RLIUP (Introduction)

Review of LHC and Injector Upgrade Plans

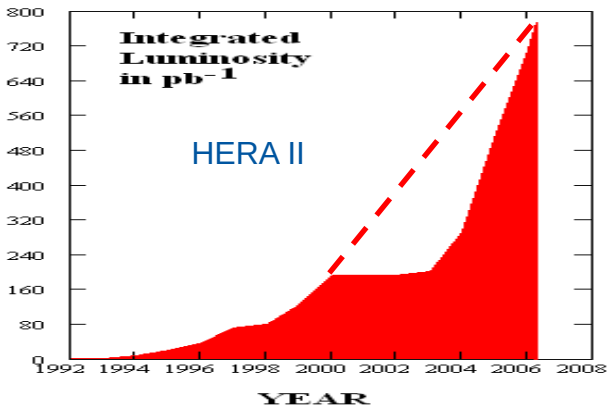
History

- Present “10 year” schedule was
  - proposed and developed at a time when we had much less information than now
  - and was not developed in a self-consistent way.

Objectives of RLIUP

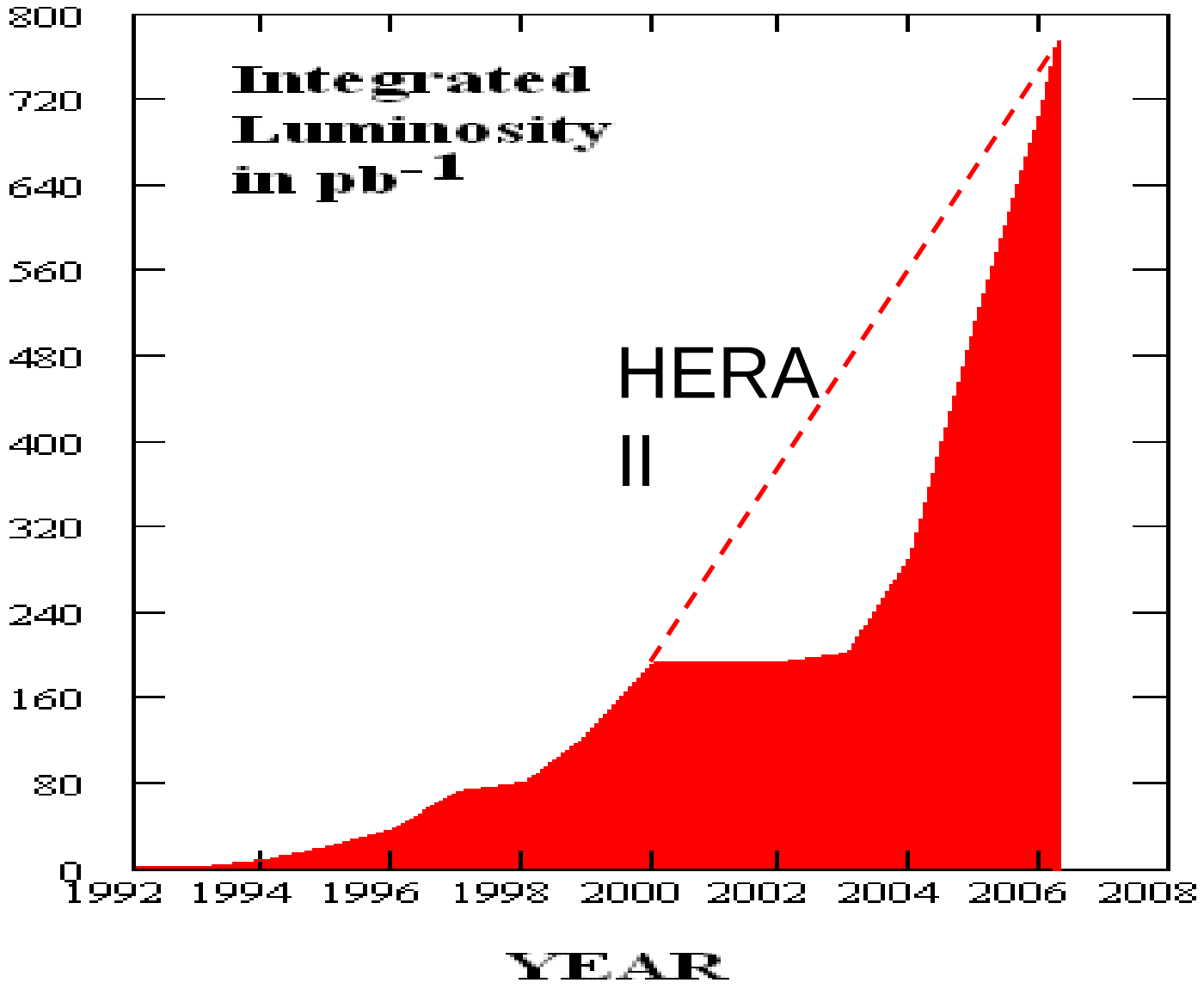
- Produce a self consistent **set** of schedules (over the next 20 years) with clear definitions of
  - Expected integrated luminosity (and beam energy) as a function of time
  - Date and duration of shutdowns
  - Relative cost of resources for each scenario
- The CERN management and the management of the experiments can then choose between the set of possibilities.

Limitations



- Time limitations
  - Scrubbing for 25ns
  - Required regular maintenance
  - Shutdowns needed for performance upgrades
  - Long stops needed for replacement of radiation damaged components
- Luminosity Limitations
  - Peak Luminosity
    - LHC
    - Injectors
    - Experiments (pile-up)
  - Integrated Luminosity
    - Machine availability (time limitations)
    - Efficiency of detectors (peak luminosity)
- Resources needed both experiment and machine

- How much integrated luminosity can be produced before there are radiation effects?
- How will these effects be evidenced?


Integrated
Luminosity
in pb^{-1}
HERA
II
800
720
640
560
480
400
320
240
160
80
0
1992
1994
1996
1998
2000
2002
2004
2006
2008
YEAR

Procedure (1)

- Identify the different phases/scenarios.
  - No Linac4 (phase)
  - With LINAC4 (phase)
  - With PIC (phase)

  } US0

  Phases since they are funded. Estimates of the integrated luminosity and time lines are however needed
  - Upgrade Scenario 1 (US1)
  - Upgrade Scenario 2 (US2)

Comparing the Phases/Scenarios

Phases/Scenarios: Post LS1—LINAC4 PSB Connection

	2015	>2016 IN / WITH IONS		2015	>2016 IN / WITH IONS
	POST LSI	LINAC4 PSB CONNECTION		POST LSI	LINAC4 PSB CONNECTION
PSB Machine			Control		✓
Magnets		%			
LL RF	%	✓	**PS Machine**		
Power Converters L4 Injection		✓	Transverse damper	%	✓
Beam Intercepting Devices		✓	Longitudinal damper	%	✓
Linac4 injection		✓			
Vacuum		%			
Interlock Systems		✓			

Comparison: LINAC4 PSB Connection -- PIC

	Any time after 2016 in // with ions	Dates & duration tbd by Eqt Groups		Any time after 2016 in // with ions	Dates & duration tbd by Eqt Groups
	Linac4-PSB connection	PICs		Linac4-PSB connection	PICs
PSB Machine			Power Convertors		%
HL RF		✓			
Power convertors ring, extraction & TL		%	**SPS**		
Electrical Systems		✓	Beam Instrumentation		✓
Civil Engineering		✓	Transverse Damper		✓
			Improved Vacuum sectorisation arcs		✓
PS			New TIVG core		✓
Beam Instrumentation		%	Other kicker impedance reduction		✓
Magnets		%	200MHz low level improvement		✓

Comparison: LINAC4 to PSB Connection – PIC (2)

	Any time after 2016 in // with ions	Dates & duration tbd by Eqt Groups
	Linac4-PSB connection	PICs
LHC Machine		
TAS, Inner Triplet & D1		✓
Exp Area		✓
Collimators Upgrade		%
Cryolink		%
Cryo Upgrade		%
Remote Handling		%
Beam Diagnostics		%

Comparison PIC – US1

	Dates & duration tbd by Eqt Groups	2021 or later		Dates & duration tbd by Eqt Groups	2021 or later
	PICs	Upgrade scenario 1		PICs	Upgrade scenario 1
		2 GeV			2 GeV
PSB Machine			High Bandwidth feedback		?
Magnets	%	✓	B-B LR compensatign wires		✓
Power converters ring, extraction & TL	%	✓			
Beam instrumentation	%	✓	**PS Machine**		
2 GeV extraction + Transfer		✓	Beam Instrumentation	%	✓
Vacuum	%	✓	Magnets	%	✓
			Power converters	%	✓
LHC Machine			RF	%	✓
Collimators upgrade	%	% %			
Cryo upgrade	%	% %			
Remote Handling	%	% %			
Beam Diagnostics	%	% %			

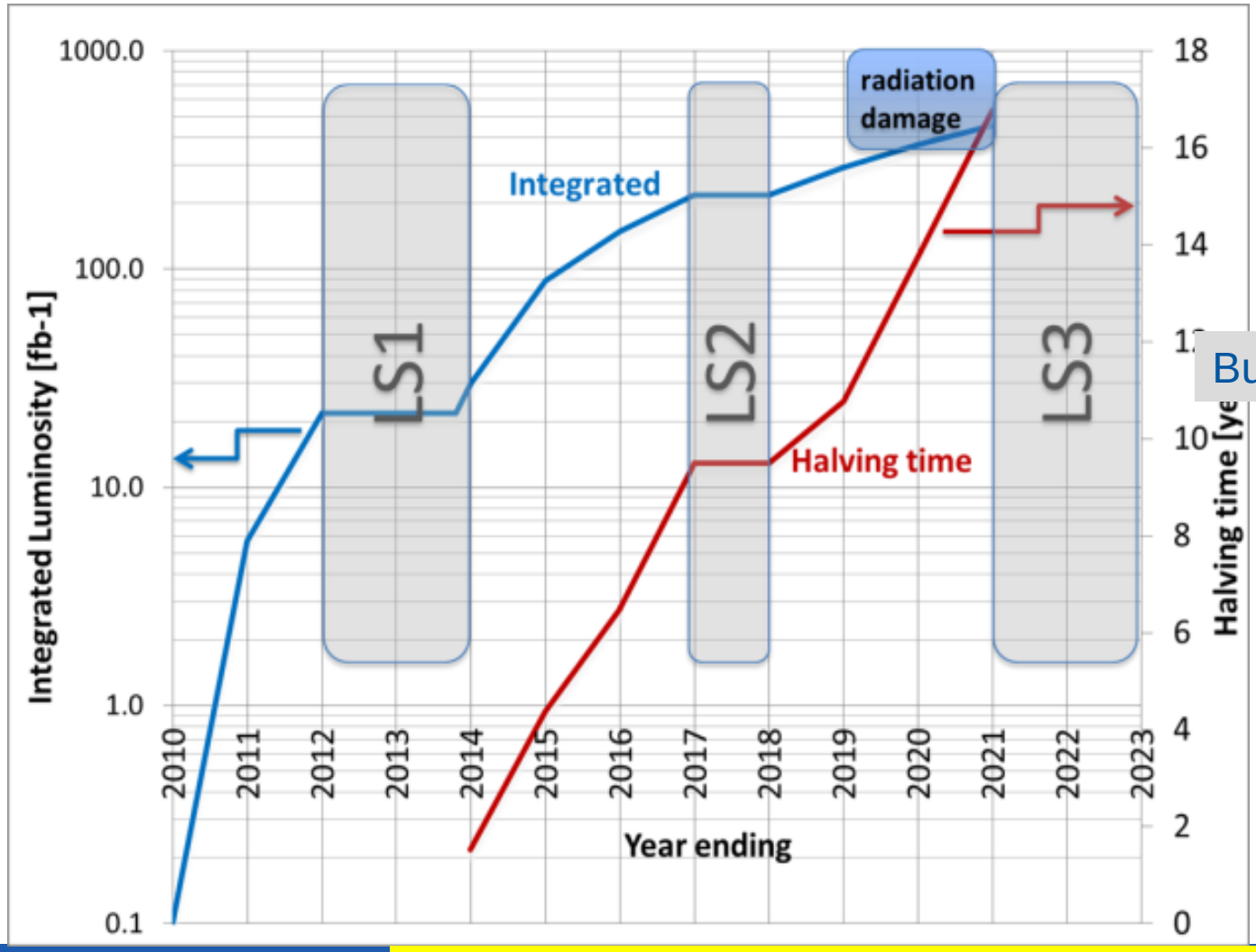
Comparison US1 – US2

	2021 or later	2021 or later		2021 or later	2021 or later
	Upgrade scenario 1	Upgrade scenario 2		Upgrade scenario 1	Upgrade scenario 2
	2 GeV	2 GeV		2 GeV	2 GeV
SPS Machine			**LHC Machine**		
200 MHz power upgrade	???	✓	Matching section remodelling (D2-Q6)	%	✓
SPS and TI2/TI8 protection devices	???	✓	Collimators upgrade	%%	✓
New wide band transverse damper		✓	Cryolink	%	✓
New external high energy beam dump		✓	Cryo upgrade	%%	✓
New collimation system		???	kicker, TDI	?	✓
aC coating of vacuum chambers		???	Interlocks & QPS	%	✓
			Remote Handling	%%	✓
LHC Machine			Beam Diagnostics	%%	✓
Higher harmonic RF	?	✓	High Bandwidth Feedback	?	✓
Collim. In dispersion suppressors.	%	✓	Halo control (e-lens or…)		✓

Procedure (2)

- For each of these independent phases/scenarios evaluate
  - The peak luminosity (limited by the LHC machine and injectors)
  - The peak luminosity (limited by the detectors: i.e. pile-up)
  - The time available for physics data taking (limited by shutdowns needed for upgrades, radiation repairs and normal maintenance)
  - Allows in an iterative way to calculate the integrated luminosity so that **a self-consistent parameter set is reached for integrated luminosity and shutdown needs.**
  - Evaluate the resources needed and the total relative cost for each self-consistent scenario

What we need



But continued to 2035

For all phases/scenarios

What we need (2)

	Integrated Luminosity	Personnel Resources	Materials Budget
US0	xx	xx	xx
US1	xxx	xxx	xxx
US2	xxxx	xxxx	xxxx

Have a great workshop!