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
- Vacuum 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,
  \( \Delta f = 16\% \) (Gaussian)
  \( \Delta f = 10\% \) (uniform)
  \[ \gamma \text{-band.} \]

• Zero crossing \( W(t) \)
  Has to shift \( f_1 \) by \( \sim 2\% \) ... not easy
  \( \rightarrow \) acceleration mode other than \( 2\pi/3 \)?

• Heavy damping
  \( Q \leq 18 \) (S).
  \( Q \leq 9 \) (L) \( (1.4 \text{ nsec}) \)

M. Woodley  Lattice File Conversion

Lattice conversion between MAD and SAD.
Needed and should be possible.

\( \rightarrow \) Meeting in Thursday morning
G. Stupakov  Alignment Tolerances

**Short-range wake**
random structure-to-structure

\[ 16 \mu m \ (rms) \rightarrow 100\% \ \Delta \xi \Rightarrow \ \text{budget} \]
\[ 5 \mu m \rightarrow 10\% \]

**Long-range**

tilt \ angle-wake effect
random str-to-str \ 80 \ \mu \text{rad} \rightarrow 10\% \ \Delta \xi \]

\[ 3 \ \text{structure girder} \rightarrow \frac{80}{\sqrt{3}} = 45 \ \mu \text{rad}. \]

**Structure bow**

\[ \text{BPM} \]

Effects smaller than \[ \text{by factor } 0.083 \]

**Girder bow**

\[ \text{each str. straight} \]

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

\[ \text{somial effects due to } L \ \& \ \beta \]
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 ≤ 5 μm

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

PTa KB.  2nd Order Effects

gradient error, systematic random.
rf phase
charge (single bunch)

bunch length → ΔEy small. ±20% OK.

Many other items. Still going on.
Emittance Increase as a Function of RF BPM Resolution – "French Curve" Algorithm
Requirements to Prelinac, BC2, ...

\[ E_x = 3 \times 10^{-7} \text{ mrad} \]

at stage 2.

\[ \Delta E_x \text{ of } \sim 20\% \text{ acceptable} \]

Main Linac

much better if it accepts

\[ E_x \ll 3 \times 10^{-7} \]

(by Laser cooling)

Xing angle

\[ \phi \sim 30 \text{ mrad (crab)} \]

- Compatible with e^+e^-?
Decoupled Modes

- DDS1 has 4 cells decoupled from the manifold.
- High Q modes exist. $Q \approx 16000$.
- Cause BBU though $|\omega_{ex}|$ is not too large.
  - Resonance between high Q and bunch-to-bunch distance. $\Delta xy$ is reduced when
    - the mode is artificially eliminated
    - or bunch distance slightly changed.
- Not seen in ASSET (long distance needed)
- Cures ($Q$ must be $\leq 1000$.)
  - lossy materials near last cells
    - cavities
  - change geometry. couple all cells
    and introduce lossy material in the manifold.
RDDSC 1 4 Cells Decoupled and a freq. dependent HOM coupler reflection coefficients.
Topics

• Phase Slip due to $f_0$ error.

30 degrees phase slip.
Start from $-15$ degrees.

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

The linac must be 1% longer.
Is this all? Presumably.

• Vacuum

Fast ion instability.

• hydrogen --- kicked away by the first bunch
• CO --- trapped in low energy regime
  ($\lesssim 100-200$ GeV)

1.4 nsec x 190 bunches x 0.75 x $10^{10}$

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

CO is a small fraction in the residual gas

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