The IDS Baseline Accelerator Systems Scenario

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IDS Plenary Meeting
16 January 2008

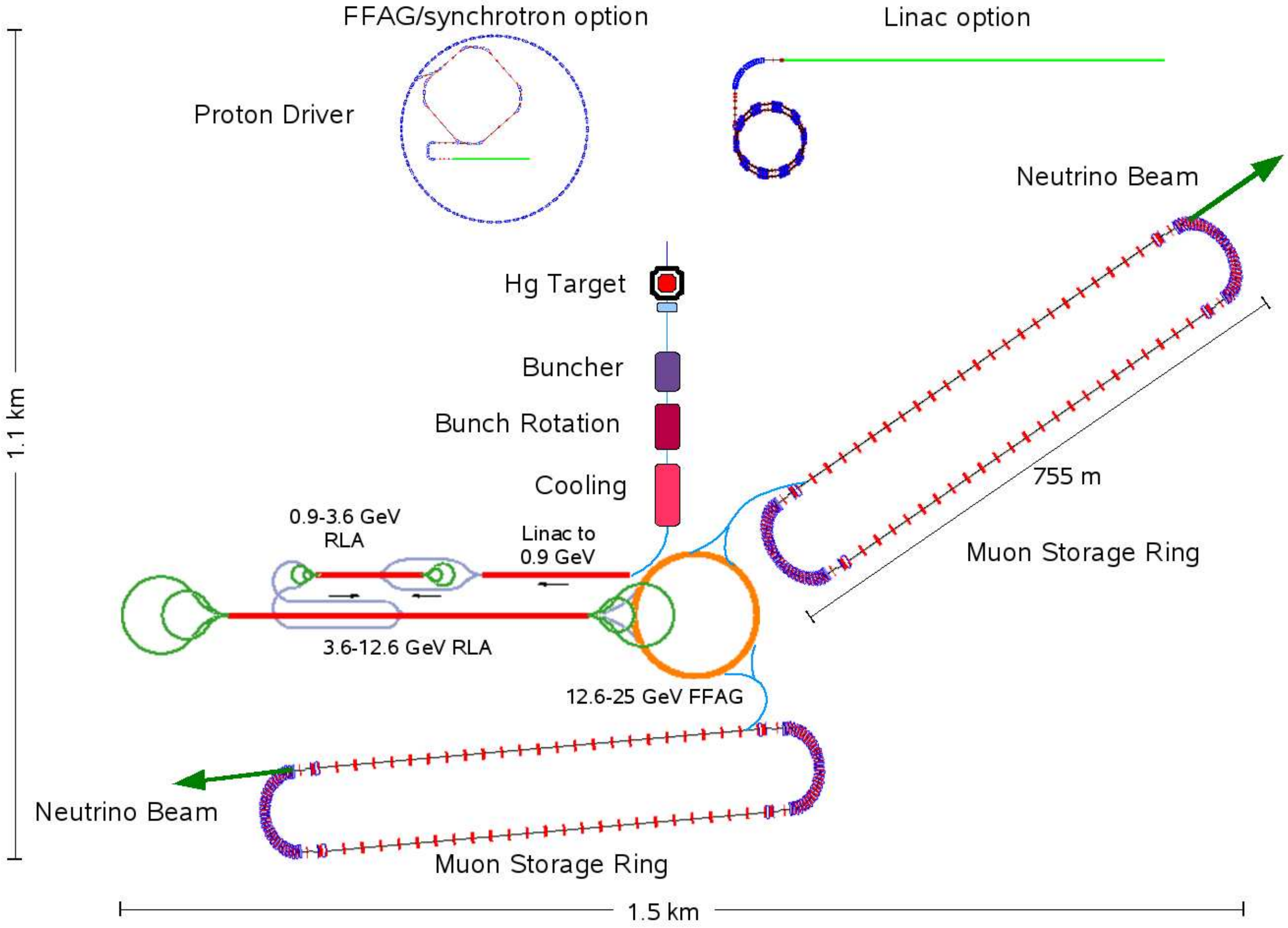
Accelerator Systems Goals

- 10^{21} decays per 10^7 second year toward target
- 25 GeV total energy muon beam
- Keep the cost down
- These are contradictory goals
  - Can increase neutrinos with more money
    - Proton driver
    - Cooling
    - Acceleration
  - Increase event rate with larger detector. . .

Accelerator Systems Components

- Proton driver, around 4 MW, 2 ns bunch length
- Mercury jet target
- Capture and phase rotation: 200 MHz train
- Cooling: “maximum” transmission into 30 mm transverse, 150 mm longitudinal acceptance
- Acceleration: to 25 GeV
- Storage ring(s): 25 GeV, 0.1/γ RMS angular divergence, “maximum” νs to 2 targets

IDS Accelerator Systems



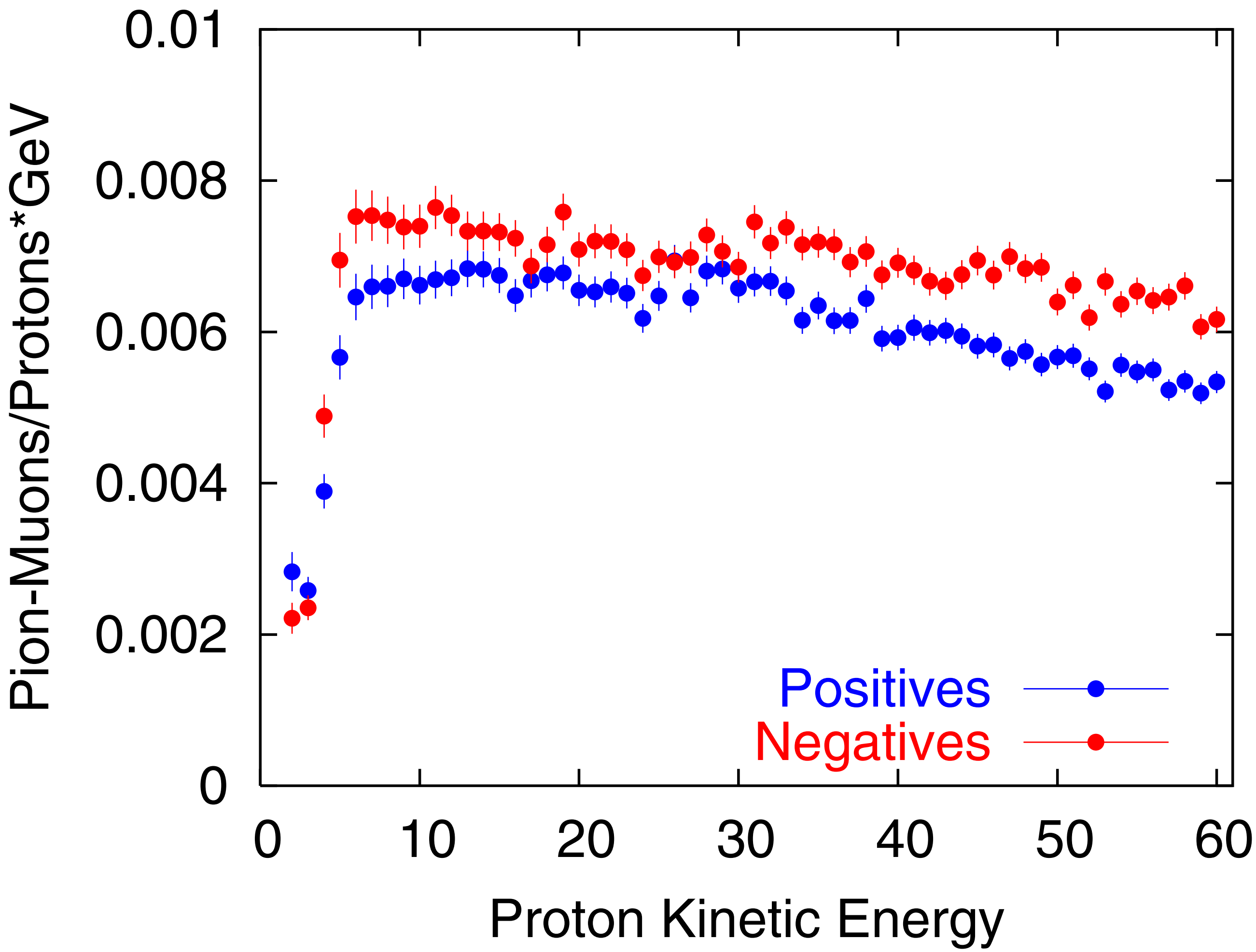
Accelerator System Baseline

- Based on the ISS design
- Some systems more well-designed than others. . .
- Will discuss possible problems later. . .

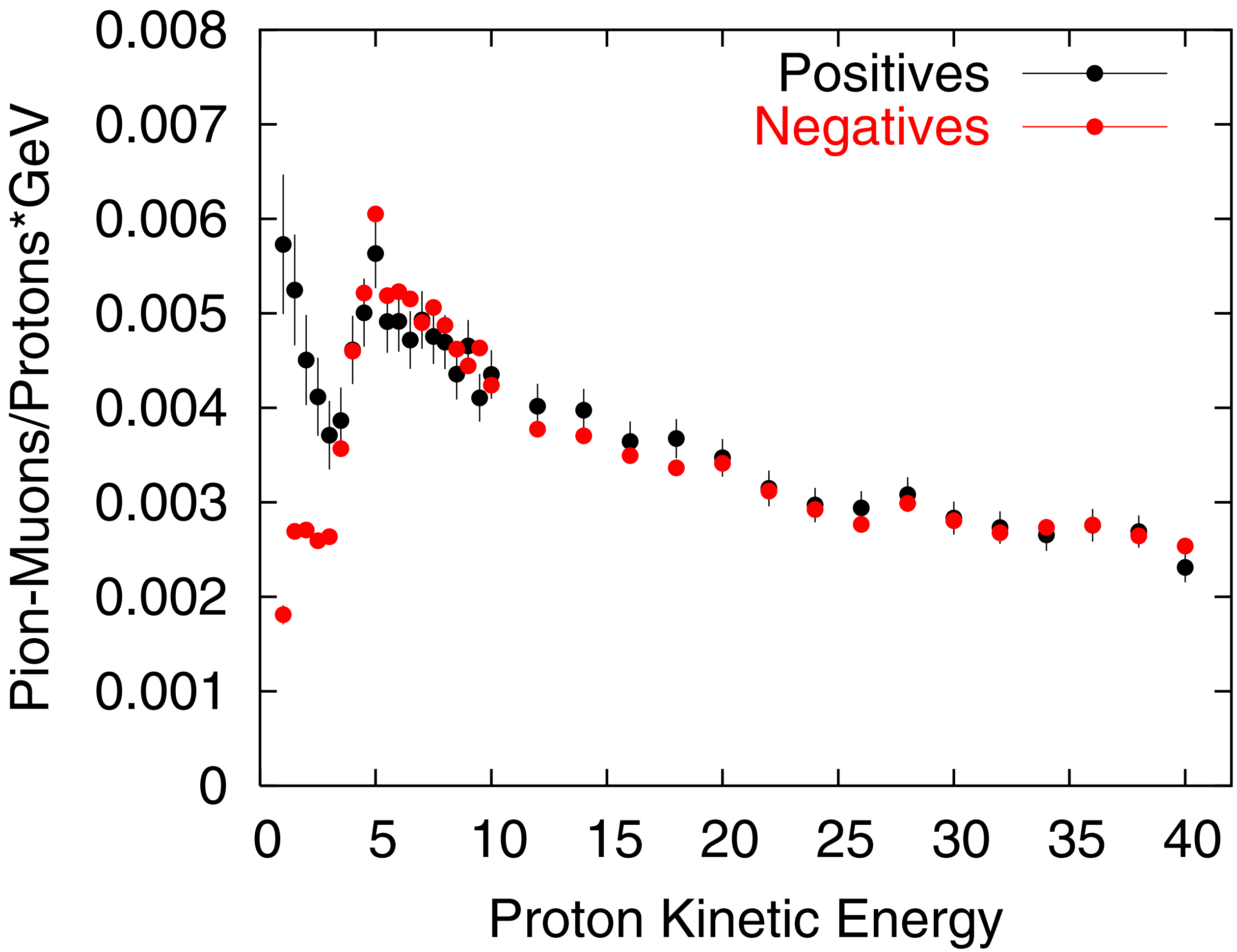
Proton Driver

- Right number of πs in accepted phase space
- Accepted pion count related to
  - Target choice
  - Beam energy
  - Bunch length
  - Indirectly to capture system?

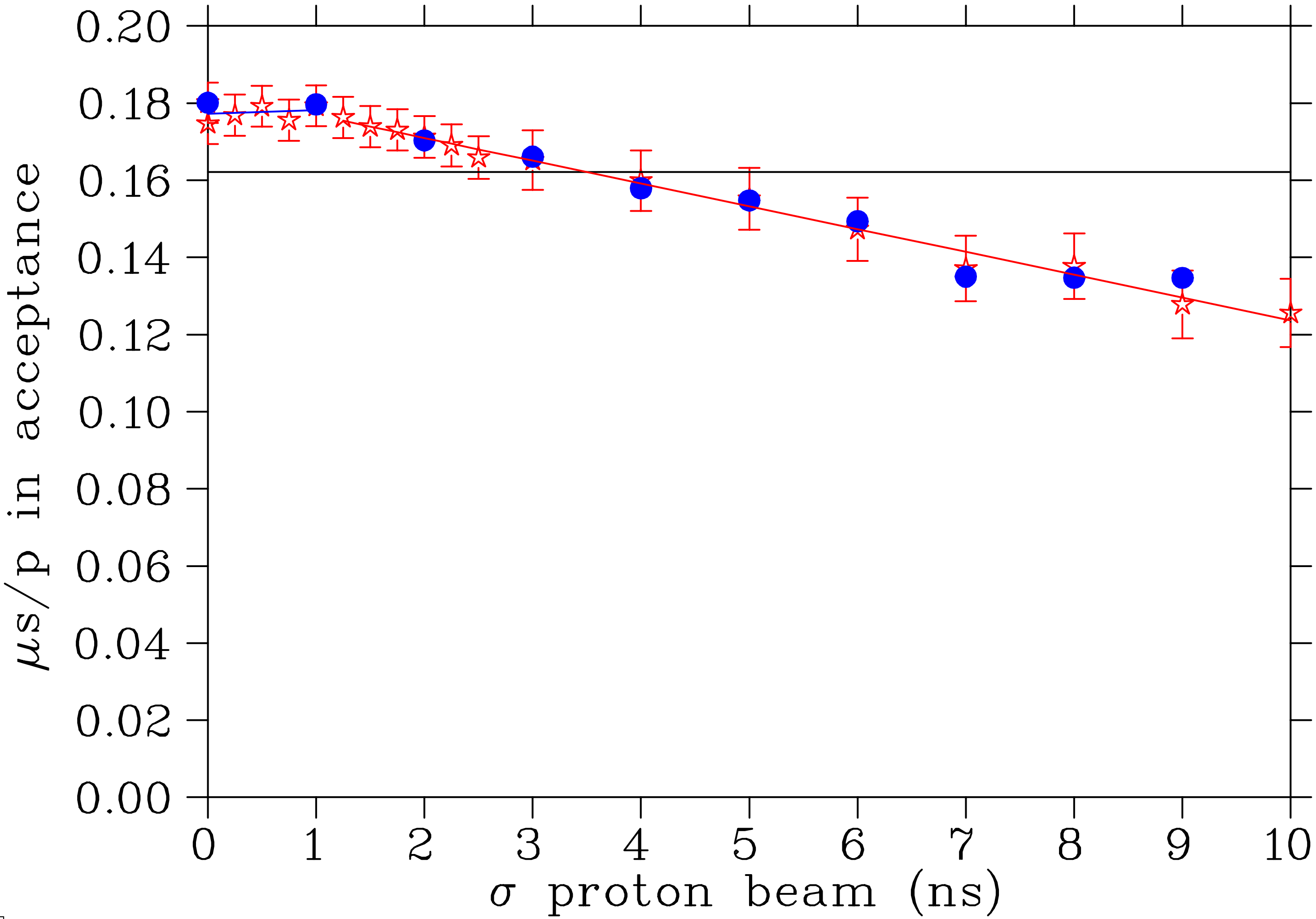
Efficiency vs. Energy
Liquid Mercury



Efficiency vs. Energy
Carbon



Efficiency vs. Proton Bunch Length



Baseline Proton Driver Parameters

Beam power	4 MW
Kinetic Energy	5–15 GeV
Repetition rate	50 Hz
Bunch length	1–3 ns
Bunches	3
Time between extractions	$\geqslant$ 17 μs
Pulse duration	$\leqslant$ 40 μs

Choosing within Ranges

- Site considerations enter
- Tied to target choice
- Only care about final μs
- Can trade poorer performance for more power
  - Radiation protection issues
- Production experiment results: change choice?
- Interaction with downstream systems
  - Bunch train pattern, muons per train

Target

- Goal: turn protons into pions, muons
- Mercury jet motivation
  - High *Z*, high pion production
    - At least for higher energies
  - Liquid jet won't break
- Liquid jet system more complex than solid
- Other liquids (PbBi)

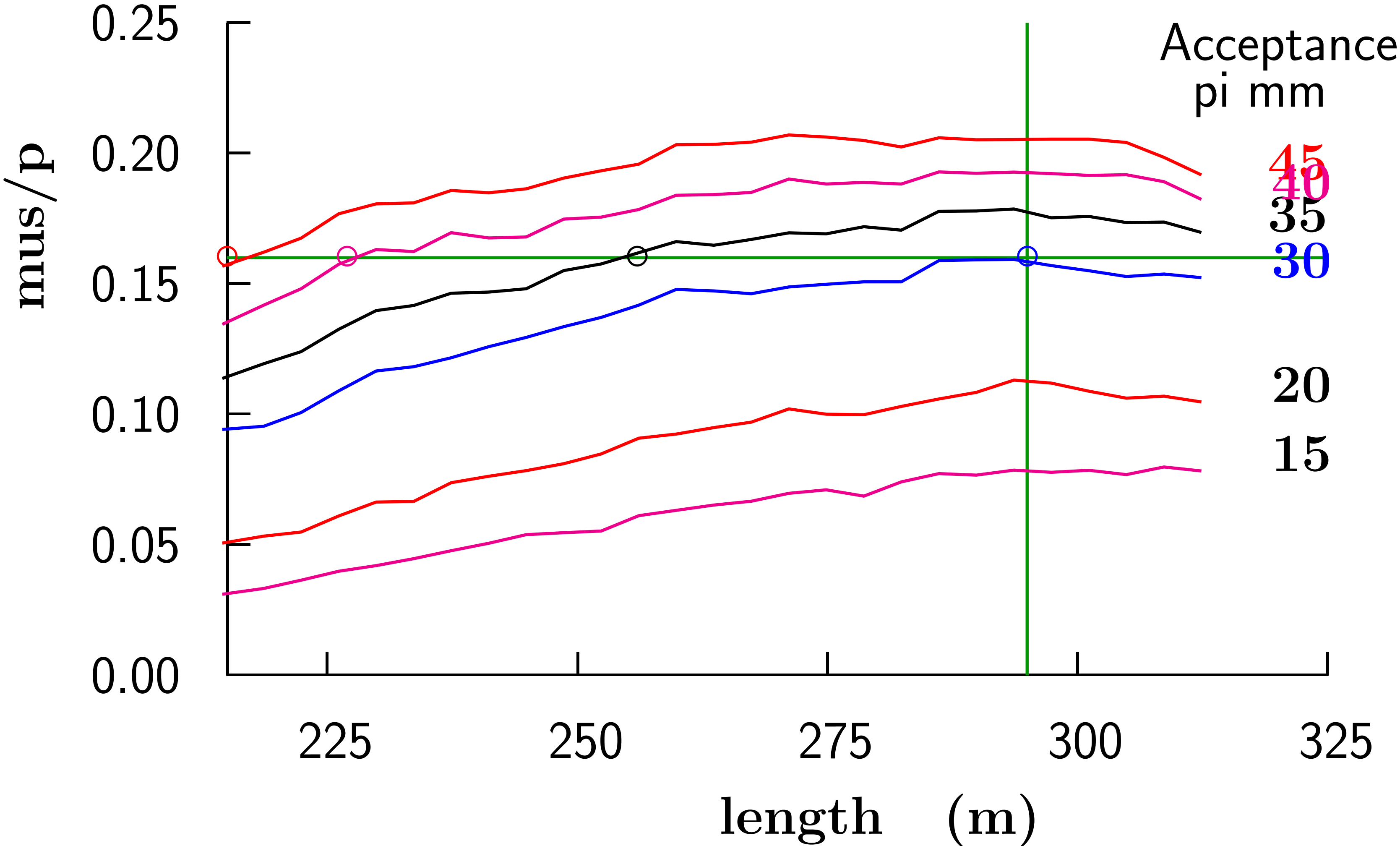
Capture, Phase Rotation, Bunching

- Start with muons from target
- Produce muons in 201.25 MHz bunch train
- Average momentum 220 MeV/*c*
  - Each bunch with same mean energy
- Designed to maximize capture
- Capture using long solenoid channel
- Bunching and phase rotation: “Neuffer” scheme
- Defined by ICOOL input file

Cooling

- Goal: increase muons within acceptance
  - 30 mm transverse, 150 mm longitudinal
- Don’t maximize cooling
  - Expensive
  - Inefficient at end (w/o tapering)
- 201.25 MHz RF, 15.25 MV/m
- FOFO magnetic lattice
- Defined by ICOOL input file

Cooling Performance vs. Length



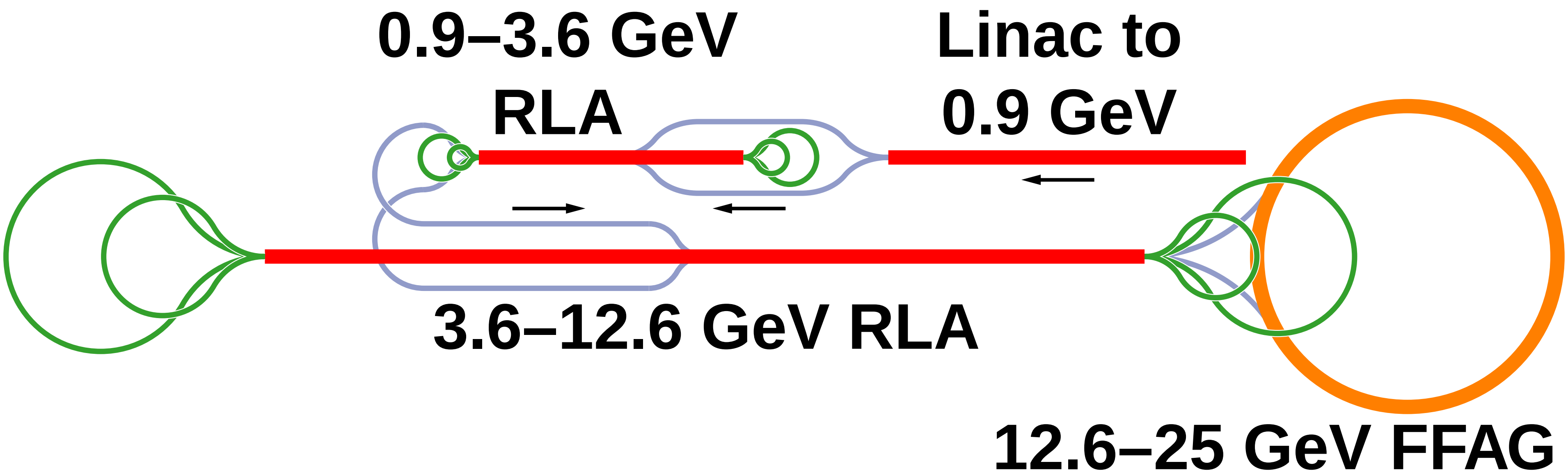
Acceleration

- Accelerate from cooling energy to 25 GeV
- Designed for cost reduction
- 201.25 MHz superconducting RF, 17 MV/m
- Different types for different energy ranges
  - Maximize passes through RF
  - Subject to cost optimization
- Not designed in detail at this point

Acceleration Stages

- Accelerate with NCRF lattice
  - SCRF cells too long: large beam size
- Linac to 0.9 GeV, 15 MV/m
- RLA to 3.6 GeV
  - Recirculate for efficiency: more passes
- RLA to 12.6 GeV
- Linear non-scaling FFAG to 25 GeV
  - Only gives more passes at high energy

Acceleration Subsystem



Storage Ring

- Racetrack shape chosen
  - Most flexible
- Try to get good efficiency
- 25 GeV total energy
- Angular divergence $0.1/\gamma$
- Two rings for two detectors
  - Each can handle both signs simultaneously
- Matching sections pointed away from detector

Storage Ring
ISS Design

- Existing design in place
- Some tracking done
- Simultaneously handles 20 GeV and 50 GeV
- May not achieve $0.1/\gamma$ angular divergence at 25 GeV