Proton Source Options

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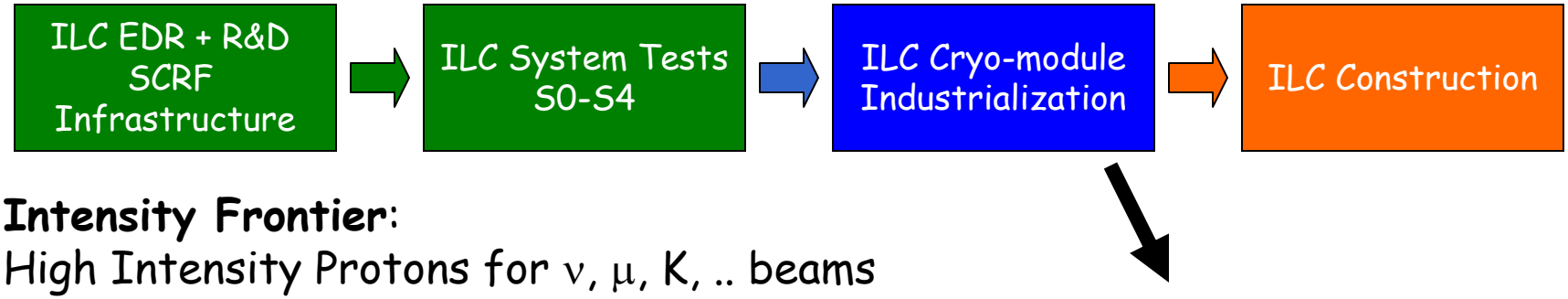
Assumptions

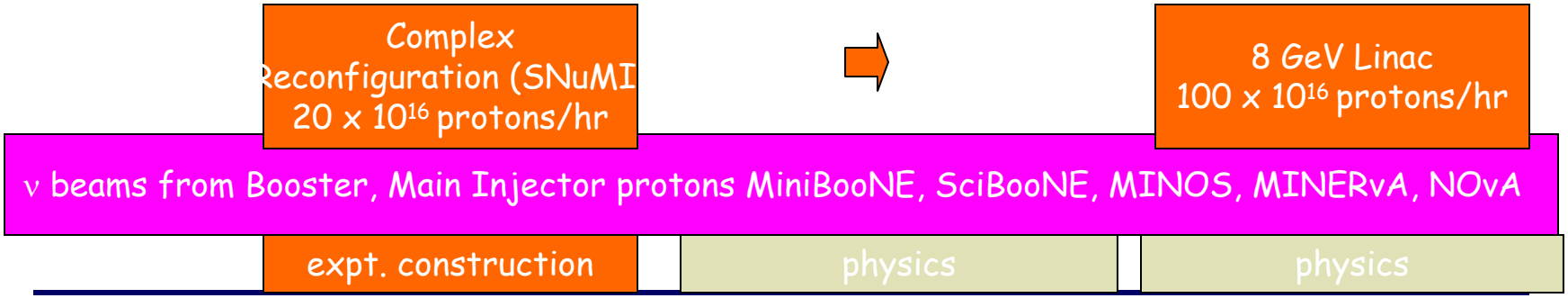
- This plan is suitable to the situation in which the decision to construct ILC occurs after 2010.
- Run II has ended and the Recycler and Antiproton Accumulator are available
- The accelerator complex will have the capability of delivering 700 kW at 120 GeV onto the NuMI target in 2012 (NOvA project).

Combined Energy and Intensity Frontier Roadmap

Energy Frontier



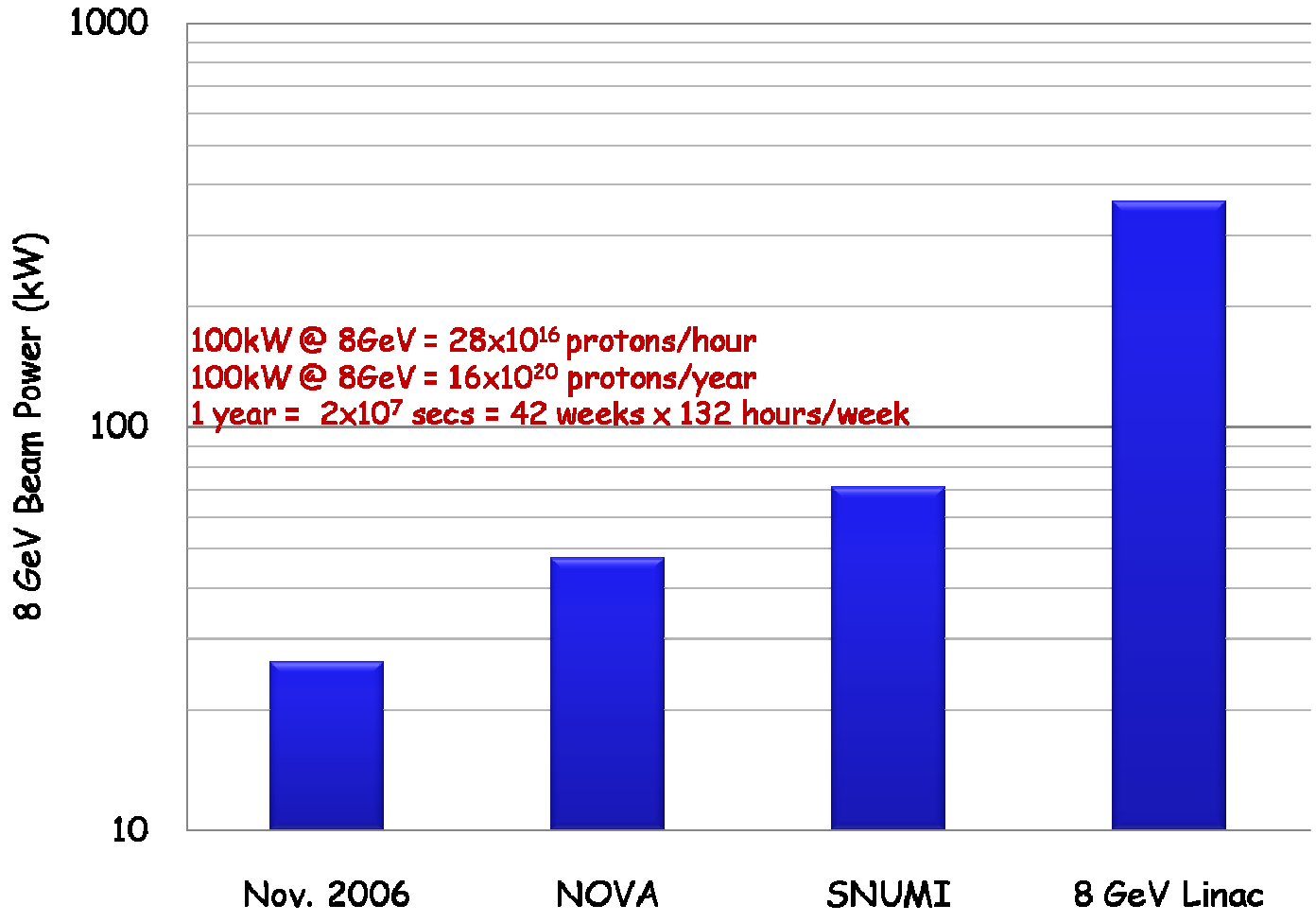
Intensity Frontier:
High Intensity Protons for ν, μ, K, .. beams



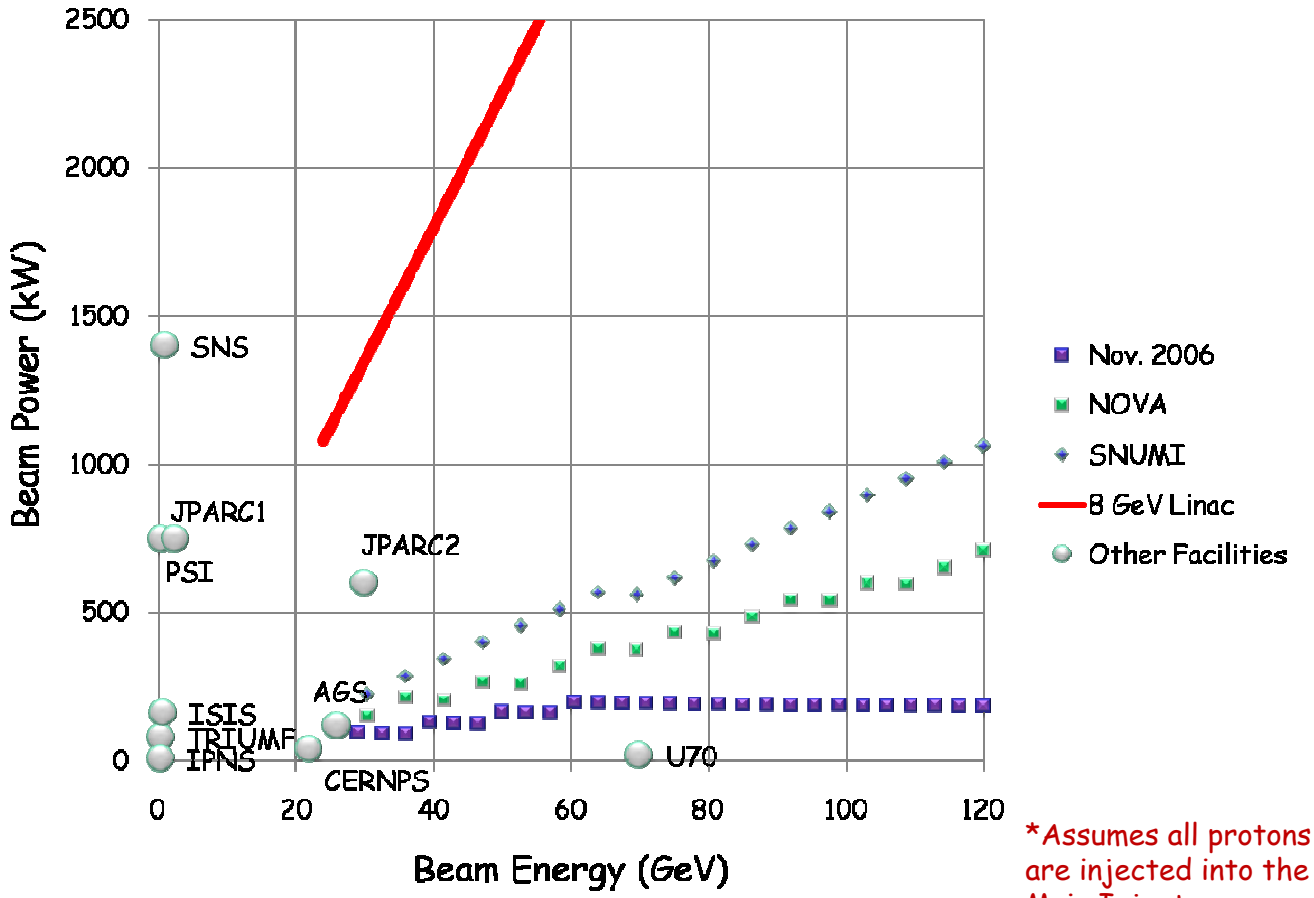
The Plan

	Now	Proton Plan	Nova	SNuMI	HINS			
Booster Batch Intensity	4.40E+12	4.30E+12	4.10E+12	4.40E+12	5.63E+13		protons/pulse	
Rep Rate	7	9	9	13.5	5		Hz	
Protons/hour	1.11E+17	1.39E+17	1.33E+17	2.14E+17	1.01E+18			
Main Injector batches	7	11	12	18	3			
MI batches to pbar target	2	2	0	0	0			
MI Cycle Time	2.4	2.2	1.33	1.4	1.4		sec	
MI Beam Power (120 GeV)	**176**	**338**	**710**	**1086**	**2314**		kW	
8 GeV Beam Power (available)	**18**	**17**	**0**	**4**	**206**		kW	
Injection energy (1st synch)	400	400	400	400	8000		MeV	
$\beta\gamma^2$	1.45	1.45	1.45	1.45	90.30			
Injection emittance	10	10	10	10	20		πmm-mr	
Injection Tune Shift	0.23	0.22	0.21	0.23	0.07			

Proton Flux

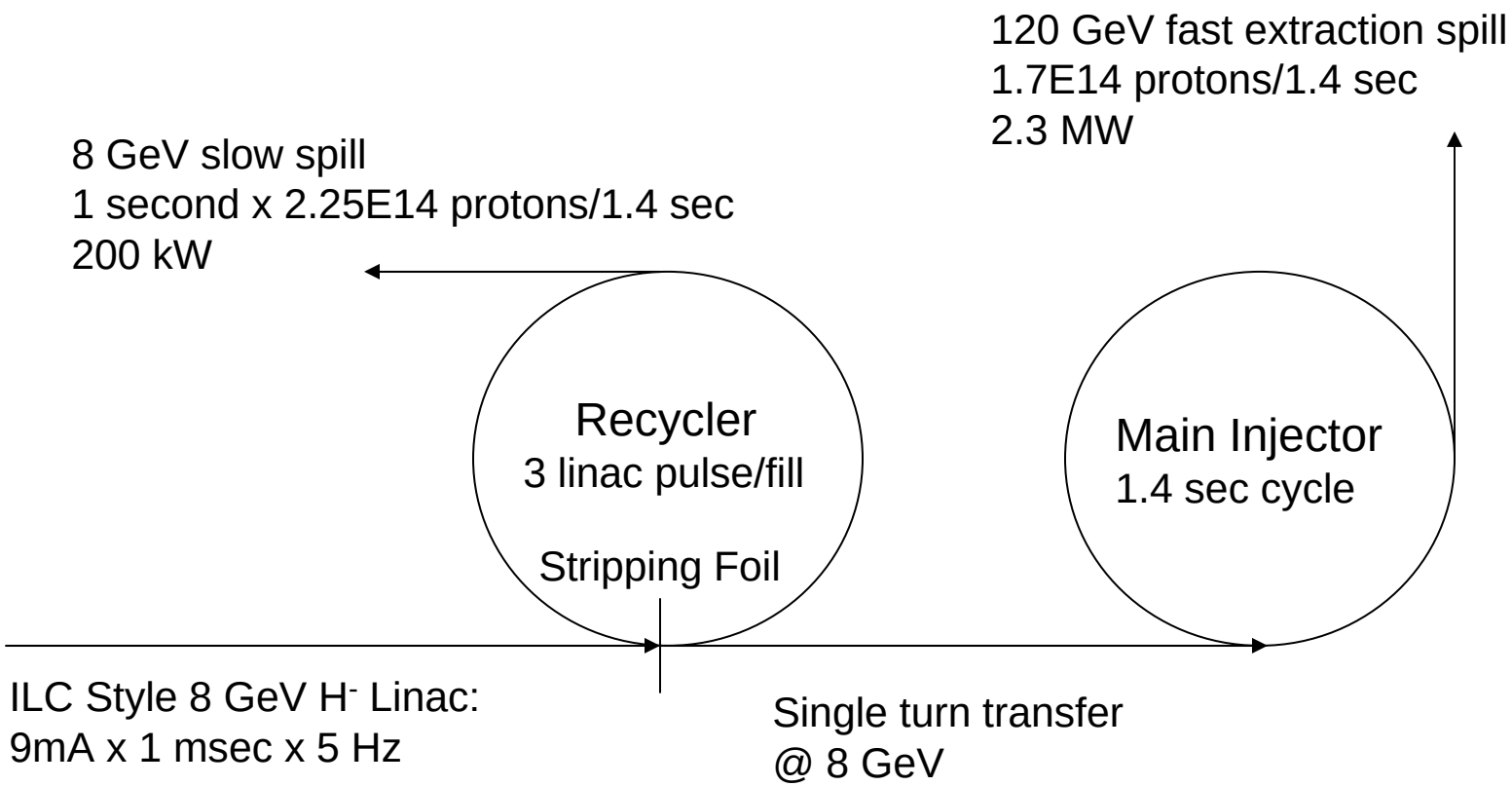

1000
100
10
8 GeV Beam Power (kW)
100kW @ 8GeV = 28x10^16 protons/hour
100kW @ 8GeV = 16x10^20 protons/year
1 year = 2x10^7 secs = 42 weeks x 132 hours/week
Nov. 2006
NOVA
SNUMI
8 GeV Linac

Proton Beam Power*



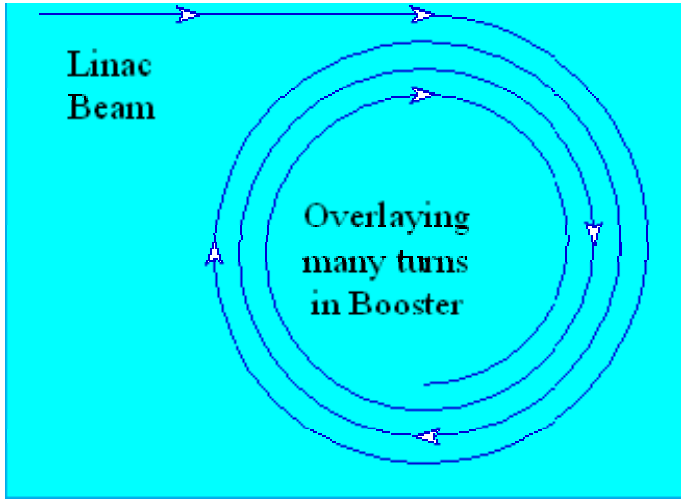
*Assumes all protons are injected into the Main Injector

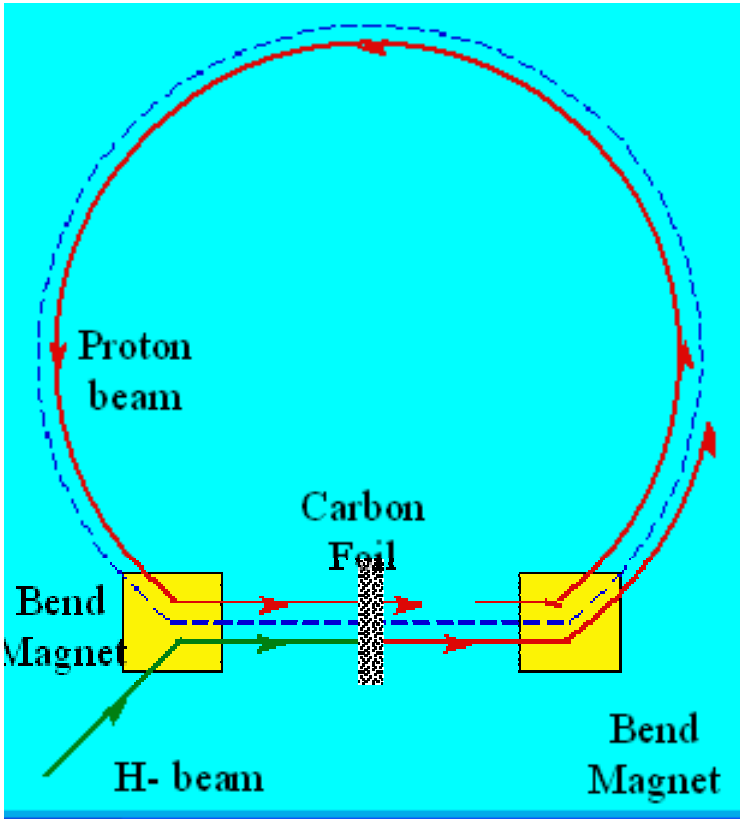
Final Stage Schematic



Multi-Turn Injection for Proton Sources

- Because a linac is a single pass accelerator, the amount of beam current that a linac can accelerate is limited by the power supplied by the klystrons(Ohms law)
- The total charge that a linac can accelerate is given by the beam current multiplied by the pulse length
  - ILC is 9mA x 1mS = 56×10^{12} electrons
  - 2.5MW at 120 GeV / 1.33 sec = 170×10^{12} protons
  - 170×10^{12} protons= 3 x 9mA x 1mS
- Current proton sources wrap the linac beam many turns around a Booster



Multi-Turn Injection and H- Stripping

- Proton Source linacs accelerate H- ions (proton + two electrons) which act effectively as negatively charged protons
- The H- beam and the circulating proton beam in the Booster merge at a injection magnet
- The merged beams would diverge again if pass through a second magnet
- A thin carbon foil inserted between the two magnets strips the two electrons from the proton
- After the stripping is completed, the beam is pulled away from the stripping foil