Project X

Status and Plans for the Pulsed Linac Transfer Lines

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Project X Fall Collaboration Meeting

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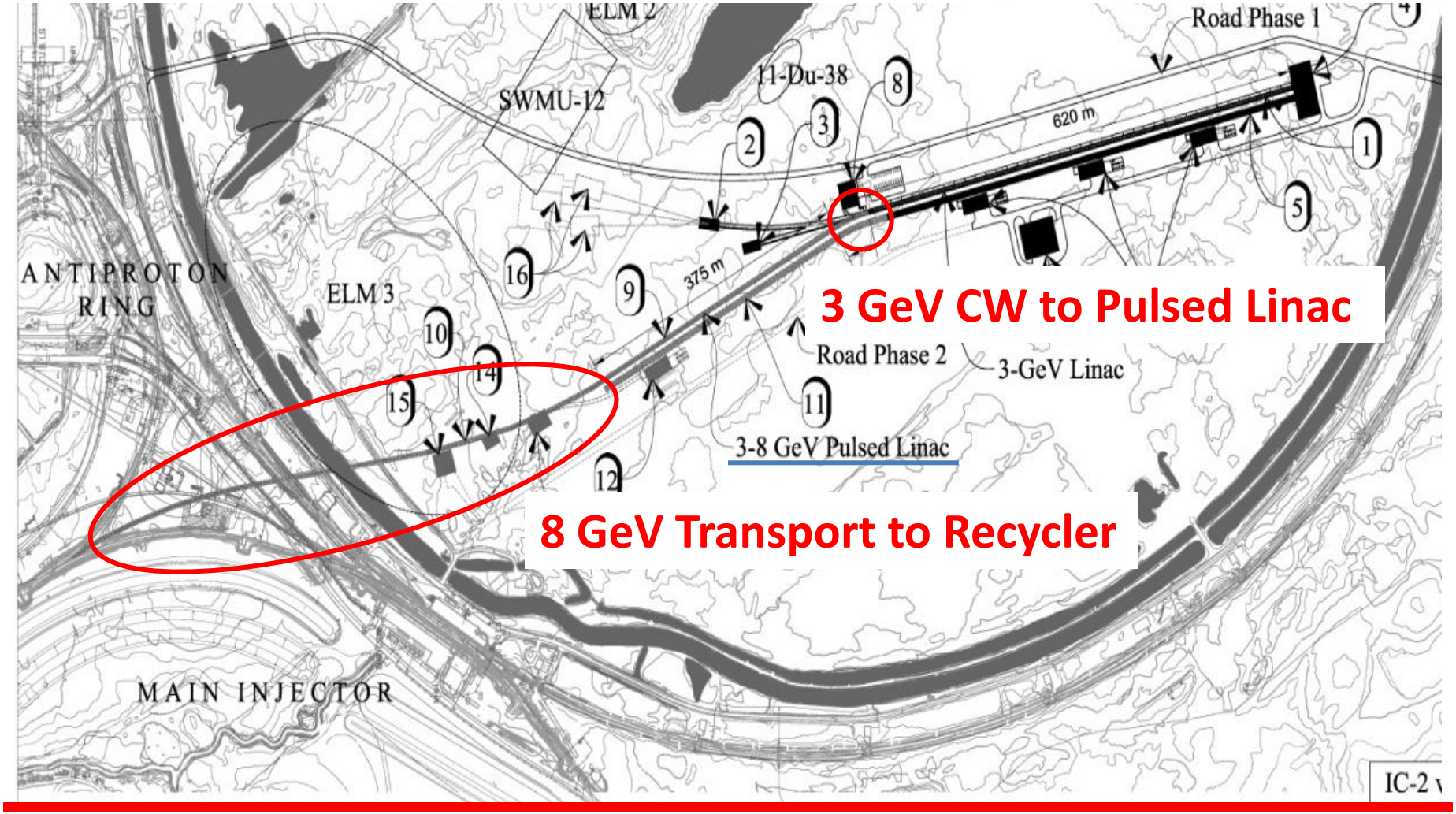
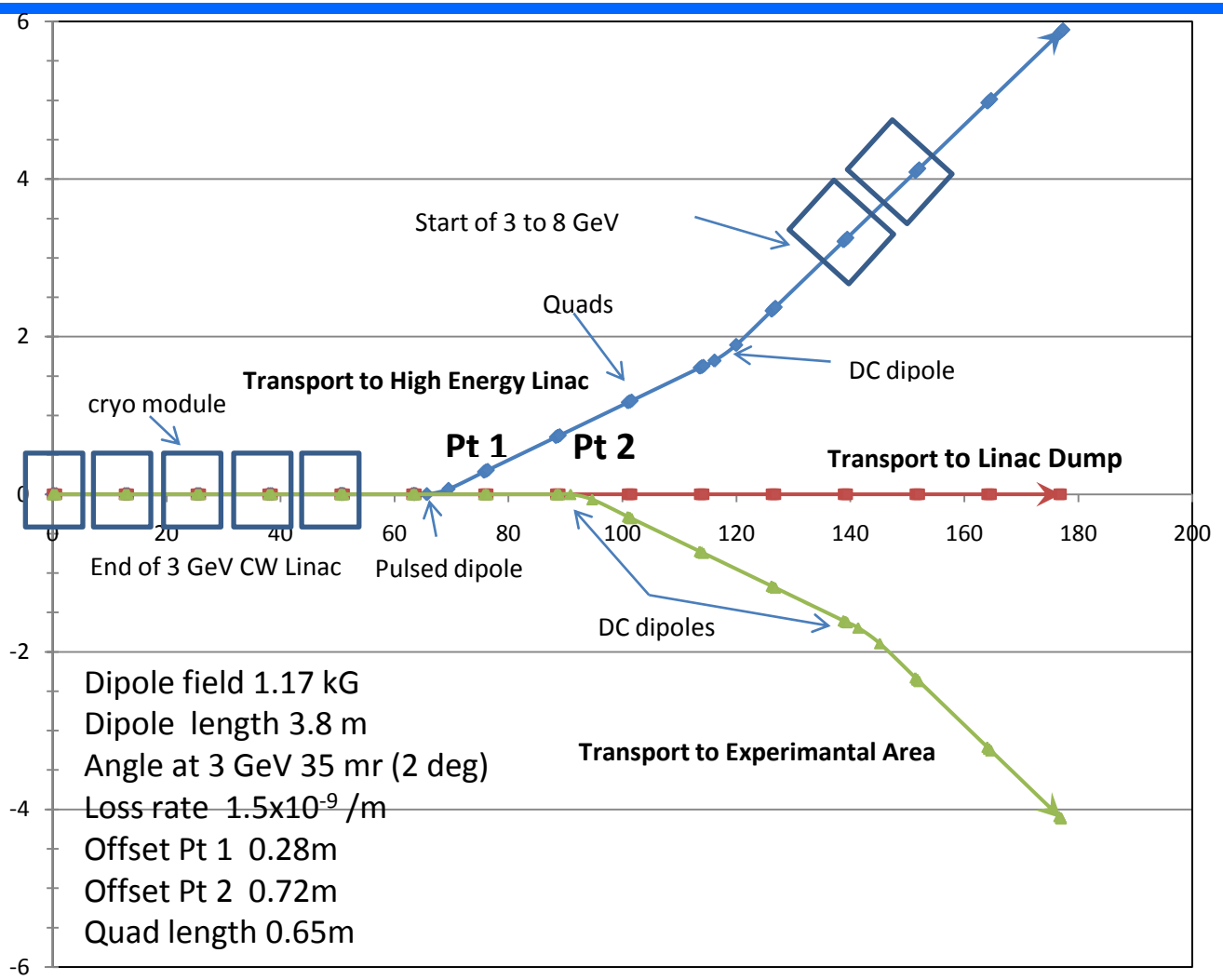
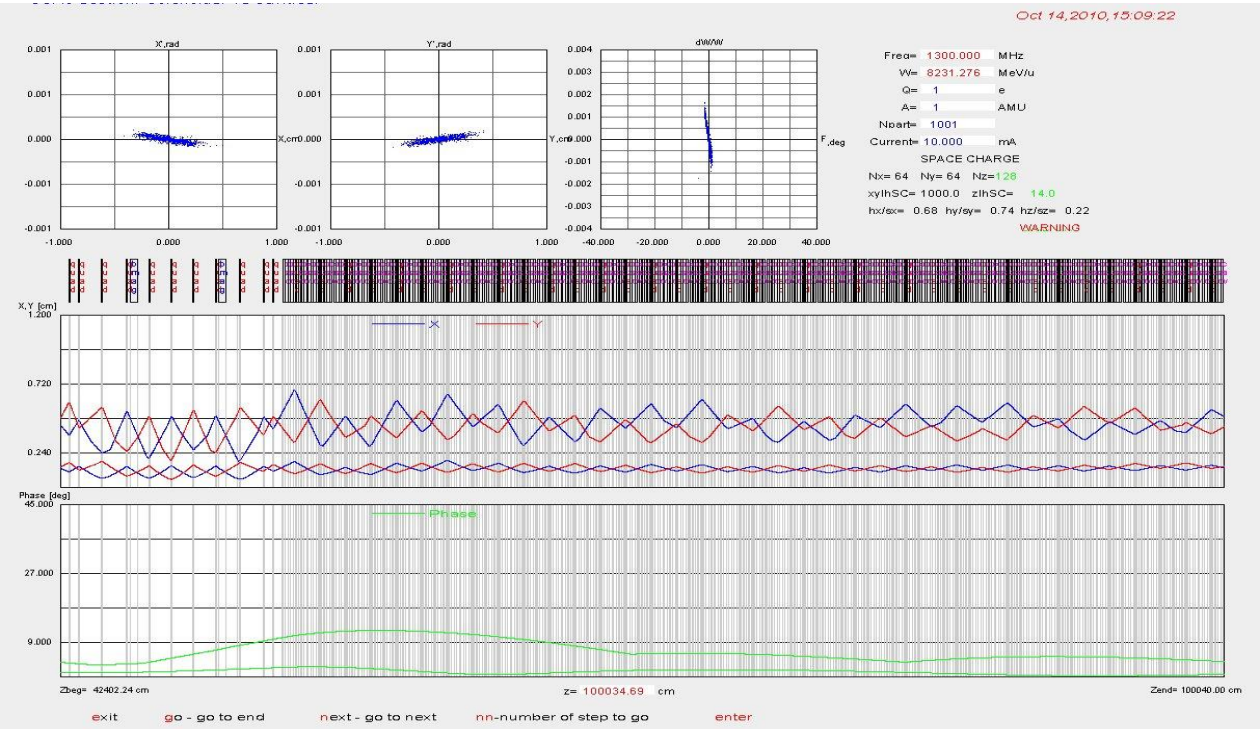
Pulsed Linac Transfer Lines



3 GeV Switchyard

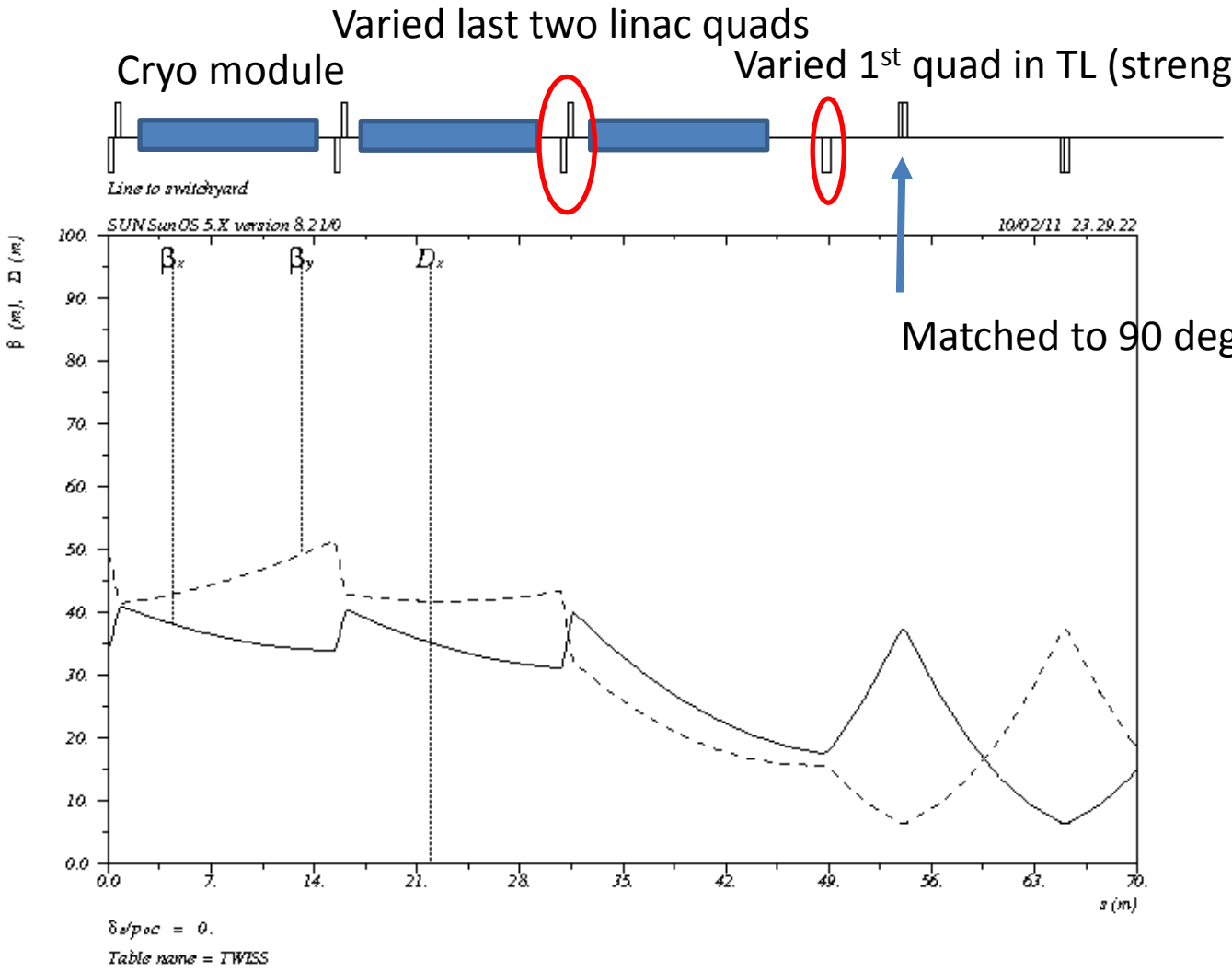


Match to Pulsed Linac



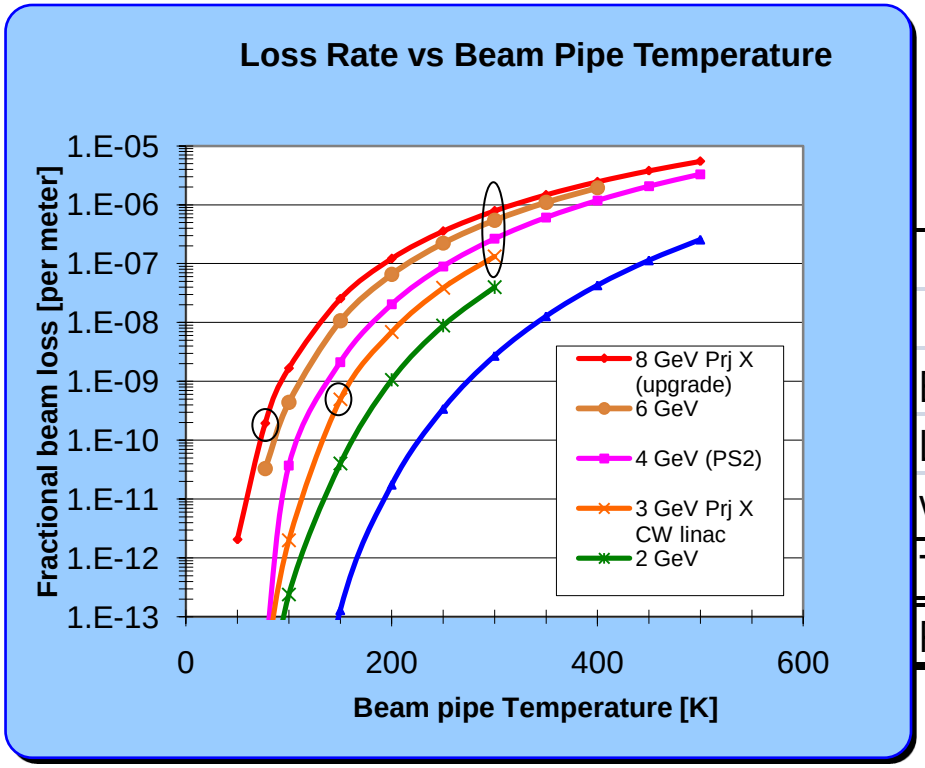
- Example of matching from 1.3 GHz CW linac (FODO) to pulsed linac… need to rematch using 650 MHz doublet

Matching from 650 Linac



Matched to 90 deg FODO

Losses 3 GeV CW to PL



At 10 Hz Intensity is 2.7×10^{14} particles/sec

Beam Power 130 kW

Loss Mechanism	3 GeV 130 kW		
	Value	loss/m	W/m
Black body	300^{0}K	1.30E-07	1.690E-02
Lorentz	1.17 kG	1.52E-09	1.976E-04
Vacuum	1×10^{-8}	1.30E-08	1.690E-03
Total		1.45E-07	0.019
Residual activation bare beam pipe [mrem/hr]			2.787

Status and Plans for 3 GeV to PL

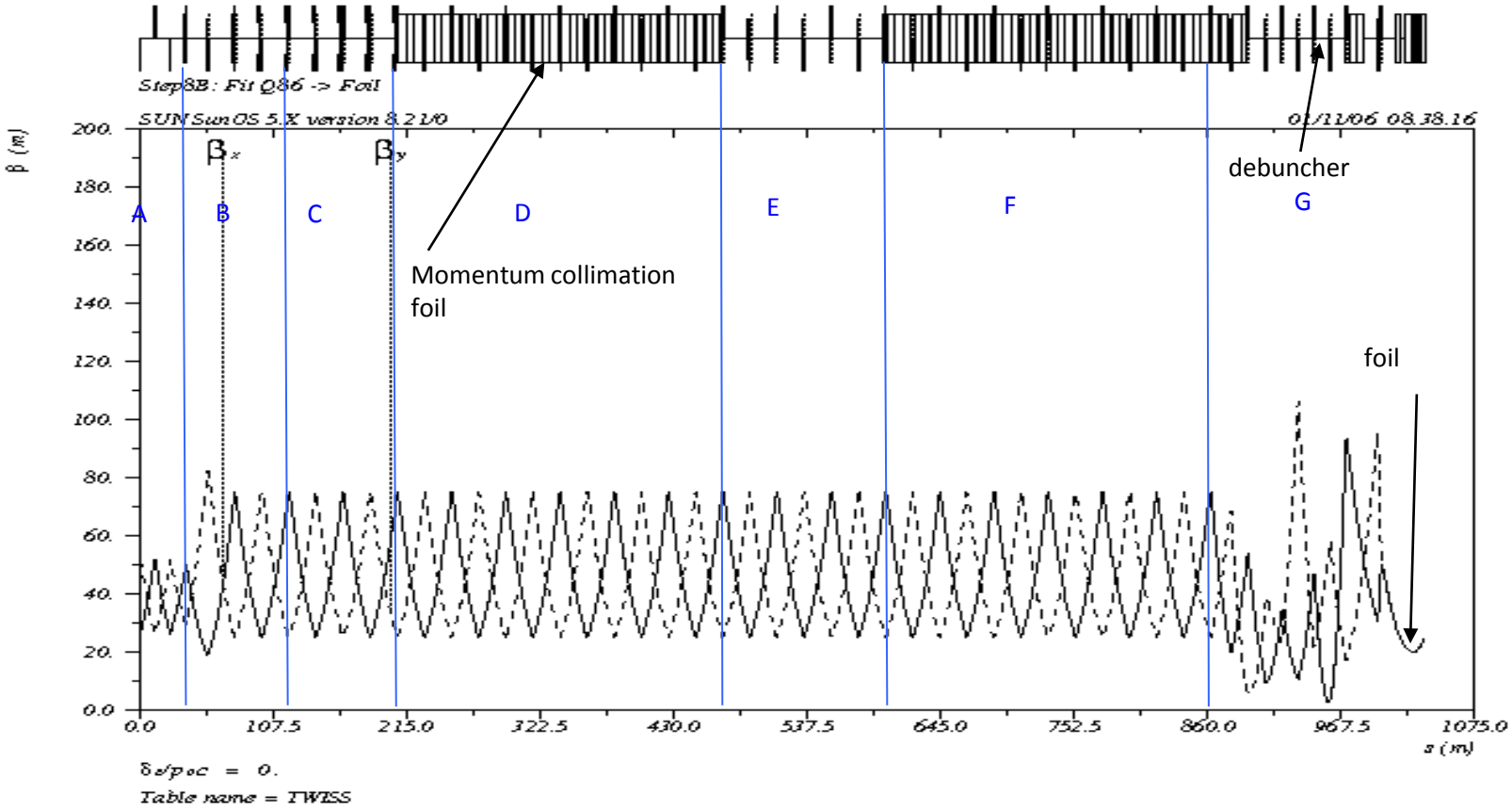
- Current TL lattice based upon 90^{o} FODO lattice with horizontal achromat.
- Initial design matched from 1.3 GHz HE CW linac to 1.3 GHz Pulsed Linac (both transverse and longitudinal)
- Current design of 3 GeV CW HE linac is with doublets – only minor change required in matching section
- When designs of CW and Pulsed are finalized (or at least stable)
  - Finalize TL design
  - Put all lattices into TRACK for error analysis
- Fairly straight forward should be no issues
  - Don’t forsee the need for collimation or cold beam tube

8 GeV Transport Line

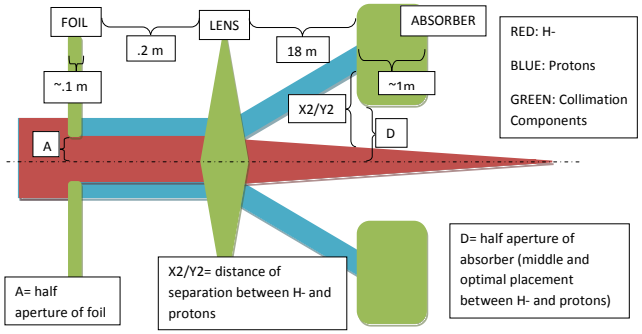
- The basic design remains constant as a 60^{o} FODO lattice from the early days of the Proton Driver
  - Five sections:
    - matching and collimation (we have a preliminary design for collimation)
    - Right bending arc
    - Straight section
    - Left bending arc
    - Matching section to ring
- Details of design change according to
  - which ring we inject
  - Operational scenarios (i.e, maximum beam intensity)
    - Full 10 Hz operation (2.7E14 particles/sec) for 345 kW
    - Just 6 linac pulses for 120 GeV neutrino program (170 kW)
  - Elevation of transport line and the requirement for vertical achromat
- Proton Driver and Project X Initial Configuration contained an 8 GeV beam dump line
  - needs re-evaluation
- Injection and transport line design will ultimately determine the footprint of the Project X facility

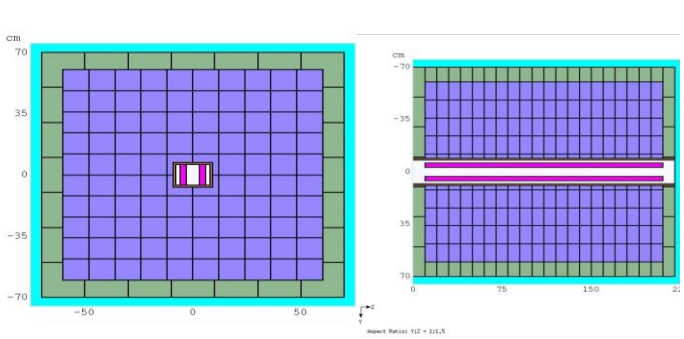
8 GeV Transport

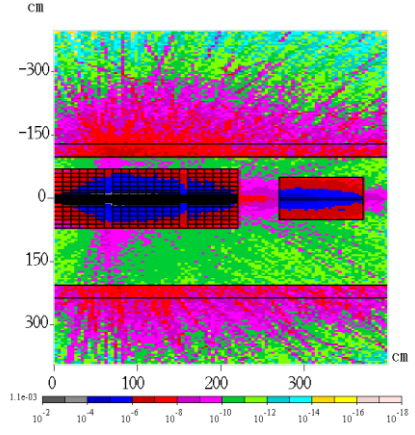
8 GeV transport line from Proton Driver design showing basic layout

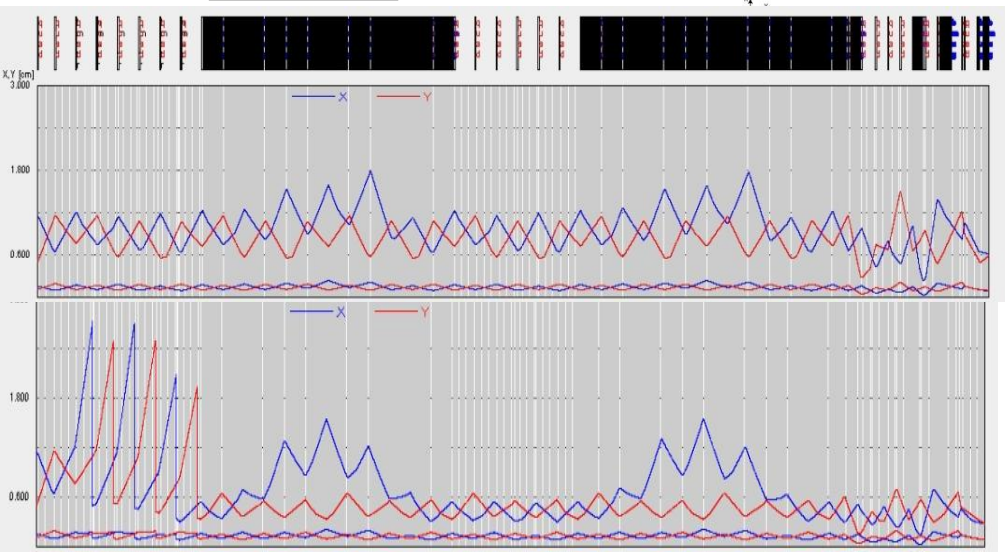


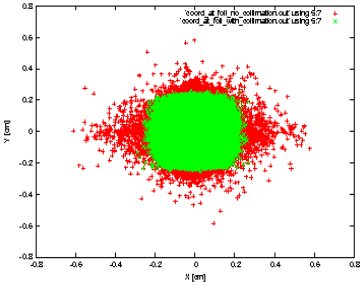
8 GeV Collimation

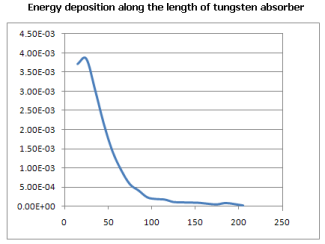


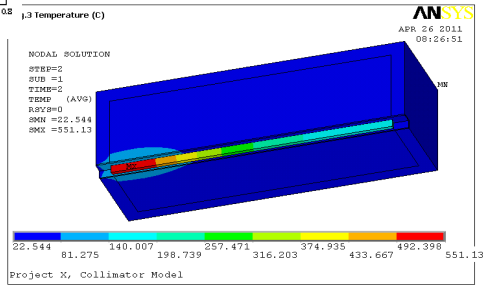












- TRACK and Mars simulations performed by David Johnstone
- ANSYS simulations performed by Zhijing Tang

Assume 1% or 345 kW on 1 jaw

Estimated loss Summary 8 GeV

Loss Mechanism	8 GeV 345 kW		
	Value	loss/m	W/m
Black body	300^{o}K	7.86E-07	2.712E-01
Lorentz	500G	5.30E-10	1.829E-04
Vacuum	1x10^{-8}	1.30E-08	4.485E-03
Total		8.00E-07	0.103
Residual activation bare beam pipe [mrem/hr]			15.420

Options

- 8 GeV Transport line options
  - Injection into fixed energy Recycler
    - both long & short pulse
    - Higher elevation than MI (at the MI ceiling
      - Requires beam line elevation change
    - Puts operational constraints on pulsed linac energy
    - Can use permanent magnets (cost savings)
    - Injection absorber a little more complicated
  - Injection into the MI (only for long pulse operation)
    - Two potential energies (8 and 6 GeV)
    - Due to LBNE utilization of MI-10l, using this straight section will require major modifications to the MI lattice
      - Need to increase it's length from 4 to 8 half cells

FY12 Plans

- When pulsed linac design is finalized
  - Update 3 GeV to Pulsed linac design
  - Update 8 GeV transfer line to Recycler
  - Perform loss analysis
  - Perform error studies
  - Update siting for complex based upon Recycler Injection
- Analyze implication of MI-10 lattice modification (i.e. the extension of MI-10 straight section)