Parameter Group. Tuesday.

Morning

K. Bane Wakes in the pre-injectors

M. Woodley Lattice file. MAD ⇔ SAD.

Afternoon Joint session with Structure Group.

G. Stupakov Structure alignment tolerances

P. Tenenbaum New smoothing algorithm of alignment

PT & K. Bane Second order effects

R. Jones Decoupled modes near downstream end.

Discussion on

- Phase slip due to frequency errors
- Vaccuum requirement

K. Bane Pre-injector Wakes

short-range wake --- no effects

long-range ..... Not negligible.

Cure is not easy because

bunch-to-bunch distance / λ is small.

Possible cures

- Detuning. To reduce wake amplitude by 1/50,
  $\sigma_f = 16\%$ (Gaussian)
  $\Delta f = 10\%$ (uniform)
  } S-band.
- Zero crossing $W(t)$
  Has to shift f_1 by $\sim 2\%$ ---- not easy
  → acceleration mode other than $2\pi/3$?
- Heavy damping
  $Q \leq 18$ (S). ≤ 9 (L) (1.4 nsec)

M. Woodley Lattice File Conversion

Lattice conversion between MAD and SAD.

Needed and should be possible.

→ Meeting in Thursday morning

G. Stupakov Alignment Tolerances

Short-range wake

random structure-to-structure

16 μm (rms) → 100% $\Delta\mathcal{E}_y$ ⇐ budget

5 μm → 10%

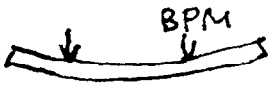
Long-range

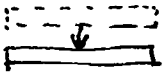
tilt angle-wake effect

random str-to-str 80 μrad → 10% $\Delta\mathcal{E}_y$.

3 structure girder → $\frac{80}{\sqrt{3}} = 45$ μrad.

Structure bow



Effects smaller than 

by factor 0.083..

Girder bow

No effects (both short & long range) in the first approx.

some effects due to $L \not\propto \beta$

P. Tenenbaum "French Curve" Correction

Divide the linac into N sections

- Standard apply correction in each section
- French curve half-section overlapped

Do not use correctors
→ Use quadrupole movers

- Better even with large mover step size.
- Convergence with fewer iterations.

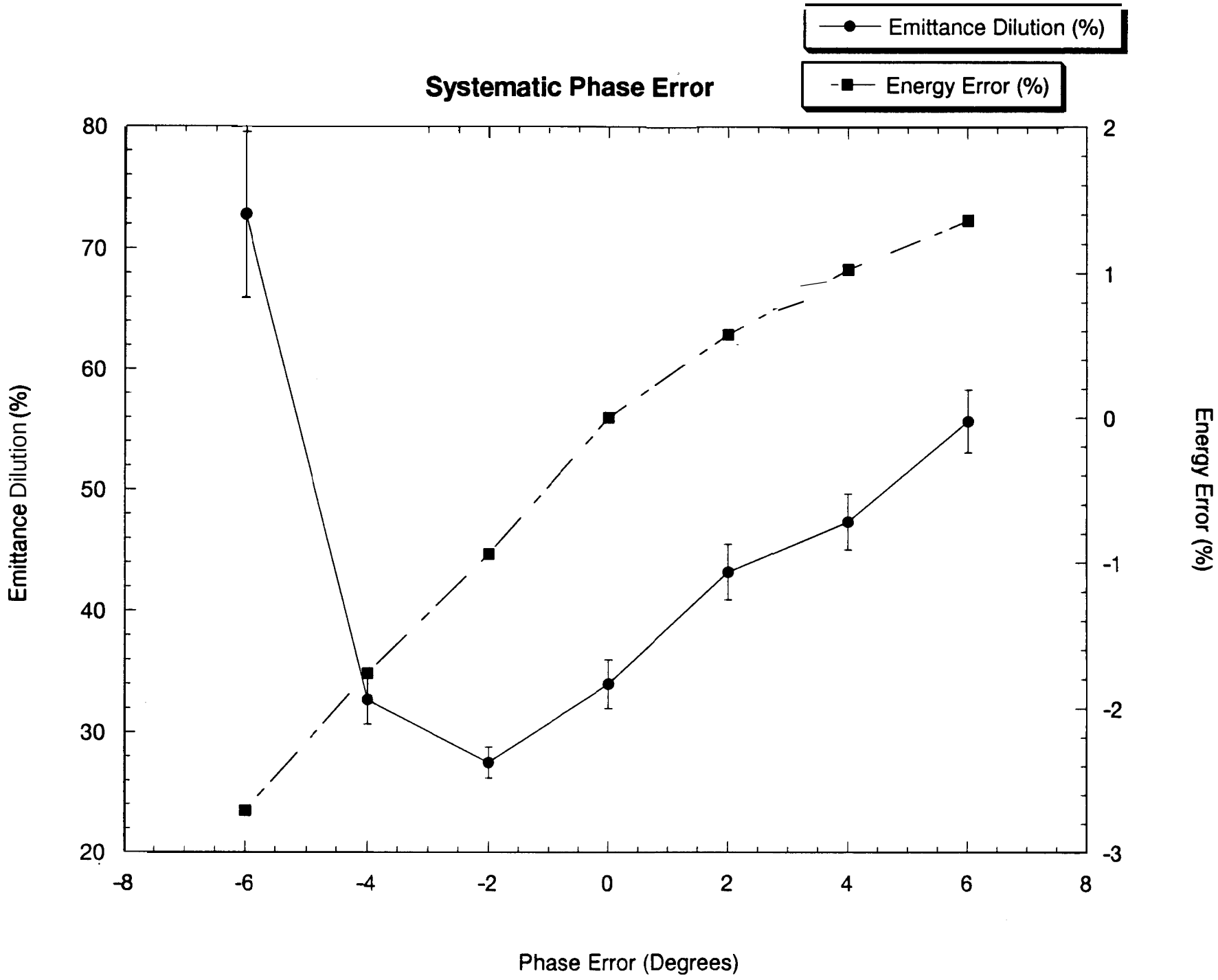
- Structure-BPM resolution should be $\lesssim 5\mu m$

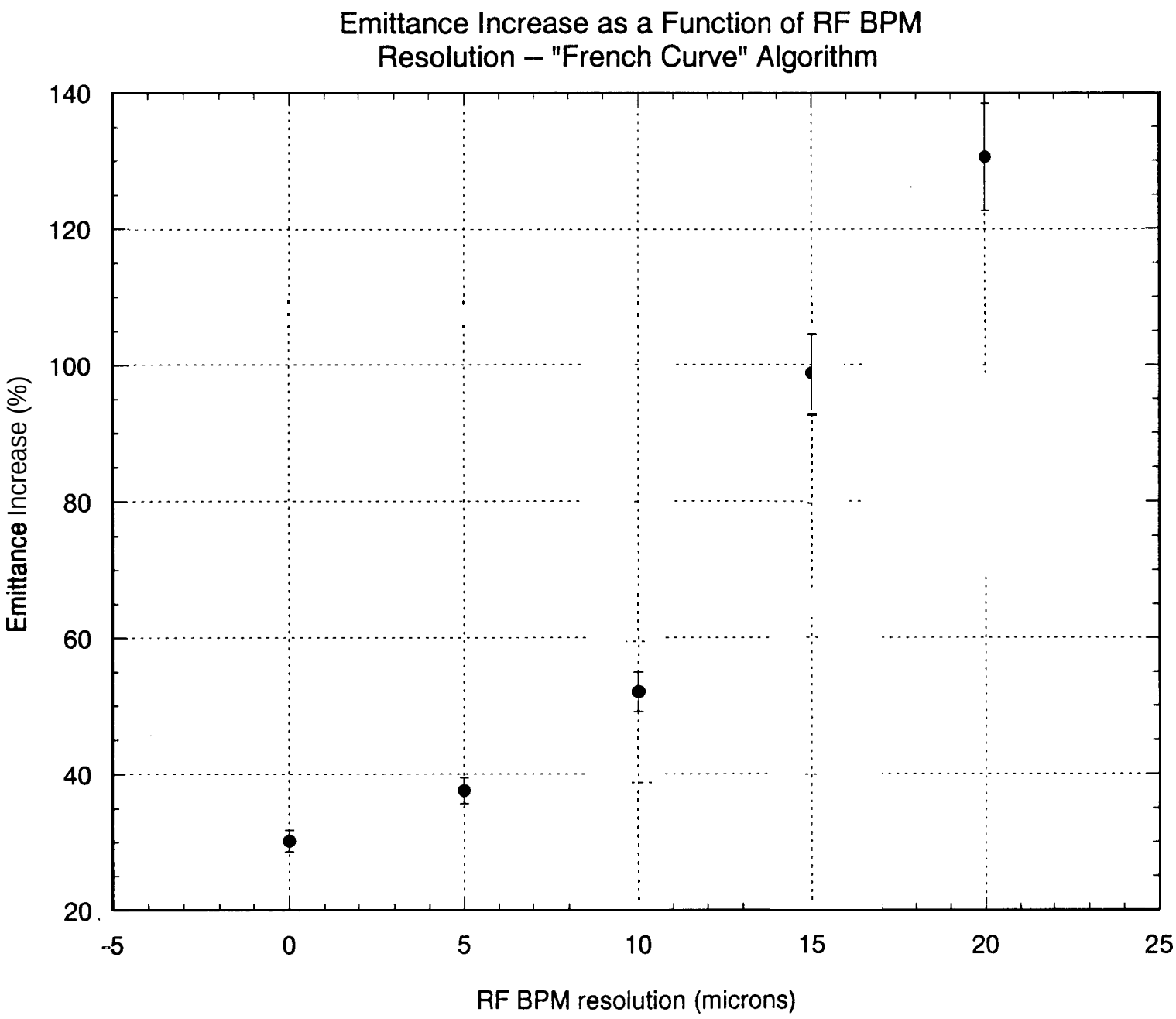
- Alignment under ATL motion.
  French curve is more effective.

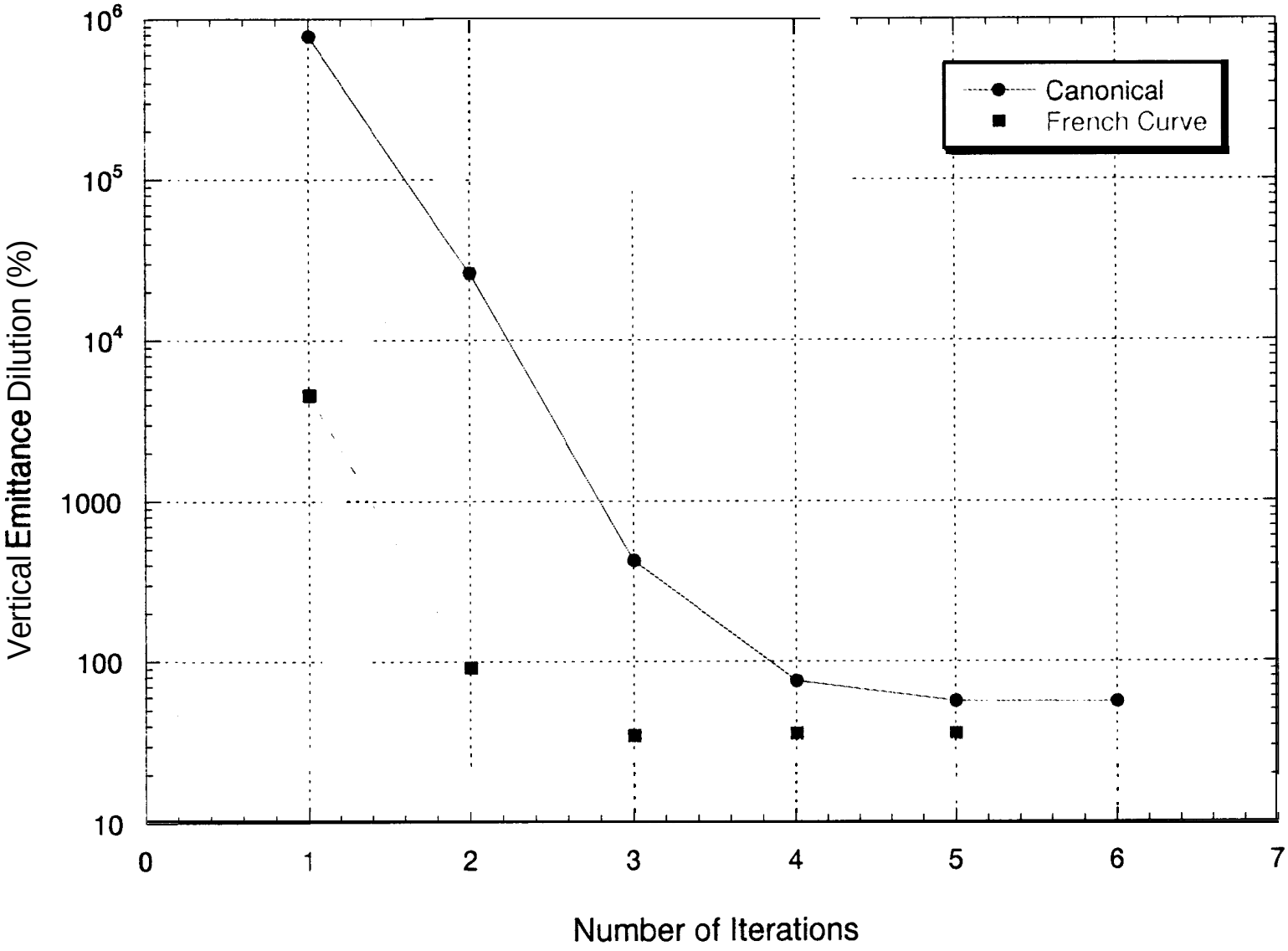
PT & KB. 2nd Order Effects

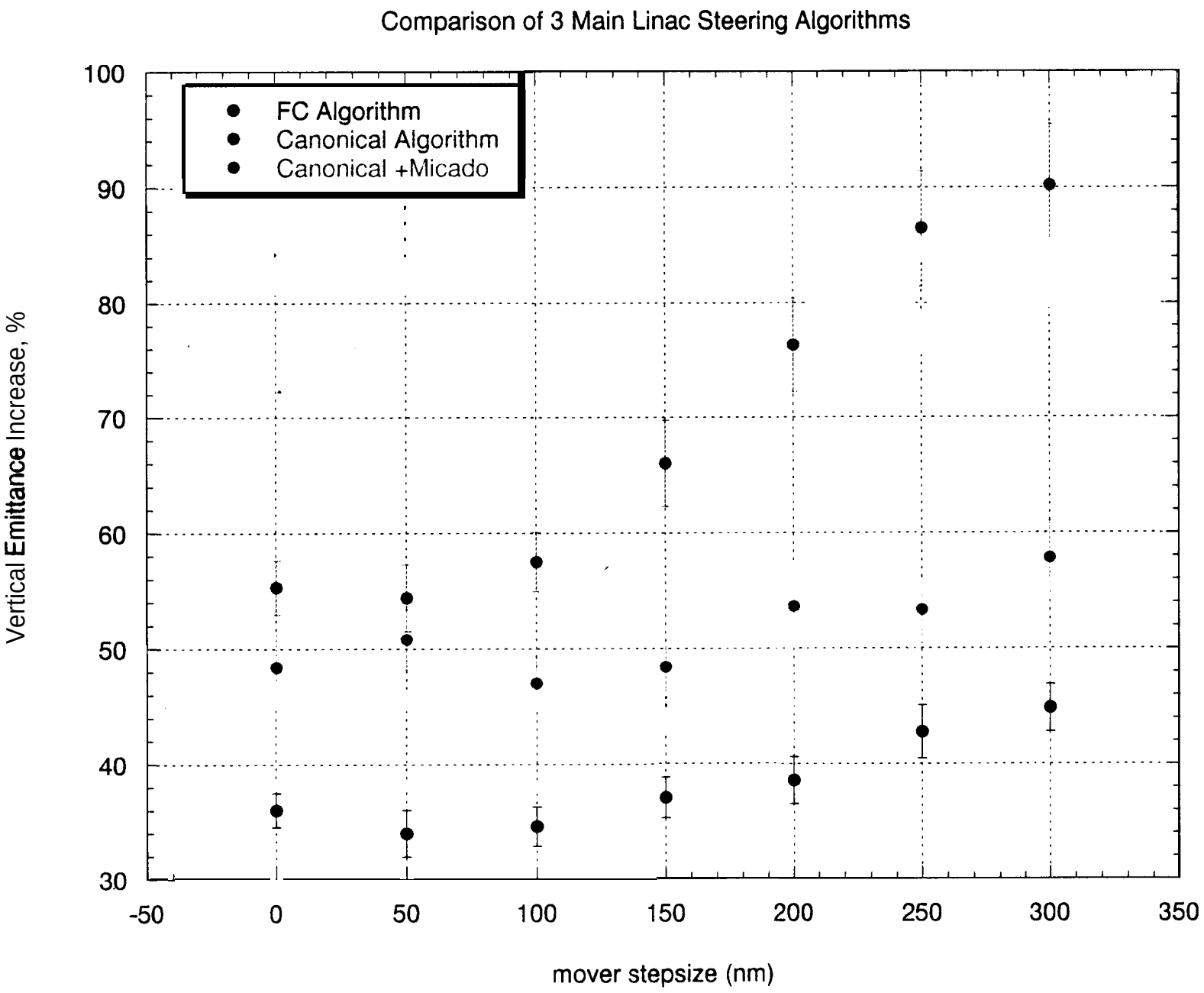
	systematic	random.
gradient error, rf phase, charge (single bunch)	Only systematic ⇒ final ΔE is tight.	
bunch length	---- ΔE_y small.	±20% OK.

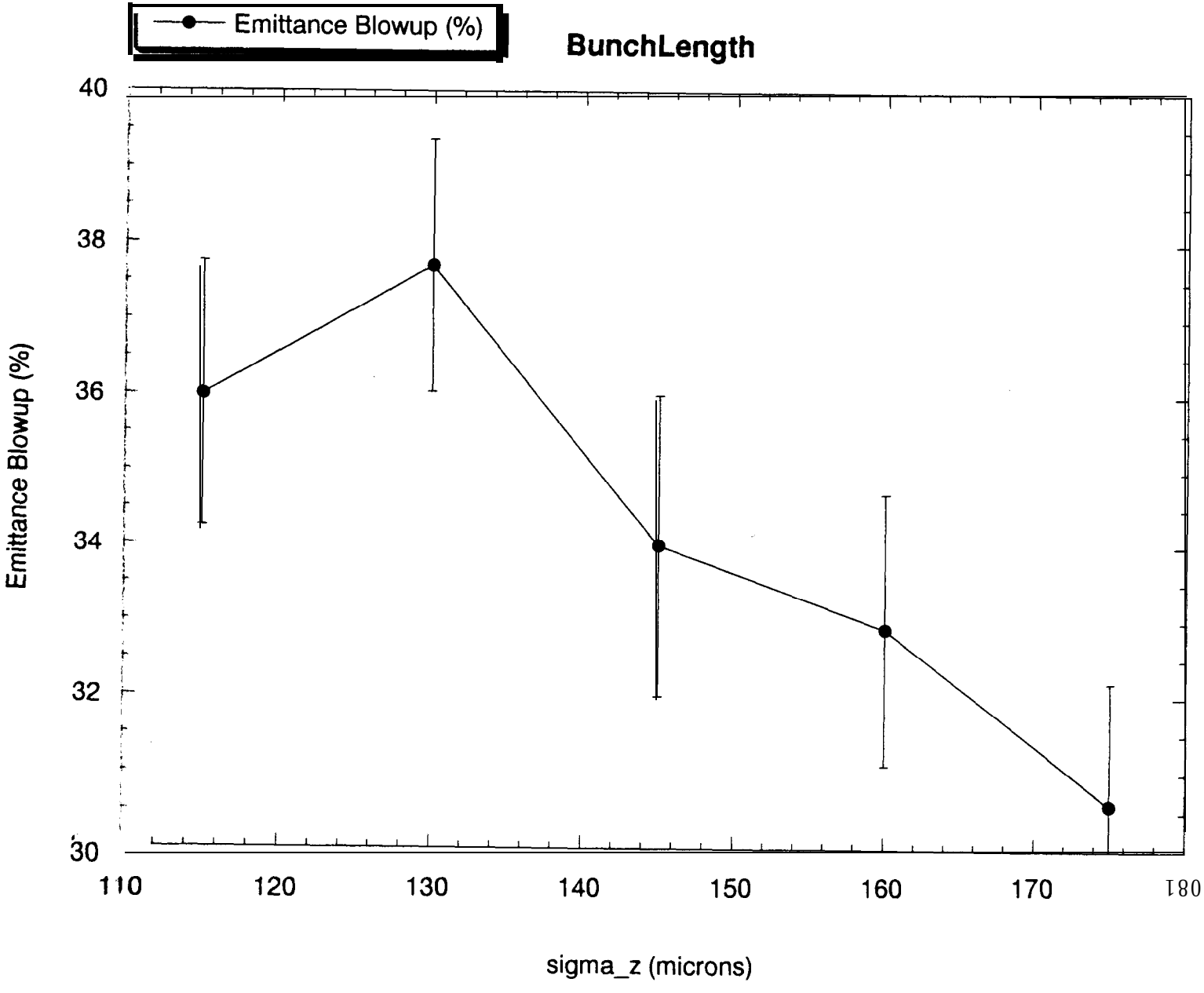
Many other items. Still going on.


Systematic Phase Error
Emittance Dilution (%)
Energy Error (%)
Emittance Dilution (%)
Energy Error (%)
Phase Error (Degrees)
80
70
60
50
40
30
20
2
1
0
-1
-2
-3
-8
-6
-4
-2
0
2
4
6
8


Emittance Increase as a Function of RF BPM Resolution -- "French Curve" Algorithm
Emittance Increase (%)
140
120
100
80
60
40
20
-5
0
5
10
15
20
25
RF BPM resolution (microns)


Canonical
French Curve
Vertical Emittance Dilution (%)
10^6
10^5
10^4
1000
100
10
0
1
2
3
4
5
6
7
Number of Iterations


Comparison of 3 Main Linac Steering Algorithms
FC Algorithm
Canonical Algorithm
Canonical +Micado
Vertical Emittance Increase, %
100
90
80
70
60
50
40
30
-50
0
50
100
150
200
250
300
350
mover stepsize (nm)


Emittance Blowup (%)
BunchLength
40
38
36
34
32
30
Emittance Blowup (%)
110
120
130
140
150
160
170
180
sigma_z (microns)

Requirements to PreLinac, BC2, ...

$\epsilon_x = 3 \times 10^{-7}$ m.rad

at stage 2.

$\Delta\epsilon_x$ of ~20% acceptable

Main Linac

much better if it accepts

$\epsilon_x \ll 3 \times 10^{-7}$

(by Laser cooling)

Xing angle

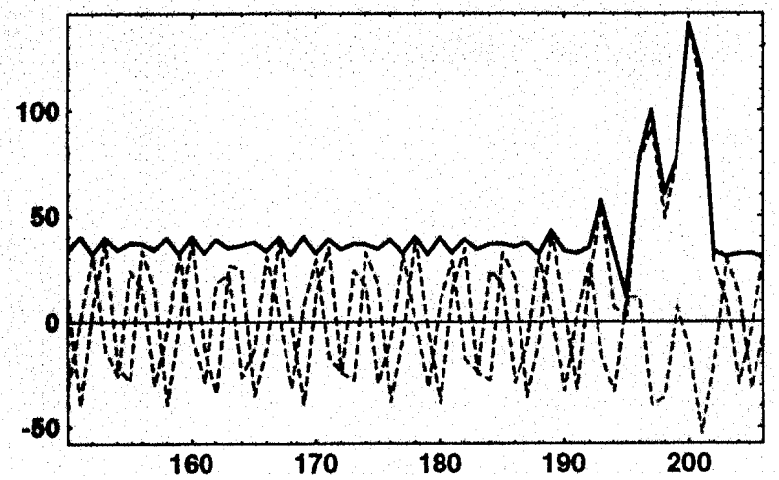
$\phi \sim 30$ mrad (crab)

· Compatible with e^+e^- ?

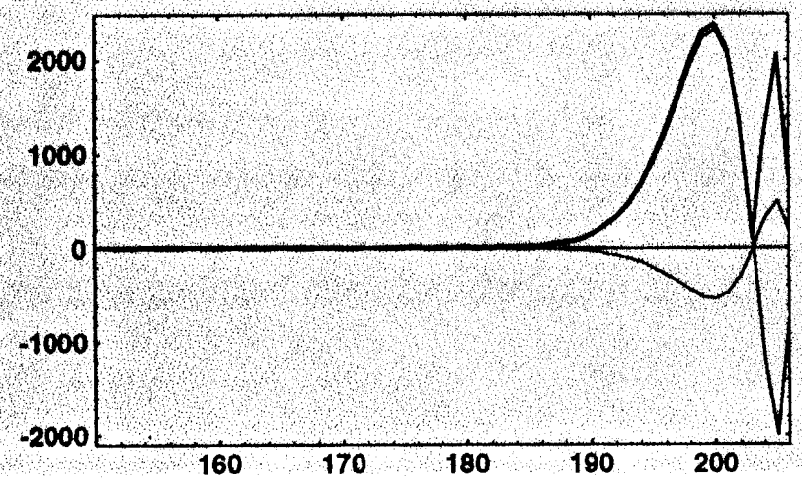
R. Jones Decoupled Modes

- DDS1 has 4 cells decoupled from the manifold.
- High Q modes exist. $Q \sim 16\,000$.
- Cause BBU though $|W(t)|$ is not too large. Resonance between high Q and bunch-to-bunch distance. $\Delta\varepsilon_y$ is reduced when
  - the mode is artificially eliminated
  - or bunch distance slightly changed.
- Not seen in ASSET (long distance needed)
- Cures (Q must be $\lesssim 1000$.)
  - lossy materials near last cells.
    - cavities
  - change geometry. couple all cells and introduce lossy material in the manifold.

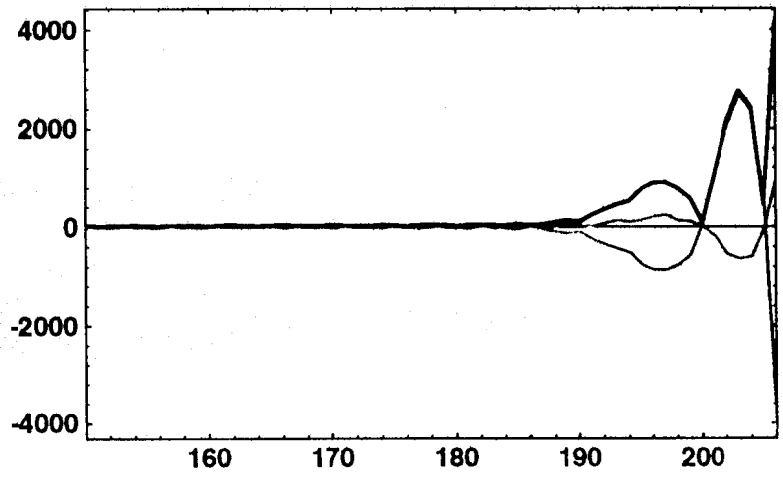
Manifold Vector Re, Im & Abs. Frequency: 16.3738



Cell TE Vector Re, Im & Abs Frequency: 16.3738

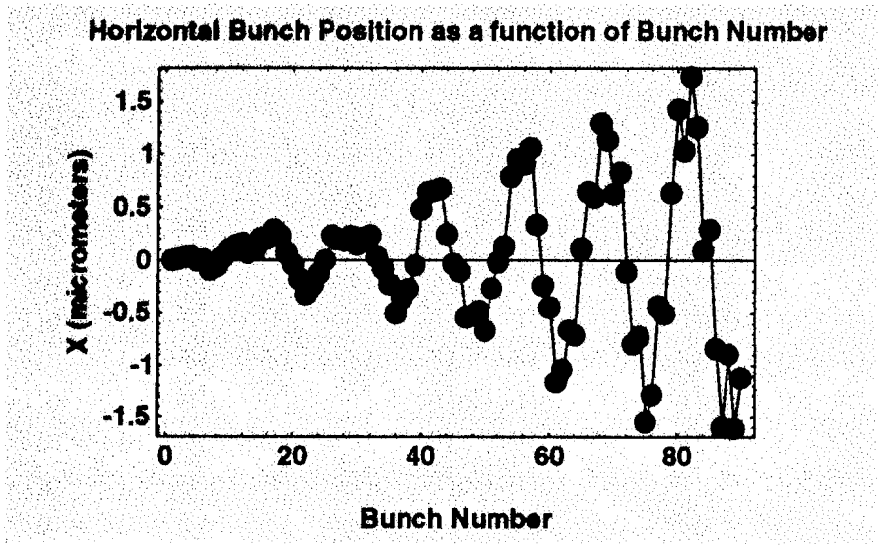


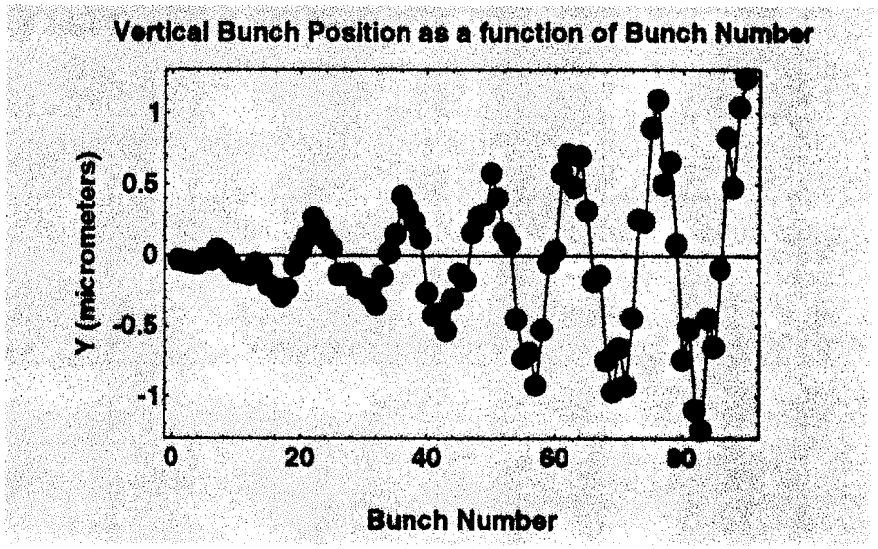
Cell TM Vector Re, Im & Abs. Frequency: 16.3738

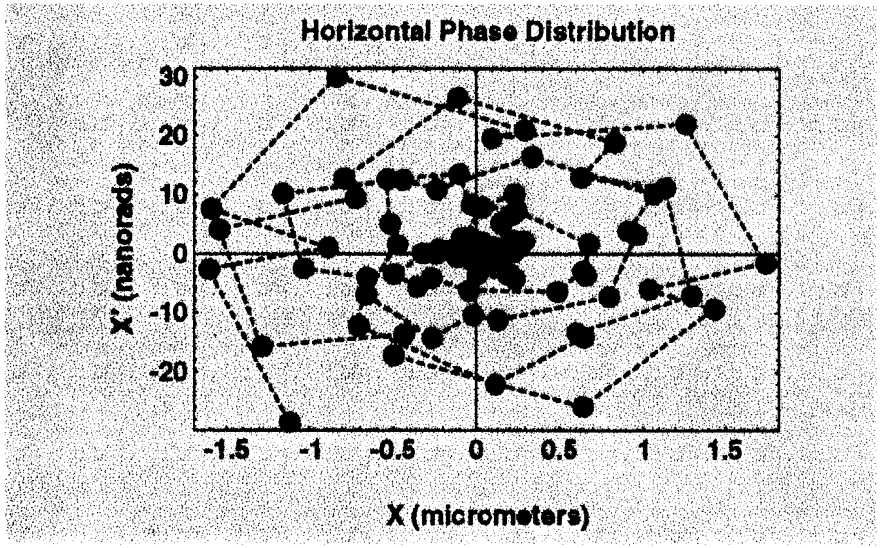


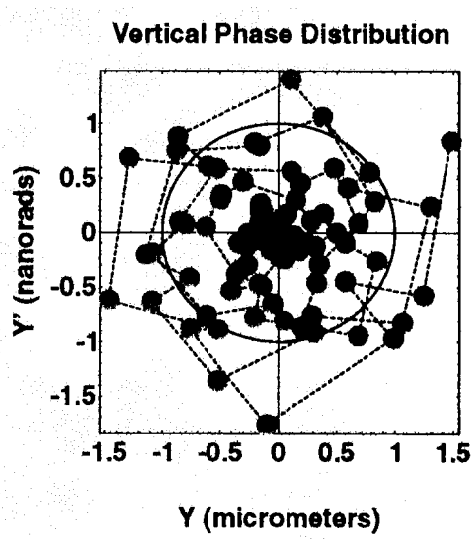
Roger M. Jones, N. M. Kroll, R.H. Miller, J. Wang, G. Stupakov & T. Raubenheimer(1-99)

RDDSC 1 4 Cells Decoupled and a freq. dependent HOM coupler reflection coefficients.









Roger M. Jones, NMK, RHM, JW, GS & TR(11-98)

Topics

- **Phase Slip due to f_0 error.**

  30 degrees phase slip.

  Start from -15 degrees.

  $\Rightarrow$ average $\frac{\sin 15^\circ}{15^\circ} \approx 1 - 0.01$

  The linac must be 1% longer.

  Is this all ? Presumably.

- **Vaccuum**

  Fast ion instability.

  - hydrogen ---- kicked away by the first bunch
  - CO --- trapped in low energy region ($\lesssim$ 100~200 GeV)
  - 1.4 nsec × 190 bunches × 0.75×10^{10}

    $\Rightarrow P_{CO} \lesssim 10^{-8}$ Torr.

    CO is a small fraction in the residual gas

    $P_{tot} \lesssim 10^{-8}$ will be OK.