

Progress Report

J. Scott Berg
Brookhaven National Laboratory
11 July 2003
FFAG03, KEK

Longitudinal Parameters in Scaling FFAGs

- Transition in scaling FFAGs occurs when $k = \gamma^2 - 1$
- Bucket area approximately inversely proportional to square root of

$$\frac{1}{k + 1} \sim \frac{4}{(\gamma_i + \gamma_f)^2}$$

- To avoid transition:
 - ◆ $k \ll \gamma_i^2 - 1$: not good, since leads to small bucket area
 - ◆ $k \gg \gamma_f^2 - 1$: bucket area essentially independent of k
- If you wish to use non-scaling dynamics: $k = (\gamma_i + \gamma_f)^2/4 - 1$

- Think in terms of normalized phase space
- Scaled emittance is $\epsilon_s = \epsilon_{\parallel} \omega / \Delta E$
- Bunching makes bunch emittance roughly inversely proportional to RF frequency
 - ◆ Scaled emittance roughly independent of bunching frequency
- Scaled longitudinal phase space transmission depends on $w = V / (\omega \Delta T \Delta E)$
 - ◆ For fixed V and w , can allow larger ΔT for smaller ω
 - ◆ Problem: RF voltage.
 - ★ Gradient decreases slowly as frequency goes down, for scaled cavity shape
 - ★ Below about 200 MHz, cavity shape decreases accelerating to surface field ratio
 - Going below 200 MHz, you don't get lower ΔT requirement
 - ★ Conclusion: want lowest frequency where you still get good accelerating to surface ratio: 200 MHz.

- Longitudinal acceptance is 4.6 eV-s, frequency 24 MHz
- Scaled emittance is 11 times larger than in US scheme!
 - ◆ Could lower RF frequency to 2.2 MHz to keep same scaled emittance
 - ◆ But for given ΔT , $\omega\Delta T$ is 8.3 times lower than in US scheme.
 - ◆ But gradient at 24 MHz is significantly lower as well
 - ◆ Question: how low must w go to accept larger scaled emittance?

Design Parameters for Non-Scaling FFAGs

- Discussion of drift length between F and D quads
 - ◆ Bob, Carol, Dejan, Scott
 - ◆ Need at least one magnet diameter between magnets for coils to come around:
about 20 cm
 - ◆ Need space for diagnostics
 - ★ Plenty of room between cavity and magnets
 - ★ Lots of phase advance across cavity
 - ◆ Need trim coils
 - ★ Built into SC magnet coils (?)