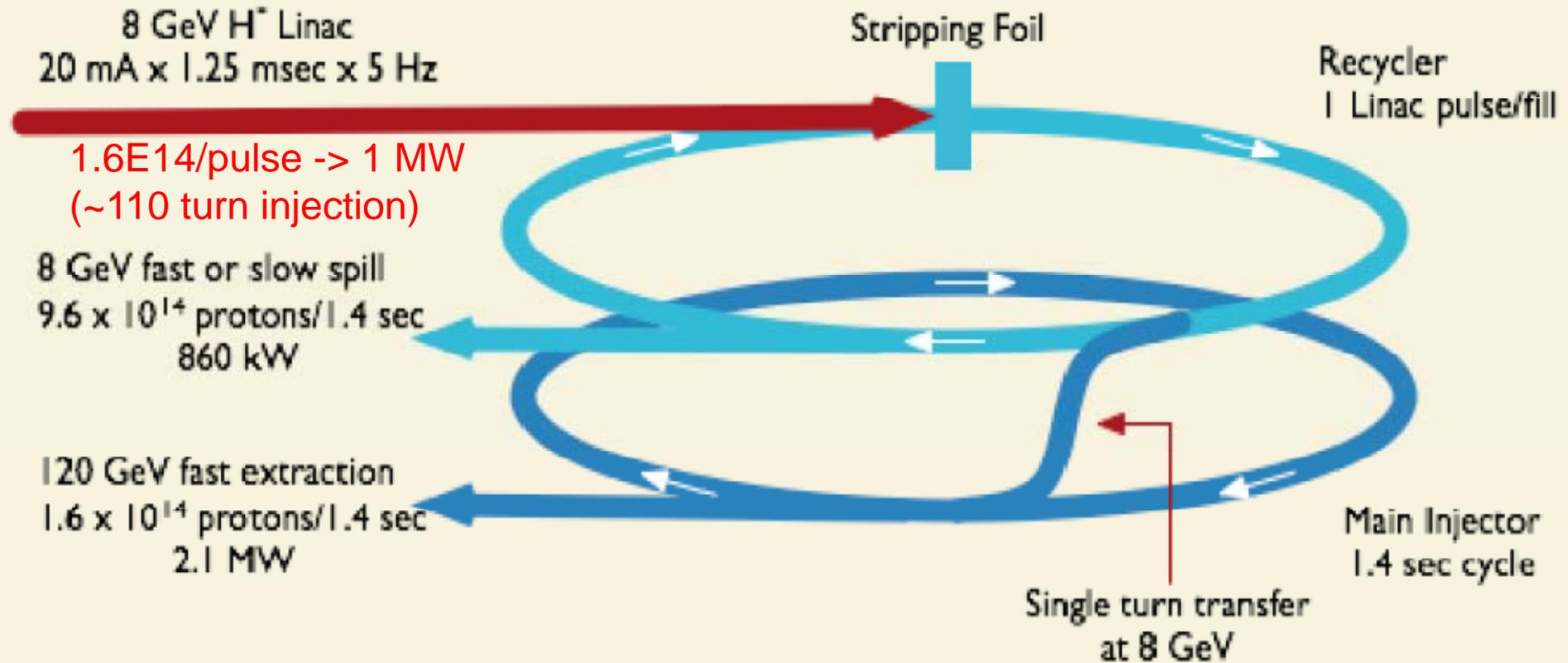


Project X: Current Layout, Plans and Requirements

Dave Johnson
Fermilab
February 18-19, 2009
Laser Stripping Mini-workshop



* Figure I.1: Schematic view of Project X.

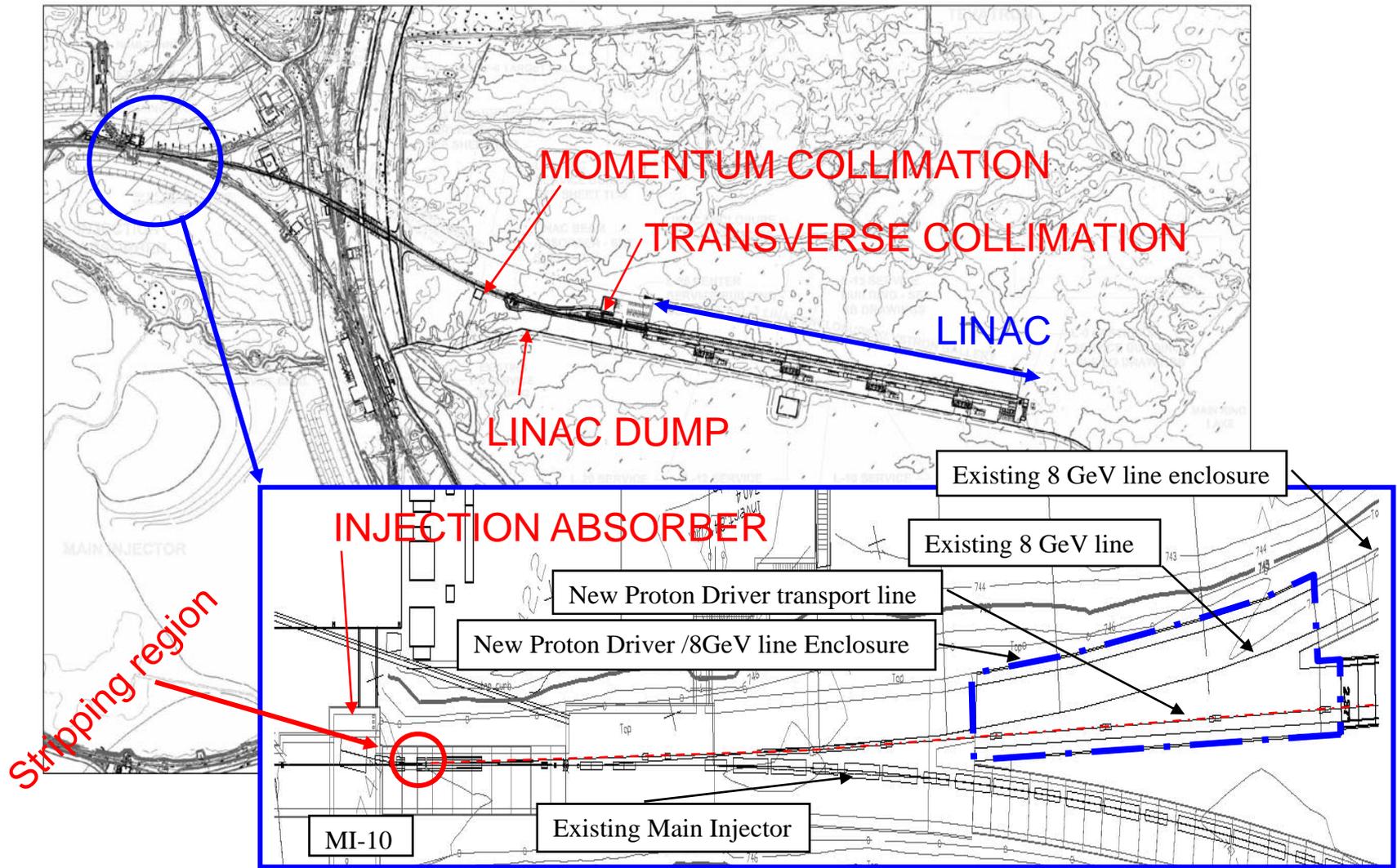
*Figure from Initial Configuration Document (ICD) v1.0 Oct 2008

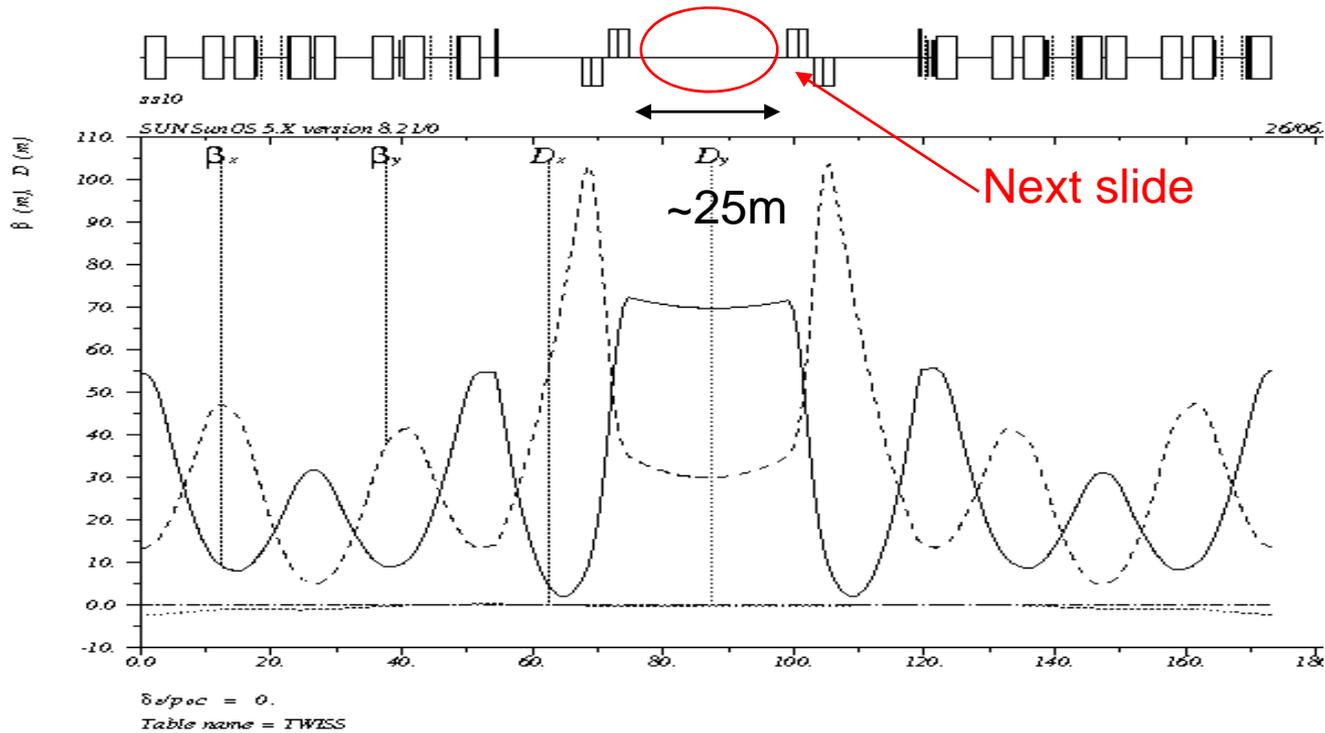
➤ Current Project X Status:

- RD&D plan presented to Fermilab AAC (Feb 09)
- Assume 4 yr RD&D plan -> CD2 in FY012 start construction FY13 or 14 (?)
- Directors Review for CD0 Mission Need (cost review) in March 09
- Investigate alternative configuration designs before CD1 (i.e. 2 GeV linac + additional RCS, or staged approach (1MW scaled down to ½ MW, etc.)

➤ Basic Injection parameters

- Energy spread +/- 2 MeV (+/-10 MeV unbunched)
- Bunch structure 325 Mhz
- Bunch length +/-10mm (~ +/- 5mm unbunched)
- Bunch intensity ~3-6E8 /325 Mhz bunch
- Total ring intensity (after 110 turns) 1.6E14 protons
- Linac emittance 2.5 - 8 π 95% normalized
- Final ring emittance ~25 π
- Transport line lattice at injection $\beta_x=\beta_y=20$ to 40m, $\alpha_x=\alpha_y\sim 0$, $d=d'\sim 0$
- Ring lattice at injection $\beta_x=70\text{m}, \beta_y=30\text{m}$, $\alpha_x=\alpha_y=0$, $d_x=d'_x\sim 0$
- Transverse phase space (horizontal painting/vertical steering)
- Longitudinal painting (phase and energy)

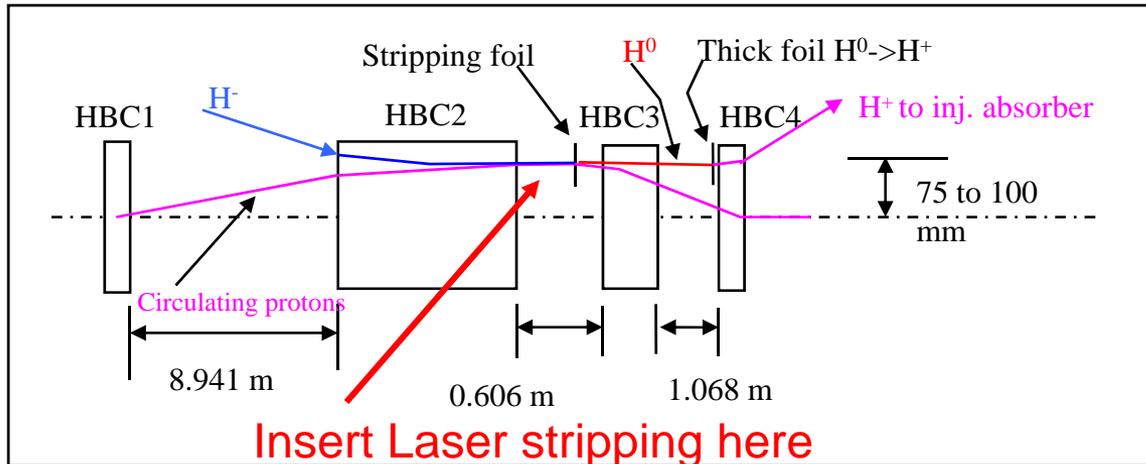




$\beta_x \sim 70$

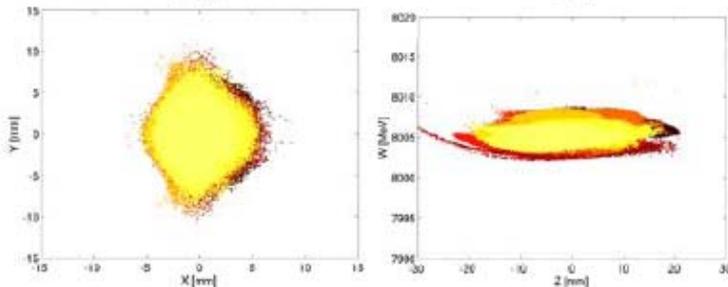
$\beta_y \sim 30$

Dispersion "free"

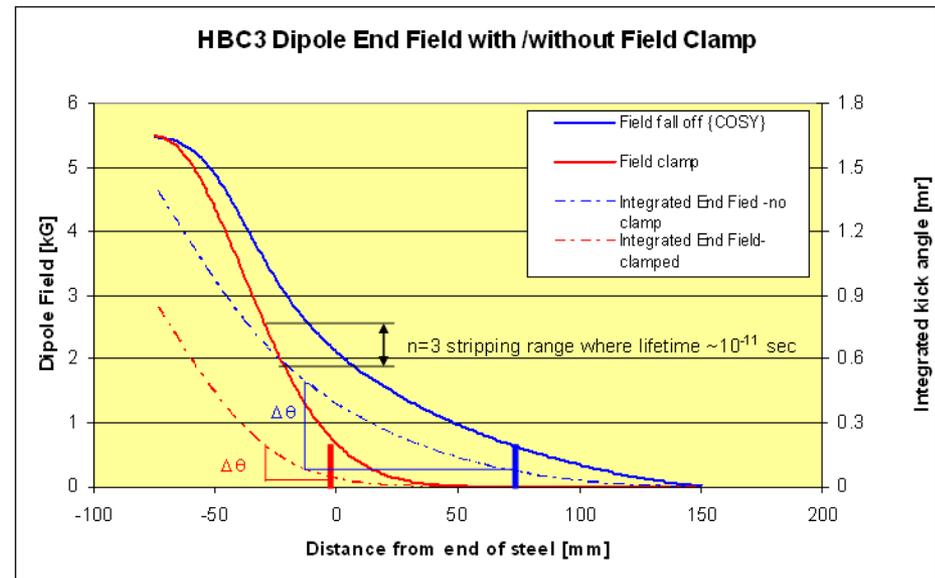


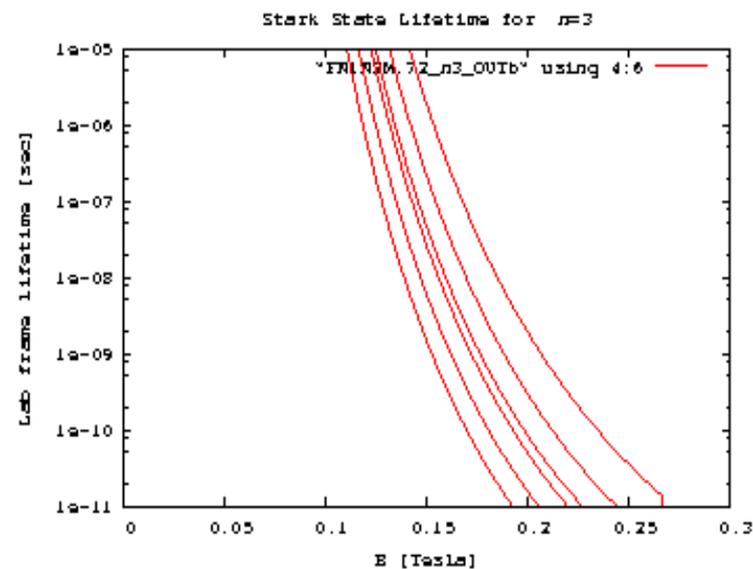
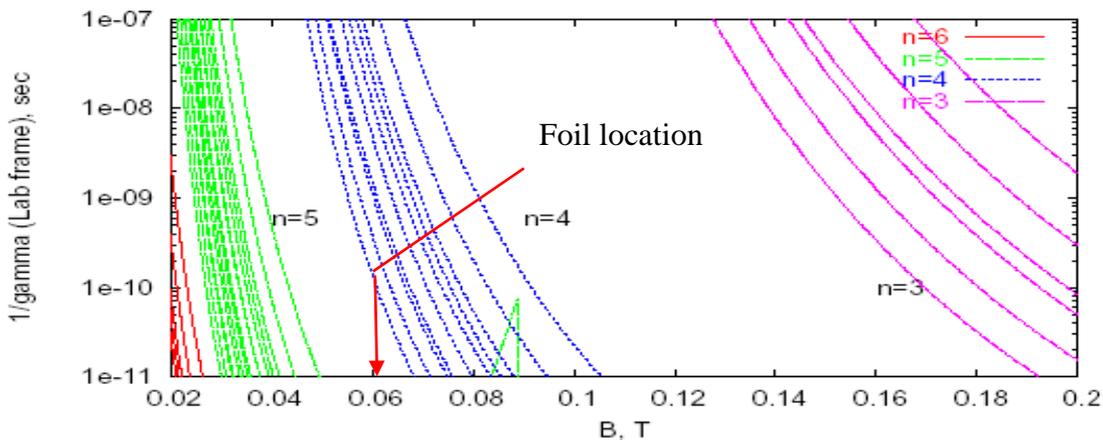
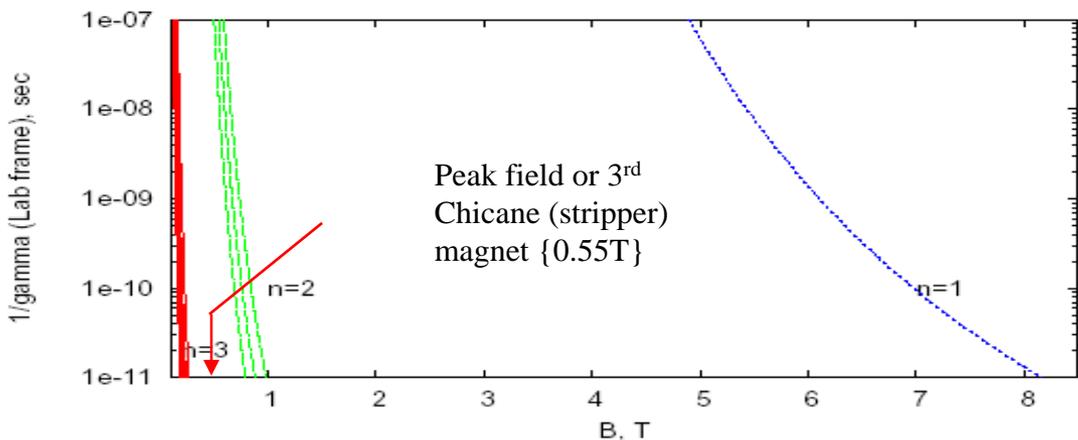
Magnet	Length [m]	Strength [kG]	Theta [mrad]
HBC1	0.7	+3.5669	+8.4211
HBC2	6.0	-0.4656	-9.4211
HBC3	2.0	-5.5620	-37.5179
HBC4	1.0	+11.4206	+38.5179

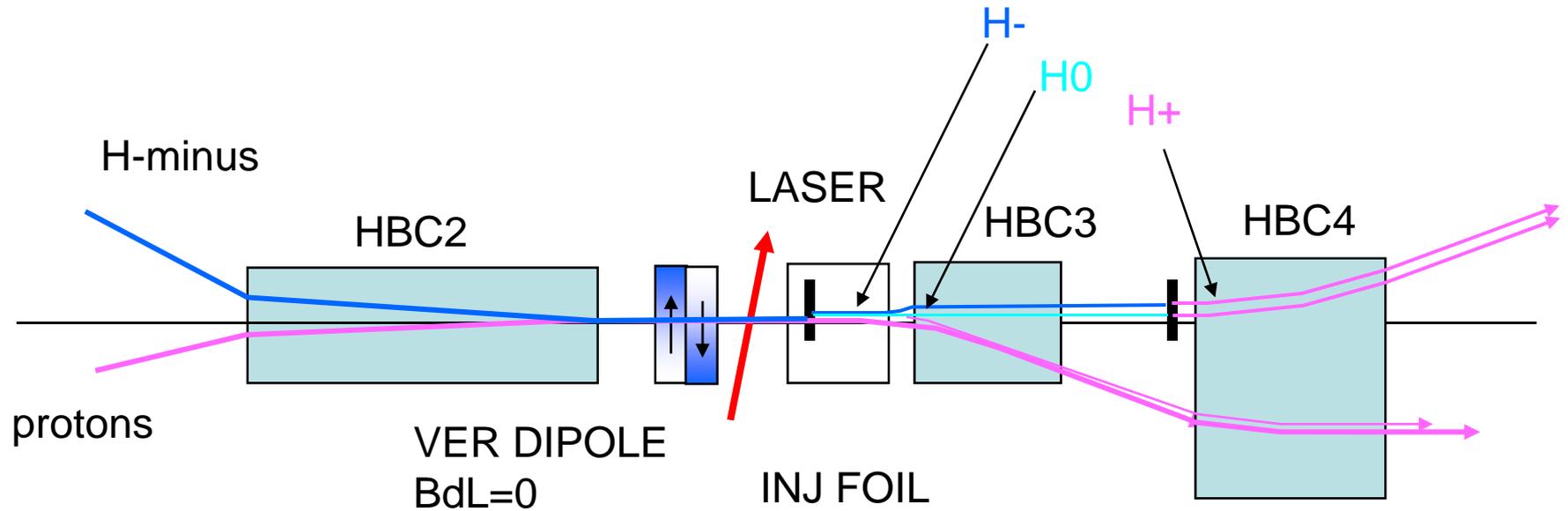
From TRACK simulation:



1 % field
1 degree phase
10 unit focusing
No collimation



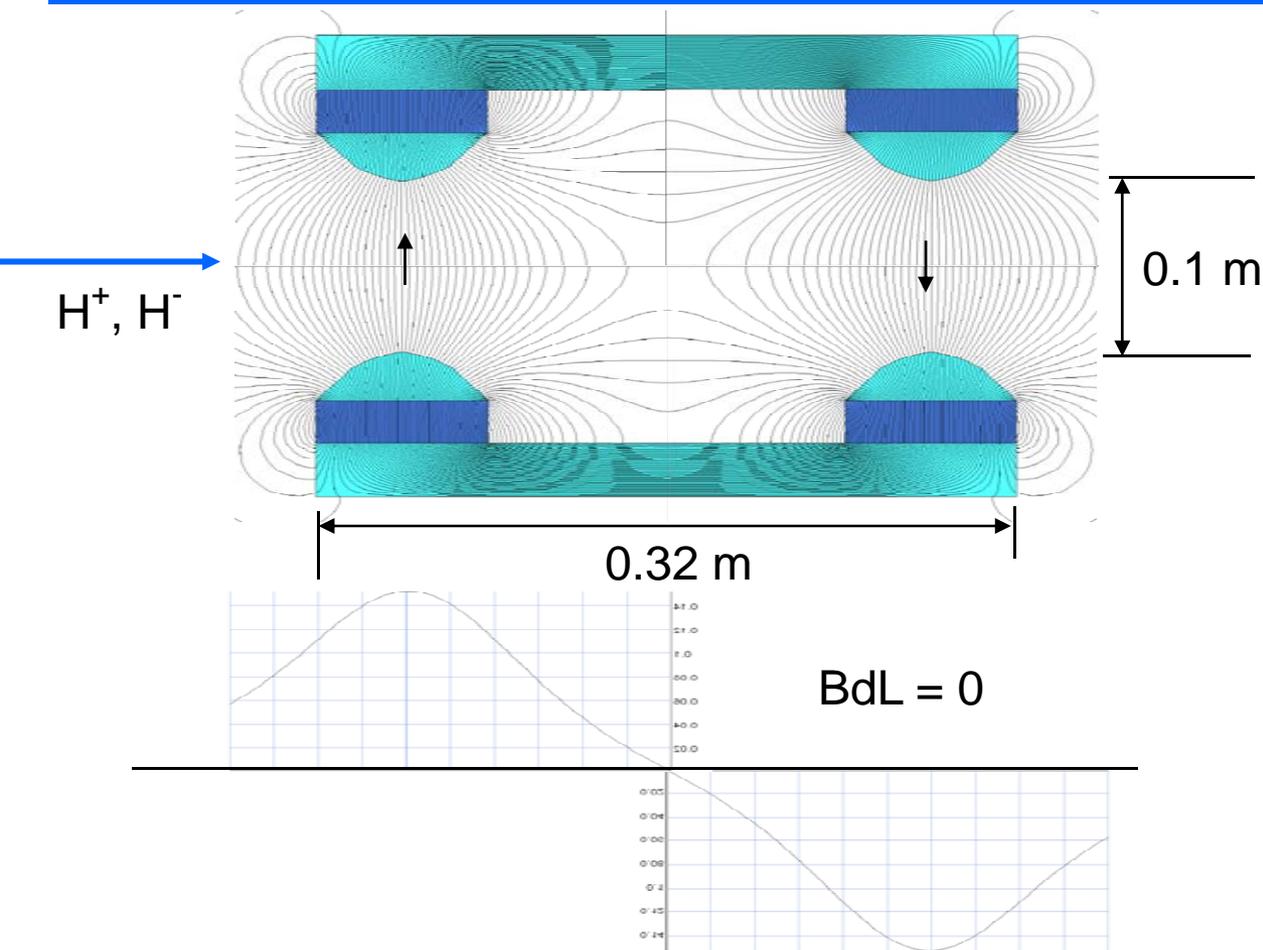




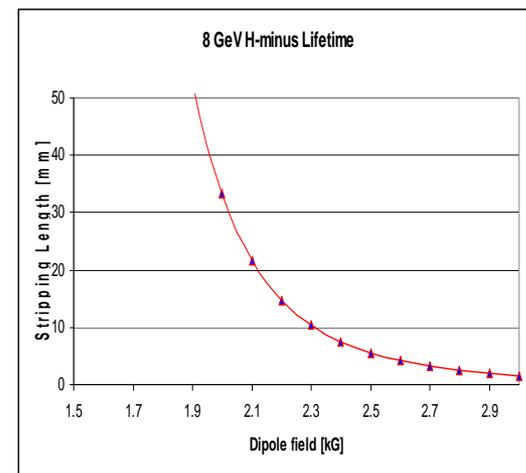
Insert:

- Vertical dipole with peak field $\sim 3\text{kG}$ and $BdL = 0$ minimal effect on circulating beam and strip the outer electron from H-
- Laser crossing

(not to scale)



- Conceptual design of permanent magnet vertical dipole with a gap of 4" and a peak field of ~ 1.5 kG.
- Flux catchers have not been included at this point
- Conclusion : $\pm 2-3$ kG magnet looks possible !



Conceptual magnet design by Vladimir Kashikhin (FNAL)

- The ultimate complete injection system design would include both stripping techniques co-existing (or swappable) in the injection straight.
- The goal of the RD&D effort for laser stripping is to produce a design for this system with >98% stripping efficiency which is compatible with the existing Recycler straight section design.
- Calculations and simulations for the laser stripping technique at 8 GeV will be performed and will determine requirements for the laser system, interaction region, injected and circulating beam parameters, and magnet systems used.
- The calculations and simulations will be based upon the SNS experience. Ultimate stripping efficiency will be predicted and the simulations performed for SNS experiments will be extended to Project X energy and beam structure. These parameters will then feed into the design of the laser system and hardware necessary.

Deliverables FY09:

- A conceptual design of a laser stripping system compatible with the ring optics of a foil charge-exchange system with system parameters and component specifications.

Deliverables FY10:

- Documentation for Conceptual Design Document
- Support for CD1 design reviews

Deliverables FY11:

- A preliminary engineering design of a laser stripping system to be incorporated in injection straight with foil system.

Deliverables FY12:

- Documentation for Preliminary Engineering Document
- Support for CD2 reviews
- Initiate final engineering design of laser stripping system

Type	FY09	FY10	FY11	FY12	TOTAL
Sci	0.25	0.125	0.125	0.125	0.625
Eng	0.25	0.25	0.25	0.5	1.25
Draft	0.125	0.125	0.125	0.125	0.5
Tech					0
M&S					\$0

- We would like to be able to install both foil stripping and laser stripping systems.
- We've looked at a preliminary concept for including laser stripping into current injection straight section design.
- We've looked at a conceptual design for a zero field integral dipole magnet
- Laser stripping task defined in the RD&D plan !
- What is optimum laser wavelength?
- Commercial laser or home built laser?
- Q switched, mode-locked, cw, fiber, pulse freq ?
- Pulse power, average power? Window survivability?
- What are optimal H- optical beam parameters?
- Do we need dispersion derivative?
- Do we need a Fabry-Perot cavity /optical resonator?