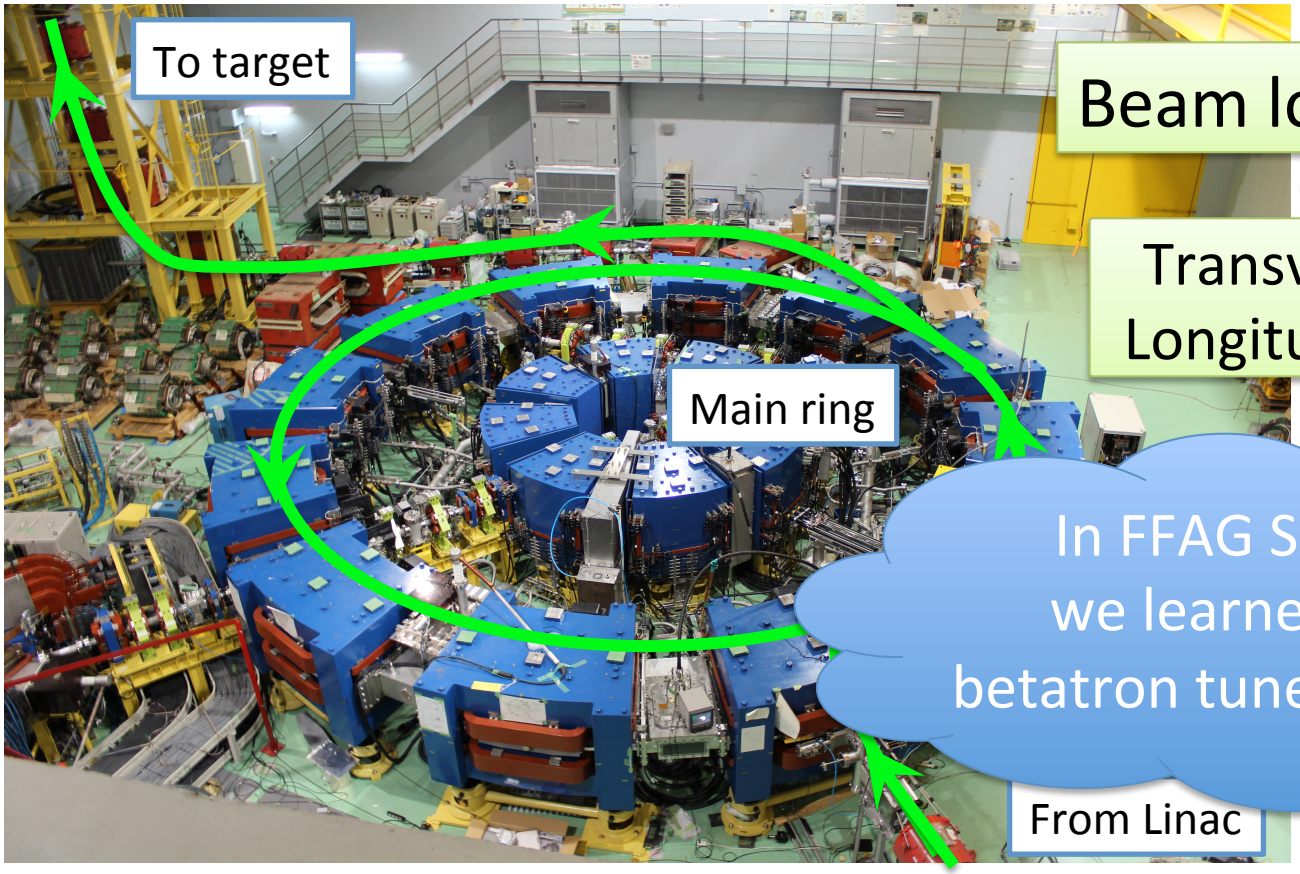
Summary

Motivation



Motivation



Beam loss at Main ring

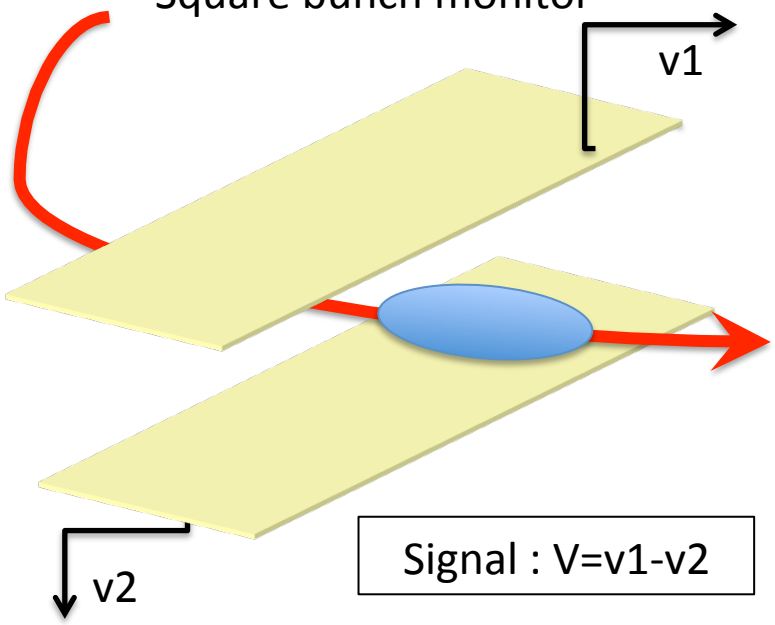
Transverse instability?
Longitudinal instability?

In FFAG School,
we learned that
betatron tunes show it.

Measure betatron tunes

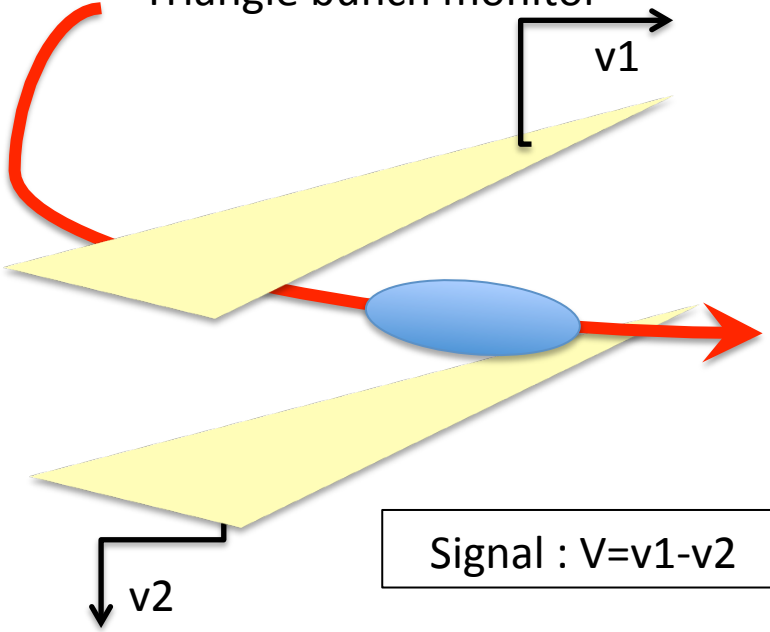
How to measure

Square bunch monitor



Signal height depends on **vertical** oscillation

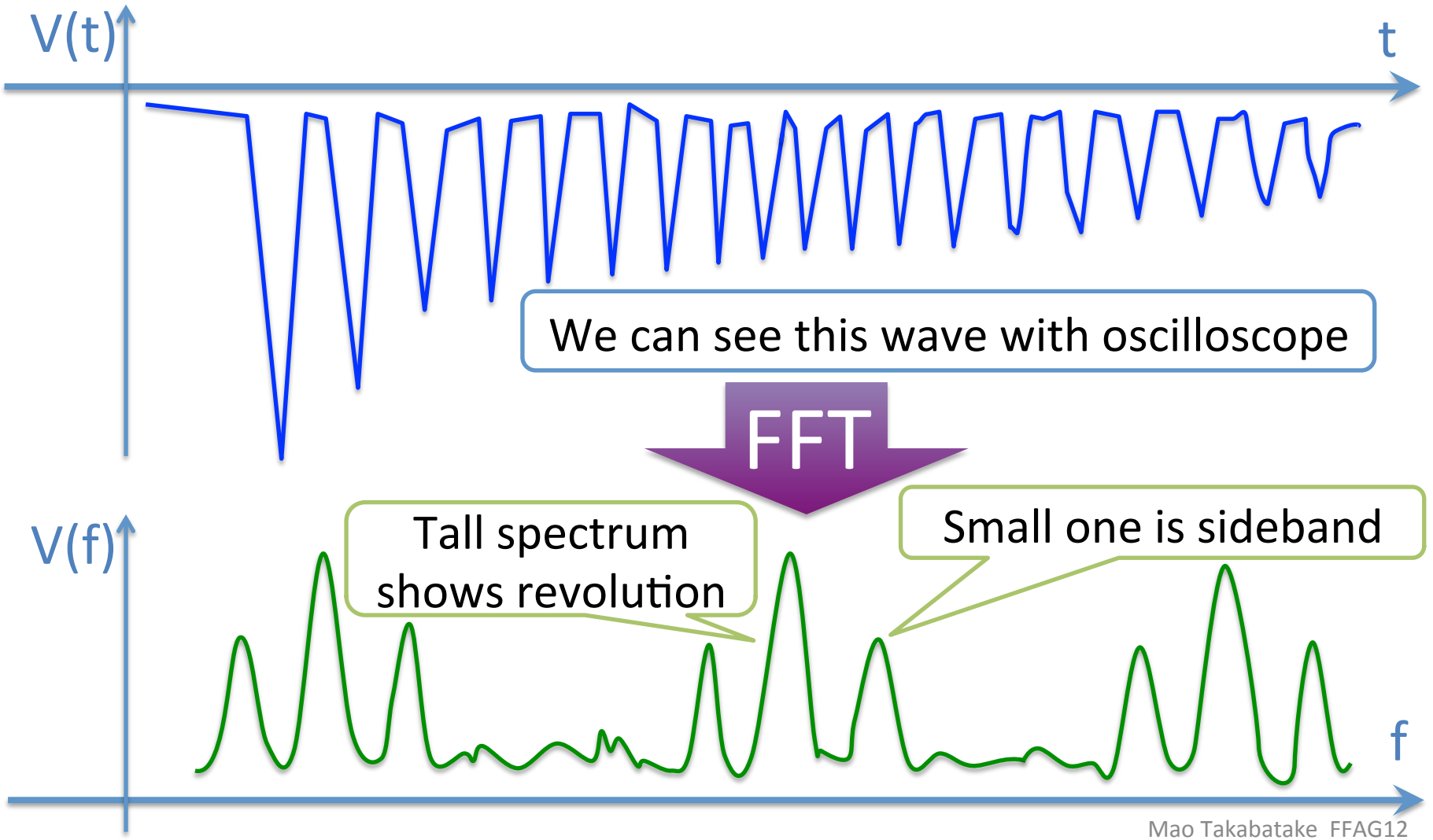
Triangle bunch monitor



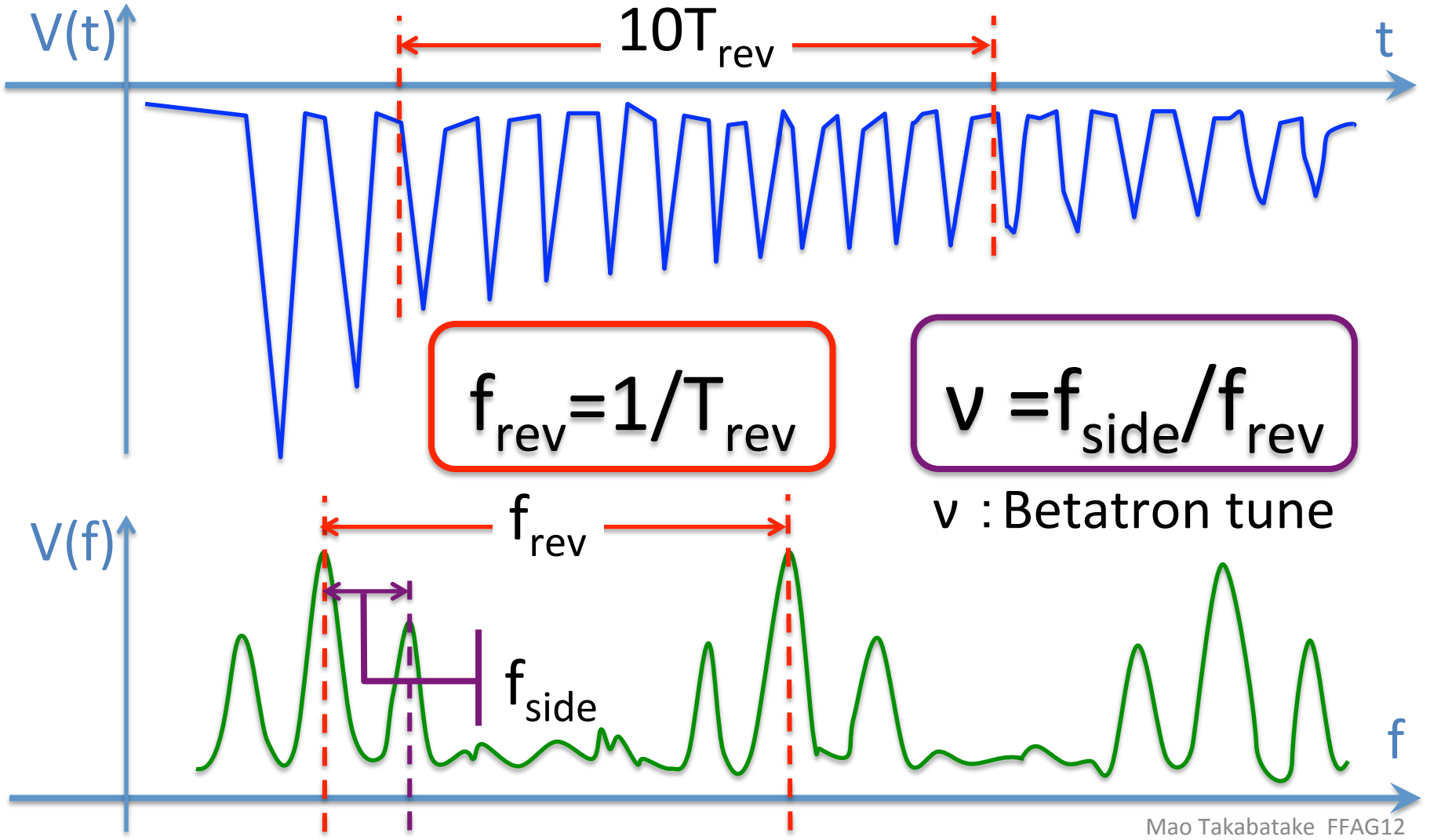
Signal height depend on **both** oscillations

Their difference shows horizontal oscillation

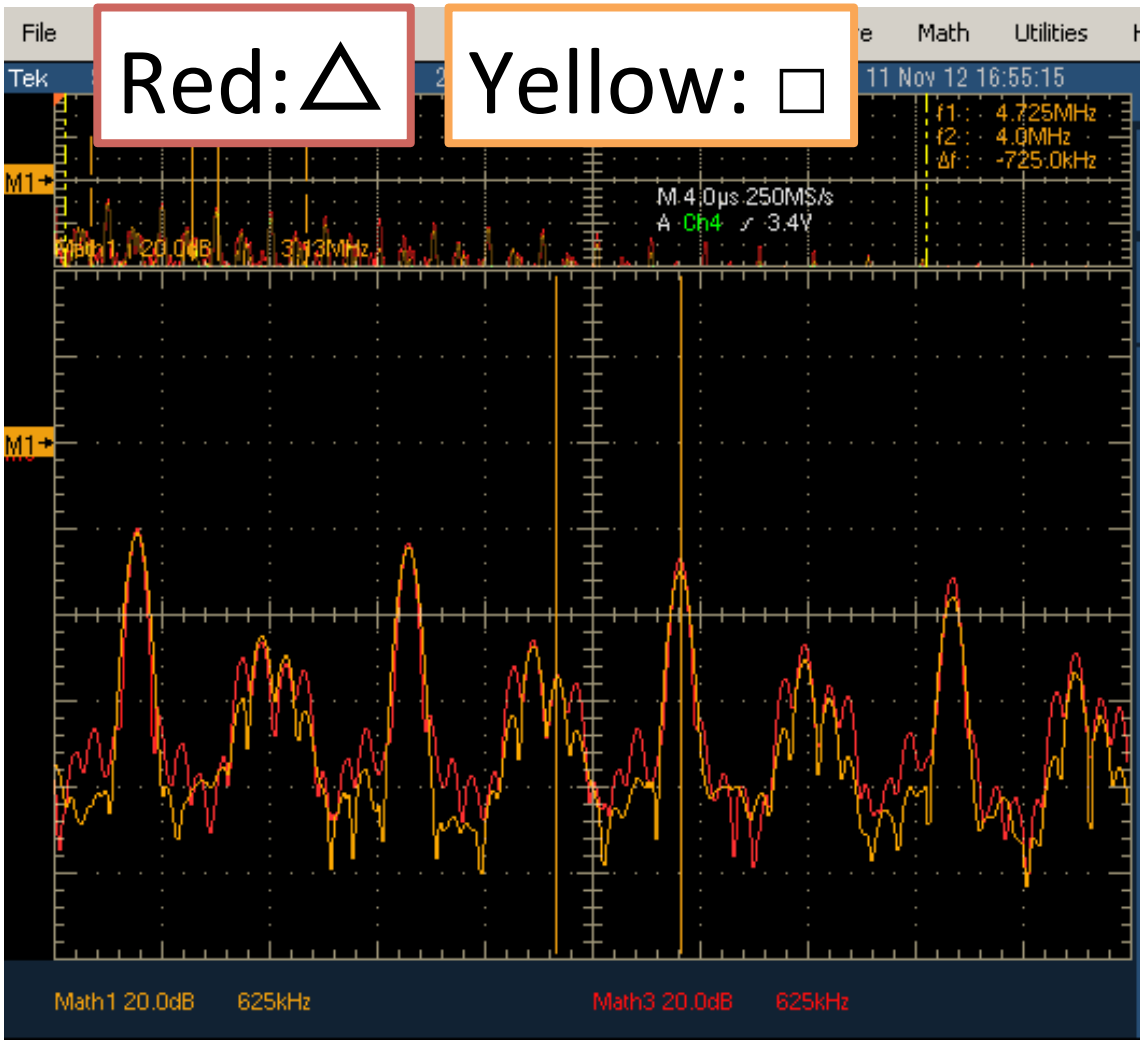
How to measure



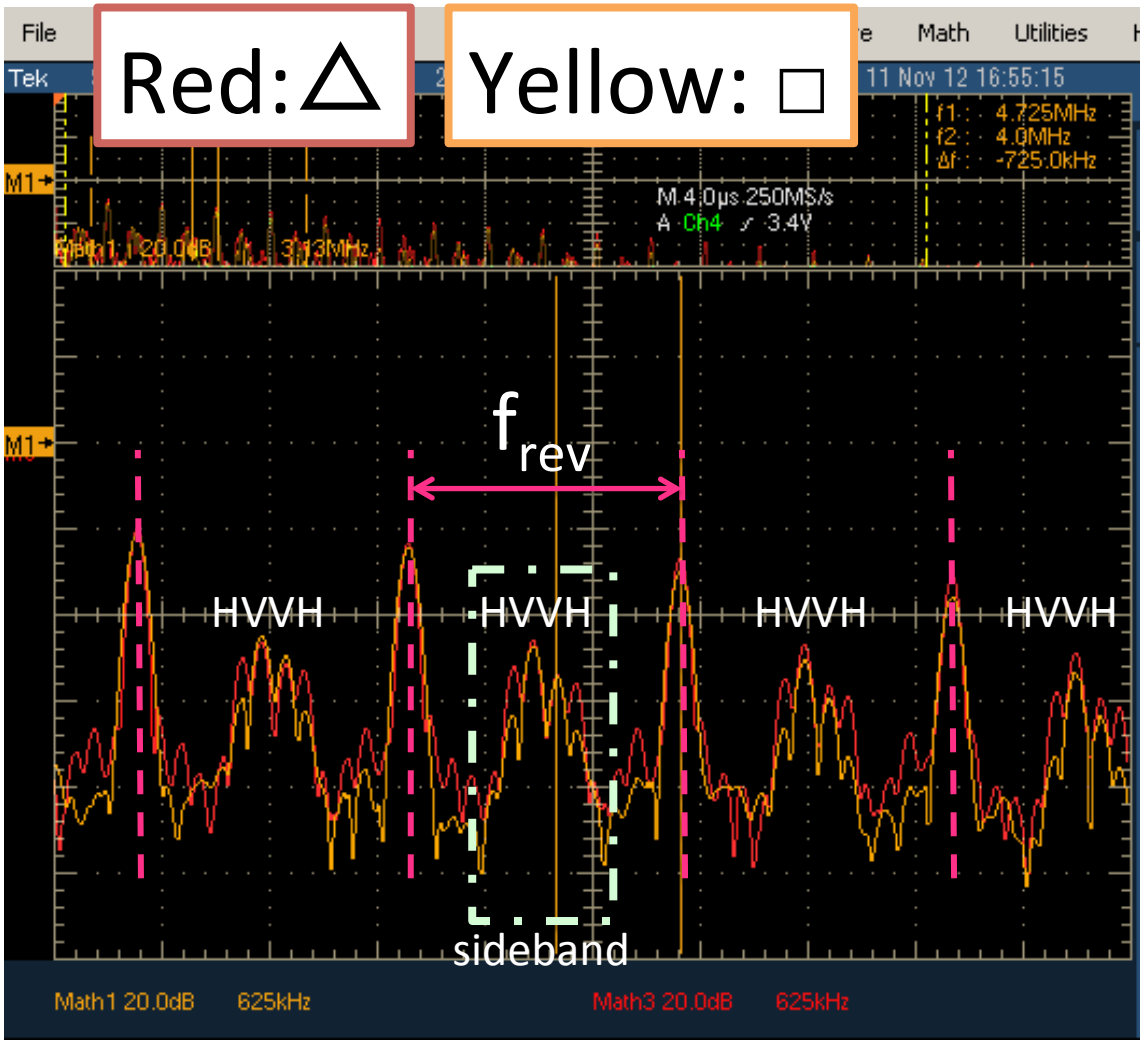
How to measure



Experiments

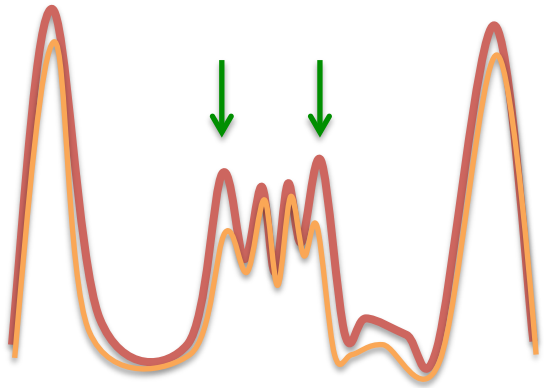


Experiments



H: horizontal

V: vertical



These difference show horizontal position

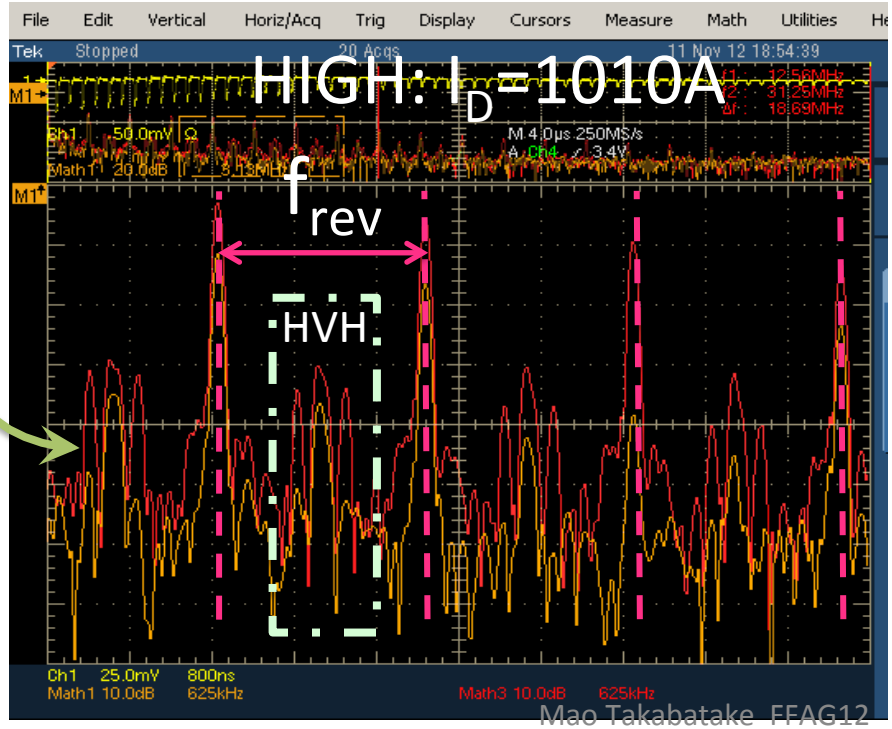
We want to make it more surely…

Experiments

Red:△

Yellow: □

$$\nu_x^2 \approx 1 + k$$
$$\nu_y^2 \approx -k + F^2(1 + 2\tan^2\varepsilon)$$
$$F^2 = \frac{\langle (B - B_{ave})^2 \rangle}{B_{ave}^2}$$

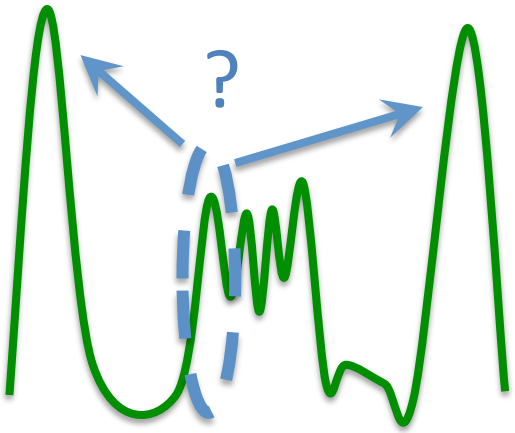


They differ in the current of defocus magnet

The spectrum of V unites!

Result

I_D[A] (F/D)	970 (814/970)	1010 (814/1010)
f_{rev}[MHz]	1.575	1.575
f_{side}[MHz] : horizontal	0.6125	0.6094
f_{side}[MHz] : vertical	0.725	0.740
ν : horizontal	0.388 OR 0.612	0.386 OR 0.614
ν : vertical	0.460 OR 0.540	0.470 OR 0.530

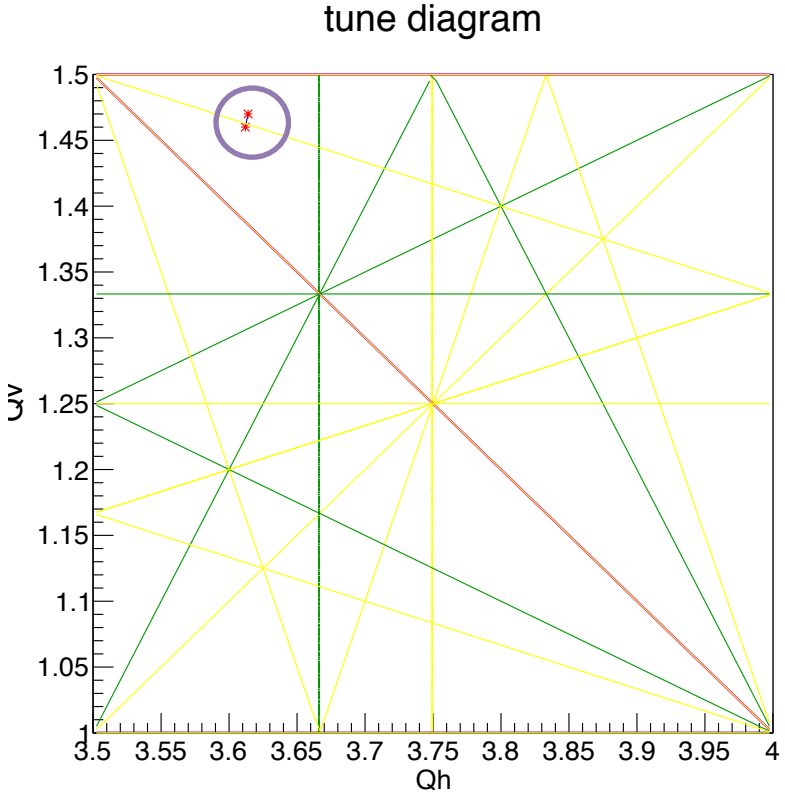


We cannot judge only by experimental result which harmonic of the spectrum is master.

Estimation

- How to judge which is master?

→We must check design of this ring



I_D[A] (F/D)	970 (814/970)	1010 (814/1010)
ν : horizontal	0.612	0.614
ν : vertical	0.460	0.470

Summary

- We measured betatron tunes for 2 different F/D ratios.
- We estimate betatron tunes.
- Betatron tunes is …

I_D[A] (F/D)	970 (814/970)	1010 (814/1010)
ν : horizontal	0.612	0.614
ν : vertical	0.460	0.470