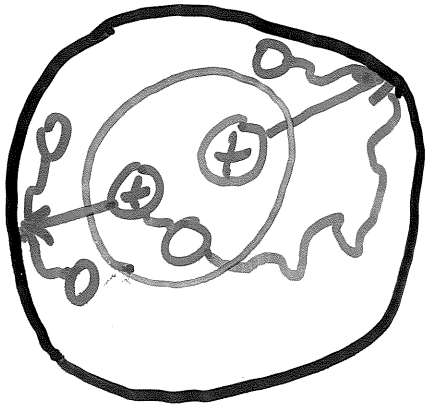
Pressure Rise Workshop

J. Y. Zhang T. Roser BNL

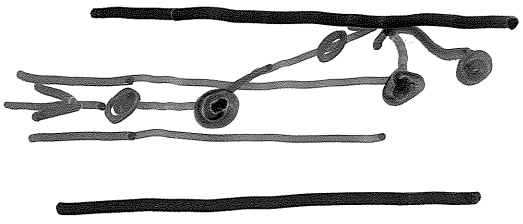
ISR vacuum instability



$$\frac{\partial P}{\partial t} = \frac{P_0 - P}{\tau} + P \sigma I \eta(I)$$

ionization ↑ secondaries

how energy HI



AGS Booster
LEAR
SIS

ecloud

electron ion desorbtion η_{EI}

baking helps (RHIC)

solenoids for ecloud

scrubbing rate for η_{EI}

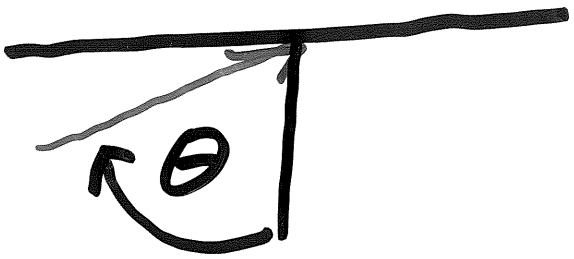
vs

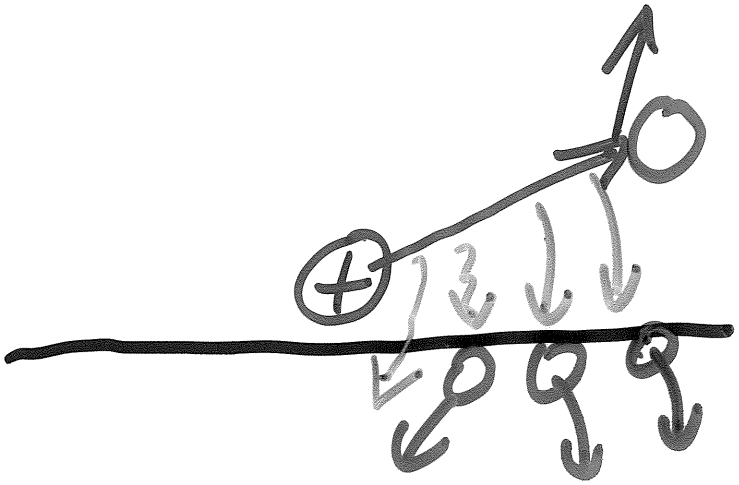
scrubbing rate for η_{EE}

η_{EI} drops more quickly

radiation hardness

$\eta_{EI}(\theta)$

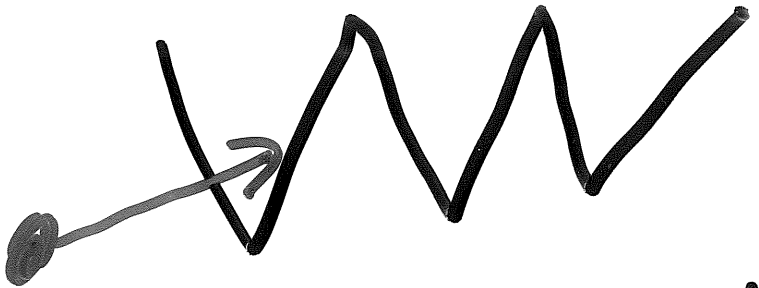




$\frac{dE}{dx}$

For RHIC and comparable γ the equilibrium charge state is fully stripped

$(\gamma-1)m_e c^2 >> E_{1S}$



How important?
VS
wash + bake

For $\theta \approx \pi/2$

$$\eta_{EI}(\theta) \sim 10^{5 \pm 2}?$$

$$\eta_{EI} \stackrel{?}{=} \eta_{EI}\left(\eta_{EE}, \theta, \frac{dE}{dx}, \ldots\right)$$

$$\ldots = \frac{d\theta^2}{ds}, E_{IS},$$

roughness

$\vdots$

Need an RMP level reference.

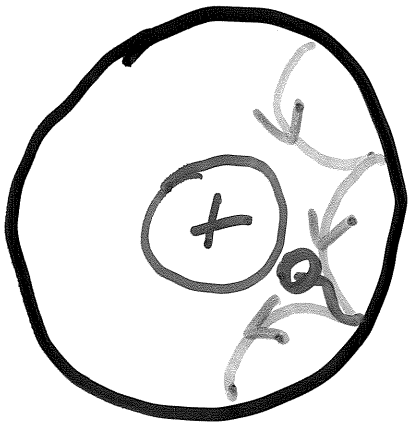
cure via cleaning with e^-, sputtering ions

EC Retrospective

K. C. Harkay

Z_{EI} and "Wakes" + produce bad beam diagnostics can be less sensitive (wire scanners)

Solenoid resonance

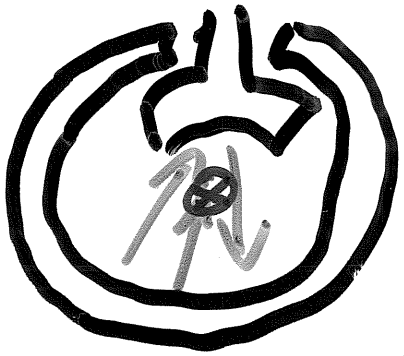


good for instability
what about ΔP?
Helps in RHIC (some)

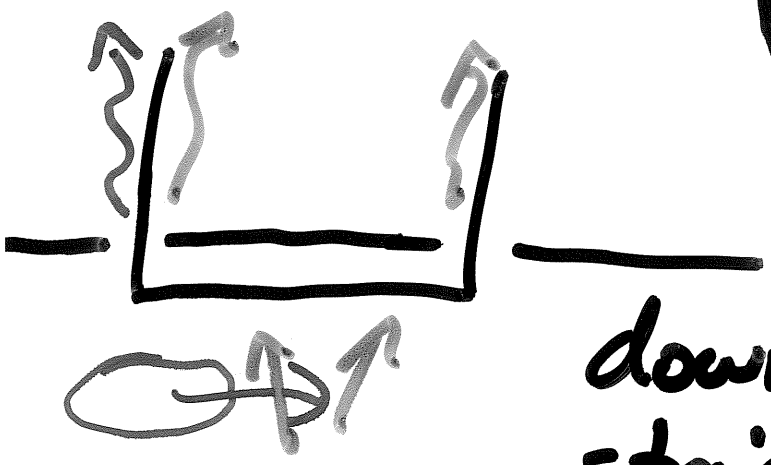
$J_{wall}(E_e)$ is standard output.

Diagnostics

Volunteers: ΔP, IPMs
wire scanners, BPMs
Don't forget Gauss' Law
with BPMs.



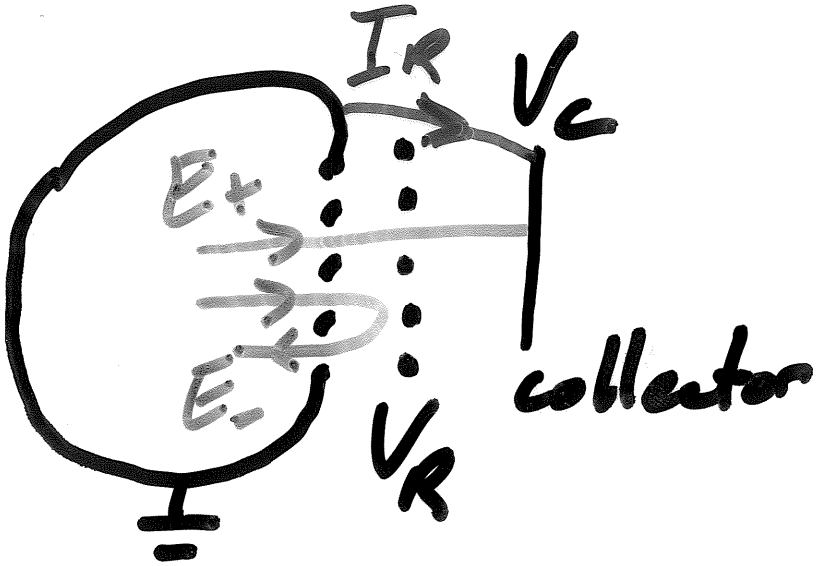
no net charge exchange.



downstream
stripline signal?
P. channel

Dedicated Diagnostics

Retarding field analyzer



Calibration!

RFA + extraction field

= Sweeper PSR

can put in a quad (planned)

ϵ_C decays during gaps

$\gamma \sim 170$ ns in PSR

low energy reflectivity + energy of electrons

Electrons in quads Banana orbits → long life

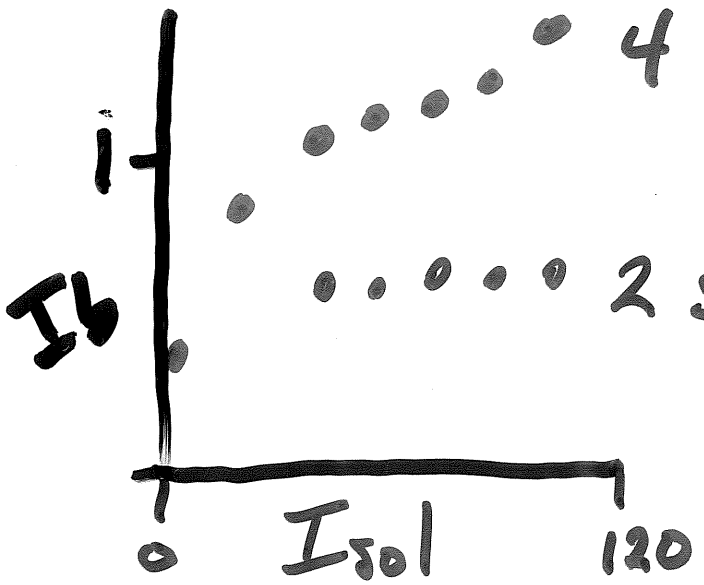
For instabilities need the whole coherent force

ECs in KEKB

H. Fukuma

vertical emittance growth in LER (e^+) beyond a threshold current

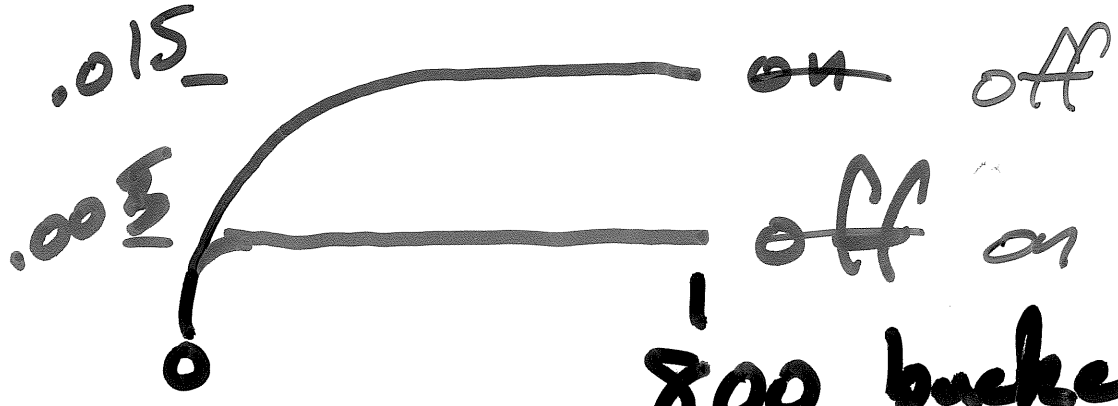
good results using weak solenoids. Puzzles remain



Do we know why?

coherent tune shift

$$\Delta Q_y = \frac{r_e}{2\gamma} \oint \beta_e \beta_y ds$$



How big are the detuning wakes?

$$A_{z,\text{coherent}} = (x^2 - y^2) \int_0^z W_z I ds$$

↑ at trailing particle

Generalized basis #

Precise cloudland sims ⟹ big fields coherent .VS. incoherent

For 4 bucket spacing the coherent tune shift saturates with solenoids at 50% emittance blowup still present at 100% Is

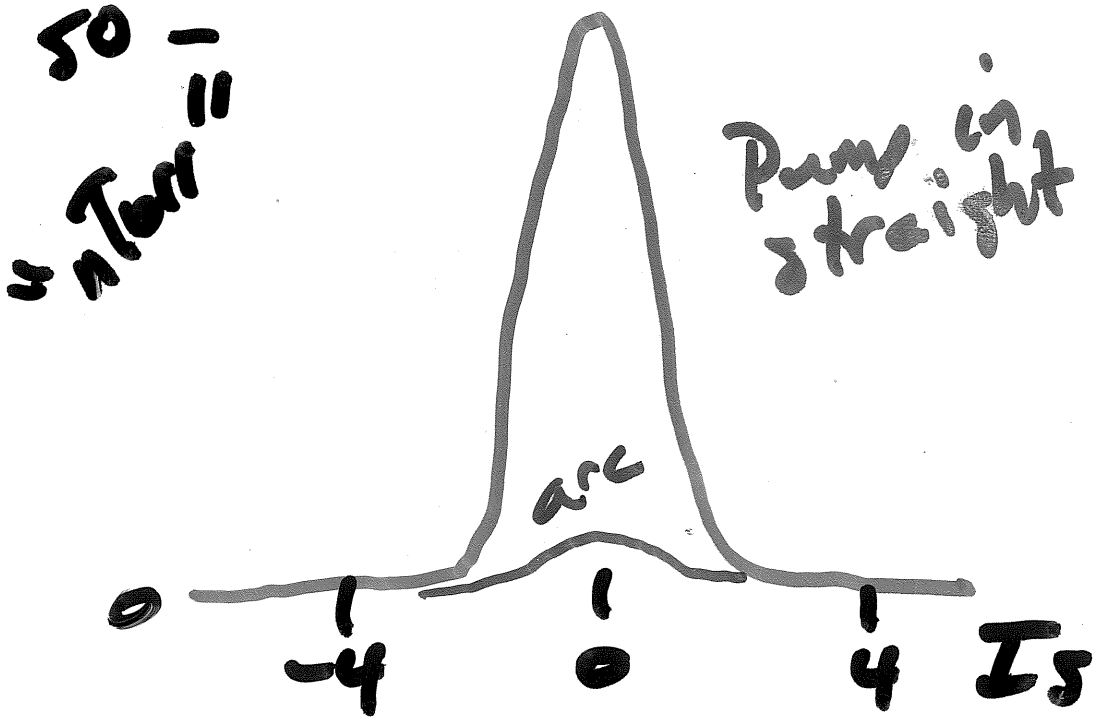
⇐ Effect of wigglers is interesting. More work planned.

Beam blowup could be single bunch head-tail

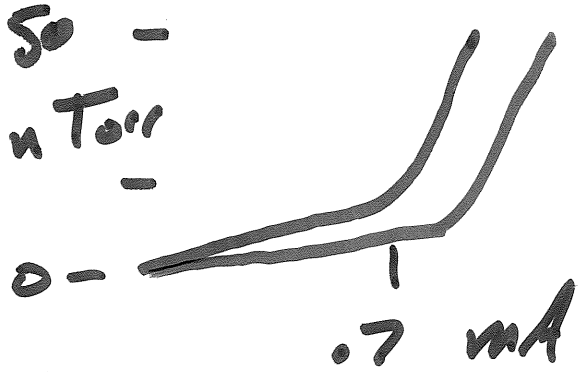
Streek camera data might show the effect, but hard to tell.

A. Kulikov PEP II

2.1 A = $\bar{I}$



nonlinear pressure rise in straights



different locations show different thresholds (RHIC)

emittance blowup in long bunch trains correlated with ΔP

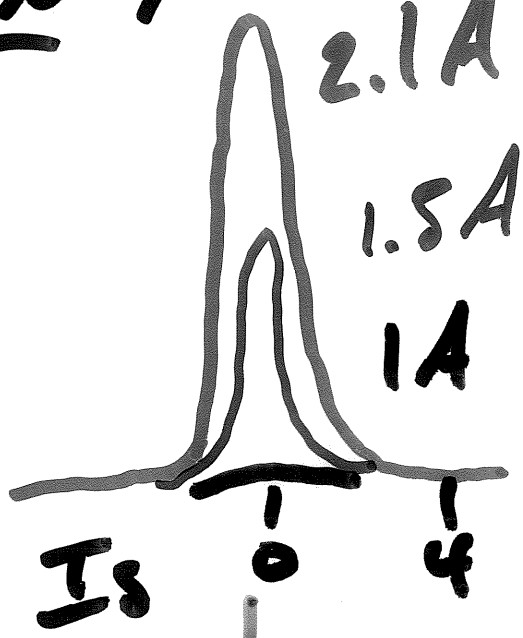
solenoids help

wind wind wind

- 50 nTorr @ 1 A 2/00
- 5 nTorr @ 1.5 A 10-03

very clear multipacting threshold

$2.4\ \mu A/cm^2$



threshold I_s linear in I_b

Things look OK now

ECs in BEPC

M. Furman for J.Q. Wang

Electron cloud is linear in the beam current (γ_s)

Energies up to 50 eV?

Solenoids help the vertical instability, and reduce E_V

50 -0
:
40 -1
0

:
600V

Voltage on button bpms shows a reduction in vertical size

large momentum aperture

$0 < \xi_{x,y} < 8$

$\xi = 1.8$ stabilizes the bunch train

A single octupole can damp as well multipacting could be a problem for BEPC II

Antechamber under design using simulations

Get $P_e \Rightarrow P_e/5$ for optimal dimensions

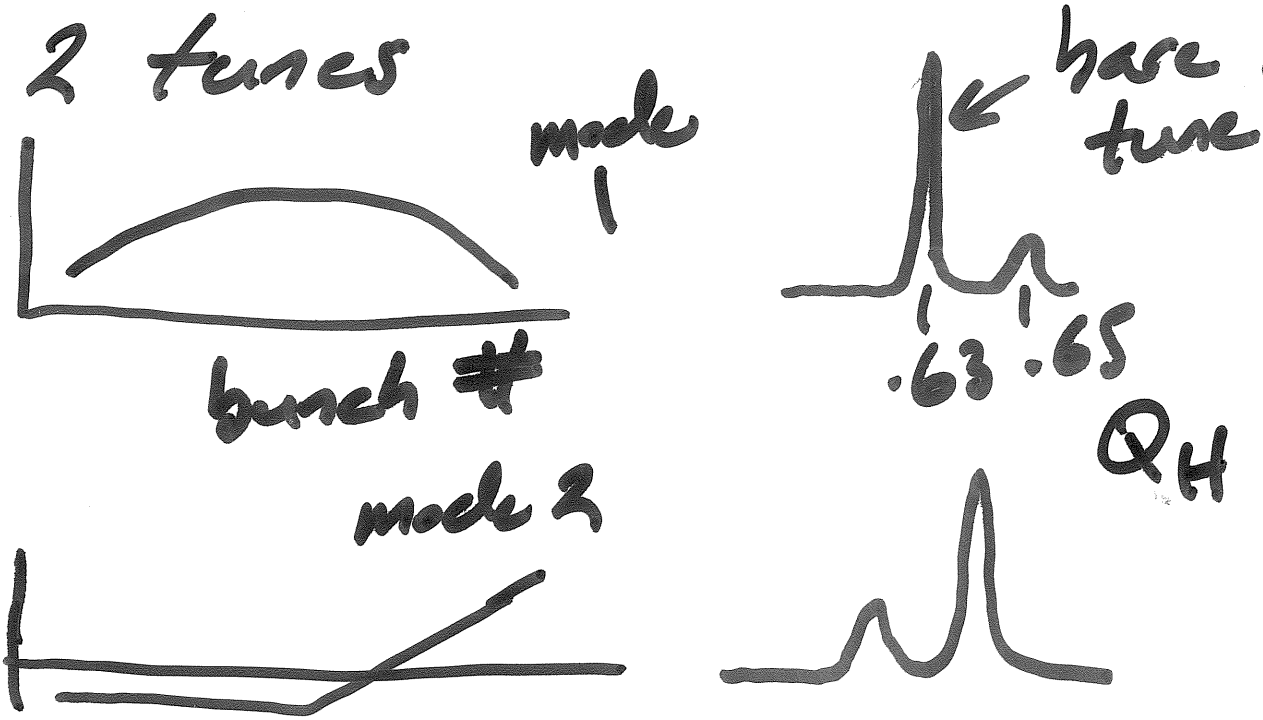
Observations in PS
and SPS G. Arduini

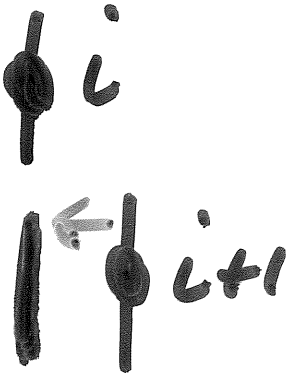
dynamic pressure rise
to 10^{-8} bar with 2-3E10
p/bunch

SEM monitor in PS → SPS
transfer will be replaced
with new device (transition radiation)
SPS shows
blow-up in ε_V and ε_H
tail bunches @ end of train
show losses
Horizontal blow-up correlates
with a coupled bunch instability
vertical with single bunch

threshold intensity for EC is smaller in the arcs than in the straights

SVD analysis shows 2 tunes



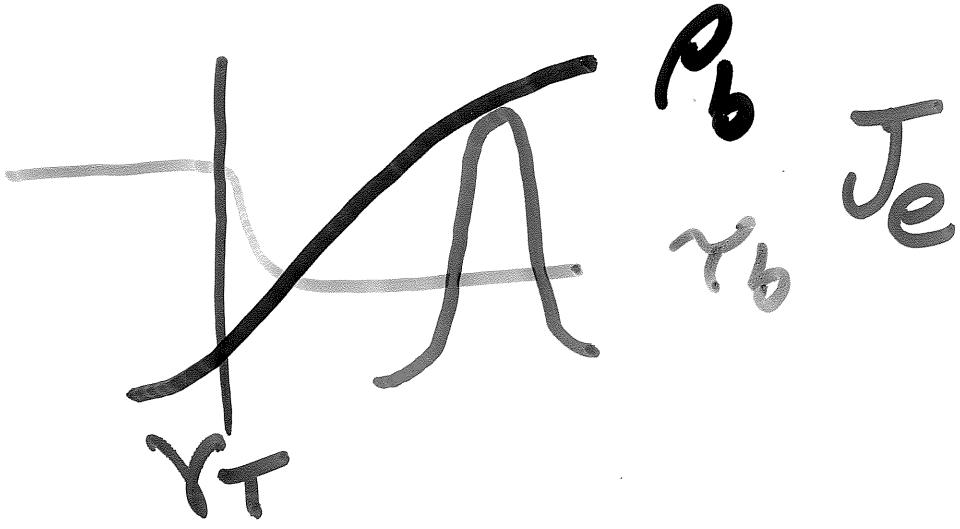


$$F^{i}_{i+k} = (x_i - x_{i+k}) \rho_i \Delta t$$

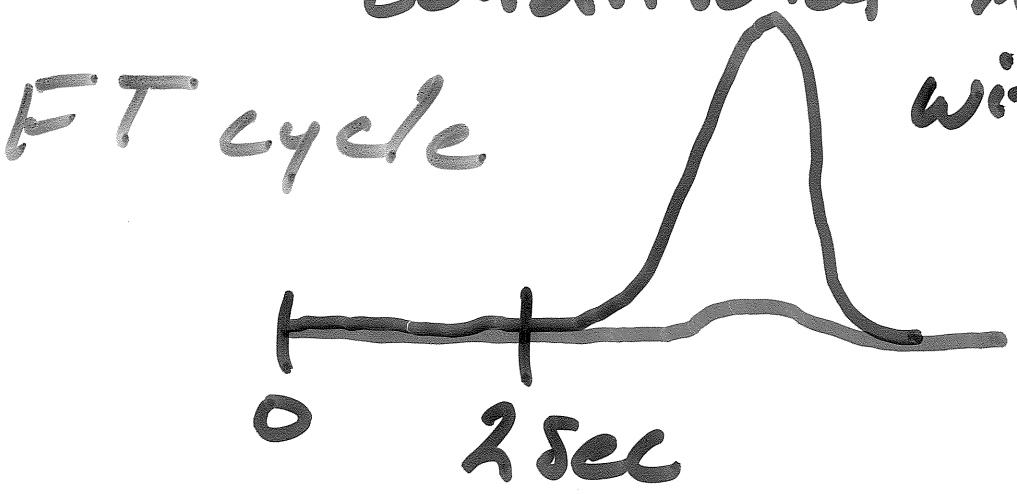
linear approx breaks down above threshold

Vertical instability
shows no sign of correlation
single bunch

For off normal operations
the PS shows EC instability
higher intensities could be
a problem
Fixed target operation
in SPS is novel
unconditioned machine



conditioned machine



$$2\,\text{sec} * \sqrt{\frac{2 \times 1\,\text{eV}}{m_e}} = 10^6\,\text{meters}$$

single species plasmas have much better confinement properties than neutral plasmas but other effects could be present.

Partial damping by transverse feed back.

Slow (1000 turn) single bunch remains

cures

TFB for CBM

octupoles (symmetry?)

$\xi \sim .5 \rightarrow 1$

Scrubbing Helps.

asymptotic behavior of SEY reduction always leaves a little.