



RF Kicker for Head-on collision

ICR, Kyoto Univ.

SOUHA Hikaru

IWASHITA Yoshihisa



RF kicker for Linear Collider

- Head-on Collision is desirable for ILC Interaction Point.
- Using RF Kicker for Beam Dump
→ Zero Crossing Angle
- Kicker's RF Strength
incoming beam passing → 0
outgoing beam passing → Peak



Advantage and Disadvantage

Advantage

- Can attain Head-on collision.
- Easier than Crab Cavity.

Disadvantage

- If stopped, beam will hit the other side.
- It may kick the incoming beam.

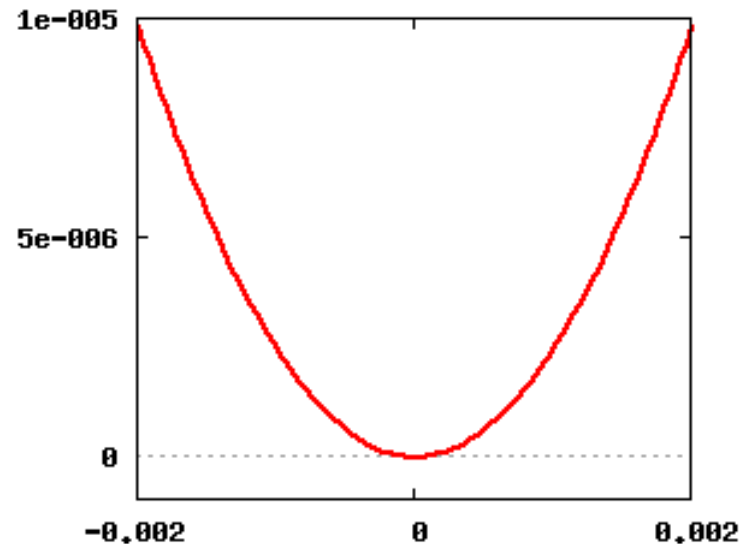
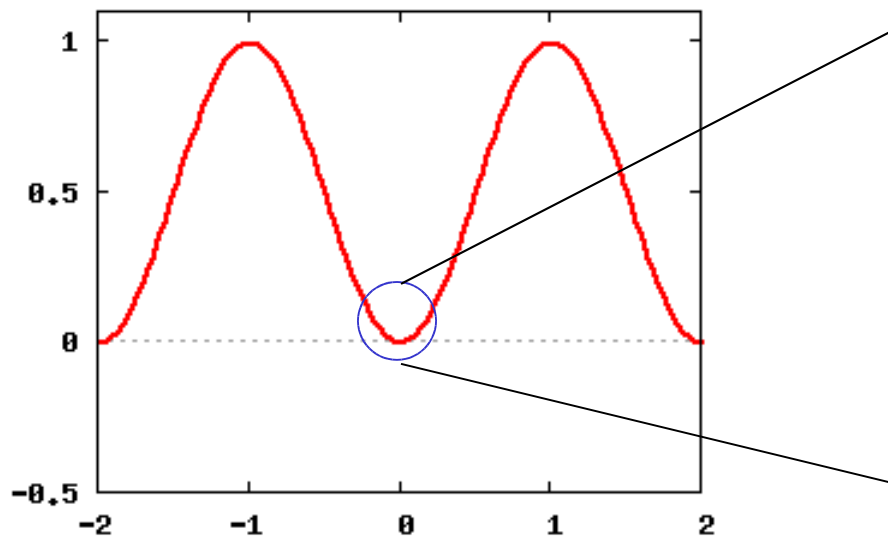


Risk of kicker trouble

- If RF Kicker stops, Beam directly hit opposite side Linac.
- 133 independent amp's are used
→ less than 1% effect from a unit.
- Some perturbation to the incoming beam.

Effect of RF Small fluctuation

- Bottom of RF is not flat.
→ Small Kick for incoming beam





Allowable Error

- Kick Angle must be smaller than Beam divergence of kicker's position

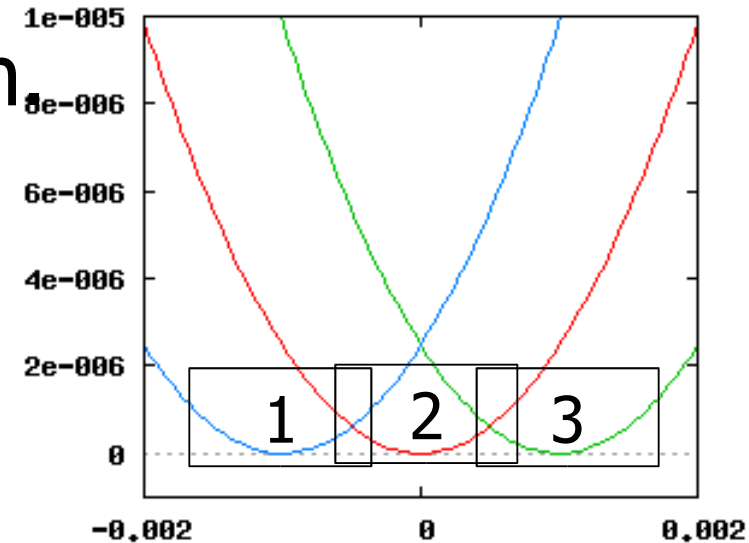
- Requirement of kick angle is,

$$\theta_x < 0.03\mu\text{rad}$$

$$\theta_y < 0.002\mu\text{rad}$$

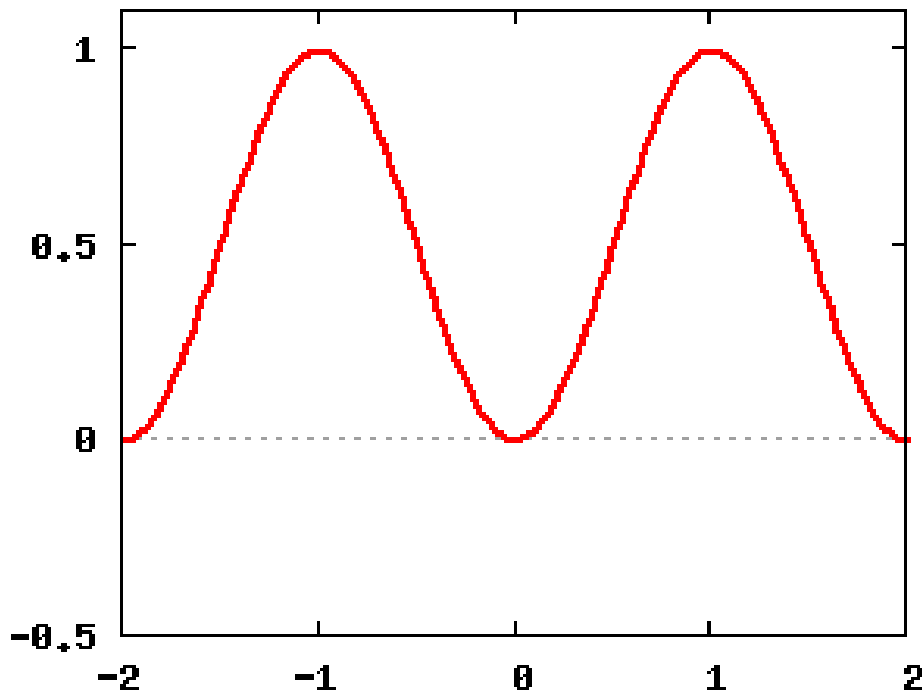
Compensation by Phasing

- Phasing = different phase for each section
- Apply each bottom to incoming beam
- No need for 133 division → divide into **some group**



Waveform 1: simple cosine

$$f(t) = 1 - \cos(\omega t)$$



Phasing division ≥ 4

1 Section = 1.0m

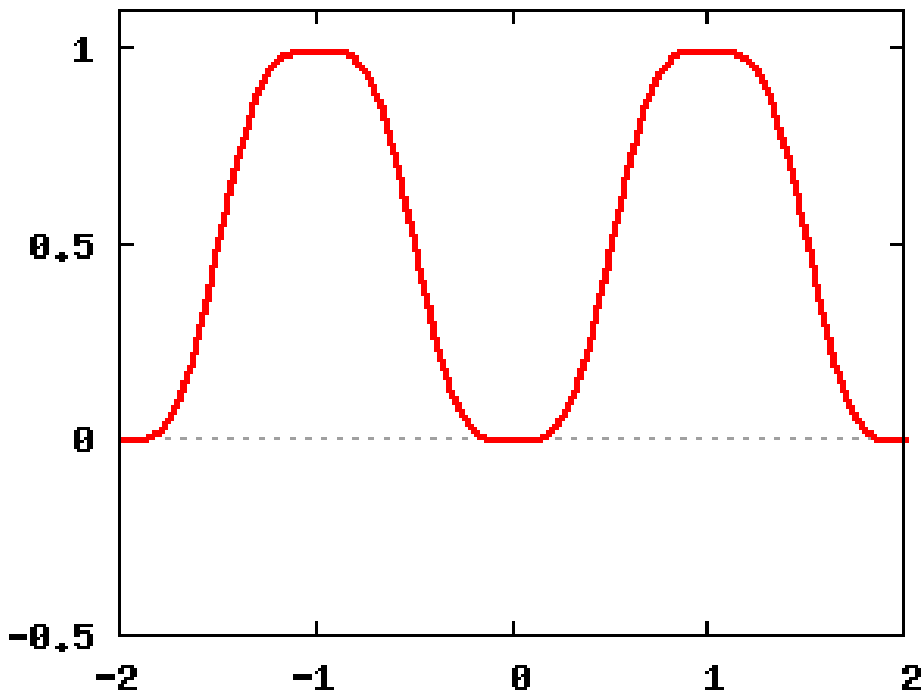
Both end $x = 0.50\text{m}$

$$\theta_x = 2.47 \times 10^{-7}$$

$$< 3.0 \times 10^{-7}$$

Waveform 2: two cosines

$$f(t) = \frac{8}{9} - \cos(\omega t) + \frac{1}{9} \cos(3\omega t)$$



Phasing division ≥ 1

$$x = 2.0\text{m}$$

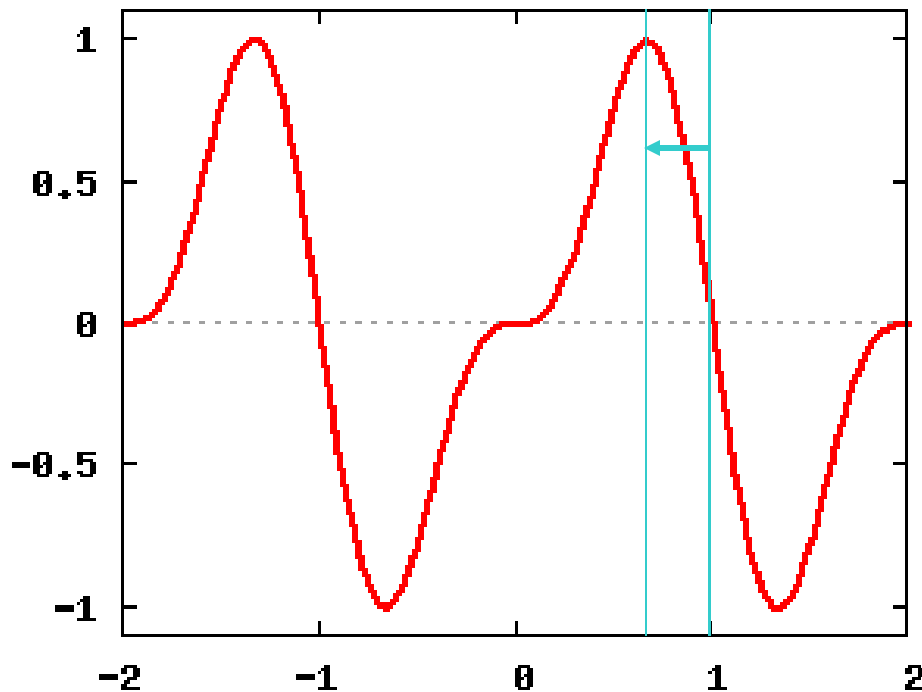
$$\theta_x = 4.65 \times 10^{-8}$$

$$< 3.0 \times 10^{-7}$$

Very stable base.

Waveform 3: sines

$$f(t) = -\sin(\omega t) + \frac{1}{2}\sin(2\omega t)$$



Phasing division ≥ 2

$$x = 1.0\text{m}$$

$$\theta_x = 9.54 \times 10^{-8}$$

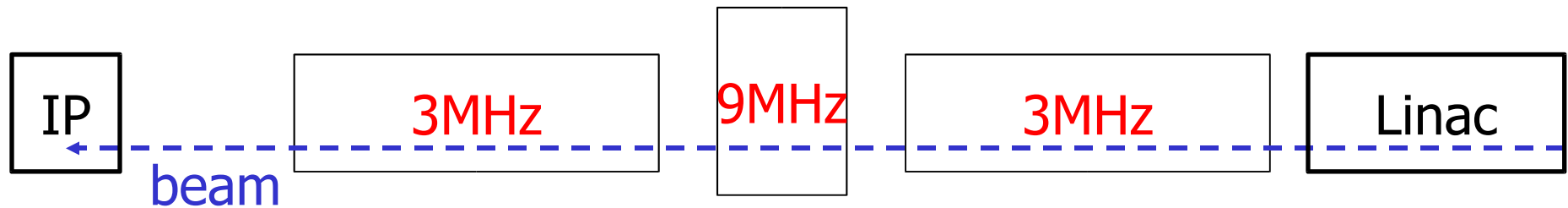
$$< 3.0 \times 10^{-7}$$

No DC System.

Peak Phase changes.



Advantage of sine option

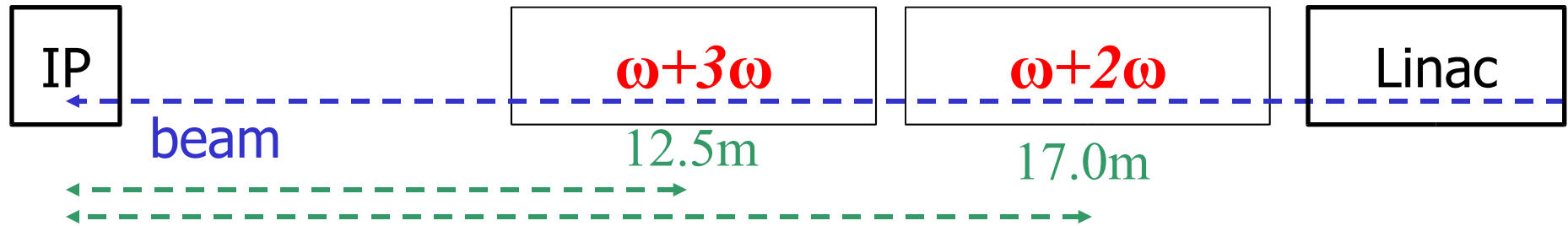


- Can apply the harmonics separately.
- Waveform $\omega+2\omega$ needs 2 groups
→ Separate RF's are useful for

Easier construction & Phasing



Expansion: 500GeV→1TeV



- Kicker's location depends on the harmonics.
→ multiple kickers can distribute.
- Operate 1 kicker for 500GeV
- Operate 2 kickers for 1TeV



RF Stability

- Amplitude jitter $\sim 10^{-2}$ has little effect
- Phase fluctuation is dominant.

for 2 grouped separate RF system,

phase	1×10^{-3}	4×10^{-3}	1×10^{-2}	3×10^{-2}	[rad]
$\omega+2\omega$	1.00	1.15	1.50	3.16	$\times 10^{-7}$ [rad]
$\omega+3\omega$	2.59	2.99	3.89	8.20	$\times 10^{-7}$ [rad]

Phase stability within **10^{-3} rad** is desirable.



Future issue

- More investigation on material for kicker core (FINEMET)
- Investigate for vertical kick by fringing field
- Beam chamber has to be insulator. Shield by thin metal(copper)?