IDS-NF Accelerator Working Group Status and Plans

J. Scott Berg
Brookhaven National Laboratory
NuFact 09
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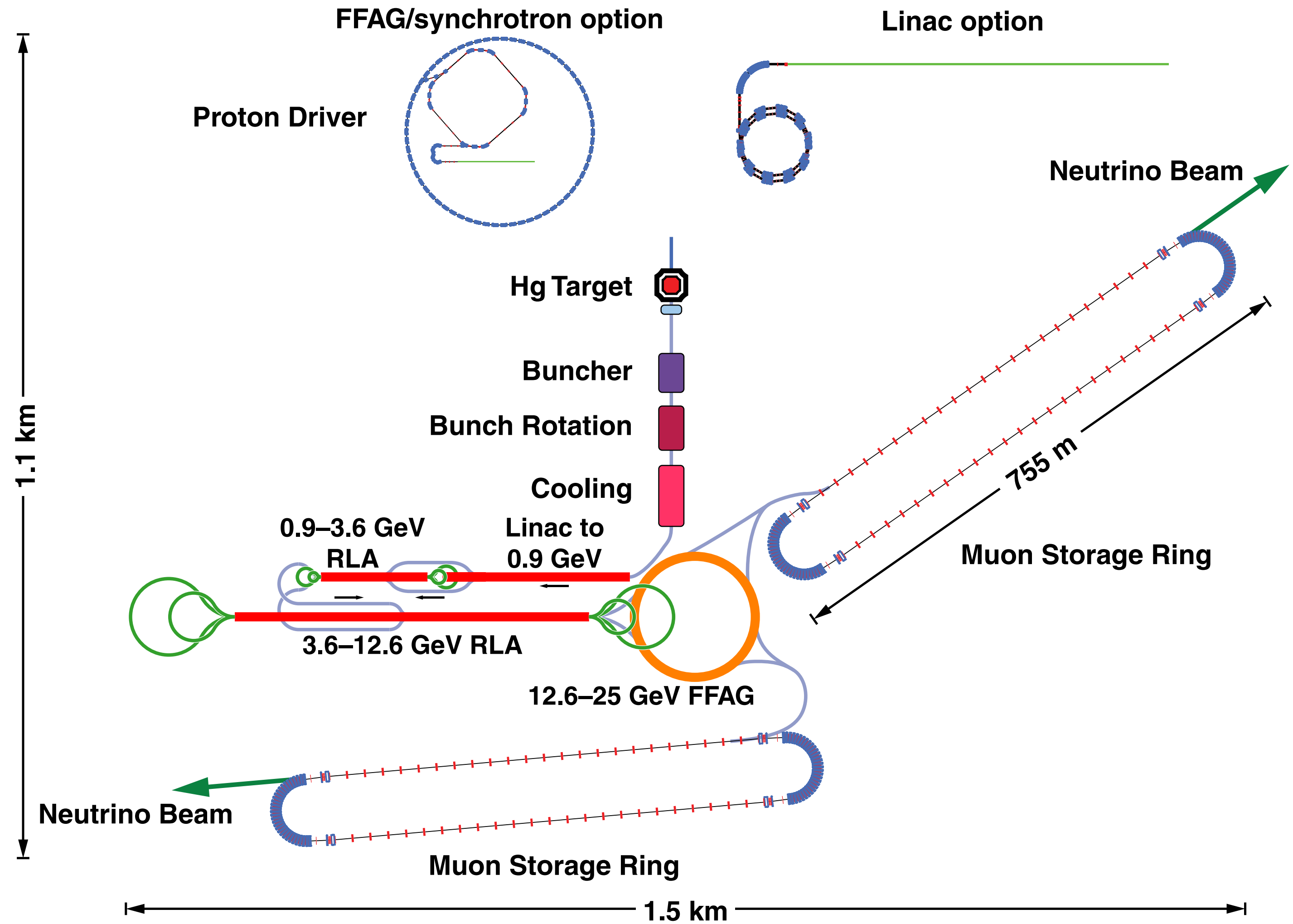
IDS-NF Accelerator Systems Overview



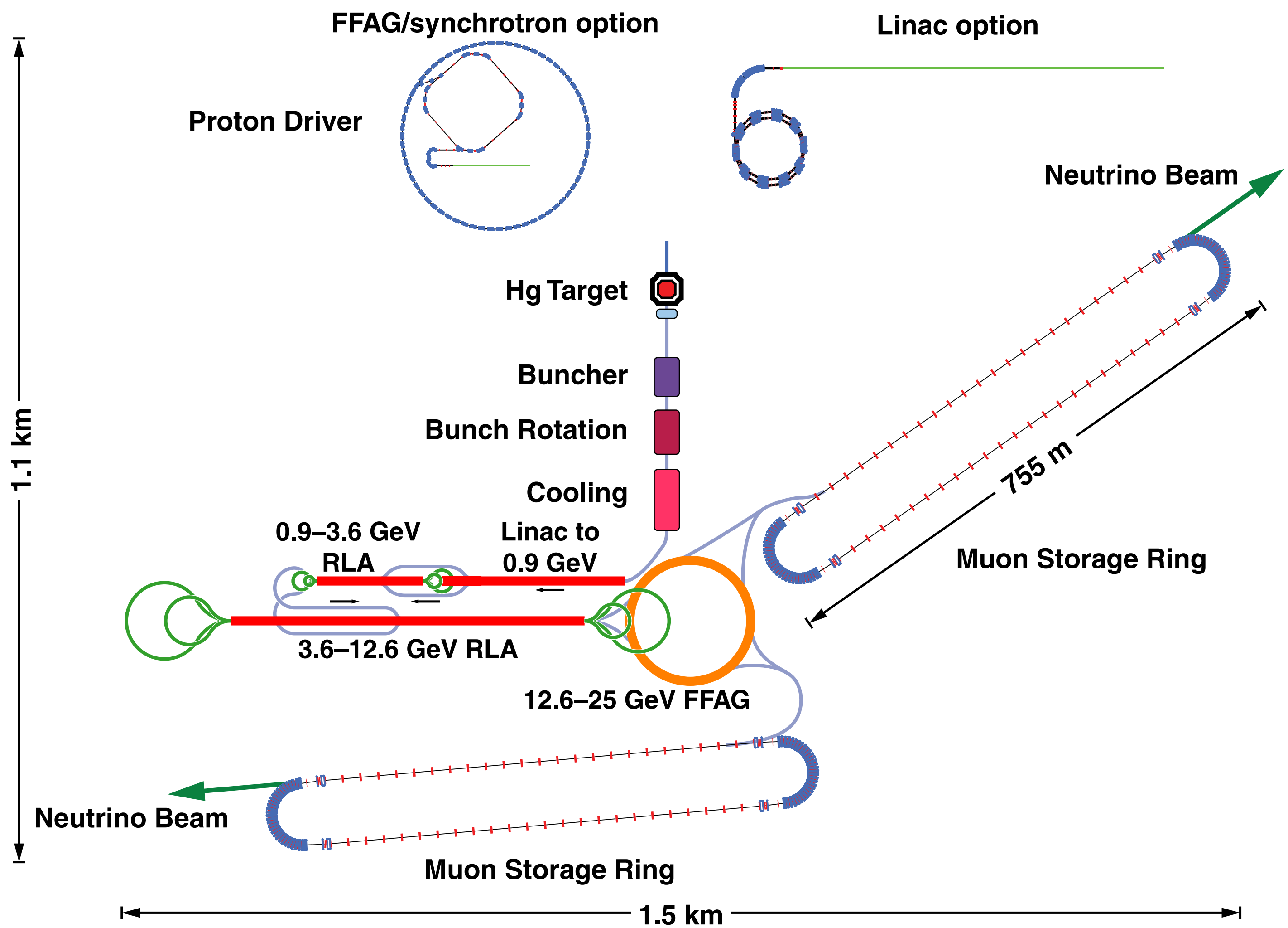
IDS-NF Accelerator Systems Baseline

- Proton driver
  - 4 MW, 50 Hz, 3 bunches, 1–3 ns long, 5–15 GeV energy
- Hg jet target
- Front End
  - Decay channel: $\pi \longrightarrow \mu$
  - “Neuffer” buncher and phase rotation
  - Modest amount of cooling

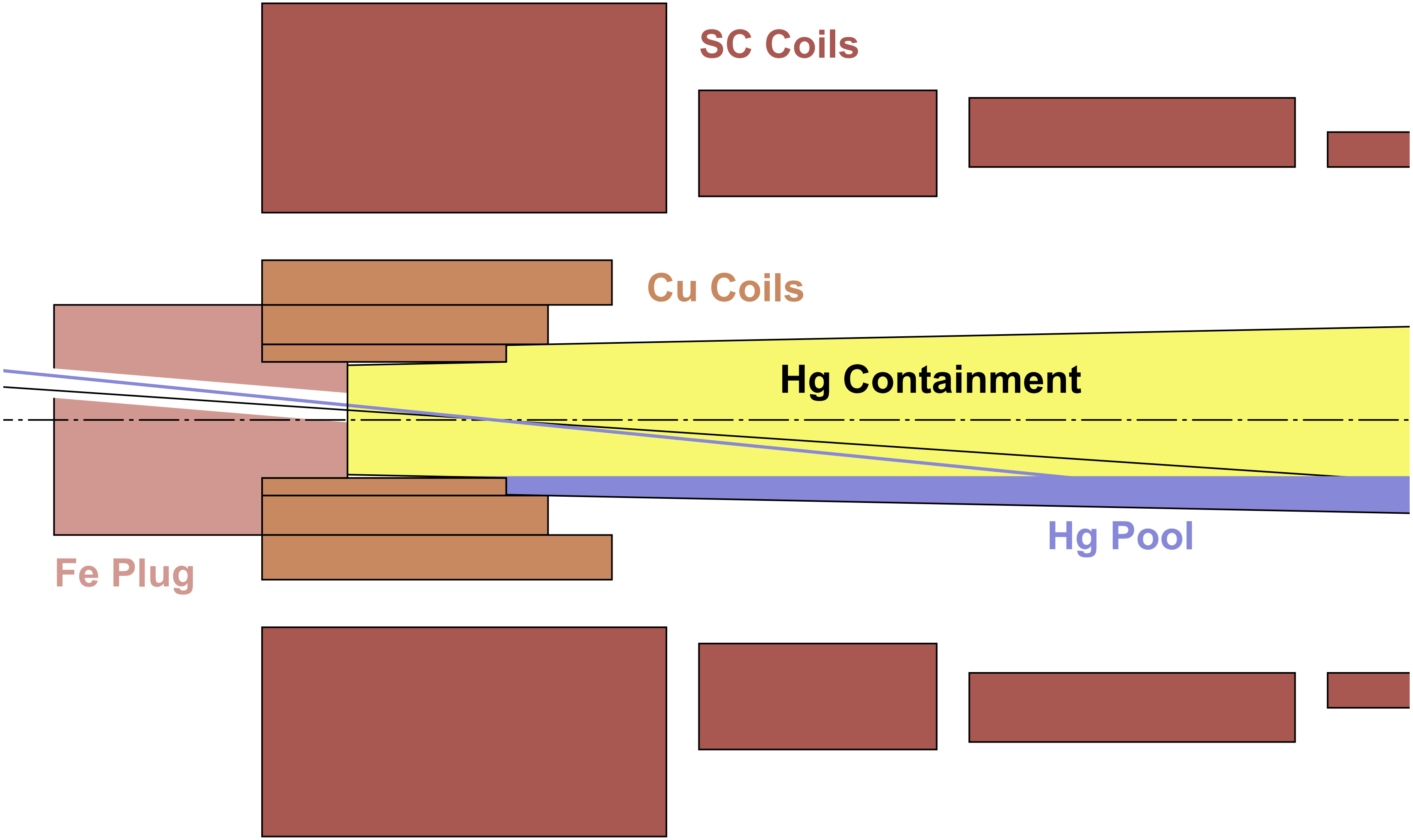
IDS-NF Accelerator Systems Baseline

- Acceleration: efficiency in RF use
  - Linac: to 0.9 GeV
  - Two RLAs: 0.9–3.6 GeV, 3.6–12.6 GeV
  - FFAG: 12.6–25 GeV
- Two 25 GeV storage rings
  - Racetrack shape
  - 3000–5000 km and 7000–8000 km baselines
  - Each can store both signs simultaneously

IDS-NF Accelerator Systems Overview



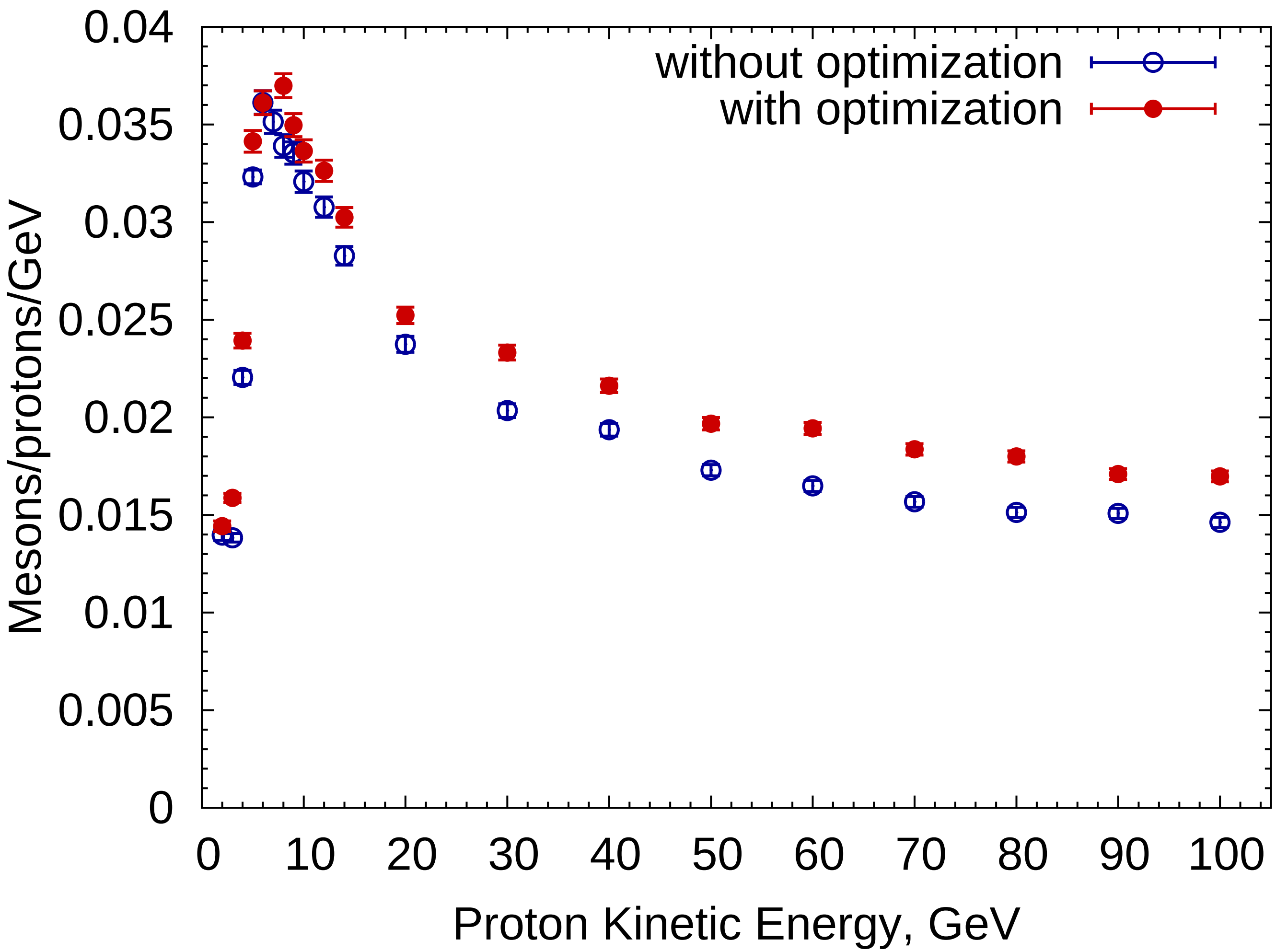
Target Area Structure



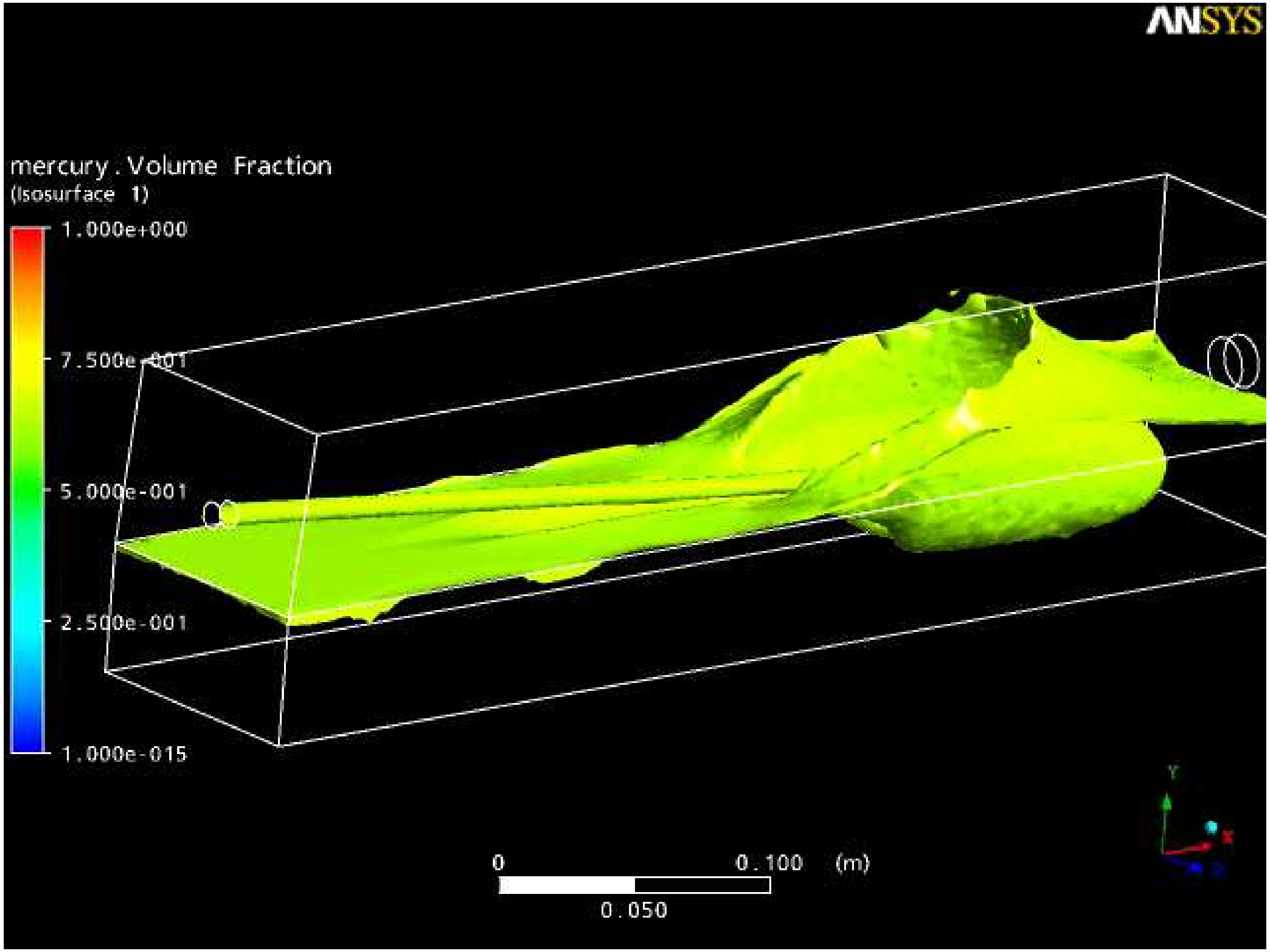
Target Results

- MERIT: can spread bunches over several 100 μs
  - Time to top off SC RF cavities in acceleration
- Optimized some Hg jet geometry parameters
  - Optimal production in 5–10 GeV range
  - Preference for beam on a particular side of jet
- Beginning studies of Hg pool dynamics

Hg Target Production vs. Energy (Ding)



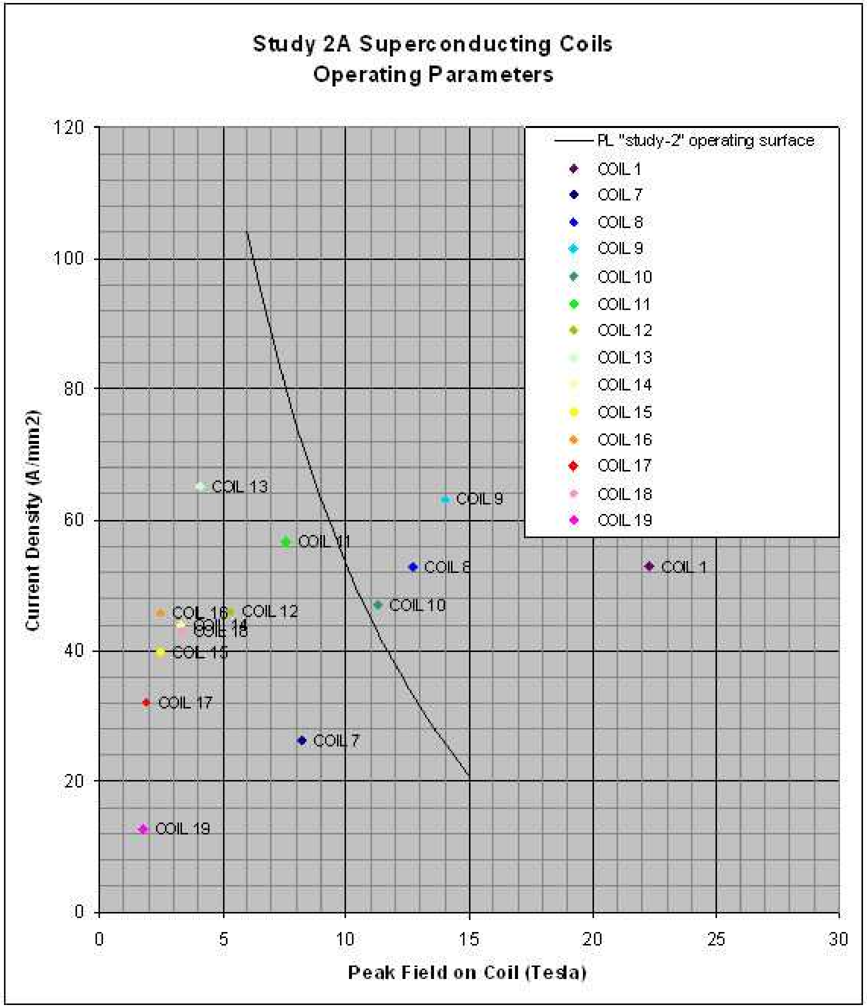
Hg Pool Splash (Davonne)



Initial Field Taper at Target

- Field profile “improved” for Study IIa from Study II
- Minimal performance gain
- Required magnet parameters unrealistic
- Switch back to Study II field profile
  - Stop taper at 1.75 T (Study IIa) instead of Study II

StudyIIa Capture Solenoid Parameters (Loveridge)



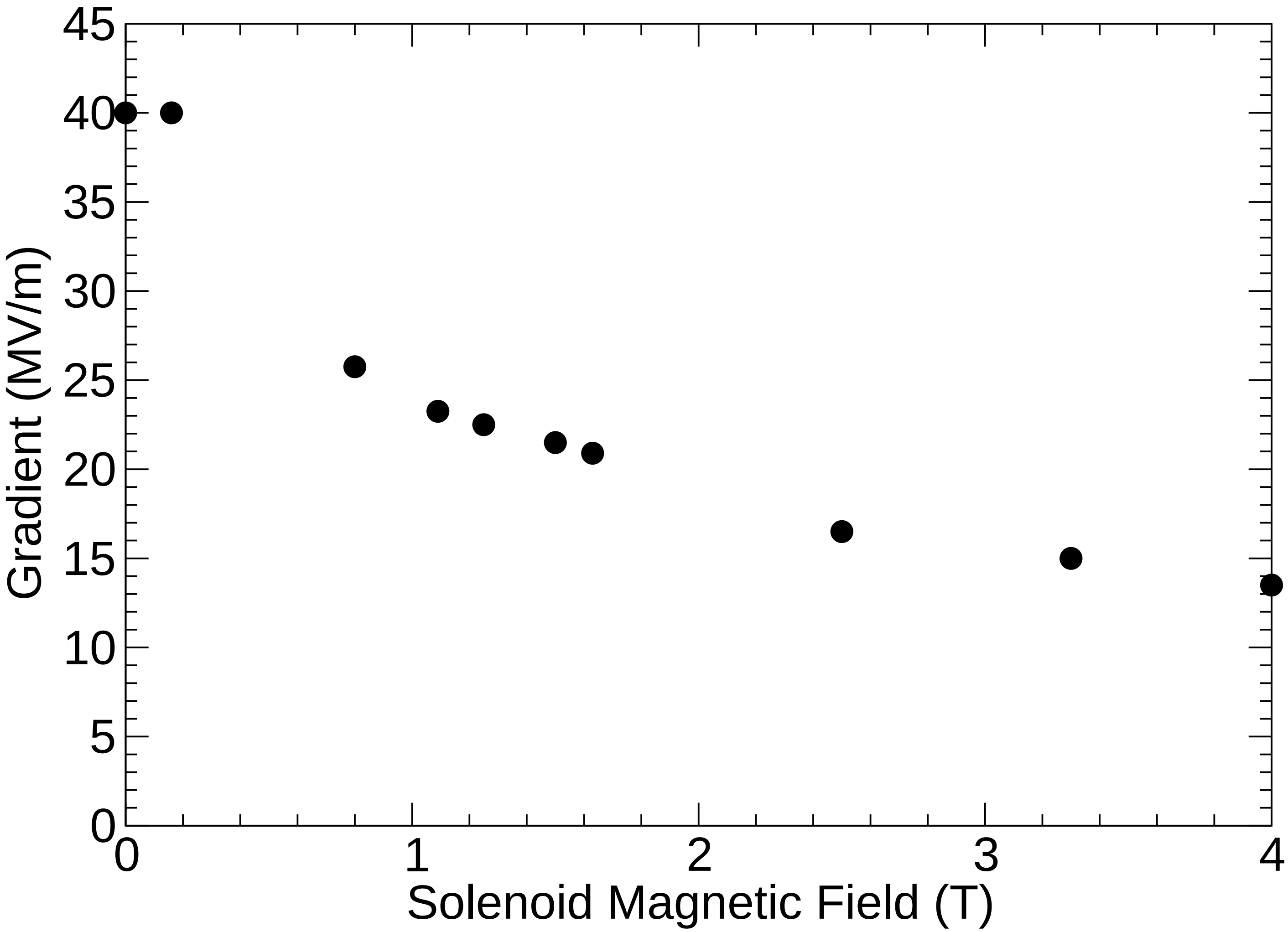
Target System Plans

- Verify production results with second code
- Production results with nonzero-emittance beam
- Continue target engineering work
- Design system with Study II taper to 1.75 T

Front End

- Task of front end
  - Convert large energy spread beam into small energy spread bunch train
  - Reduce transverse emittance
- Primary challenge: high RF gradients in magnetic field
- Goal: choose front end design compatible with gradient/magnetic field imitations

Achievable Cavity Gradient vs. Magnetic Field (Moretti)



Front End Progress

- Shorter buncher/rotation designed (Neuffer)
  - Higher RF gradients than previously
  - Not larger than cooling. . .
- Experimental and theoretical studies of RF breakdown in magnetic field
- Beginning studies of cavity shielding: results not too bad
- Neuffer phase buncher/rotation for low-frequency CERN scheme

Front End Tasks

- Study other lattice possibilities
- Make decision on realistic gradient/magnetic field relation
  - Won’t have certainty on our time scale
- Make decision on lattice design
- CERN looking at low-frequency scheme (not baseline)

Linac/RLA Acceleration Progress

- All lattices and transfer lines designed (Bogacz)
- First pass at tracking through the system
- Error analysis
- All results good so far

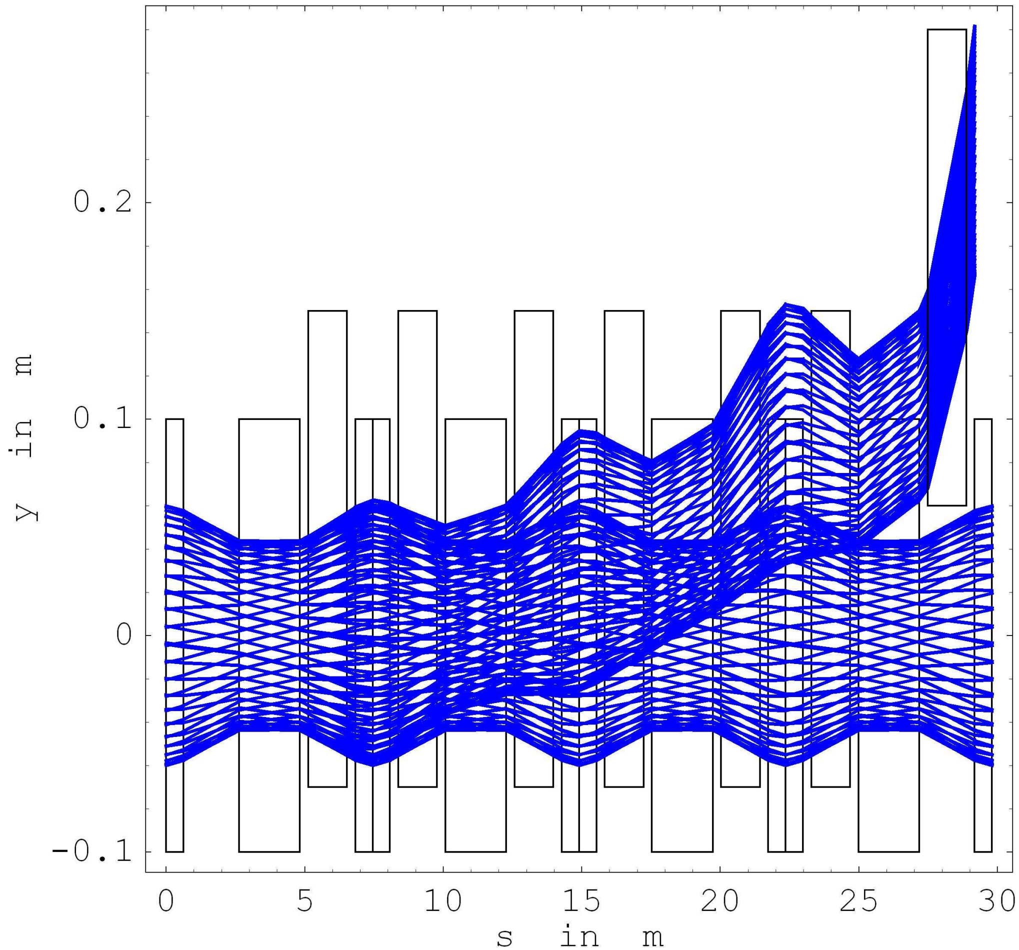
Linac/RLA Acceleration Progress

- More complete tracking of the system (ZGOUBI/other)
- Engineering of components

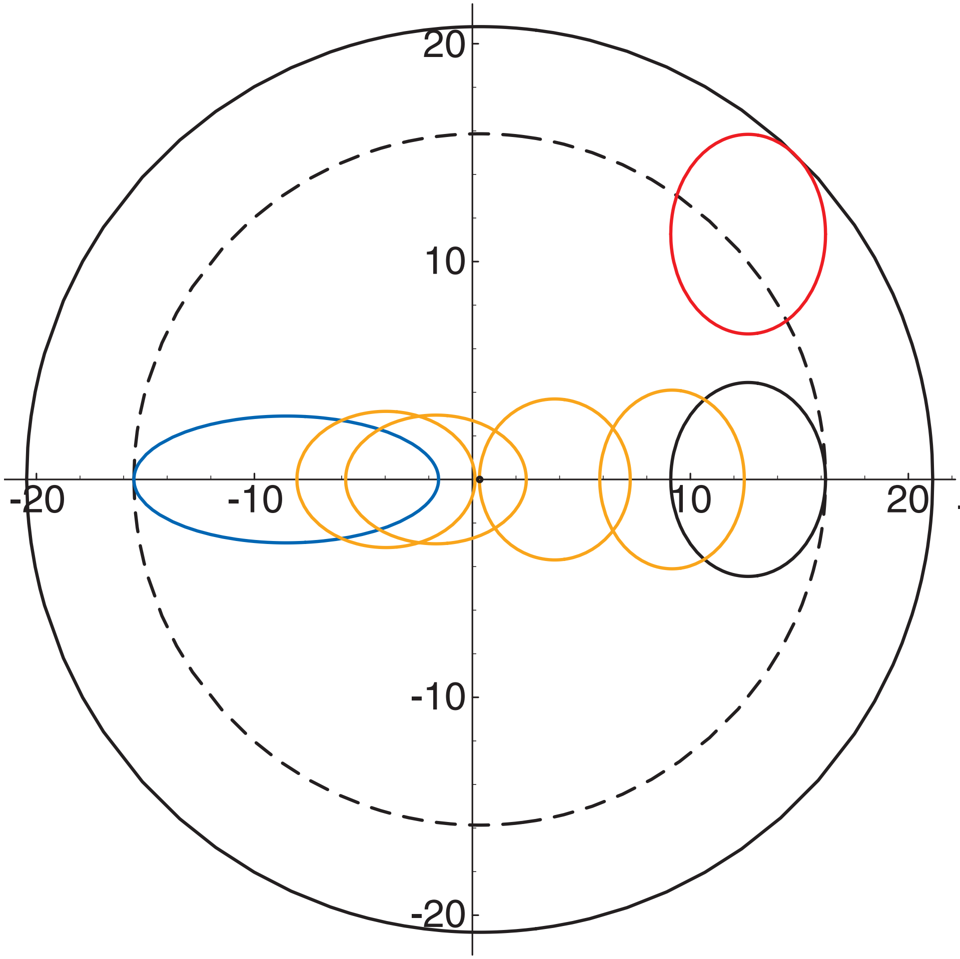
FFAG Acceleration Progress

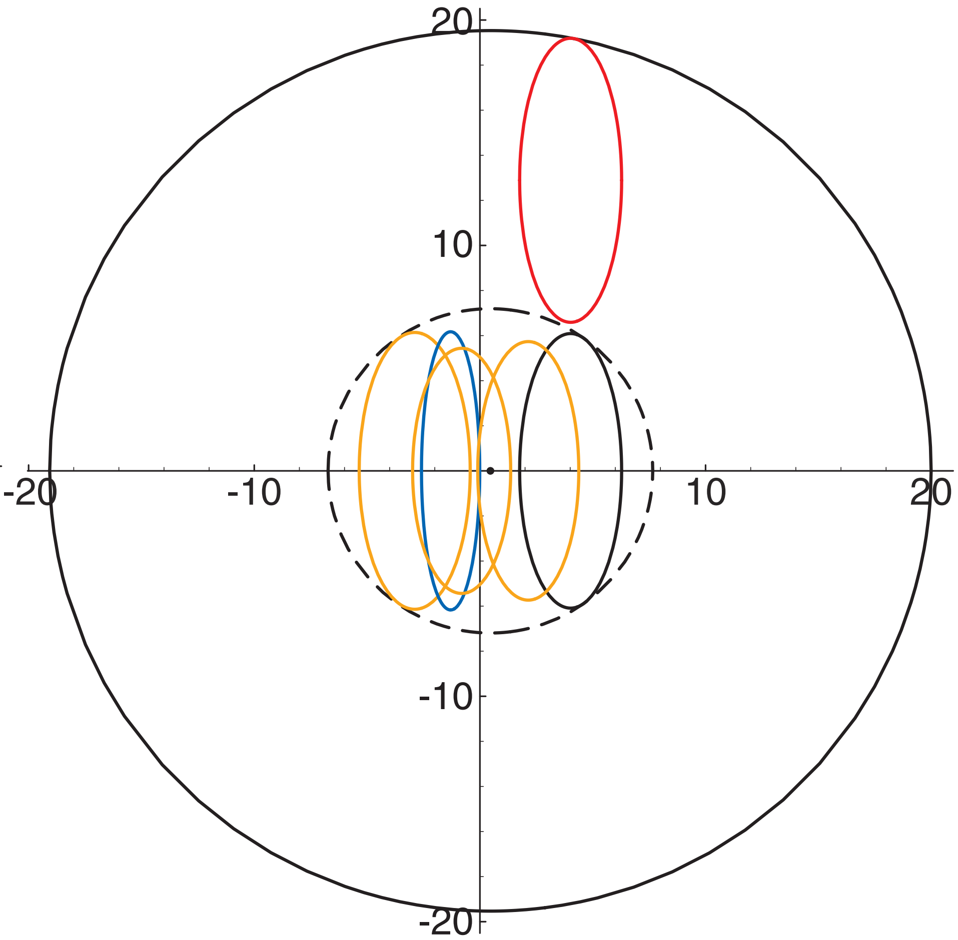
- Biggest challenge: injection/extraction
- Large transverse amplitude
  - Couples to longitudinal dynamics
- Injection/extraction scenario designed
  - Fields limited to 0.1 T
  - 6 kickers for FODO injection and extraction
  - Superconducting septum
  - Larger aperture magnets
    - Orbit distortions analyzed

FFAG Extracted Beam (Pasternak)



Magnet Aperture in FFAG Extraction Region (Kelliher)





FFAG Acceleration Progress

- Started injection/extraction for triplet
- Updated designs: space for injection/extraction
- Chromaticity correction (Machida)
  - Fix transverse amplitude coupling to longitudinal
  - Design with corrected chromaticity
  - Dynamic aperture loss, improved by partial correction
  - Designed insertions (injection/extraction)

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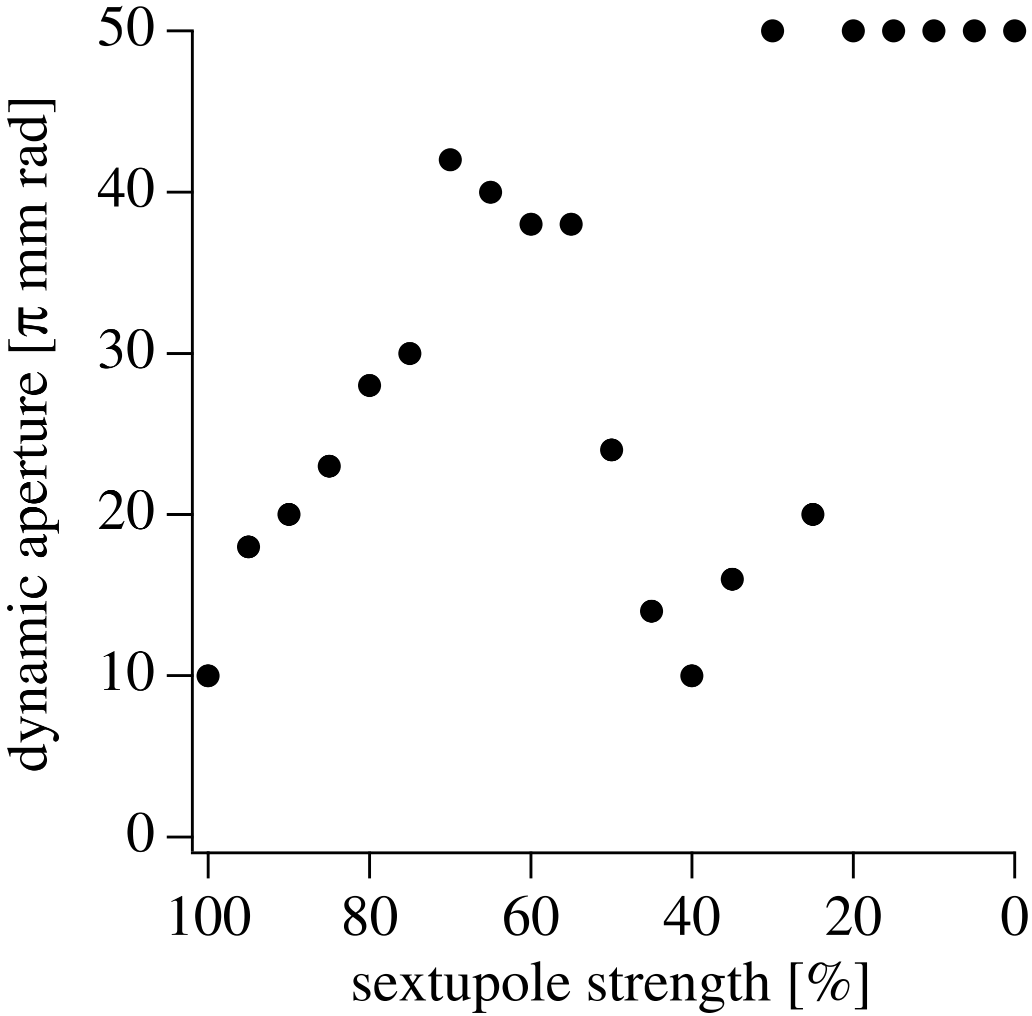
Dynamic Aperture vs. Sextupole Strength



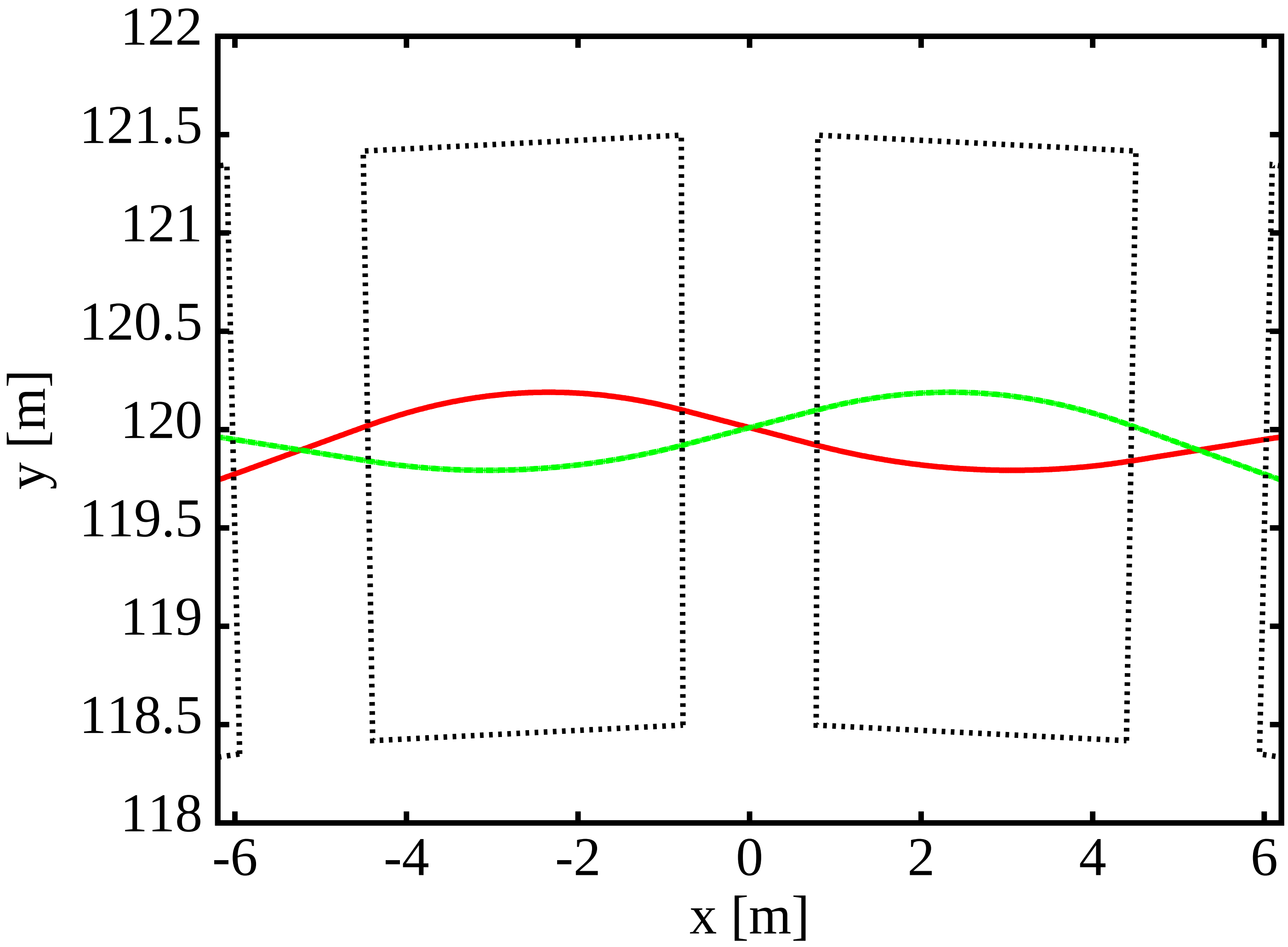
FFAG Acceleration Plans

- Finish injection/extraction for triplet
- Engineering of injection/extraction
- Engineering of entire system
- Decide between FODO/triplet designs
- Determine amount of chromaticity
  - Cost
- Optimize design for beam quality

Scaling FFAG

- Scaling FFAG for acceleration
- Not in baseline design
- Both signs same direction
- FODO lattice
- Harmonic number jump
- Two cell types
  - Lower k in arcs for HNJ
  - Higher k in straights to fit in cavity

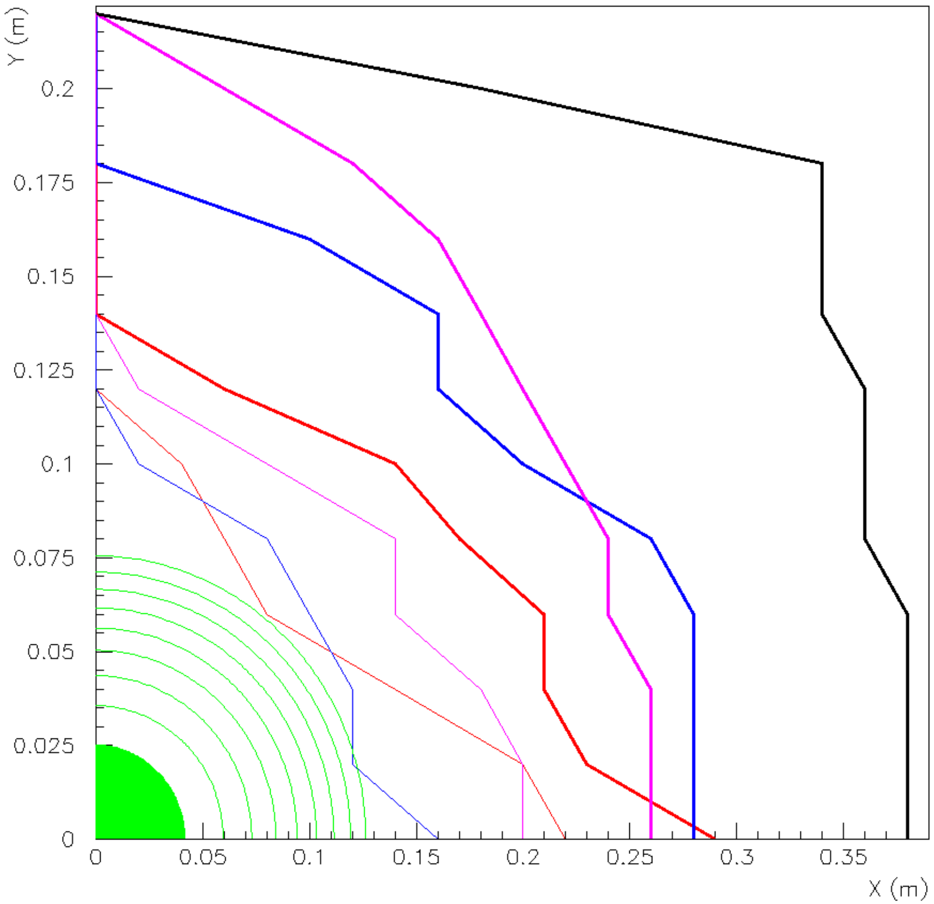
FFAG FODO Lattice Trajectories (Mori/Planche)



Storage Ring Progress

- Have design for 1600 m ring (Prior)
  - Tracked, excellent dynamic aperture
- RF not needed to keep trains separated if energy spread modest
- Shorter 1000 m ring possible, but
  - Need RF to keep trains separated
  - Higher field magnets in arcs
  - Likely less efficient
  - Unlikely cost savings: motivation political

Storage Ring Dynamic Aperture (Apollonio)



Summary

- Making decent progress on subsystem designs
  - Biggest challenge still front end: RF with magnetic field
- Ultimate goals
  - Track beam through entire system
  - Engineer and cost