Project X

Review Transfer/Injection R&D Plan – Siting Issues

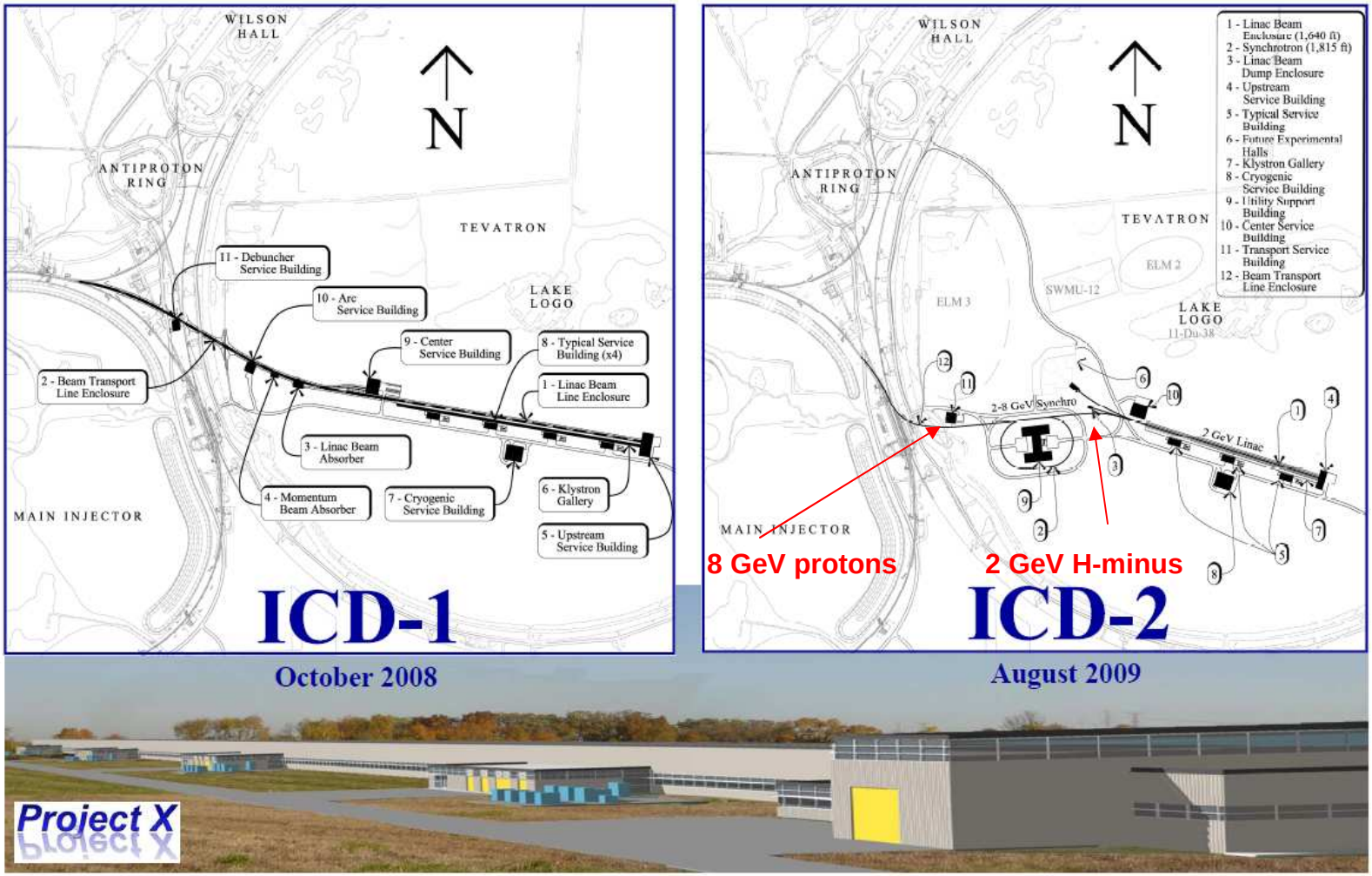
David Johnson

Fermilab

October 11, 2009

Fermilab Site and Stay Clear Regions

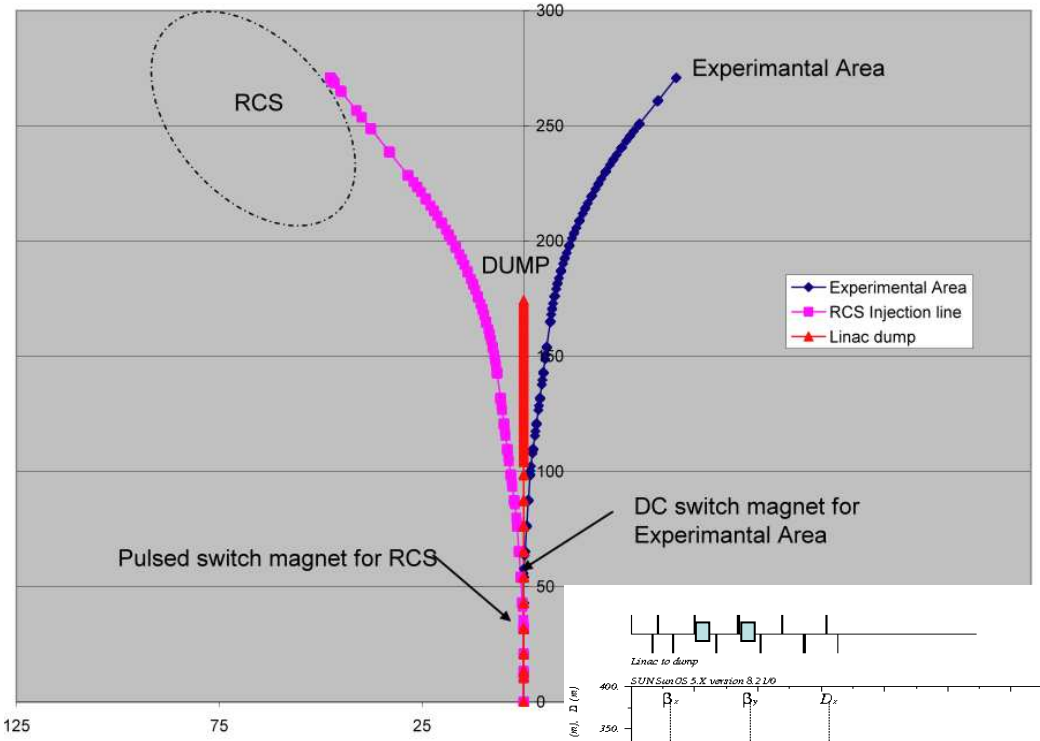
Comparison of ICD-1 and ICD-2 Siting

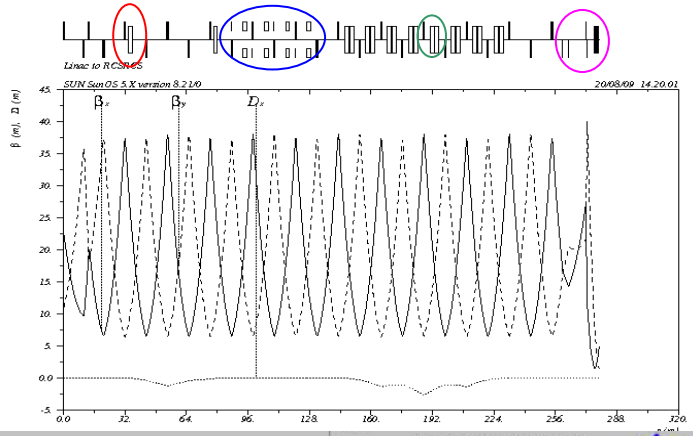


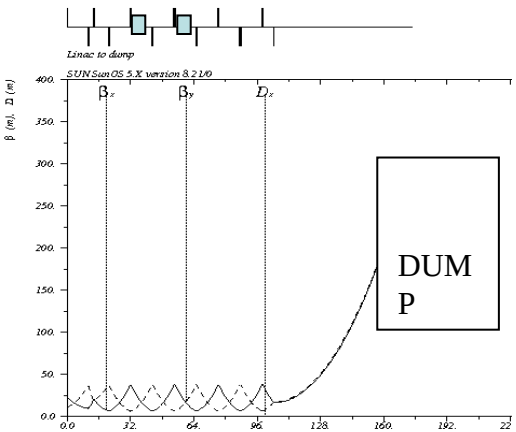
2 GeV Transport

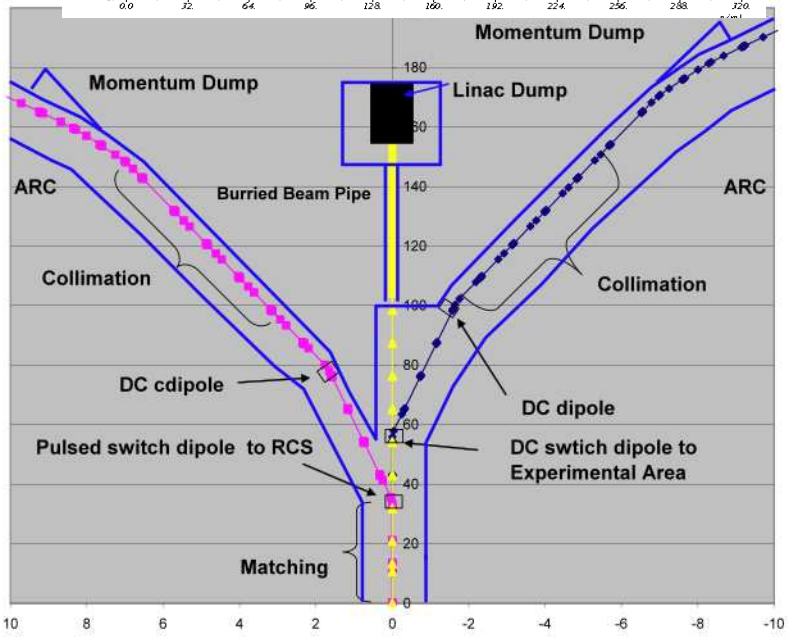
- Linac Accelerates only H-
- Split between RCS (85 kW), Experimental Area (2 MW), and Linac dump (200 kW)
- Low loss transport lines <residual> ~5 mrem/hr
  - Loss rate goal for Linac to RCS: 6×10^{-7}/m
  - Loss rate goal for Linac to Exp. 2.6×10^{-8}/m
- Single particle (Lorentz, gas, black body) not an issue with transport to RCS, but BB may be an issue for transport to Exp.
- Difference in beam power potentially different collimation schemes
- Convert H- to protons for delivery to Exp. (current thought at end of line)
- Splitting to experiments using deflecting cavity
- Transport lattice is straight forward

2 GeV Transport





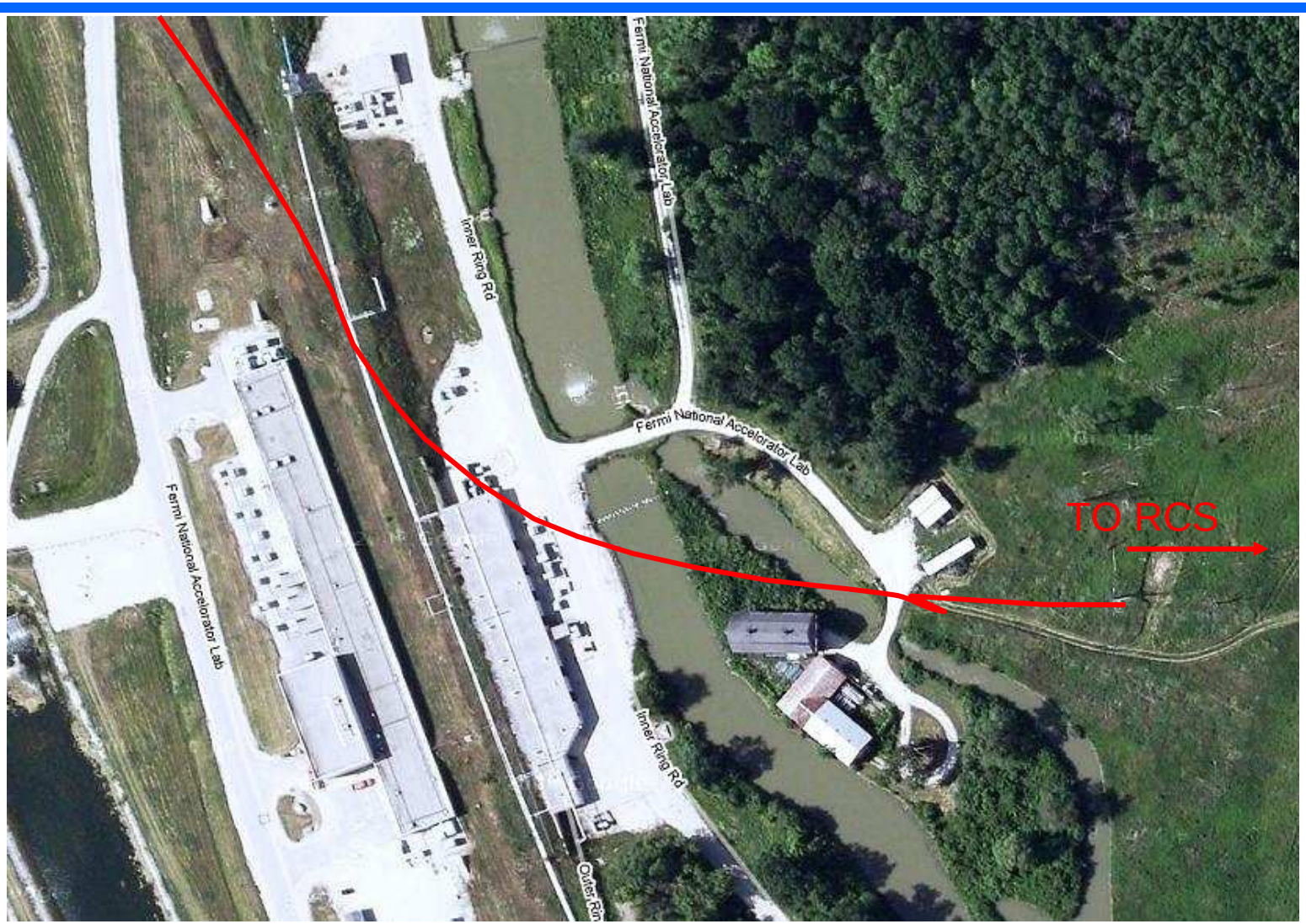




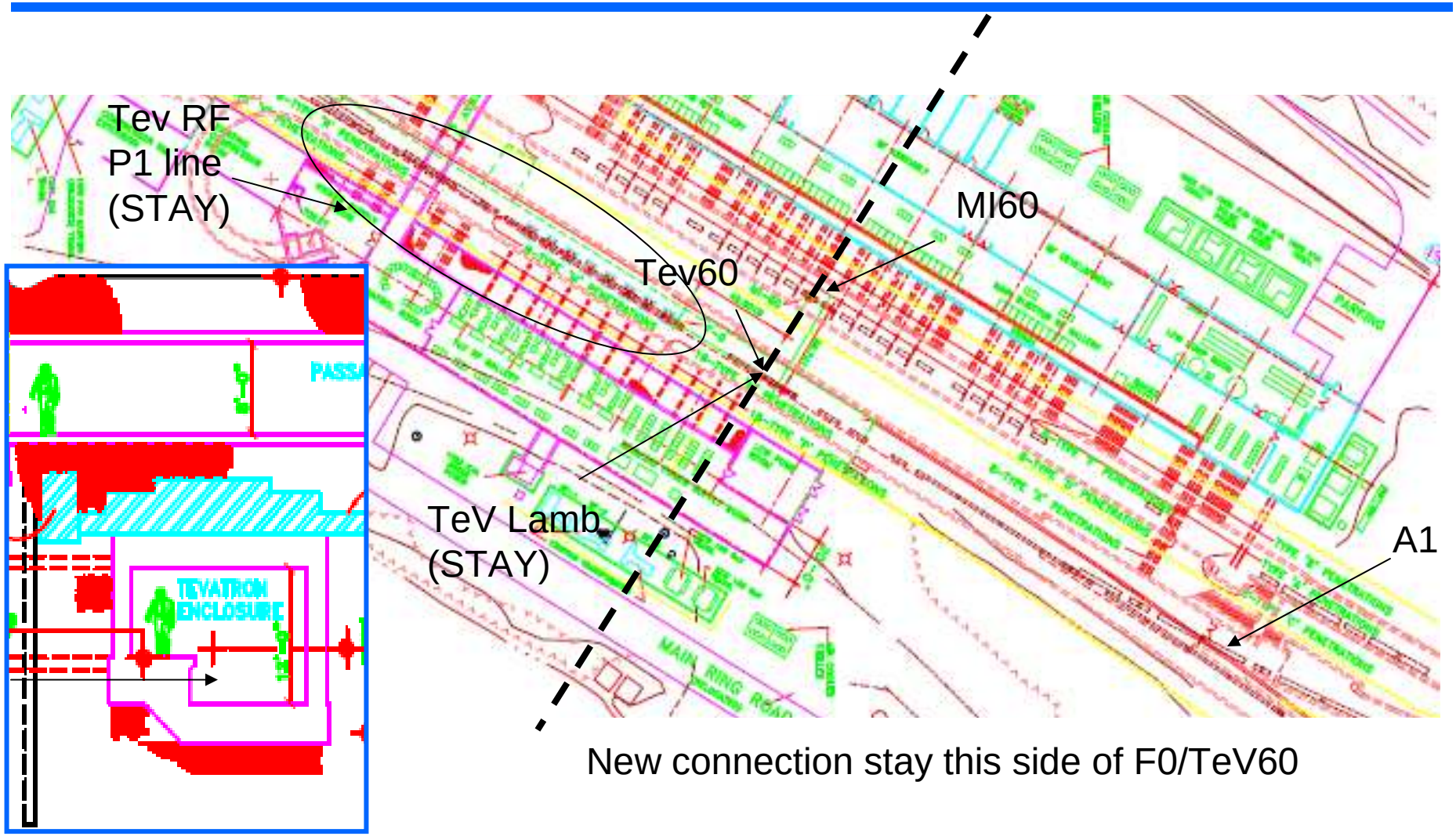
8 GeV Extraction &Transport

- RCS Extraction region is tight but is doable
- Provide for an extraction dump (no RCS abort to track energy)
- Transport 8 GeV protons: RCS to Recycler (340 kW)
- Fixed energy Recycler -> transport with permanent magnets. Geometry dictates some combination of powered an permanent magnet solution
- Needs to fit into existing A1 transport line through one of the most congested areas on site. (like putting 10lbs in a 5 lb bag)
- Transport lattice is straight forward
  - 3 horizontal achromats
  - Vertical achromat
  - Dump switch
  - Matching sections
- Recycler Injection is straight forward
  - A copy of the Nova Injection (with a little bit different magnet parameters)
  - Also a complicated location (where A1 crosses NuMI & DUSEL)

RCS connection to MI

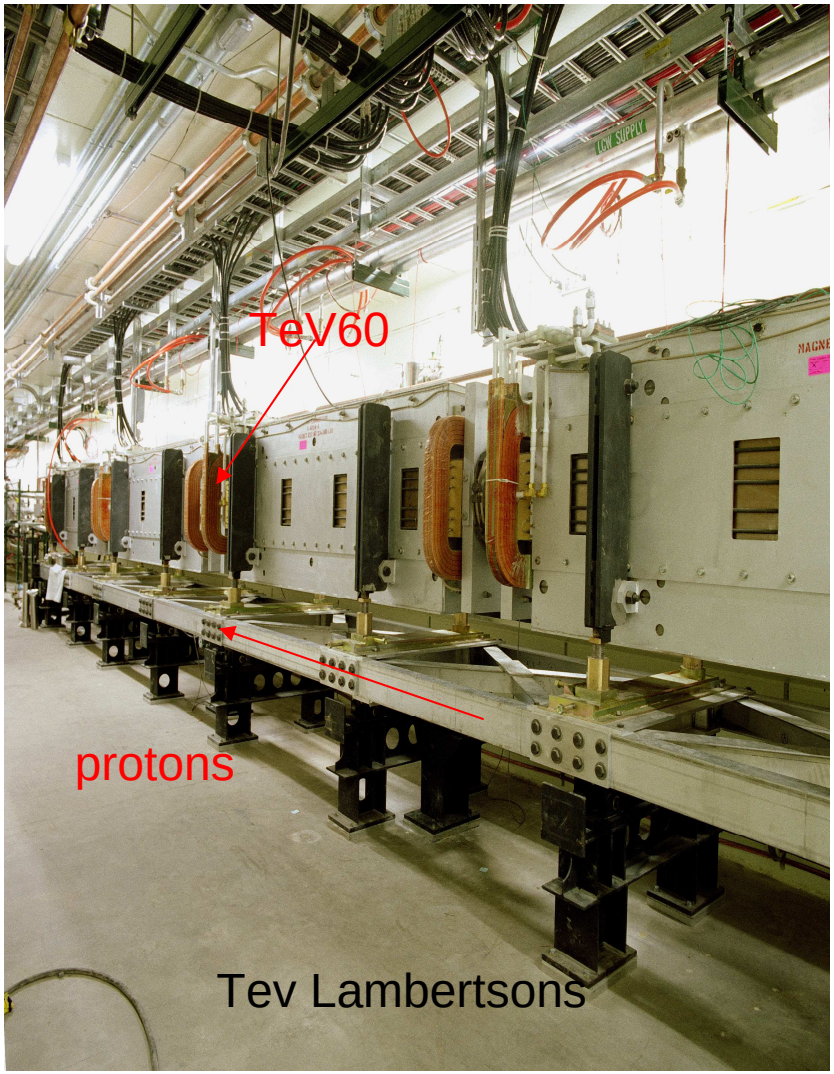


MI/Tevatron connection

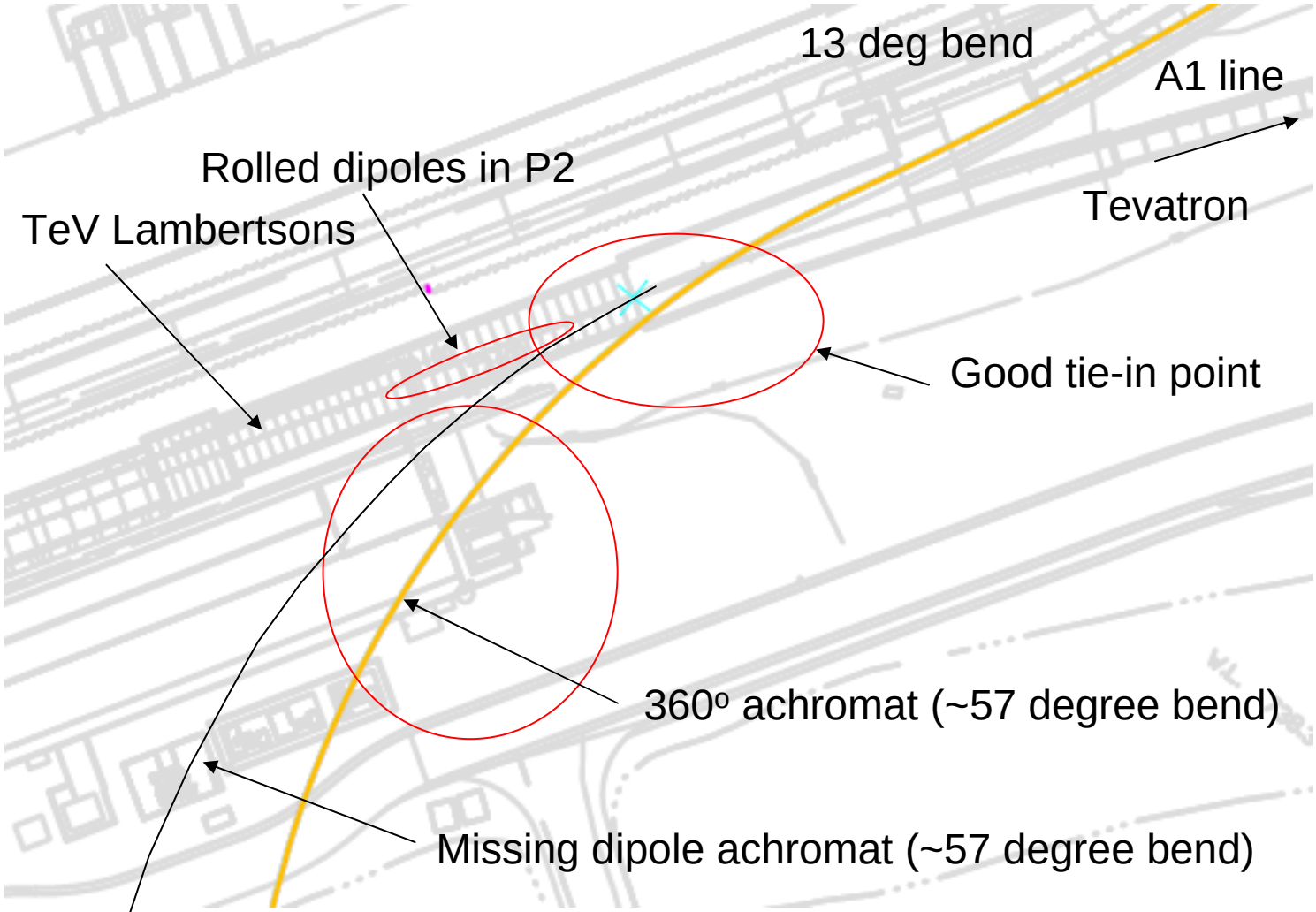


New connection stay this side of F0/TeV60

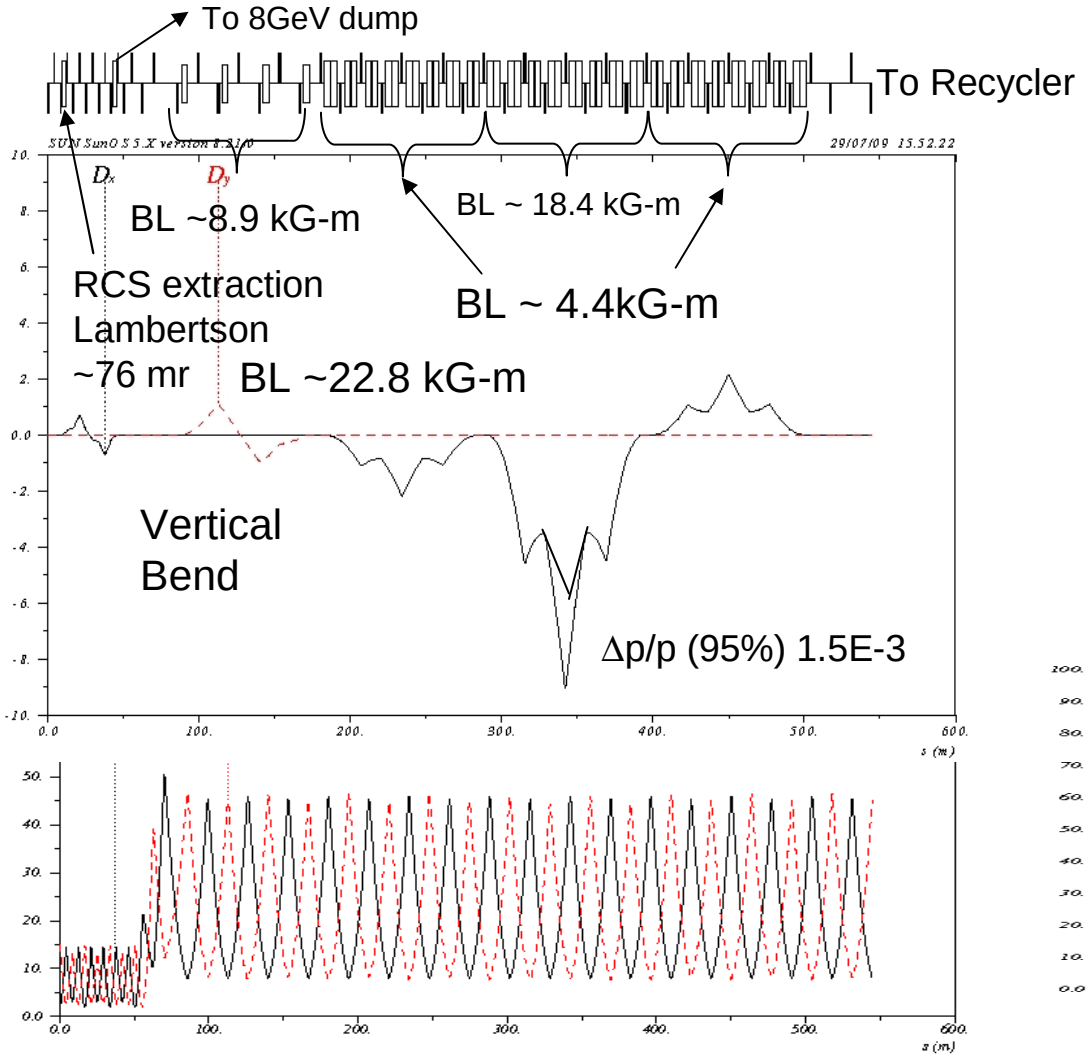
Inside of F0 Tunnel

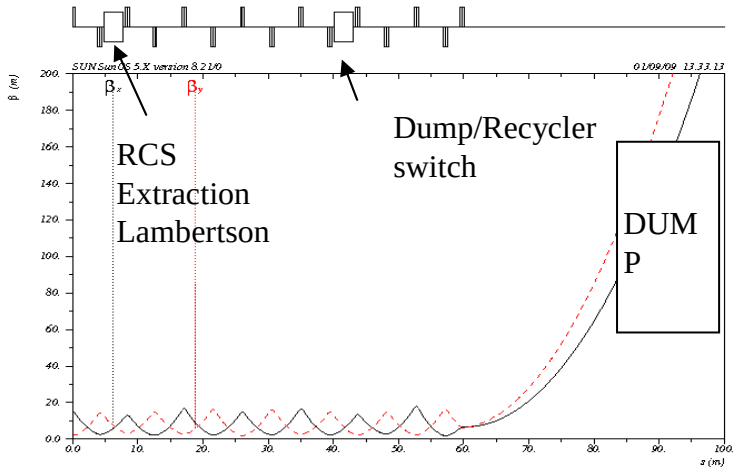


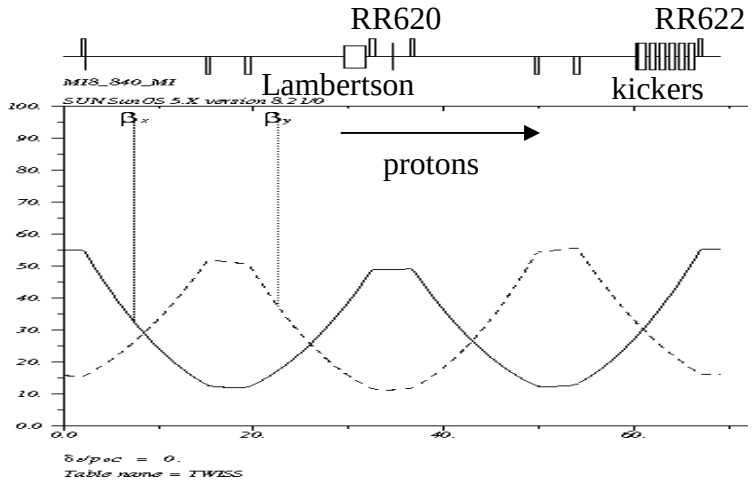
First pass solution to get into A1 line



Preliminary FY10 Transfer /Injection R&D Plan







Preliminary FY10 Transfer /Injection R&D Plan

Summary of 2 & 8 GeV Transport

- Design for 2 GeV is straight forward
  - Need to pay attention to collimation design
  - Need to pay attention to losses in Experimental line
  - Optimization of magnet designs
- Design of 8 GeV extraction/transport/injection is straight forward
  - Optimization of extraction Lambertson design
  - Permanent magnet and electromagnet design optimizations
  - Specification and design for proton collimators (trans & mom)

Status of ICD-1 & ICD2

- Both ICD-1 and ICD-2 designs are still on the table,
  - will there be an ICD-3 incorporating the best of both or something different ????
- Many ICD-1 design issues have been flushed out to the point of identifying no “show stoppers” and could quickly resume if design moves forward.
- ICD-2 design issues are in their infancy and require more effort to bring to the design level of ICD-1.
- Strategy for the first part of FY10 will be to focus on most pressing design issues for ICD-2 while still addressing issues that may be common to both designs (such as transverse collimation and beam absorbers).
- Once the preferred configuration has been determined, R&D effort will shift to focus on the preferred configuration.

FY09 R&D Plan (for ICD-1)

- The R&D program was broken up into 2 tasks:
  - Transfer Line R&D (included 5 tasks)
  - Recycler Injection R&D (included 7 tasks)
- All tasks were ICD-1 Design specific and many started on a more detailed conceptual design and could move into a pre-engineering design

Transport Line

1. Optics/footprint
2. Vacuum System
3. Transfer Line Collimation
4. Energy Correction System
5. Linac Absorber

Recycler Injection

1. Recycler/Injection lattice
2. Injection Chicane system
3. Foil Stripping system
4. Laser Stripping system
5. Transverse painting
6. Longitudinal painting
7. Waste beam handling

Status of FY09 R&D Plan

- None of the R&D tasks were time sensitive, in that early R&D was not on critical path.
- After the Project X ICD-1 Directors Review an alternative configuration was introduced.
- Many tasks were not addressed during FY09 due to the impending alternative design. Some issues were not relevant to new alternative configuration…
- Following items were addressed

Transport Line

- Transfer Line Collimation: continued conceptual design of 2 stage collimation system using TRACK and MARS (low level activity)

Recycler injection

- Recycler Injection Lattice- created a simplified Recycler lattice to fine tune injection straight, ring tune, and phase trombone
- Implementation of transverse and longitudinal painting for the Recycler into ORBIT
- Minimal effort on further refinement for injection waste beam dump

Preliminary FY10 Transfer /Injection R&D Plan

ICD-1

Transport Line

- Continue Collimation design

Recycler Injection

- Further optimization of Recycler lattice (detailed modifications required)
- Investigation of dynamic aperture, space charge, tune footprint, etc.

ICD-2

Transfer Line

- Optimization of transfer lines
- RCS extraction/Recycler Injection optimization
- Collimator design (in conjunction with ICD-1 effort)

RCS Injection

- Injection optics
- Foil stripping
- Laser stripping
- Waste beam handling