Acceleration Issues and Plans

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Designs
What are We Considering?

- Types of designs that have been considered
  - RLA-only designs (Study I, Study II)
  - RLA-to-FFAG designs (Study IIa/b, UK?)
  - FFAG-only (scaling) design (NuFactJ)

First Step
Get Existing Specs

- Get parameters for existing designs
- Need this as a basis for comparison
- Need a starting point to examine parameter dependence
- Want enough to simulate
- See ISS web page for what we have
- Missing lots of specifics
  - Don't have anything from Study II (on its way hopefully. . .)
  - Missing pieces from Study IIa/b, but this is most complete
  - UK Scheme?
  - NuFactJ, need more specifics on FFAG parameters, RF systems undefined
  - Everyone is missing transfer lines. . .

ISS Acceleration Web Page

International Scoping Study Machine Working Group Acceleration

US Neutrino Factory Acceleration Design

- Matching from cooling into acceleration
  - Component specifications
  - ICOOL input file
- Pre-accelerator linac
  - Component specifications
  - DIMAD-style input file
  - for001.dat for ICOOL, hard-edge model
- Dogbone RLA
  - Talk with latest machine description
- 5–10 GeV and 10–20 GeV FFAGs
  - Lattice parameters
  - Optimization procedure
  - Cost model used for optimization
- Superconducting cavity specifications

NuFactJ Acceleration Design

- The NuFactJ report page, containing a copy of the NuFactJ report (local copy)
- FFAG lattice parameters

RLA Issues

- All designs except NuFactJ require some kind of RLA
  - FFAGs probably can't work at low energies with high-frequency, high-gradient RF
- Switching RLA-only design to dogbone
- Using more turns in Study IIa dogbone for efficiency
  - Helps answer question of whether to add a 2.5–5 GeV FFAG
- Lower energy dogbone if we consider 2.5–5 GeV FFAG

Non-Scaling FFAG Issues

- Doublet/triplet
  - Doublet designs seem to be preferred
  - Need to verify injection/extraction scheme
- Need to verify that they perform as expected (tracking)
  - Especially look at sensitivity to errors: cross many resonances
- Other types of FFAG lattices
  - Linear field magnets, compact repetitive cells (doublet/triplet) give huge dynamic aperture: baseline
  - Other designs have been proposed (e.g., isochronous FFAGs), but may not have dynamic aperture we need: verify
  - Try using scaling FFAGs in Study IIa scenario
- In general: need to do 6-D tracking with complex acceleration

Scaling FFAG Issues (NuFactJ)

- Need to get more well-defined lattices
- Need to ***clearly*** define RF system(s) that will be used
- Do beginning to end 6-D tracking

Superconducting RF Systems and Magnets

- What gradient should we count on?
- What magnetic field at SC cavities (zero or 0.1 T)?
  - The SC cavity guys say you can run at 0.1 T
  - Nobody has ever run a real machine at high field
- Shielding scenarios for magnets
  - We are concerned with the near field
  - Need to work with real magnet designs: iron, etc.
  - Solenoid (linac), quadrupole (RLA), combined-function (FFAG)
  - Could use ***a lot*** of help from a magnet engineer
- Need magnet designs for inter-magnet spacing (FFAG)
- These numbers drive the lattice designs

Interaction with Other Systems

- Acceleration system strongly coupled to the rest of the machine
- Acceptance needed depends on the amount of cooling
  - Vary acceptance of acceleration system
  - Choose design in conjunction with upstream
- RF frequency related to the bunch structure upstream
  - High-frequency RF (200 MHz, etc.) requires bunched beam
  - NuFactJ assumes big single bunch: low frequency
    - ⋆ Allows FFAGs at very low energy
- Assuming 20 GeV final (total?) energy. Will that change?

Tasks

- Get “baseline” designs, with holes filled in
  - Maybe can live without transfer lines, but must know enough to get cost
- Need to work on 6-D simulation of all systems, especially FFAGs
  - No “resetting” the bunch distribution from one stage to the next!
    - ⋆ Allow replacing transfer lines with a ***linear*** transformation
  - Verify that FFAG systems will really work as advertised
    - ⋆ May lead to FFAGs becoming more expensive to get acceptance
- Need to produce variety of RLA designs
- Need to get some serious magnet designs: look at spacing