IDS: Linear Non-Scaling FFAG

J. Scott Berg
Brookhaven National Laboratory
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FFAG Introduction

- Fixed Field Alternating Gradient accelerator
- Magnetic fields do not vary with time
  - Still have large energy range
  - Tradeoff: horizontal aperture
- Alternating gradient
  - Reduced aperture from cyclotron

Why Use an FFAG?

- Most expensive part of acceleration is RF
- Reduce RF cost: make more passes through RF
- RLA passes limited to 4–5 (switchyard)
- Earlier estimates: cost reduction by factor of 3

Goals of FFAG Study

- Settle on parameters
- Demonstrate we can accelerate beam coming from RLA
- Determine how to do injection/extraction
- Get sufficient costing to make comparison to RLA cost

Settle on FFAG Parameters (Berg)

- Have basic set of parameters
  - About 60 cells, FODO, doublet, or triplet
  - 460 m circumference
  - About 1500 MV of 200 MHz SCRF
  - Magnet aperture radii of 10 cm (D) and 20 cm (F)
  - Maximum magnet fields around 8 T (D) and 3.5 T (F)

Settle on FFAG Parameters (Berg)

- Parameters must be adjusted slightly
  - Asymmetry in time of flight vs. energy
  - Insuring beam is matched longitudinally
- Take into account time of flight dependence on transverse amplitude

Injection and Extraction (Pasternak)

- Large fields (tenths of a T), 1 μs rise/fall
  - Use many kickers to reduce fields
- Achieving sufficient beam separation from magnet
  - Keeping septum fields reasonable
- Avoid perturbations
  - Symmetry important in FFAG lattices

Chromaticity Correction

- Time of flight depends on transverse amplitude
- Different transverse amplitudes experience different longitudinal dynamics
- Effective longitudinal emittance growth
  - Reason for not using second FFAG
- Effect is proportional to chromaticity

Chromaticity Correction (Machida)

- Produce chromatically corrected lattice
- Nonlinearities reduce dynamic aperture
  - Better if tune kept low
- Cost is increased horizontal aperture
  - Check what this does to cost
  - May lose benefit of FFAG
- Time of flight must be re-corrected

FFAG Work Plan

- Finalize parameters, including matching to RLA/storage ring
- Choose injection/extraction scheme
  - Engineering of kickers
- Study benefits of chromaticity correction
- Tracking
- Engineer for cost, compare to RLA