Project X RD&D Plan
RR and MI Rings

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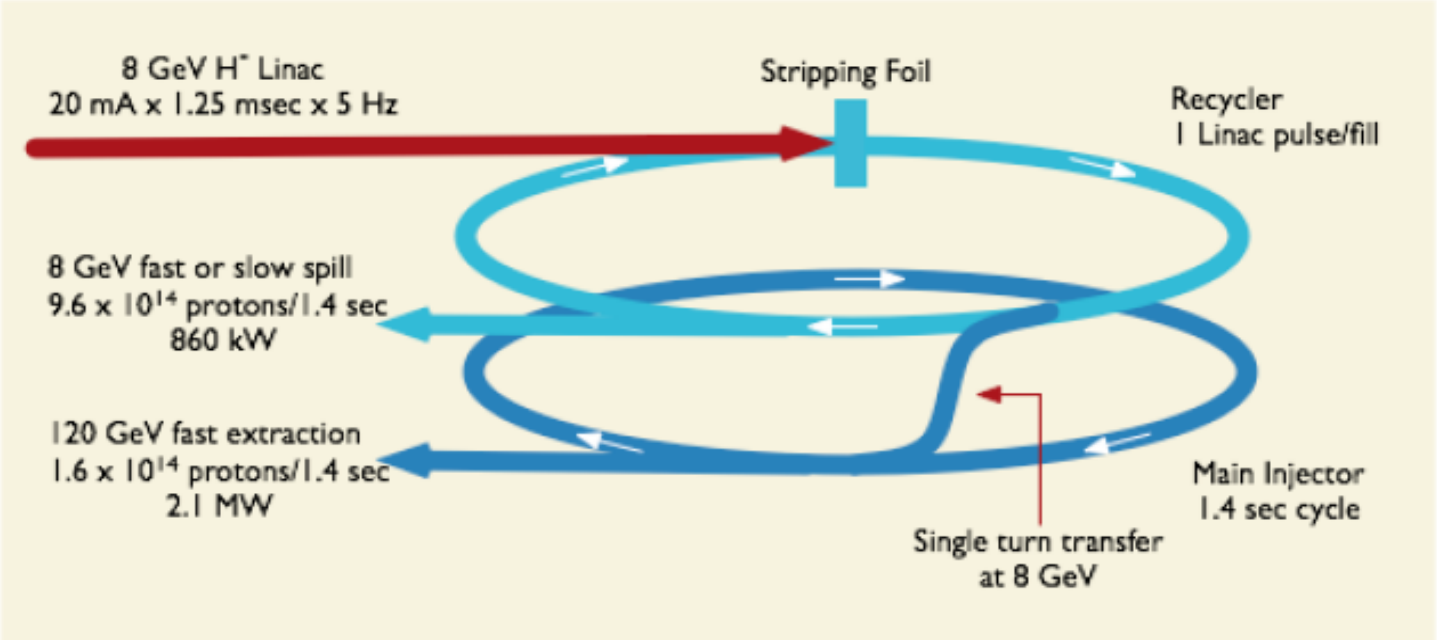
Project X Collaboration Meeting
September 11-12, 2009

Outline

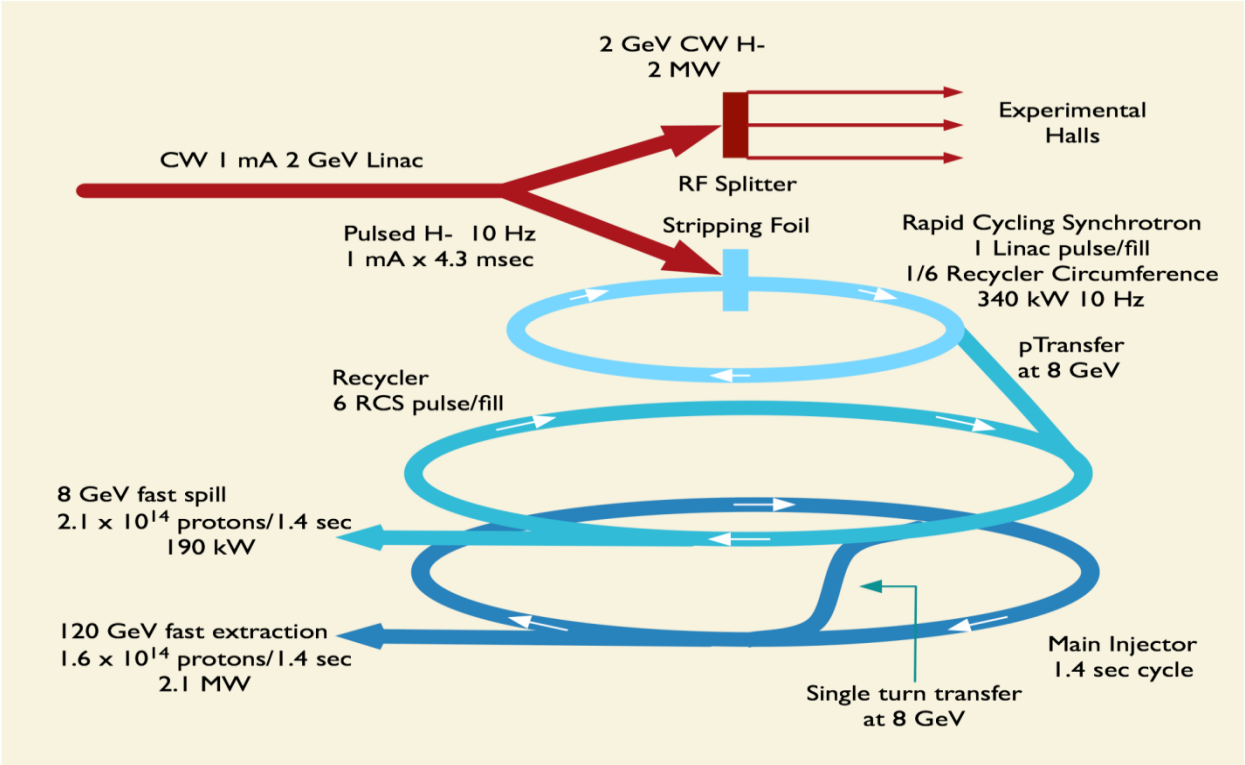
- Comparison between ICD-1 and ICD-2.
- Recycler requirements.
- MI requirements.
- Major R&D elements.
- Recent Progress.
- Tentative Plan for FY10.

ICD-1 Configuration



- 100 turns injection from Linac to RR
- Phase space painting in RR.
- One turn injection for RR to MI (bucket to bucket)

ICD-2 Configuration



- Bucket to bucket transfer from RCS to RR (six injections)
- One turn injection from RR to MI.

Project X Recycler Requirements

Description	Req.	Unit
Recycler		
Energy	8	GeV
Storage Efficiency	99.5	%
Average Recycler Beam Current	0.6	A
Availability	95	%
Injection Rate	5	Hz
Maximum Space Charge Tune Shift	0.05	
95% normalized transverse emittance	25	p-mm-mrad
r.m.s. normalized transverse emittance	13	p-mm-mrad
Bunching factor	2	
Longitudinal emittance per Bunch	0.5	eV-Sec
Cycle Time	1.4	sec
RF Frequency	53	MHz
Abort Gap Length	700	nsec
Peak Recycler Beam Current	2.356	A
Fast Extraction Rate	15	Hz
Fast Extraction Pulse Length	1.6	microsec

Second harmonic rf

Longitudinal painting (ICD-1 only)

53 MHz rf system

MI Requirements

Description	Req.	Unit
Main Injector		
120 GeV cycle Time	1.4	sec
RF Frequency	53	MHz
Abort Gap Length	700	nsec
Acceleration Efficiency	99	%
Main Injector Beam Current	2.356	A
Final Energy	120	GeV
120 GeV Beam Power	2.1	MW
Availability	87	%
Injection Energy	8	GeV
Longitudinal emittance per Bunch	0.5	eV-Sec
Space Charge Tune Shift	0.05	0
95% normalized transverse emittance	25	p-mm-mrad
r.m.s. normalized transverse emittance	13	p-mm-mrad
Bunching factor	2	0

Only 1% allowable loss

Second harmonic rf.

Major R&D Elements

NO CHANGE BETWEEN ICD-1 AND ICD-2

- The current MI rf system does not have enough power to accelerate the beam. We currently have no second harmonic system in MI. Need a 53MHz rf system (including a second harmonic) for RR.
- The MI crosses transition.
- Electron cloud instabilities and mitigation.
- Beam stability and losses in both MI and RR.

Recent Progress (1) E-Cloud Simulations and Measurements

- Continued the e-cloud generation simulations with PONSIT
  - Comparison with RFA data helped fix SEY.
  - Comparison for two rf frequencies.
  - Simulation results for both bend and straight regions.

- Made great progress with e-cloud microwave measurements.
  - Data from both bend and field free regions.
  - Direct phase shift results.

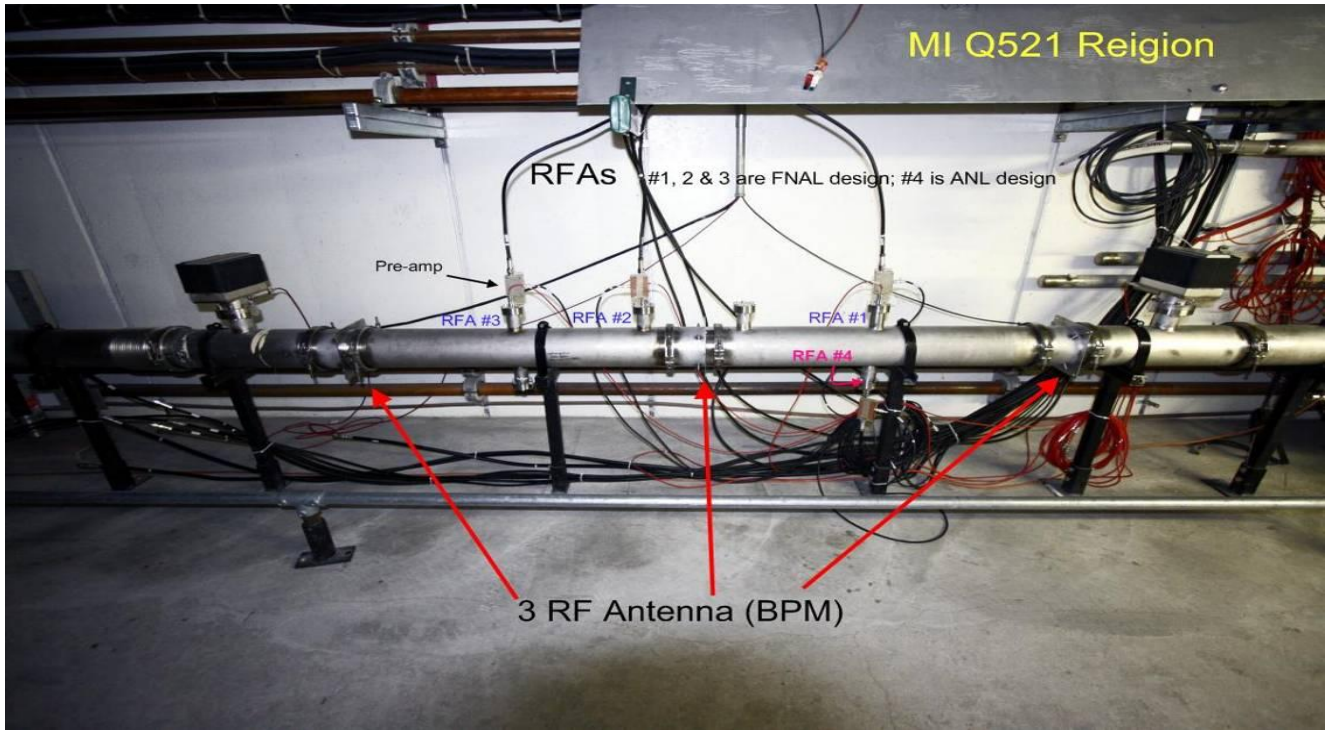
- Developed and installed in the MI new improved RFA detectors.

Recent Progress (2)
E-Cloud Mitigation

- Collaborated with BNL in coating with TiN two cylindrical 3ft beam pipes and installed one in MI.
  - An additional 10ft of cylindrical beam is going to be send for coating.

- We have developed a detailed plan with SLAC for the coating of a 20ft long elliptical beam pipe with hardware that can be used for in situ coating of the MI beam-pipe.

MI E-CLOUD SET-UP



Recent Progress (3)New MI/RF System

- Developed a cavity design that meets all the requirements for the fundamental 53MHz rf system.
- Have identified a power tube that will work for both 53 and 106 MHz handle the currents required.
- Started work on a higher order mode damper.

Project X Tentative FY10 Plan (1)

- MI/RR RF
  - Continue the cavity simulations
  - Work on a prototype
  - Investigate the power tube mounting
  - Tuner simulations and mechanical design

Project X Tentative FY1O Plan (2)

- E-Cloud Simulations
  - Continue the PONSIT simulations and comparisons with beam data.
  - Compare with another generation code.
  - Start beam dynamic simulations.
- E-cloud Measurements
  - New dedicated set-ups for microwave measurements.
  - Compare the microwave results with the RFA for both coated and un-coated beam pipes.
  - Try and measure tune shifts
- E-Cloud Mitigation
  - Develop hardware for in-situ TiN coating in MI.
  - Set-up for beam-pipe coatings in Fermilab.
  - Follow the developments in alternative coatings.

Project X Tentative FY10 Plan (3)

- Space charge simulations
  - How important is the space charge tune shift?
  - What are the losses as a function of bunching factor?
  - Check simulation results with current beam data.