IDS Accelerator Working Group Summary

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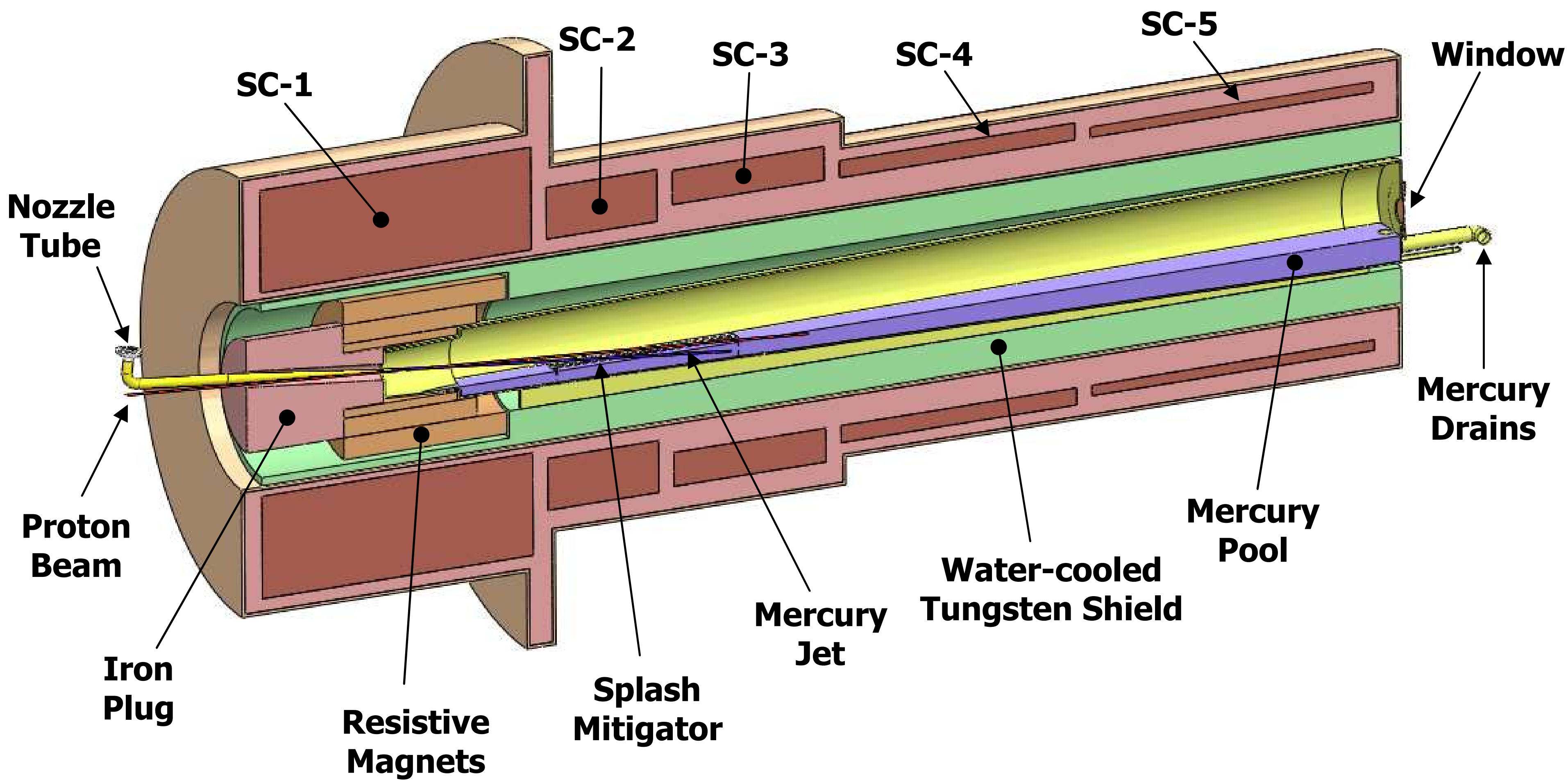
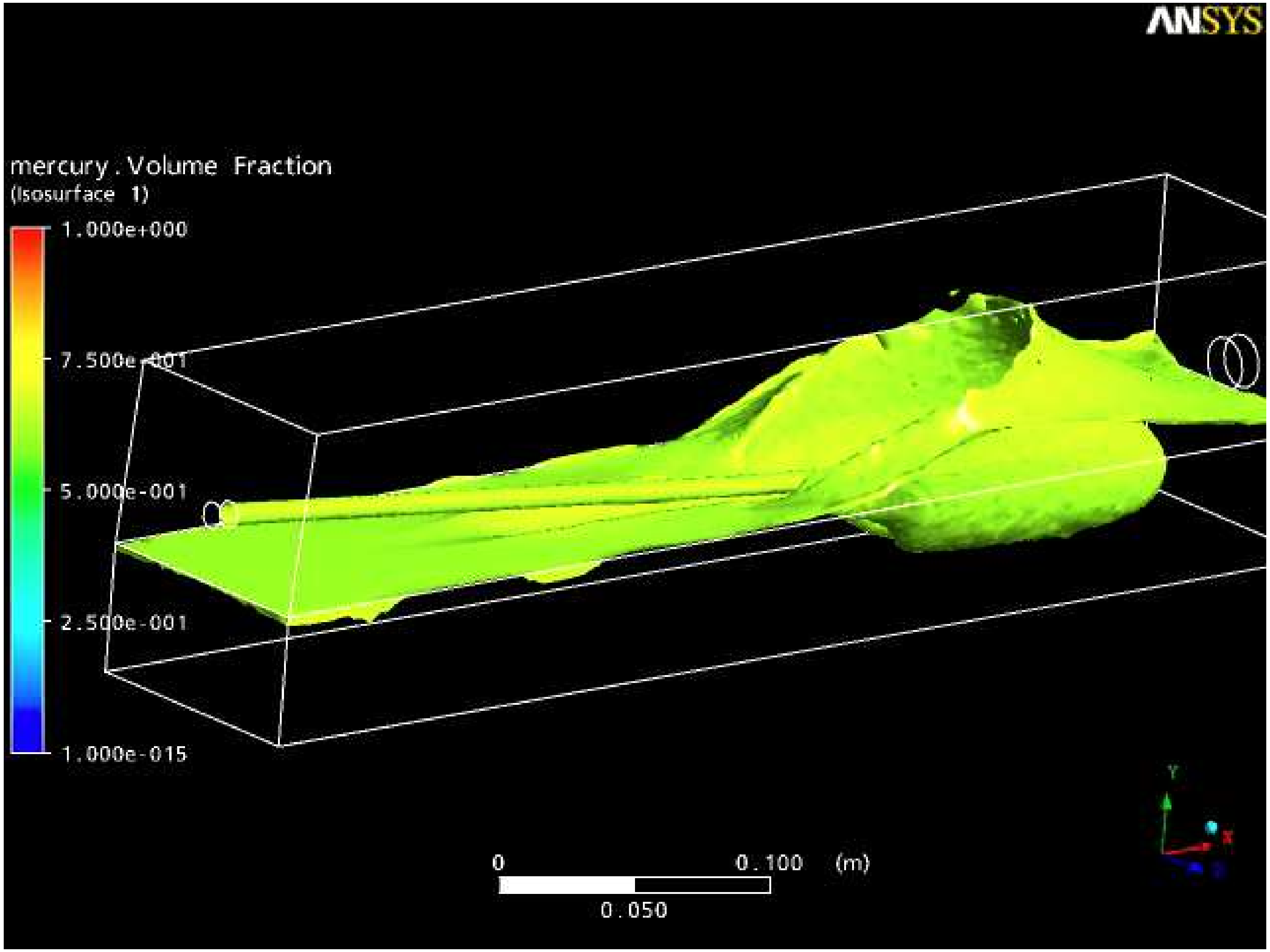
Target

- Beginnings of target infrastructure
- Major concern with infrastructure: mercury
  - Volume of mercury: consider shortening dump
  - Containment
  - Mercury splash (ideas for reduction)
- Need design and test of CW system
- Understand MERIT jet growth past nozzle

Target Infrastructure



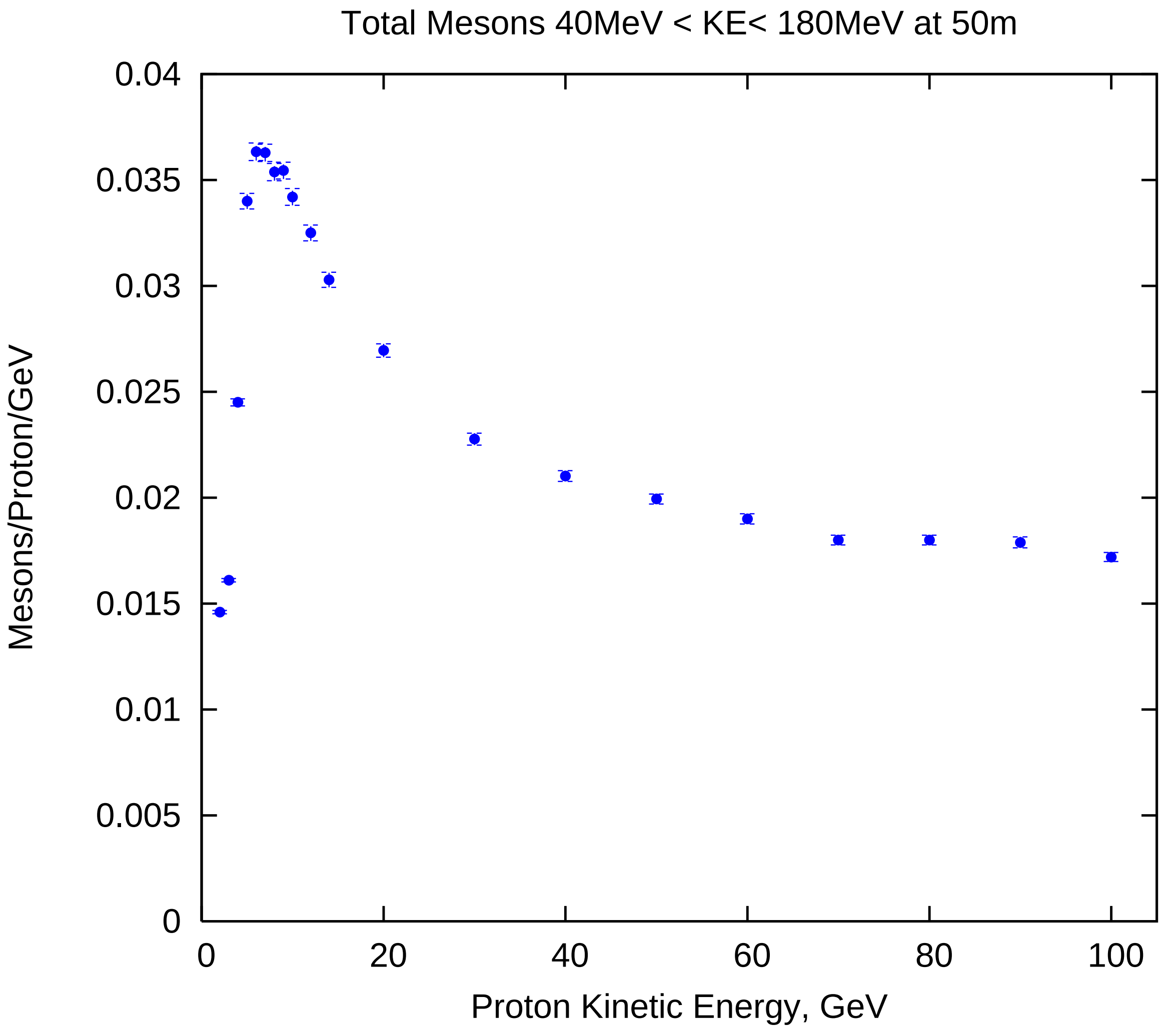
Target
Mercury Splash



Target Production

- Re-optimize target geometry for each energy
- Peak around 6–7 GeV, significant reduction outside that
- Results at high energy changed from MARS14 to MARS15

Target Meson Production



Proton Drivers

- Most cases add to existing proposals
- SPL, Project-X start with long linac
- All rely on some combination of
  - Linac
  - Synchrotron
  - Accumulator
  - Compressor

Proton Drivers
Linac Based

- SPL-based
  - Linac, accumulator, compressor
  - Increase rep rate & energy from low-power
  - 6 bunch studied: too many
  - 3 or 1 bunch possible
- Project-X based
  - Studied 3 methods to reach NF parameters
  - Favored is linac, 21 GeV synchrotron, compressor

Proton-Driver Ring Based

- Green-field proposal
  - Short linac (low energy looks easier)
  - H^{-} injection to synchrotron
  - Final stage non-scaling nonlinear “pumplet” lattice or synchrotron
- ISIS upgrade
  - Large longitudinal emittance a concern: bunch compression

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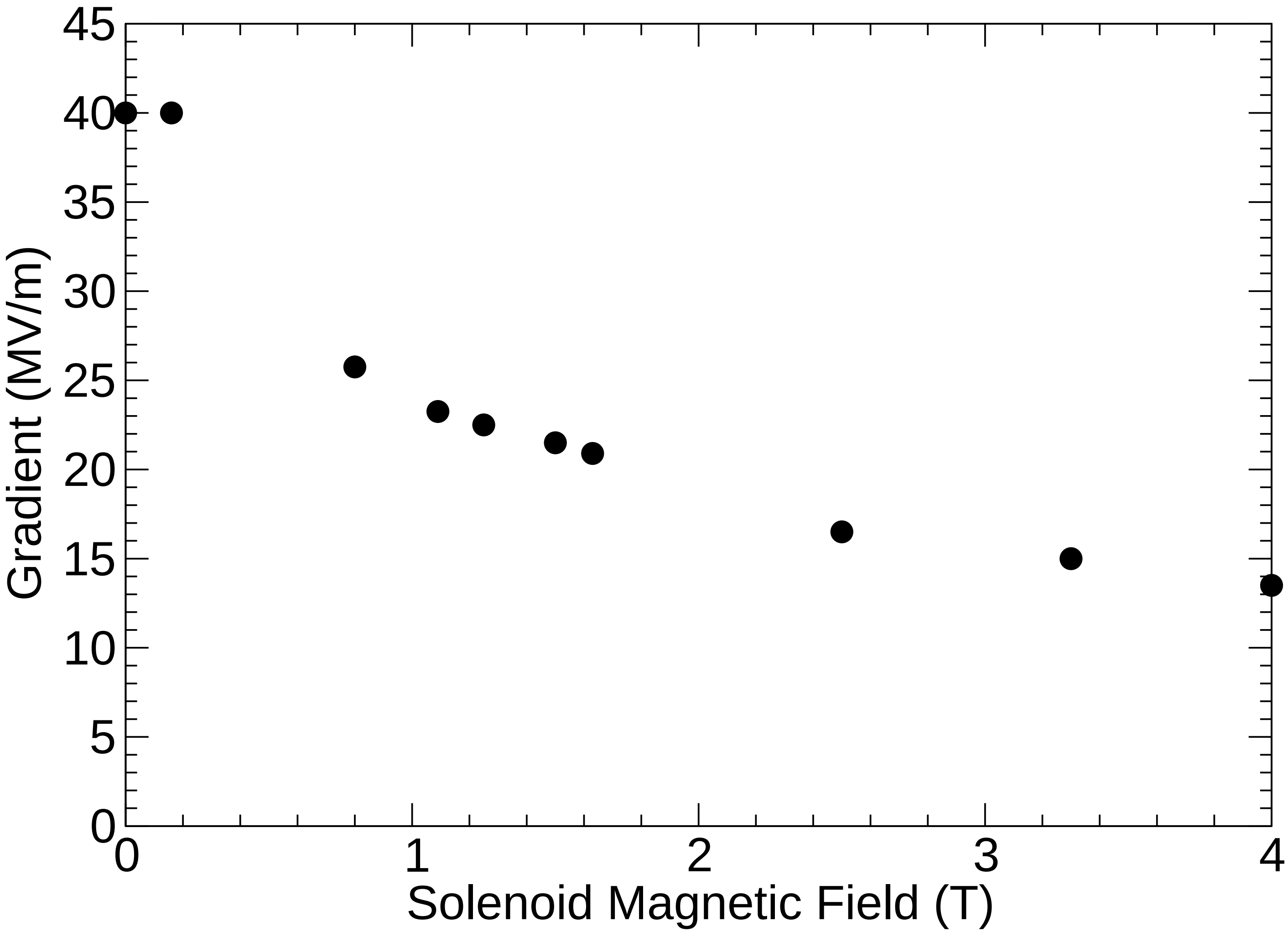
RF in Magnetic Fields

- Achievable gradient reduced in magnetic fields
  - Our baseline appears to be beyond limits
- Study with modeling and experiments
- Look at lattices that work with lower magnetic fields at cavities

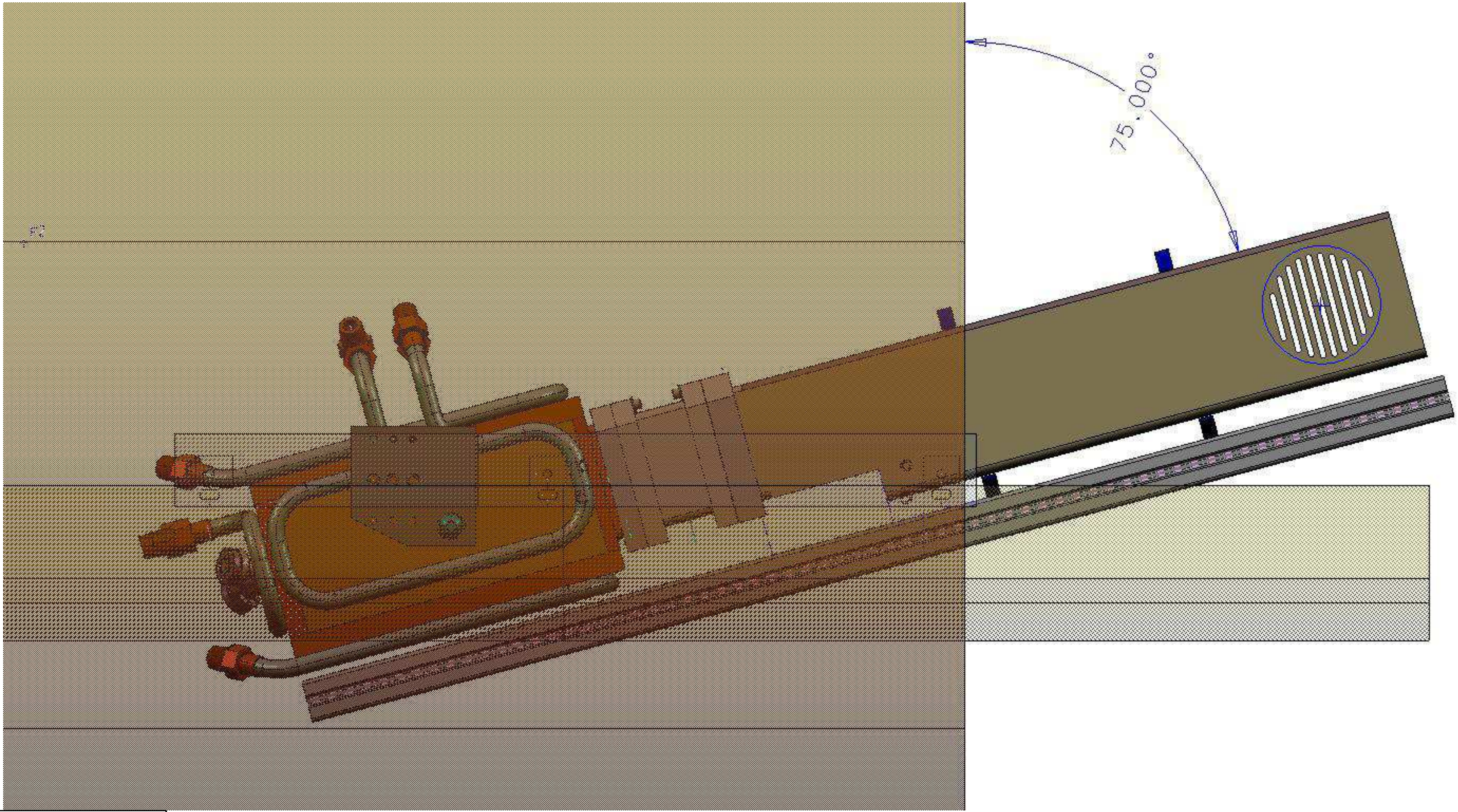
RF in Magnetic Fields
Gradient Plot



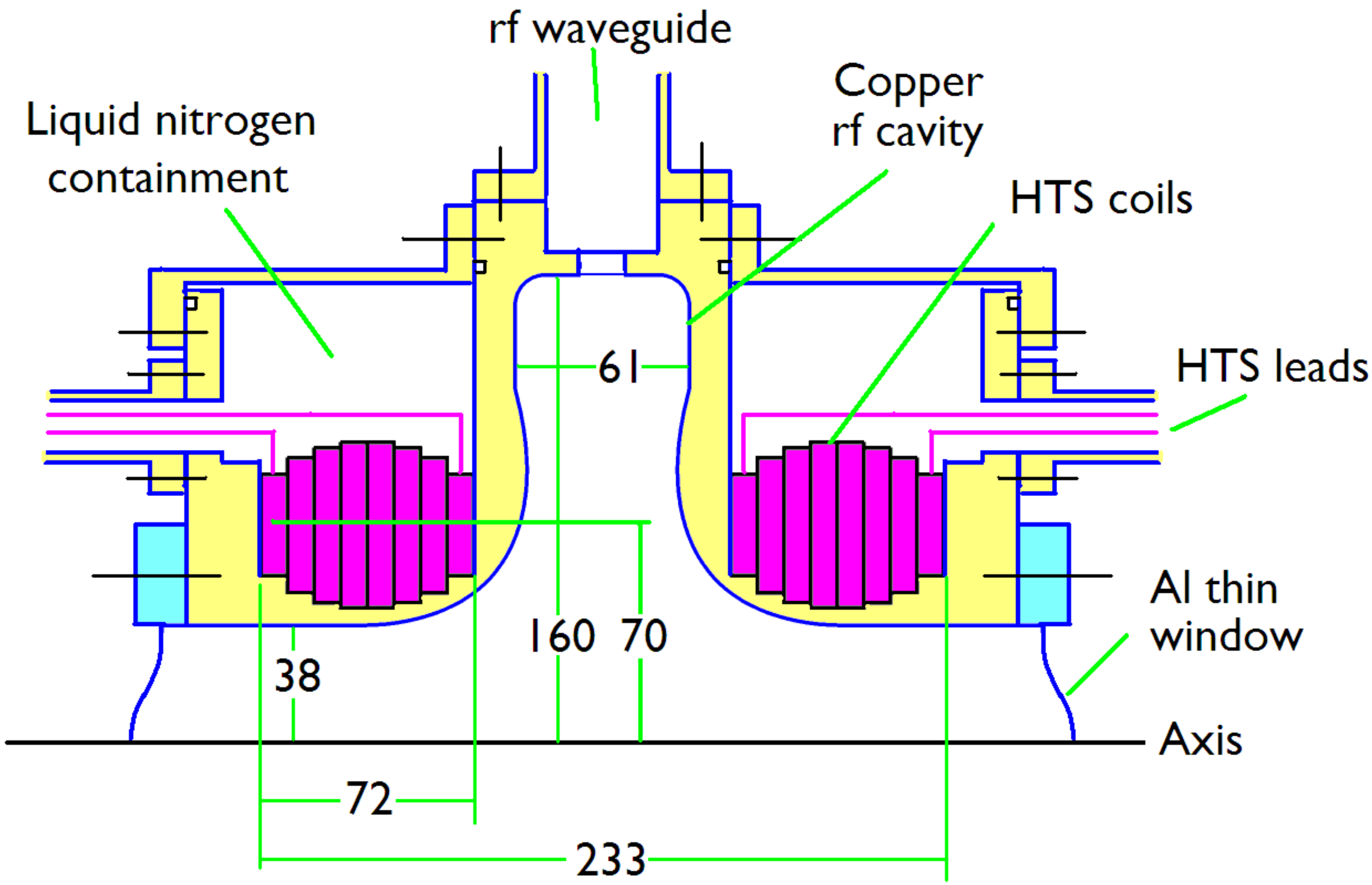
RF in Magnetic Fields Experiments

- MuCool/MTA experimental program
  - 201.25 and 800 MHz
  - Pressurized gas cavities
- MICE will have 1.5–2.5 T at 8 MV/m
  - Possible higher gradients with fewer cavities
- New proposals: magnetic insulation
  - Rotatable pillbox
  - Magnetically insulated lattice cell

RF in Magnetic Fields
Rotatable Pillbox



RF in Magnetic Fields
Magnetically Insulated Lattice



RF in Magnetic Fields Alternative Lattices

- Modified magnetic lattice
  - Shielded solenoids
  - Alternating solenoid
  - Somewhat reduced performance
- Capture at higher energy
  - Increased longitudinal phase space area
- Gas-filled cavities
  - Ionization of gas by beam a concern

RF in Magnetic Fields
RF Modeling

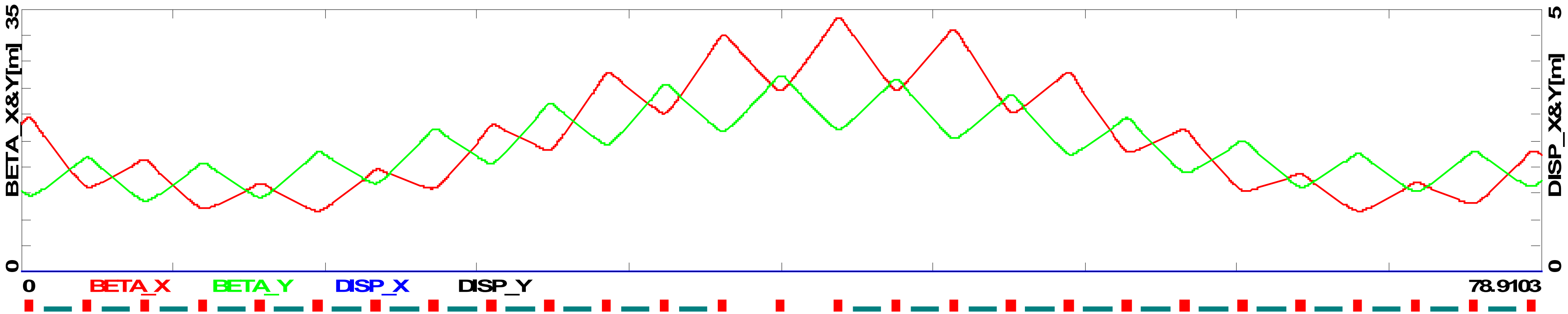
- Breakdown model proposed
  - Current generated from needle-like asperity
  - Hits different surface, depositing energy
  - Heats surface, leading to fatigue
- There are other models that disagree (?) with this

CERN Front End Plans

- 5 GeV jet in MARS
- Study 44/88 MHz cooling with Neuffer phase rotation
- Contribute to
  - Baseline optimization
  - End-to-end simulation
  - As possible considering manpower

Acceleration Linac and RLAs

- Magnet strength variation along linac
  - Two halves have different variations
  - Improves performance, despite β variation
- Benefits of chromaticity correction
- Discussion of fringe effects, tracking



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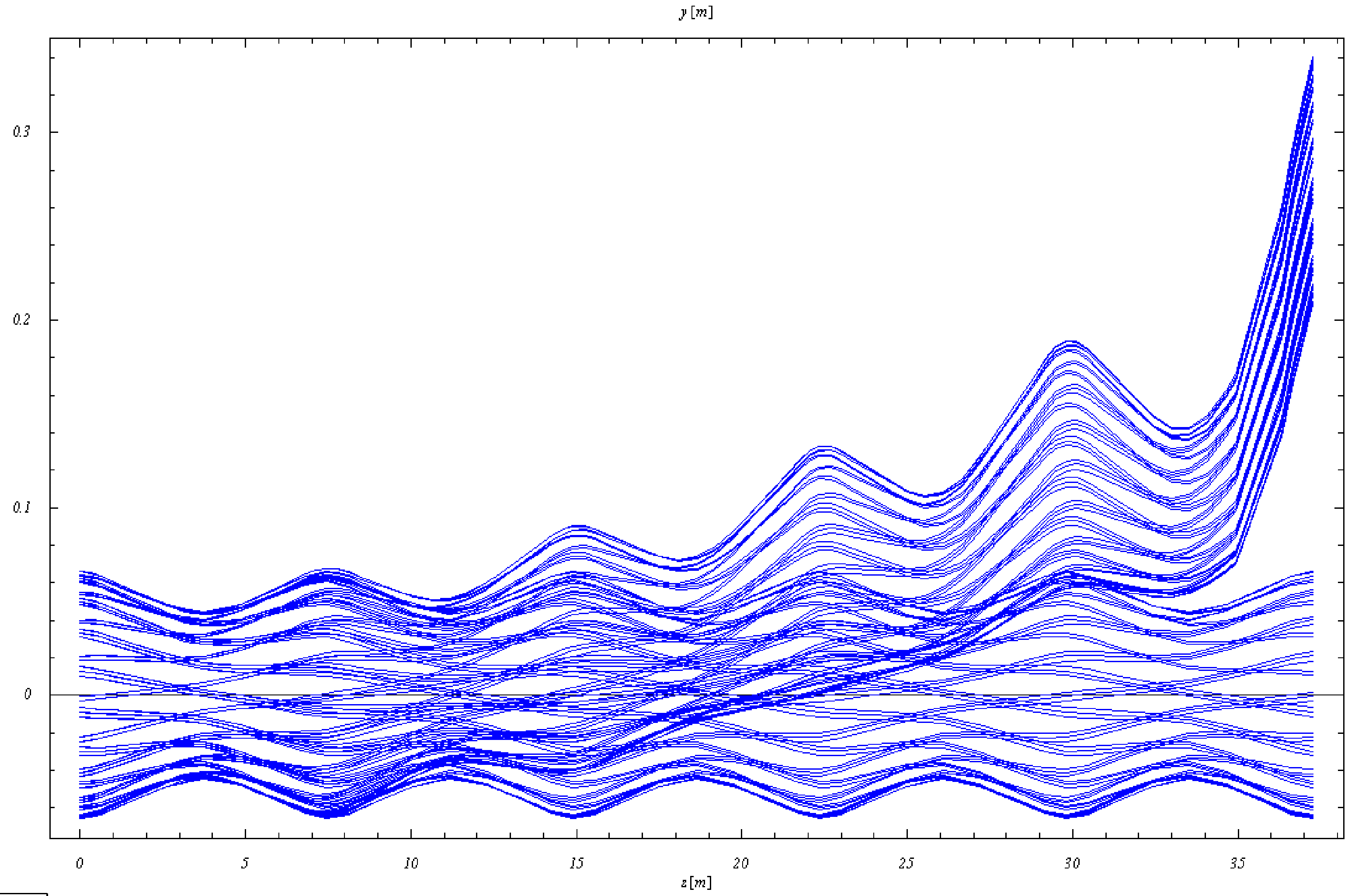
Acceleration
FFAG Injection/Extraction

- Several configurations (triplet, FODO, doublet)
  - FODO preferred: injection symmetry
- Short drifts (2 m)
- Need large kicker strengths or many kickers
- Prefer kickers below 0.1 T
- 6 kickers, vertical extraction
- Superconducting septum preferred
- Need extra aperture in magnets in inj/ext region

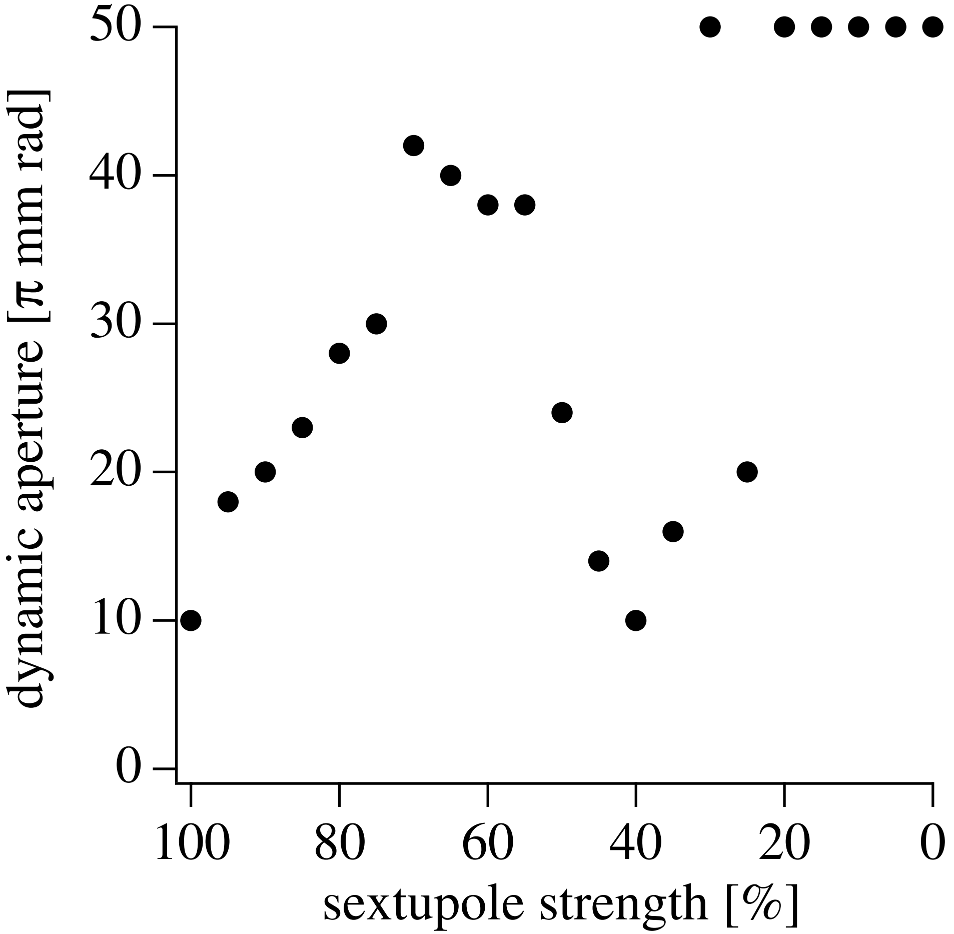
Acceleration
FFAG Extraction

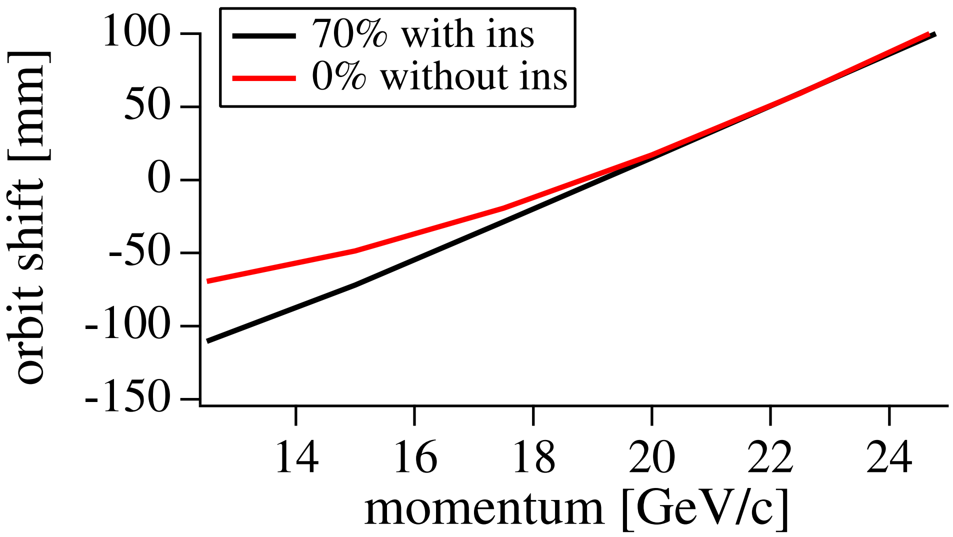


Acceleration
FFAG Improvements

- Prefer longer drifts, but hurt performance
  - Add insertions with long drifts
  - Breaks symmetry, can kill performance also
- Correct chromaticity: fix different time of flight for large amplitude
  - Kills dynamic aperture
- Partial chromaticity correction works well
  - Some cost in aperture, performance

Acceleration
FFAG Chromatic Correction

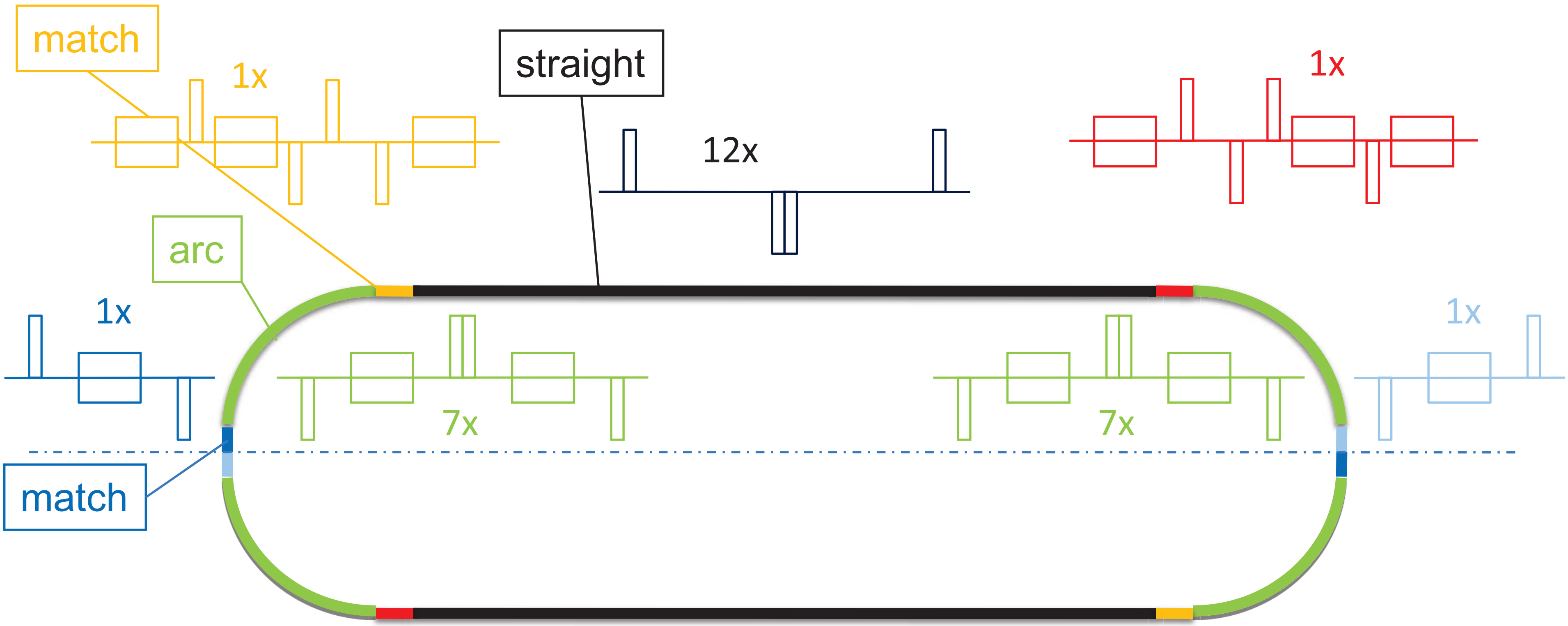




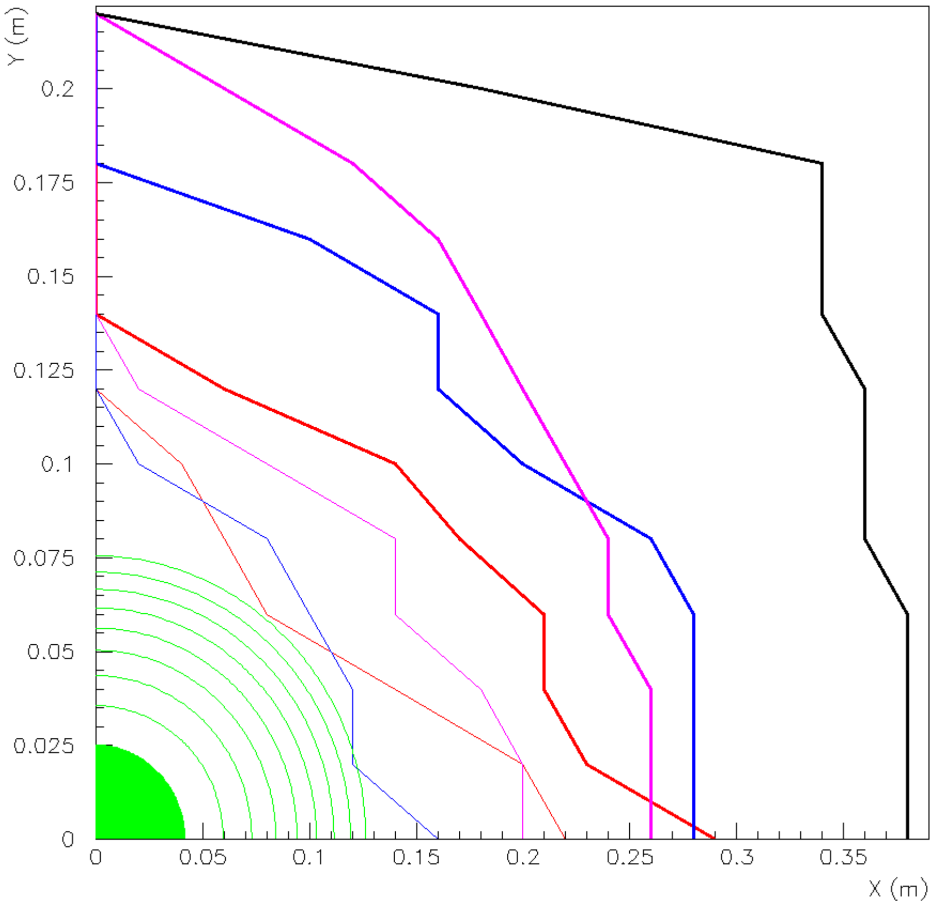
Storage Ring

- Beginnings of tracking
  - Very good dynamic aperture (no errors)
- Chromatic corrections
- Discussion of flux determination
- How much we can shorten storage ring?
  - Depth issue
- Bunch train lengthening: need RF?

Storage Ring



Storage Ring Dynamic Aperture



General Simulation

- Collective effects
  - Beam loading should be included
  - HOMs probably not a concern (check)
- Simulation
  - Working with different codes
  - Some interface and analysis code written

Conclusions

- We are rapidly settling on designs
- The tracking is starting
  - Need to progress to a complete end-to-end simulation
- RF in magnetic fields a significant concern
  - Many ideas for dealing with it
  - All have a cost
  - Make best guess about the limitations

Important Work Items/Questions

- Achieving bunch requirements for proton driver
- Bunch timing tolerated on target
- Mercury jet size evolution
- Limitations of RF in magnetic field
- FFAG design with injection/extraction
- Tracking end-to-end
- Storage ring circumference and depth
- Do we do low energy neutrino factory?