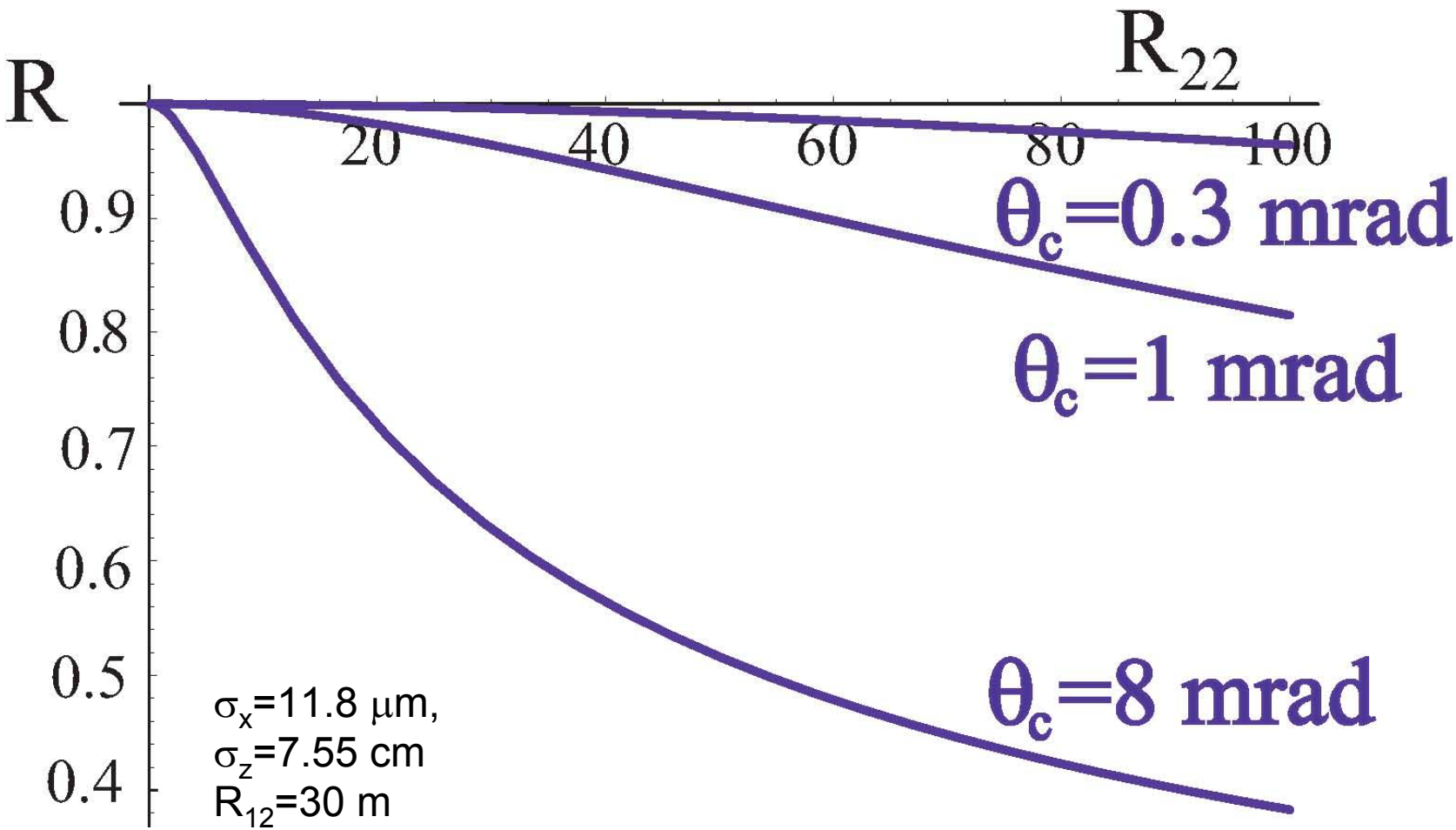
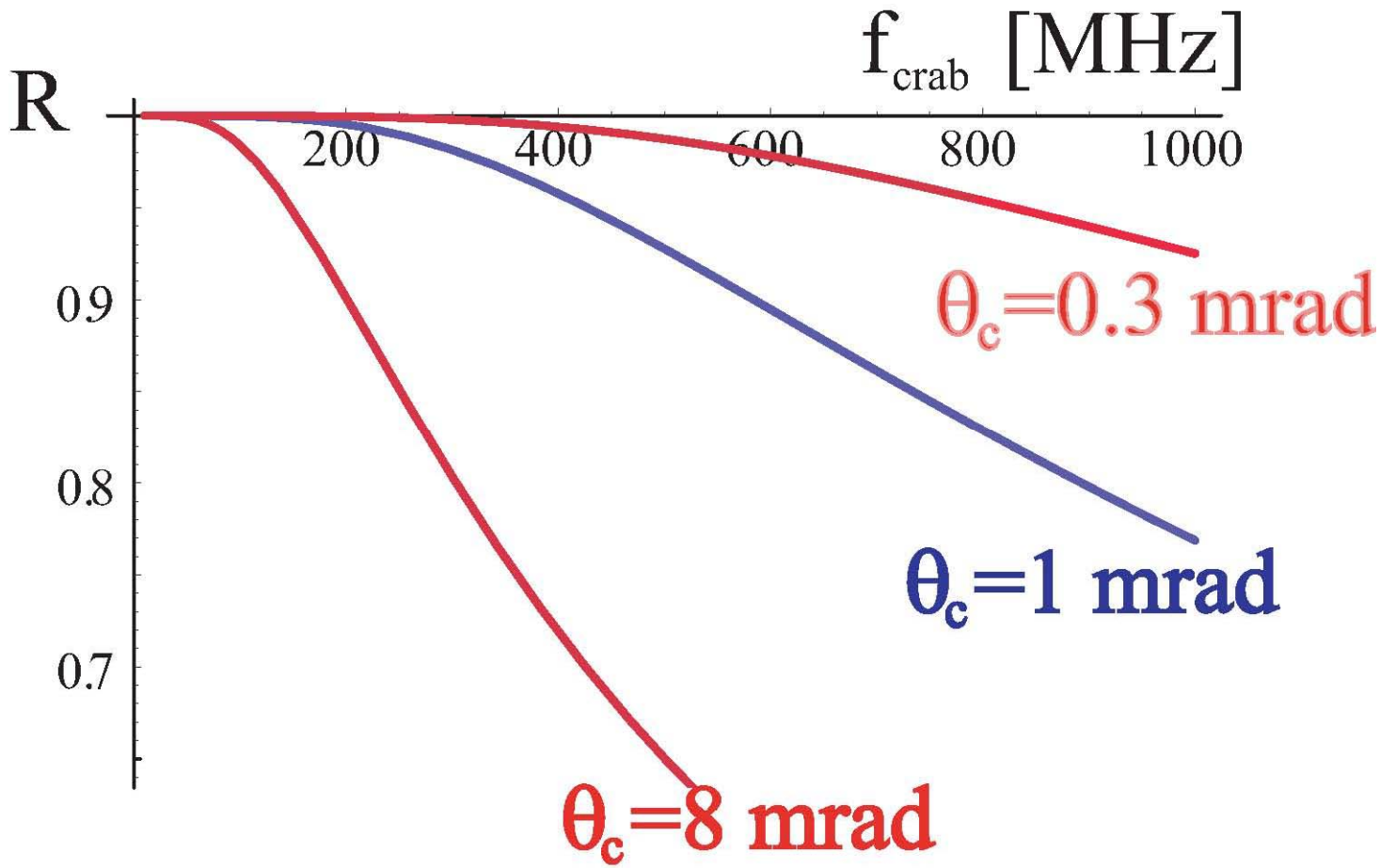
effect of R_{22} from crab cavity to IP

$$R \equiv \frac{L}{L_0} = \frac{|R_{12}|\sigma_x \cot(\theta_c/2)}{2R_{22}\sigma_z^2\sqrt{\pi}} \exp\left(\frac{R_{12}^2\sigma_x^2\cot^2(\theta_c/2)}{8\sigma_z^4 R_{22}^2}\right) K_{1/4}\left(\frac{R_{21}^2\sigma_x^2\cot^2(\theta_c/2)}{8R_{22}^2\sigma_z^4}\right)$$



effect of crab cavity frequency

$$R \equiv \frac{L}{L_0} = \frac{\sqrt{1+\cos\theta_c}}{\sqrt{2\pi}\sigma_z}\int_{-\infty}^{\infty}\exp\left(-\frac{s^2(1+\cos\theta_c)}{2\sigma_z^2} - \frac{\sin^2(\theta_c/2)(-k_c s+\sin(k_c s))^2}{k_c^2\sigma_x^2}\right)ds$$



diffusion rate due to crab phase noise

$$\sigma^2 \approx \sigma_0^2 + DN$$

$$D_{Simulation} \approx 1.4 \times 10^{-3} (\Delta x)^2$$ Ohmi

$$D_{1D-theory} \approx \frac{1}{2} \frac{\beta^2}{\sigma^2} D_{Sen-Zorzano} \approx 3 \times 10^{-5} (\Delta x)^2$$

with correlation time 100 turns,
for the nominal LHC

emittance growth from noise

including decoherence & feedback (Y. Alexahin):

$$\frac{1}{\varepsilon}\frac{d\varepsilon}{dt} \approx f_{rev}\frac{1-s_0}{4}\frac{(\Delta x)^2}{\sigma_x^2}\frac{1}{\left(1+\frac{g}{2\pi|\xi|}\right)^2}$$

g~0.2 feedback gain, ξ~0.01 total beam-beam parameter, s_0~0.645 related to the fact that only a small fraction of the energy received from a kick is imparted on the continuum eigenmode spectrum

1% emittance growth per hour

$\leftrightarrow$ Δx=1.5 nm with feedback

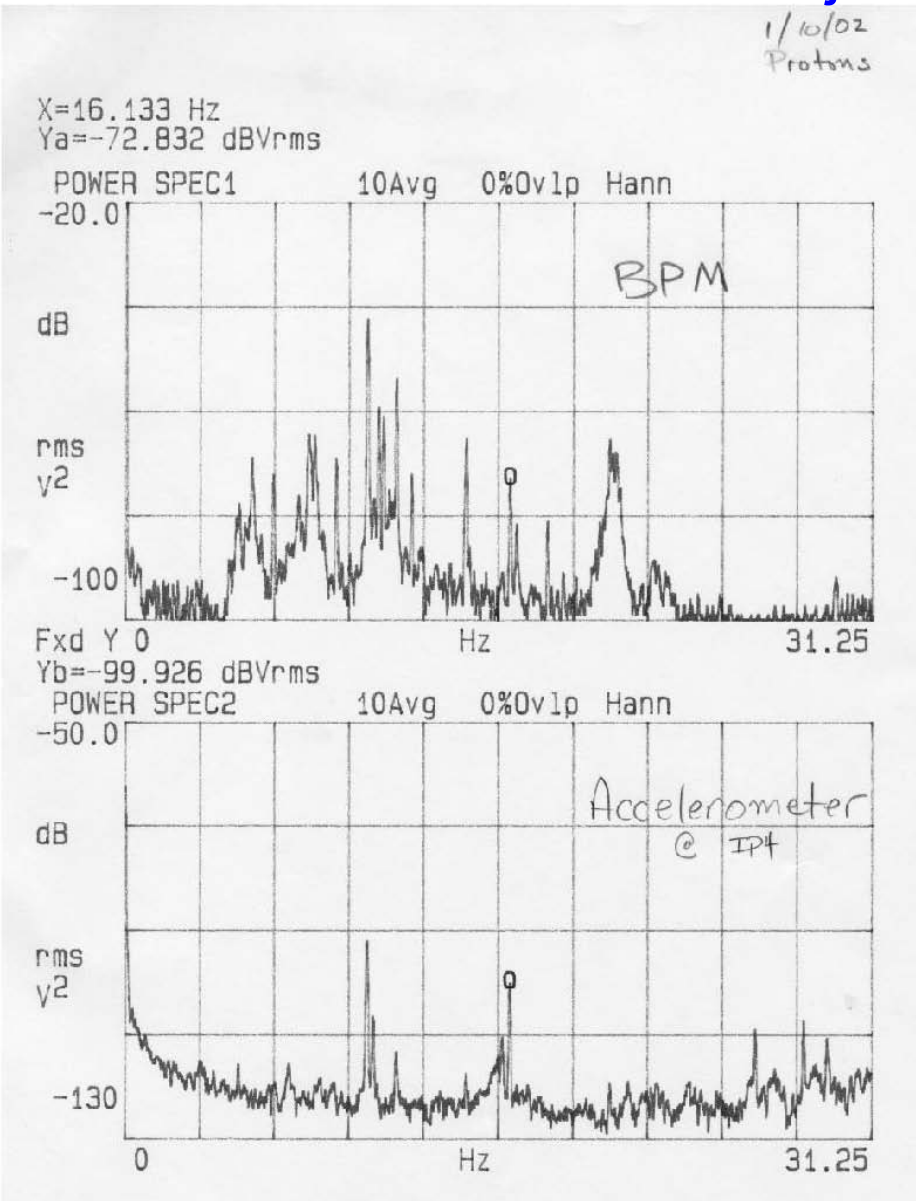
$\leftrightarrow$ Δx=0.6 nm w/o feedback

Spectra of horizontal beam and triplet motion (IP 4 triplet):

Nanobeam'02

Christoph Montag

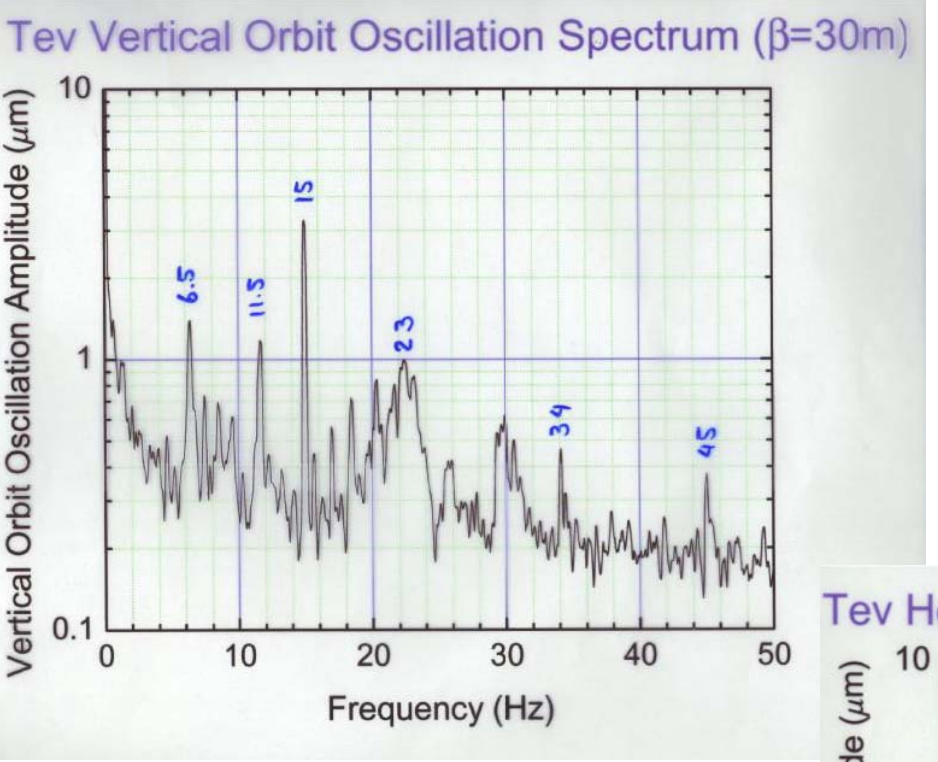
RHIC beam jitter & magnet vibrations



IR triplet vibrations have been identified as source of beam motion around 10 Hz

vibration of cold masses within the cryostat at ~10 μm level rather than vibration of triplet as a whole

modulated beam-beam interaction causes emittance growth at start of each store



Nanobeam'02

Vladimir Shiltsev

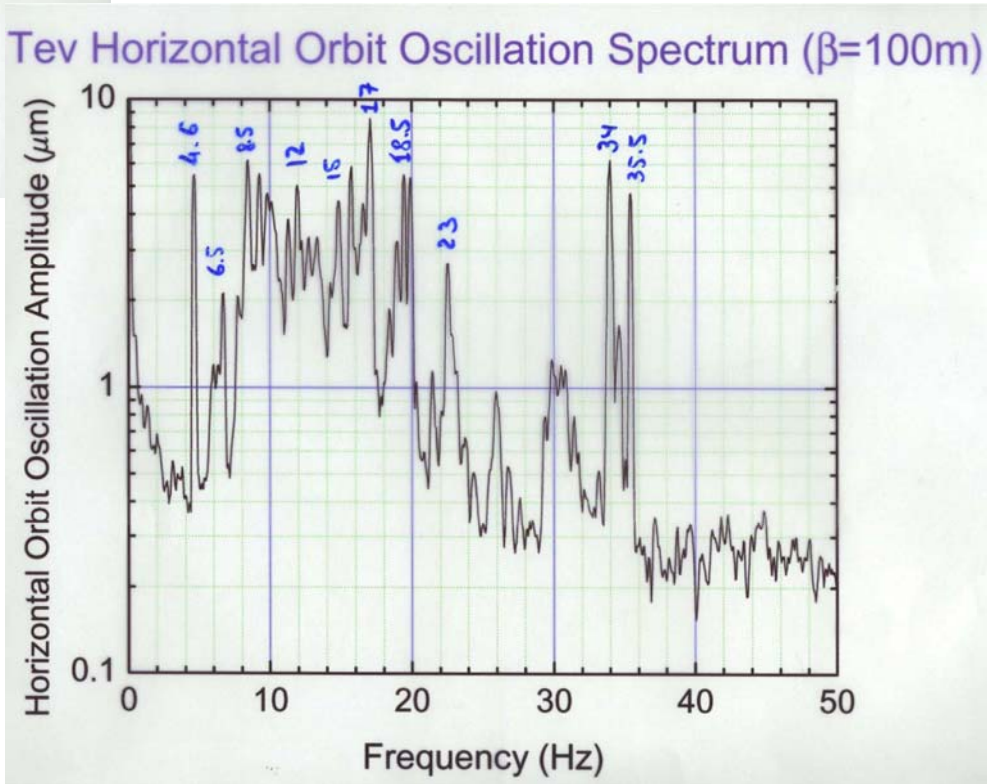
Tevatron fast beam motion

low-β quad vibration frequencies

-CHL compressors

-stand resonances

beam/quad amplitude >10



should we initiate a measurement of vibration levels in an LHC low-β quadrupole?