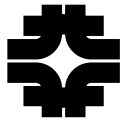
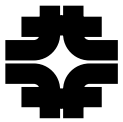


Overview of Plans for High Intensity Neutrino Beams

R. Dixon



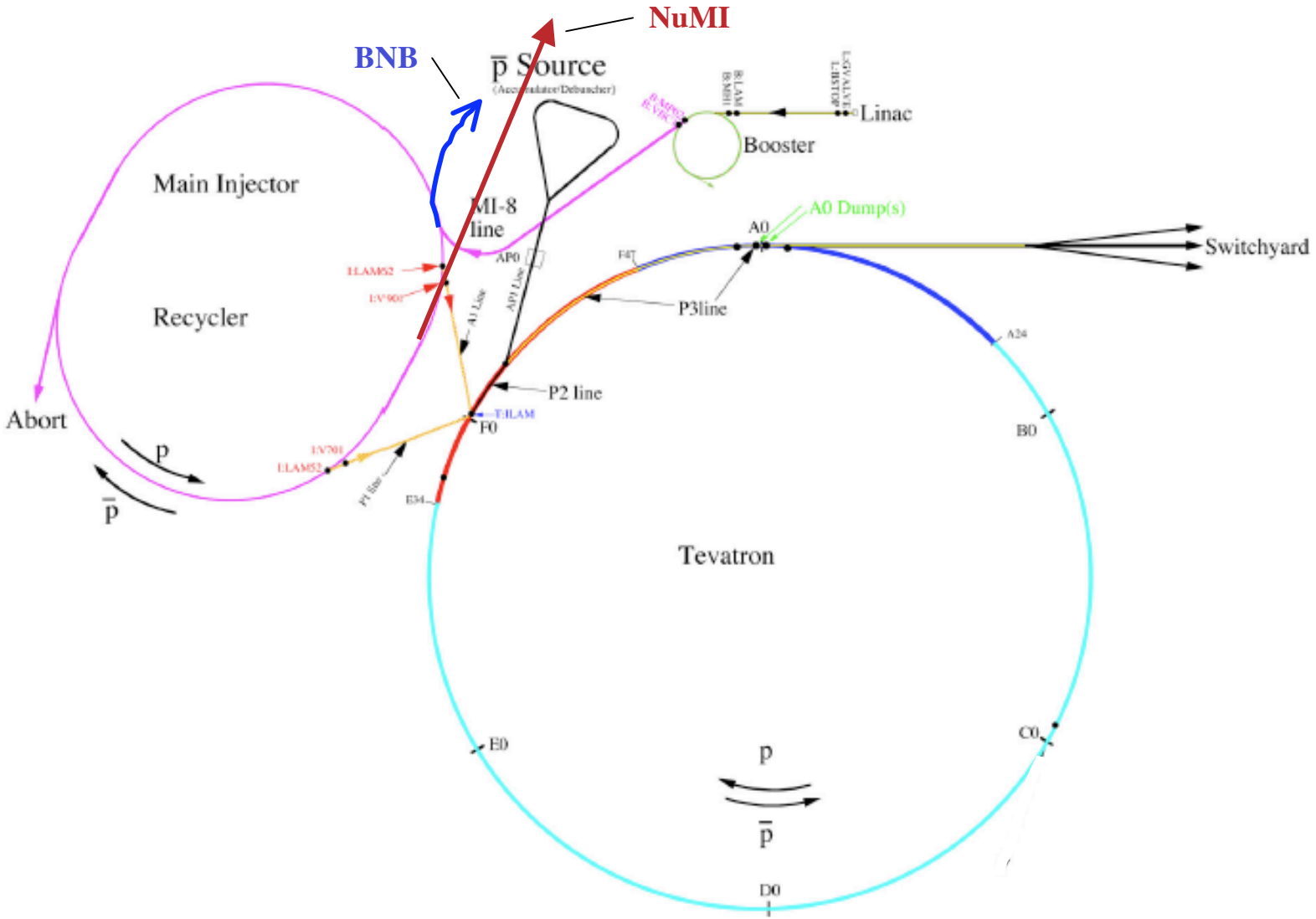
Overview

- High Intensity Neutrino Beams using existing Accelerator infrastructure
  - Historical Perspective
  - Status of Plan
  - Preview of upgrades necessary

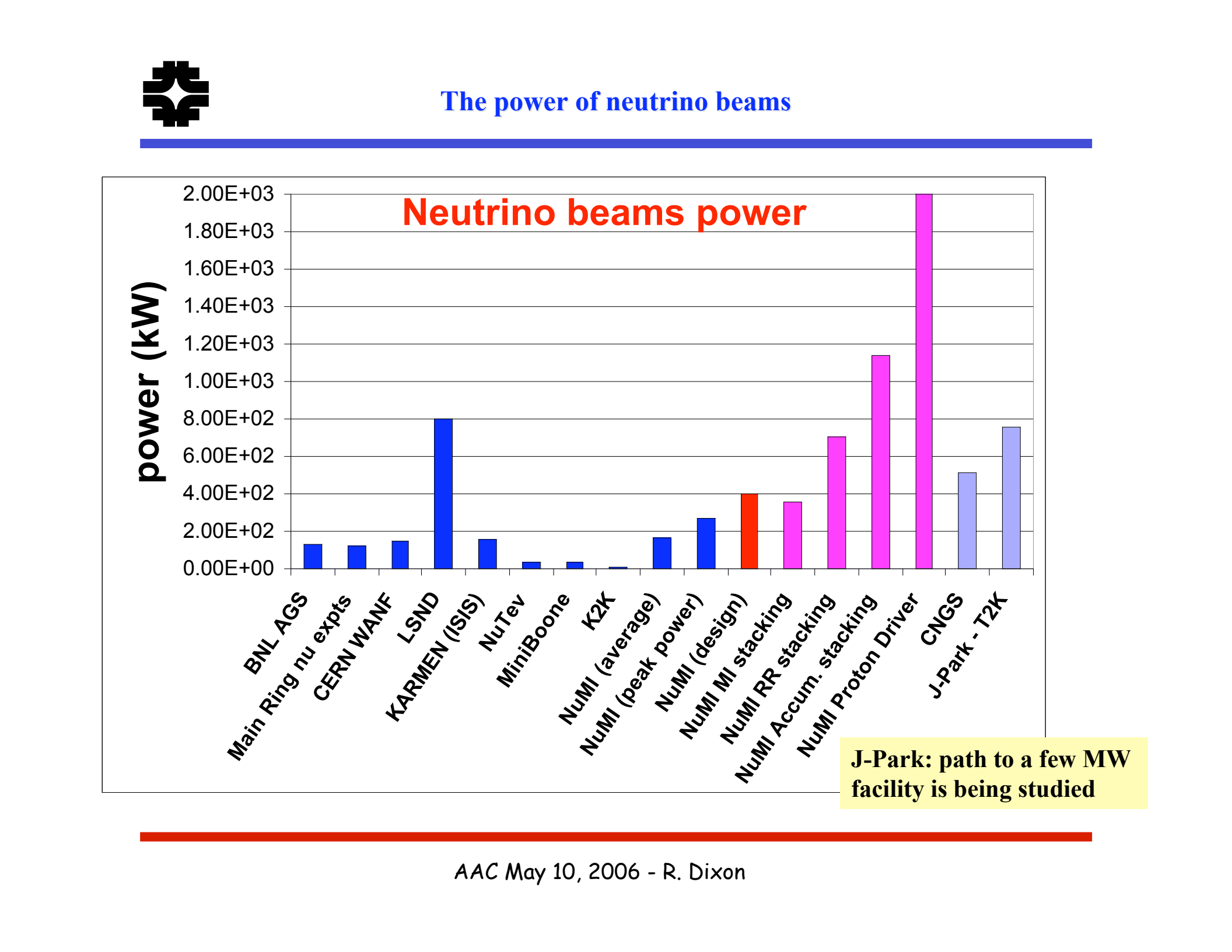
Historical Highlights

- 2005-- Laboratory and DOE conclude that Tevatron is likely to be decommissioned by about 2010
- 2005-- Proton Plan to increase proton intensities for NuMI and the Booster Neutrino Beam (BNB) baselined
- Dave McGinnis (and others) realize that decommissioning the collider frees up infrastructure that could be used to support the Laboratory's neutrino program before or instead of a Proton Driver
- Alternate Proton Source (APS) concept developed by Dave McGinnis
  - Plan has the advantage that it can be staged
  - Early stages are relatively low cost and there is benefit after each stage is completed
- APS shown to Physics Advisory Committee at June, 2005 meeting
  - Plan was discussed as a backup plan for NOvA should there be no Proton Driver
- Spring, 2006 becomes an official part of Lab strategy for providing neutrino beam to NOvA
  - I charge a small group led by Alberto Marchionni to develop a plan for 700 kW
  - Work begins work to define a project-- SNuMI (Superbeam upgrade to NuMI)

Accelerator Layout



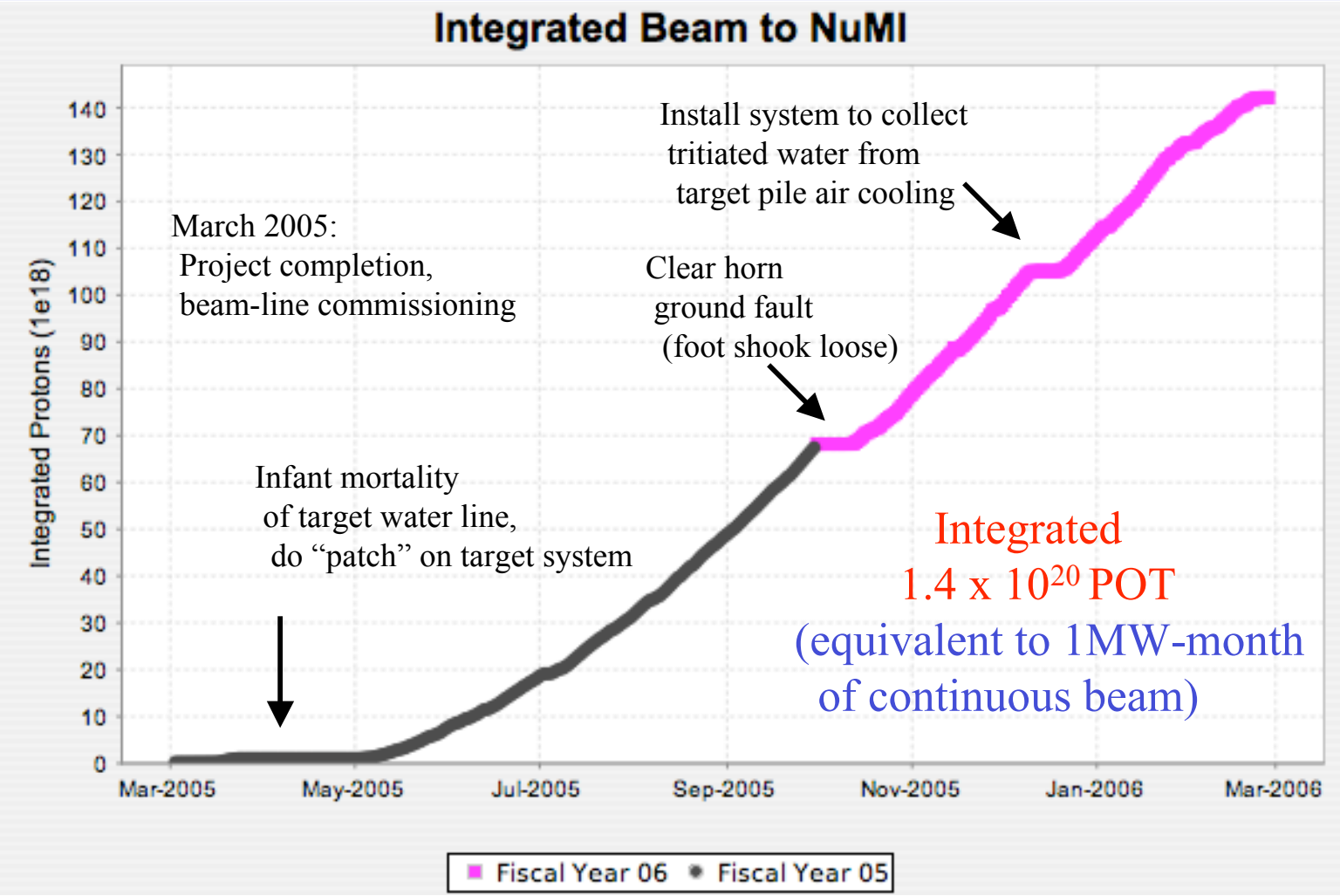

To Soudan Mine
MINOS Near Detector
MiniBooNE
Booster
Decay
Enclosure
Target
Enclosure
Tevatron
Main Injector
FERMILAB #98-1348D



The power of neutrino beams

J-Park: path to a few MW facility is being studied

NuMI Operational Issues*



*slide courtesy Jim Hylen

Charge for First Stage

- "I would now like you to develop a conceptual design and cost estimate for a modification to the Recycler and Main Injector to provide a 0.7 MW 120 GeV beam to NuMI after the collider program ends. The main feature of this upgrade is to convert the Recycler into a proton accumulator, shortening the Main Injector cycle time from 2.2 seconds to 1.5 seconds. . .

- The conceptual design should consider all aspects of high power acceleration and transport; beam stability, RF power, instrumentation, collimation, transport and targeting, radiation shielding, groundwater and air activation for all facilities . . ."

Complete Proton Plan

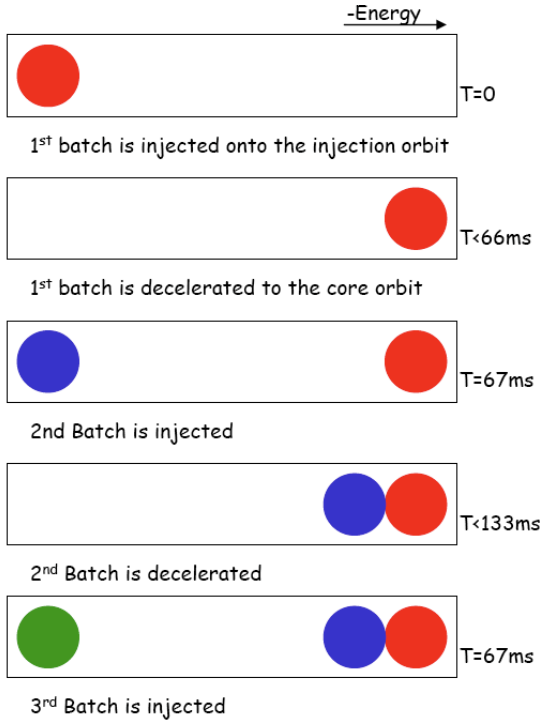
- 400 KW Neutrino Beam
  - Booster at 9 Hz
  - Intensity = ~5 X 10^{12} per batch
  - MI ~ 4 to 5 X 10^{13} per cycle
- Requires Proton Plan improvements to Linac, Booster, and MI
  - Highlights
    - Loss Reduction in Booster and Main Injector
    - Increase cycle time of Booster
    - Booster injection improvements
    - New correction elements
    - Slip Stacking in the Main Injector
    - MI aperture and collimation

700 kW Neutrino Beam

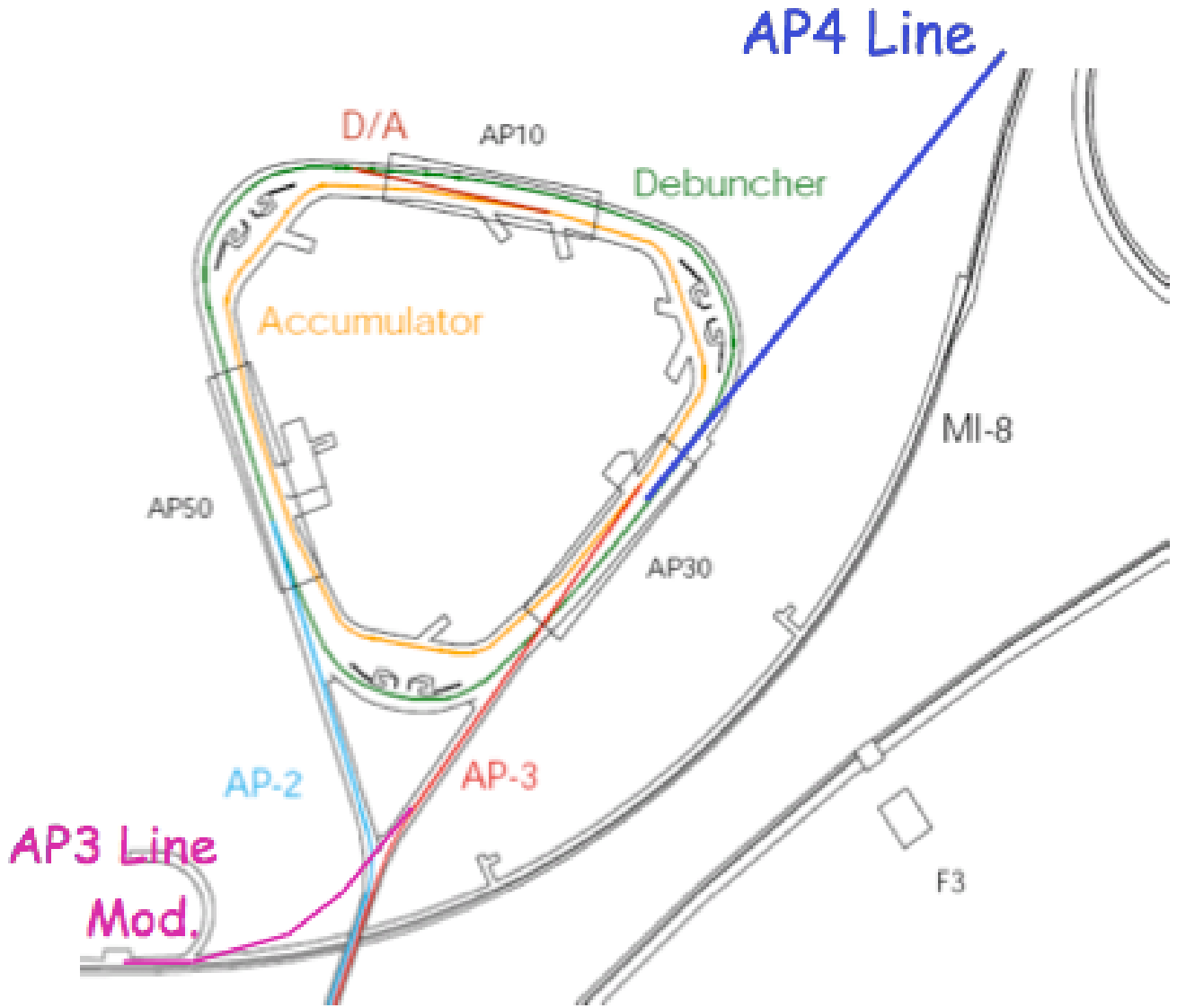
- Upgrade Booster to 15 Hz operation
- Convert Recycler to Proton Pre-injector
  - Construct new Injection line from MI-8 line into Recycler
  - Add 2 RF systems to Recycler
  - Implement Slip Stacking in Recycler
- Results
  - Reduces cycle time of MI to ~1.5 sec
  - MI Intensity --> 5.4 X 10^{13}
  - Beam Power ~ 700 kW

1 Megawatt Neutrino Beam

- Tevatron decommissioned
  - Add injection line from Booster to the Antiproton Accumulator
  - Momentum Stack up to 4 Booster batches in the Accumulator
  - Transfer accumulator beam into Recycler
- What is needed
  - New RF system in Main Injector
  - New injection line for the Accumulator



Construction for Accumulator Adding Accumulator



Beam, Target, and Horn

- Issues
  - Beam certification-- probably straightforward
  - Target-- NOvA medium energy horn less constained than present situation ==> flexibility in design
  - Thermal shock
  - Humidity in Target Chase
  - Decay Pipe Window
  - Hadron Aborber
  - Shielding assessment and ground water protection

Possible Schedule Scenario

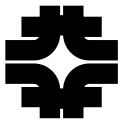
- Shutdown in 2010 for approximately a year to complete work for achieving 1MW
  - Turn beam on in 2011 at 700 kW
  - Running at 1 kW steadily in 2013

This does not take full advantage of staging

Staging gives us additional flexibility

Benefits of Staging

- Because the concept uses existing infrastructure the performance can be broken into stages
- Project staging has the important benefit of providing
  - a fraction of the total performance
  - at a fraction of the total cost
- The schedule for each stage is driven by physics need and funding availability
- **Each stage is based on standard accelerator technology and accelerator parameters that are currently achievable.**



Summary

- Upgrading existing infrastructure can deliver up to 1 Megawatt neutrino beams without large costs
- Technical Challenges do not appear insurmountable
  - No new technology is necessary
  - Some construction
  - Total cost < $50M
- Conservative schedule scenario has 1 MW beam by 2013
  - 700 kW beam could be running in 2011