Project X

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Strategic Engineering Planning Meeting
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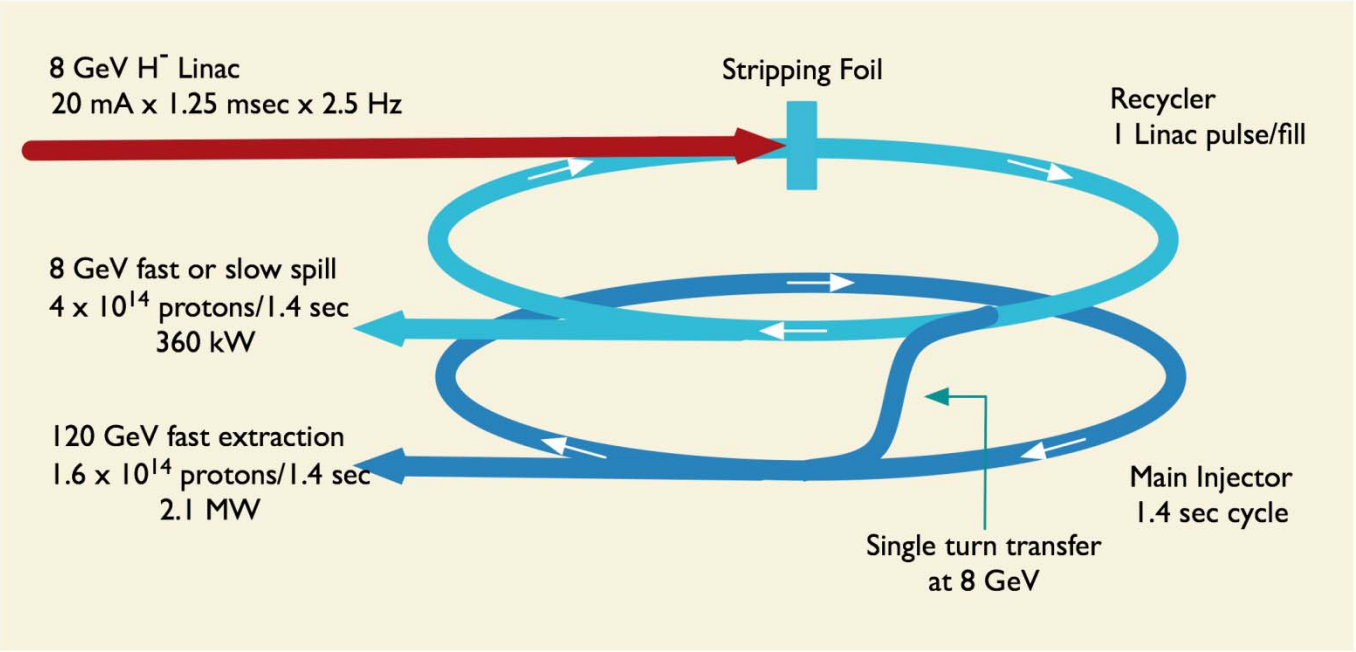
Technical Description

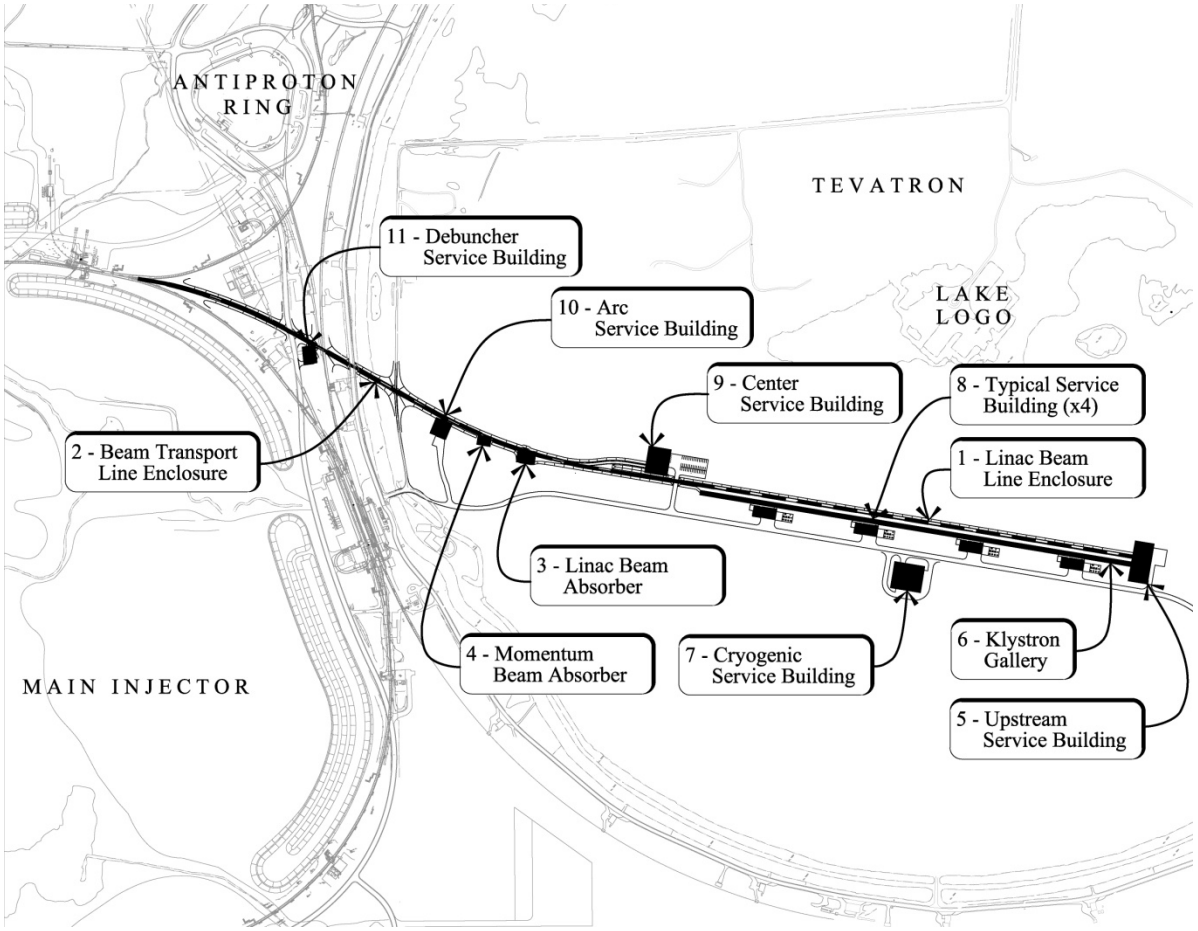
- Project X is central to Fermilab's strategy for future development of the accelerator complex:
  - Energy Frontier: Aligned with ILC technology development; Fermilab as potential site for ILC or a Muon Collider
  - Intensity Frontier: World leading program in neutrinos and rare processes; Fermilab as potential Neutrino Factory site
- The P5 report defines mission need for a multi-MW proton source based on :
  - A neutrino beam for long baseline neutrino oscillation experiments
    - 2 MW proton source at 60 - 120 GeV
  - High intensity, low energy protons for kaon and muon based precision experiments
    - Operations simultaneous with the neutrino program.
  - A path toward a muon source for a possible future neutrino factory and/or a muon collider at the Energy Frontier.
    - Requires upgrade potential to 2-4 MW at ~8 GeV.

Initial Configuration-1

- Project X Design Criteria
  - 2 MW of beam power over the range 60 – 120 GeV;
  - Simultaneous with at least 150 kW of beam power at 8 GeV;
  - Compatibility with future upgrades to 2-4 MW at 8 GeV



Initial Configuration-1 Provisional Siting



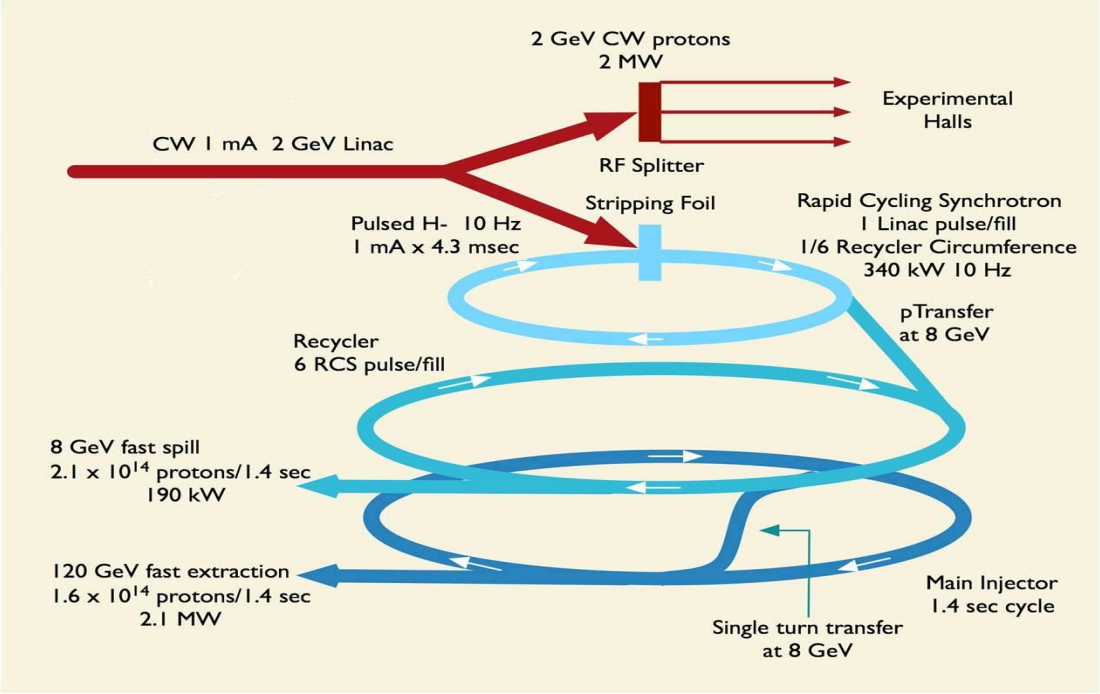
Initial Configuration-2

- Consideration of alternative designs is required by the DOE Project Management Order.
- A primary consideration is the low energy program
  - The Recycler as utilized in the ICD-1 has limitations in providing a flexible source of useful beam to the low energy flavor program
- Primary alternative we are looking at:
  - Linac operated in CW (1 mA) mode up to 2 GeV
  - Rapid cycling synchrotron for acceleration from 2 GeV to 8 GeV

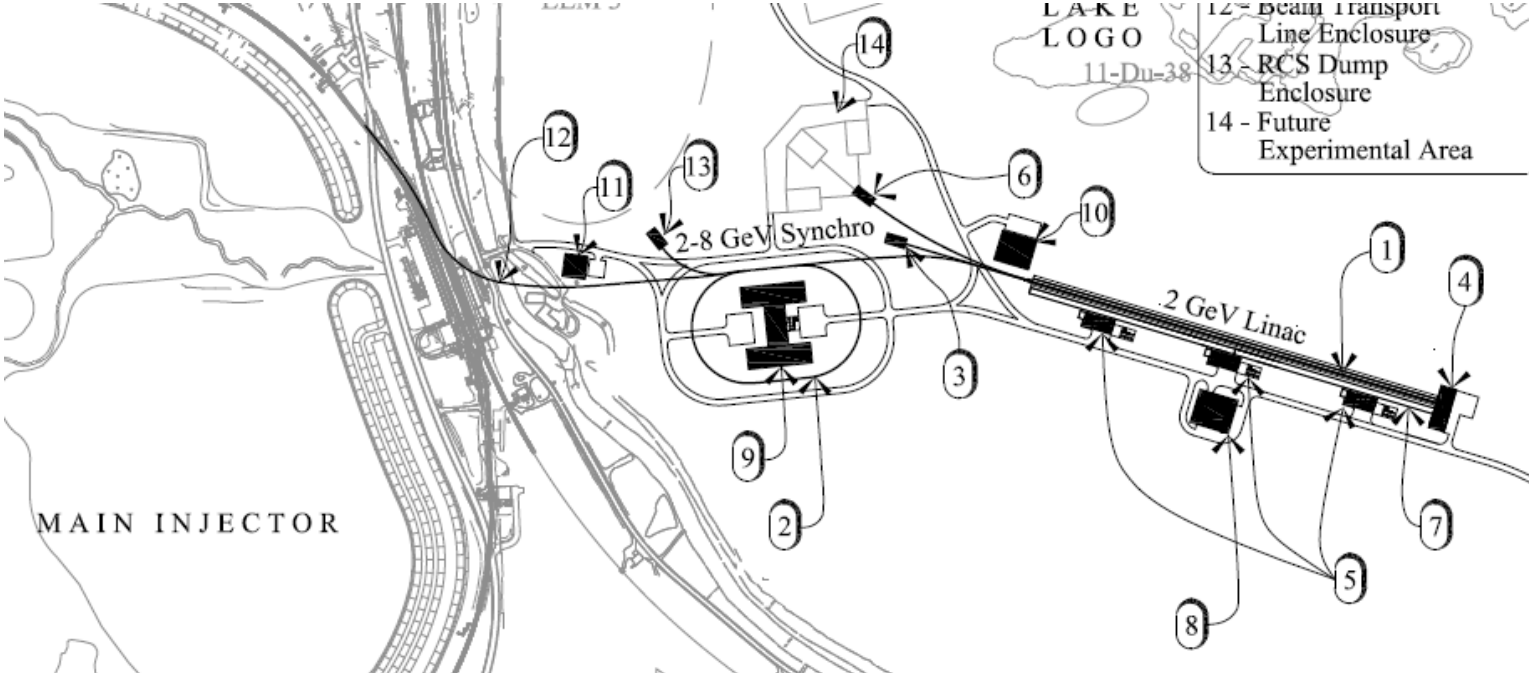
  $\Rightarrow$ "Mix and match" opportunities for the evaluation phase
  - Upgrade to NF/MC power capabilities requires more thinking
- Initial Configuration Document-2 (ICD-2) under development
  - Document, and associated cost estimate, to be prepared utilizing same team, methodology, and design criteria as ICD-1
  - Anticipate release soon

Initial Configuration - 2

- Project X Design Criteria
  - 2 MW of beam power over the range 60 – 120 GeV;
  - Simultaneous with 2 MW beam power at 2 GeV;
  - Compatibility with future upgrades to 2-4 MW at 8 GeV



Initial Configuration-2 Provisional Siting



Collaboration

- Project X will be managed as a national collaboration with international participation
  - Umbrella MOU for RD&D collaboration has been signed by

SLAC	BNL
JLAB	ANL
ORNL/SNS	LBNL
ILC GDE/ART	Michigan State University
Cornell University	

  - MOUs for β=0.8 cavity development with four Indian institutions
  - Working on an MOU of cooperation with CERN/SPL
- Currently anticipate up to 50% of labor could be by collaborators and not at FNAL (which is reflected in OHAP)

Current CD-0 Status

- Project X is moving through the DOE system in coordination with the Long Baseline Neutrino Experiment (LBNE) and the muon to electron conversion experiment (Mu2e)
  - LBNE and Mu2e will both establish mission need (CD-0) on the basis of modest upgrades to the existing complex.
    - Both have been told to expect CD-0 “shortly”, and to be prepared for CD-1 at the end of FY2010.
  - The Project X mission will be to provide significant extension of the reach of these two initiatives, while simultaneously creating a broader range of intensity frontier opportunities
- Several briefings for the Office of Science on strategy, including to Bill Brinkman by Pier Oddone on August 13

⇒CD-0 for LBNE & Mu2e are pre-requisites to CD-0 for Project X

Accomplished FY09

- Initial Configuration Document (ICD-1 V1.1) and updated RD&D plan (V2.2) released in March 2009
- Initial cost estimate based on ICD-1 released and subject to Director's Review in March 2009.
  - The review utilized Collaboration members as reviewers, and included DOE observers. ICD-1 is currently under (soft) configuration control.
  - TPC = $1.5B.
- Work initiated on developing an alternative design concept based on a 2 GeV CW linac, followed by a 2-8 GeV rapid cycling synchrotron.
  - Initial Configuration Document (ICD-2) in preliminary draft
  - Associated cost estimate under development.
    - Primary motivation for IC-2 is to provide a more flexible base for the low energy rare processes program supported by Project X

Strategy to reach CD-0 in FY10

- Anticipated funding for FY10
  - M&S $2.5M
  - SWF @ FNAL $3.4M
  - To collaborators $1.6M
- Refine IC-2 and document it in ICD-2, cost estimate, and revised RD&D Plan, all in fall 2009
- Participate in fall physics workshops
- Present IC-2 concept and revised RD&D plan for Fermilab AAC meeting in November 2009
- Hold Director's Review of Initial Configuration Cost Range in January 2010

Strategy to reach CD-0 in FY10

- Identify ICD-1 or ICD-2 as preferred option to move forward in January 2010. Evaluation metrics:
  - Cost
  - Performance
  - Technical risk
  - Upgradeability/flexibility
  - Interactions with other programs

  ⇒ Weighting associated with metrics is to be determined(!)

- Initiate pre-conceptual development of the preferred configuration

Current Staffing – all part time

- Senior management team established
  - Steve Holmes, Sergei Nagaitsev, Jim Kerby, Elaine McCluskey
- System managers appointed

325 MHz rf	Ralph Pasquinelli
1.3 GHz rf	John Reid
Cavities and Cryomodules	Mark Champion
Main Injector/Recycler	Ioanis Kourbanis
Instrumentation	Manfred Wendt
Controls	Jim Patrick
Cryogenics	Arkadiy Klebaner
Conventional Facilities	Russ Alber
8 GeV Transfer Line	Dave Johnson
Integration	Sergei Nagaitsev

Current Effort

- Effort for FY09 through August
  - 13 to 14 FTE
  - Collaborator effort limited to date
- Current scientific staffing to guide the project is adequate
- FY10 resource request would double current FY09 effort

FY10 Scope of Work

- Detailed work list by system with resource needs (see handout)

PROJECT X FY10 WORK PLAN DETAILS AND RESOURCE REQUIREMENTS

WBS/Responsible Manager	FY10 Deliverables	Resource	FTE
Project Management/Holmes			
	Complete ICD-2		
	Complete Mission Needs Statement for CD-0		
	Establish Project Management team		
	Establish preferred configuration		
	Request PED funds for FY2012		
	Initiate work on all CD-1 documentation		
	Travel Budget		
	SWF Budget		
		Executive Direction	0.3
		Acc Sci Exp	0.3
		ME Tech Mgr	0.3
		Project Manager	0.3
		Proj Cntrls	0.5
Linac RF Systems/Reid/Pasquinelli			
	325 MHz test station (after configuration decision)		
		ME Design	0.5
		RF Eng	1.0
		RF Tech	1.0
	325 MHz conceptual design		
	Test prototype phase shifter produced by industry (AFT)		
	1.3 GHz conceptual design		
		RF Eng	0.9
		Appl Dev & Sys Analyst	0.3
		RF Tech	0.6
		RF Sci	0.3
		Elec Des	0.1
	3L AC 1.3 GHz conceptual design		

With additional resources

- Project X FY10 funding guidance is ~70% of the system manager identified budget needs, making the project funding limited at the moment. Within our current funding guidance, using additional staff resources is difficult. With additional financial resources, could fund additional staff for
  - Beam physics design
  - Chopper studies
  - RF system and coupler design
  - 325 MHz cryostat studies
- HINS and SRF programs both support Project X, so additional staff for their work helps Project X (especially HINS)

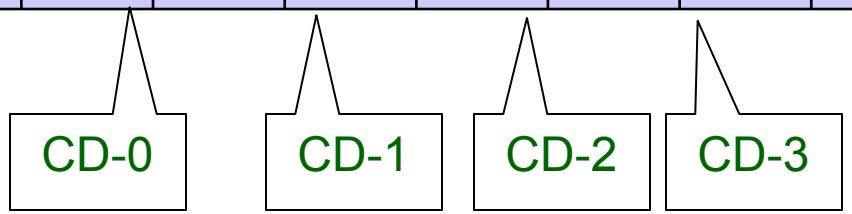
FY11 Scope of Work & Resource Needs

- With CD-0 in 4QFY10, conceptual design would begin in FY11
- Exact work plan will depend on configuration decision, but generally
  - Developing CD-1 documentation, including writing CDR
  - Prototyping of components
  - Cryogenic distribution planning
  - Controls hardware platform R&D
  - Timing and Machine Protection system
  - Instrumentation specification
  - Finalize new MI RF system specifications
  - Design Recycler lattice
  - Preliminary space programming for facilities
  - NEPA
- Resource requirements for FY11 in OHAP

FY12+ Resource Needs

- FY12 & FY13 – preliminary design and baseline development working toward CD-2/3a in FY13H2, using PED funds

	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19
FTE Average Per Year:	13.37	26.49	69.10	89.20	104.85	113.44	111.46	116.54	142.15	131.79	91.97



- We feel input to OHAP is at a high level and as accurate as we can make at this time, given assumptions used in putting the estimate together. It is not funding limited during the project phase, but includes only 50% of the required labor as being from FNAL.