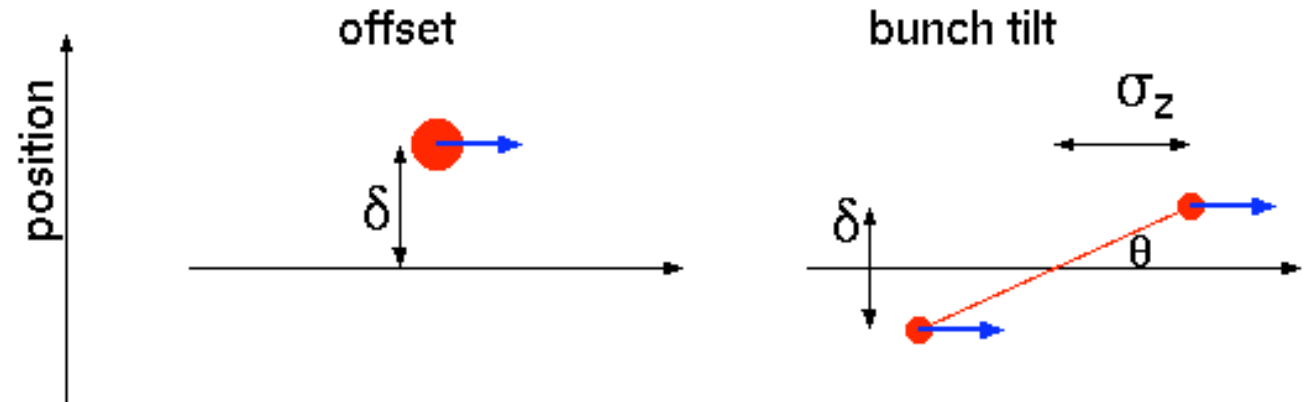


# Signal contamination due to an angle jitter at IP-BPM

- Motivation
  - IP-BPM designed for ATF2 is expected to have angle insensitivity.
  - 1 nm position signal should not be contaminated by 100  $\mu$ rad angle signal
  - To check this is enough?
- Answer to that question
  - OK, if we have more than 2 BPMs, then we are able to separate angle and position.
- Started thinking other effect
  - effect of tilted bunch at a focusing optics.

HONDA Yosuke  
13 Apr. /05  
ILC WG4 meeting

# Review of tilted bunch signal



- refer: slac tilt monitor report
- Tilted bunch (y-z correlation)
- 90 deg. out of phase
- ATF beam
  - bunch length: 8mm
  - cavity freq.: 6.5 GHz
- Same amount of amplitude
  - 1nm offset
  - 0.1 urad tilt

$$V_y(t) = Q\delta\theta\sigma_z \frac{d^2V}{dQdy} \sin(\omega t)$$

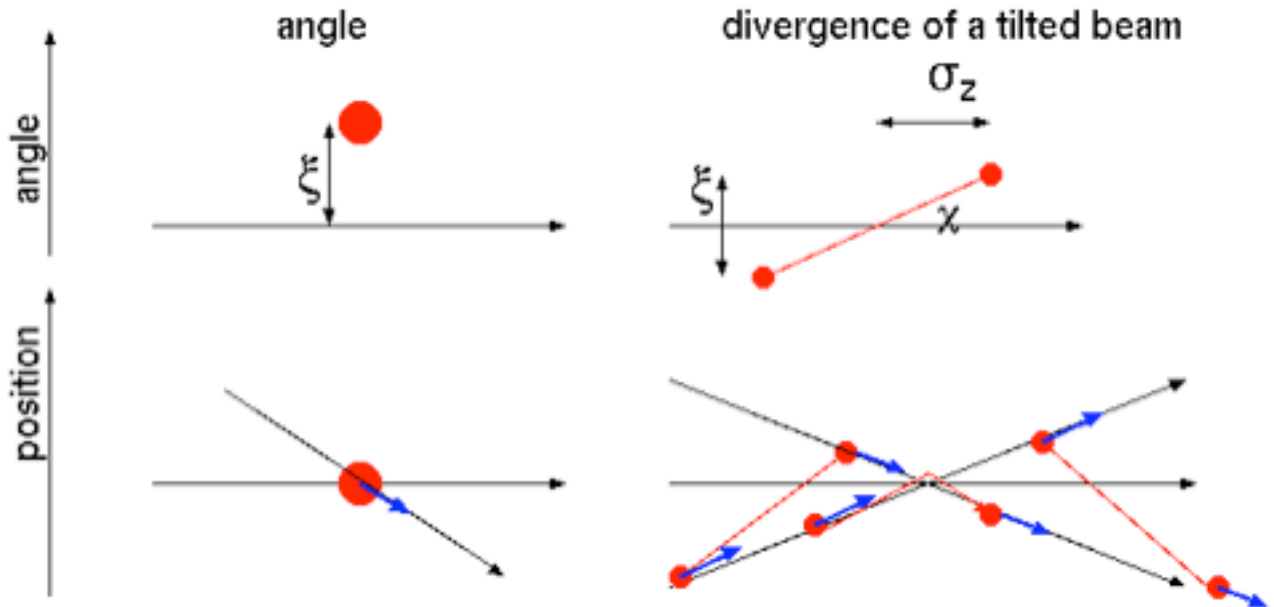
$$V_+(t) = -\frac{Q}{2}\theta\sigma_z \frac{d^2V}{dQdy} \sin(\omega(t + \sigma_z c))$$

$$V_-(t) = -\frac{Q}{2}\theta\sigma_z \frac{d^2V}{dQdy} \sin(\omega(t - \sigma_z c))$$

$$V_t(t) = V_+ - V_- = Q \frac{d^2V}{dQdy} \theta \frac{\omega\sigma_z^2}{c} \cos(\omega t)$$

$$|V_t|/|V_y| = \pi f \frac{\sigma_z}{c} \sim 0.5 \quad (\text{ATF param.})$$

# Tilted divergence signal



- Same kind of thing can be thought in the case of angle-z correlation. (tilted divergence)
- 90 deg. out of phase from beam angle signal
  - beam angle signal is 90deg. out of phase with respect to position signal
  - In phase with position signal.
- Same amount of amplitude
  - 1 urad angle trajectory
  - 0.1 urad/mm angle-z correlation

$$V_a(t) = Q\xi\theta\sigma_z \frac{d^2V}{dQdy'} \cos(\omega t)$$

$$V_+(t) = -\frac{Q}{2}\chi\sigma_z \frac{d^2V}{dQdy'} \cos(\omega(t + \sigma_z c))$$

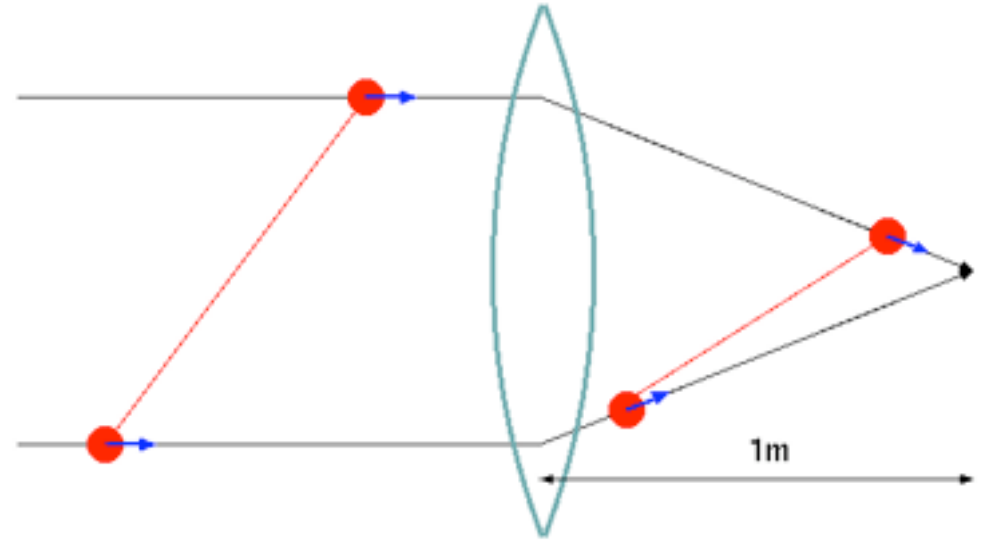
$$V_-(t) = -\frac{Q}{2}\chi\sigma_z \frac{d^2V}{dQdy'} \cos(\omega(t - \sigma_z c))$$

$$V_{td}(t) = V_+ - V_- = Q \frac{d^2V}{dQdy'} \chi \frac{\omega\sigma_z^2}{c} \sin(\omega t)$$

$$|V_{td}|/|V_a| = \pi f \frac{\sigma_z}{c} \sim 0.5 \quad (\text{ATF param.})$$

# Estimation of jitter effect

- 100 urad tilted beam in a normal optics is converted into a 0.1 urad mm angle-z correlation in a focuse optics.
- If IP-BPM has same amout of sensitivity for
  - 1 nm offset
  - 100 urad beam angle
  - (assuming phase detection)
- Assuming not to use phase information
  - 1 nm offset
  - 1 urad beam angle
  - 0.1 urad/mm tilted divergence
- Need to know typical beam tilt jitter in the extraction line.
  - SLAC team may have data.



$$|V_y(\delta = 1nm)| / |V_a(\xi = 100\mu rad)| = 1$$

$$|V_y(\delta = 1nm)| / |V_a(\xi = 100\mu rad)| = 100$$