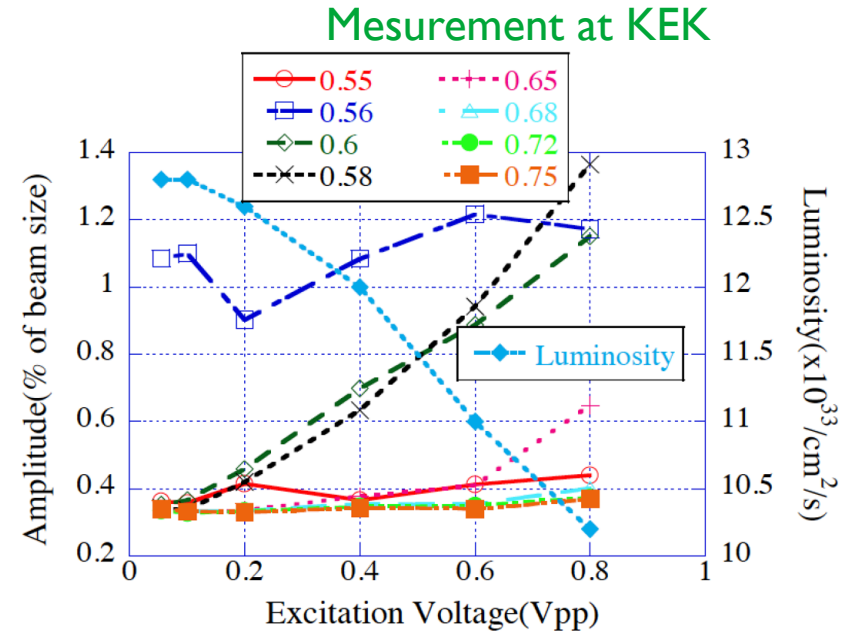
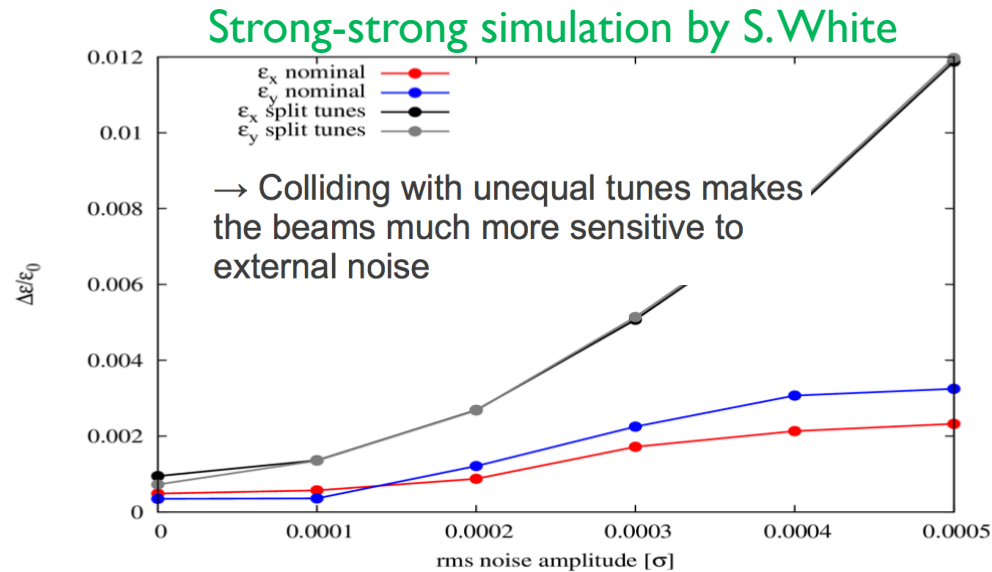


# Comments on BBNoise and E-lens instability

K. Ohmi (KEK)  
BB2013

# Alternative understanding in noise effect



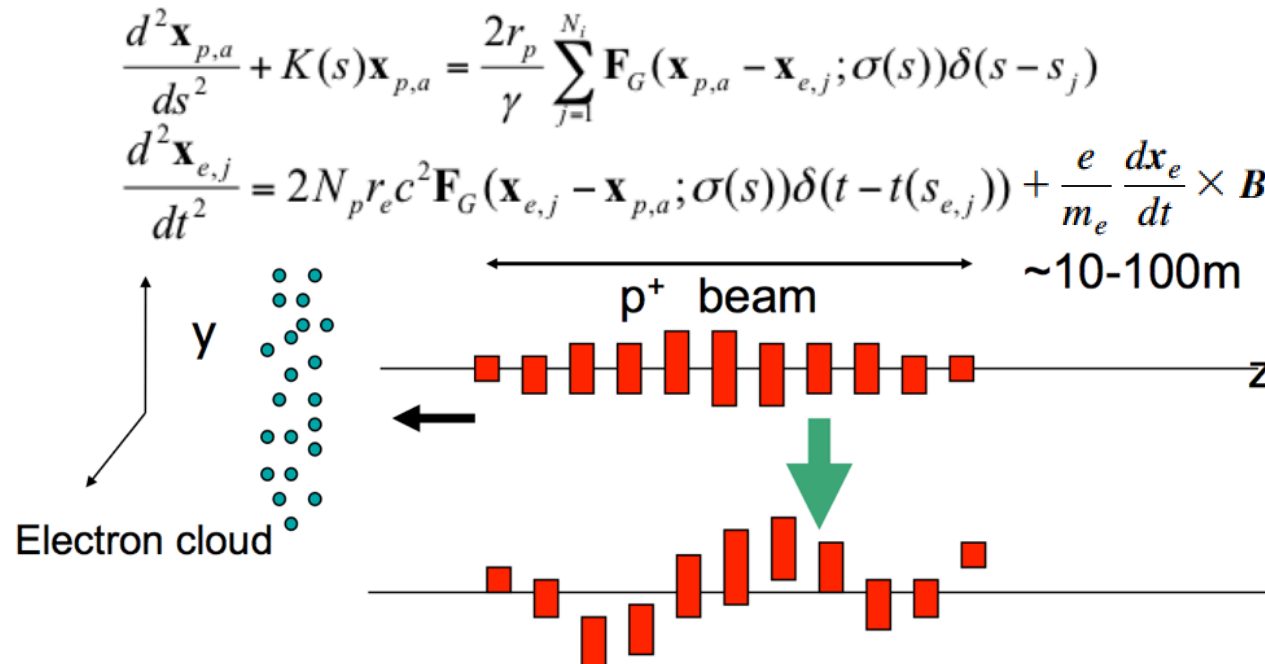
- Unequal tune result seems to fit weak-strong picture. Quadratic increase for noise amplitude .
- In equal tune, white noise induces  $\sigma$  mode, then the amplitude does not contribute emittance growth, results in non quadratic increase.

# Heat-tail instability due to e-lens.

## Tracking simulation

- Solve both equations of beam and electrons simultaneously and **self consistently**.
- Electrons are produced and tracked with the exact initial condition.

A typical ep instability simulation method, K. Ohmi et al., PRST 5, 114402(2002).



# Frequency range of the wake

$$\omega_e = \frac{eB}{m_e} = 2\pi \times 6.6 \times 10^{12} \text{ Hz} \quad B = 6 \text{ T}$$

$$\omega_e \sigma_z / c = 1550 \quad \sigma_z = 0.44 \text{ m}$$

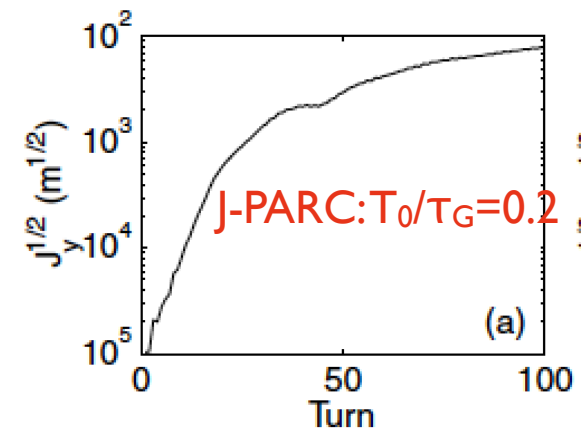
- Stability

$$U = \frac{\sqrt{3}}{\Delta\omega\tau_G} = 1$$

$$\Delta\omega = \omega_e \eta \sigma_{\Delta p/p} = \frac{2\pi\nu_s \omega_e \sigma_z / c}{T_0} = \frac{3.5}{T_0} \quad \nu_s = 0.00036$$

- Unstable  $T_0/\tau_G > 2$

Higher field -> stronger damping



# Analytical formula for the threshold

$$W_1(z) = c \frac{R_S}{Q} \frac{\omega_e}{\tilde{\omega}} \exp\left(\frac{\alpha}{c} z\right) \sin\left(\frac{\tilde{\omega}}{c} z\right), \quad cR_S/Q = \frac{\lambda_e}{\lambda_p} \frac{L}{(\sigma_x + \sigma_y)\sigma_y} \frac{\omega_e}{c}.$$

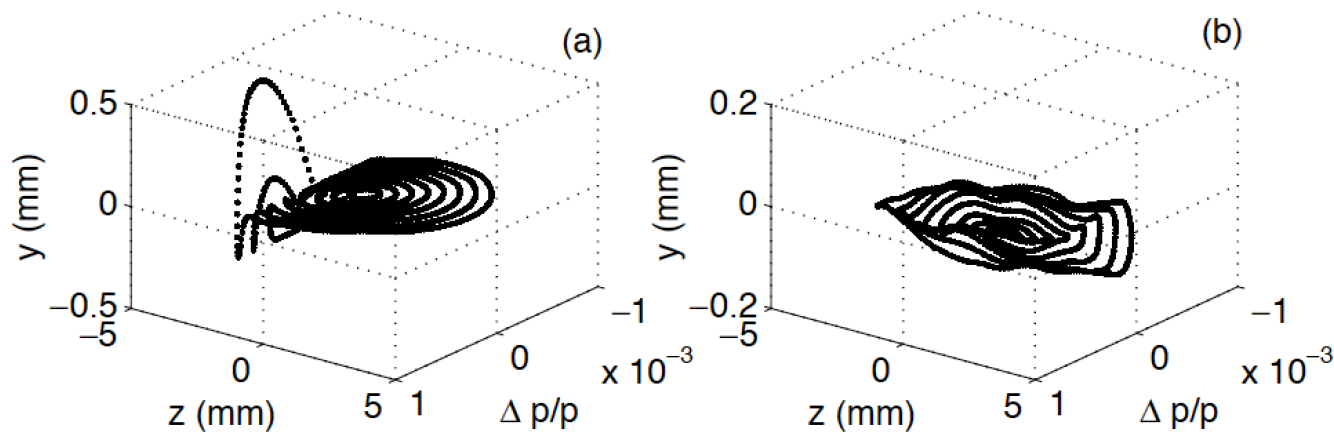
$$\begin{aligned} Z_1(\omega) &= \frac{c}{\omega} \frac{R_S}{1 + iQ(\frac{\omega_e}{\omega} - \frac{\omega}{\omega_e})} \\ &= \frac{\lambda_e}{\lambda_p} \frac{L}{\sigma_y(\sigma_x + \sigma_y)} \frac{\omega_e}{\omega} \frac{Z_0}{4\pi} \frac{Q}{1 + iQ(\frac{\omega_e}{\omega} - \frac{\omega}{\omega_e})}, \end{aligned}$$

The shape of the wake is different, but the stability should be similar in the order of magnitude.

$$U \equiv \frac{\sqrt{3}\lambda_p r_p \beta \omega_0 |Z_1(\omega_e)|}{\gamma \omega_e \eta \sigma_{\delta E/E} Z_0}$$

# Another method

- Simulation using multi-circular distribution in longitudinal phase space.
- Landau damping due to the slippage is taken into account automatically. But I feel the result is inaccurate for high  $\omega_e \sigma_z / c = 1550$

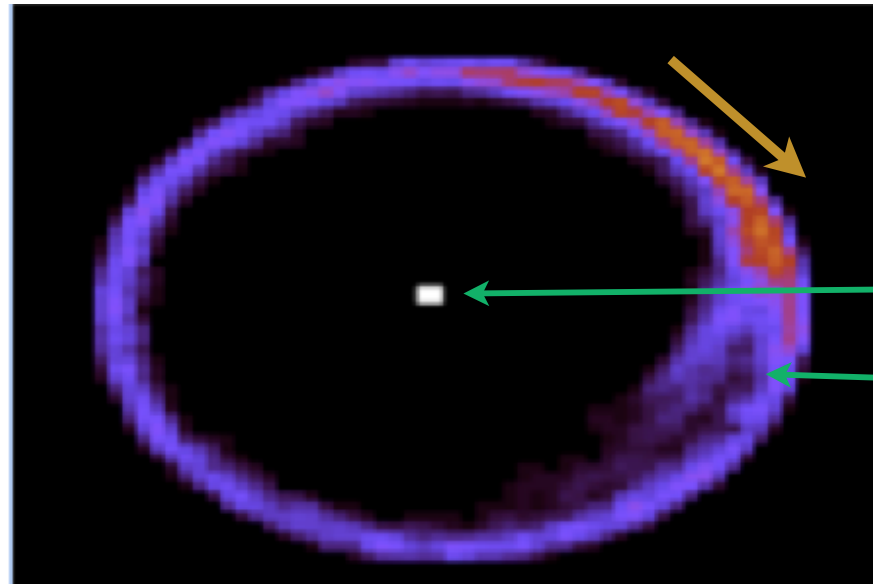


K. Ohmi, F. Zimmermann, PRL85, 3821 (2000)

# Complete PIC like PEHTS/HEADTAIL

- Very hard for  $\omega_e \sigma_z / c = 1550$

# Slow mode related to EB drift



Transverse plane

Beam

Electron cloud rotating  
around the beam

- Frequency depend on macroscopic radius of electron motion  $\bar{r}$ .

Rotate around beam

$$\omega = \frac{r_e \lambda_p c^2}{\omega_e \bar{r}^2}$$

- Can the motion be coherent?