3.1 Main linac layout and parameters

Outline

- Linac Overview
  - Nominal beam parameters - table
  - Basic Beam parameters at various energies and upgrades - table
  - Briefly discuss upgrade strategy
- Linac Layout
  - Overview of two rf schemes and association with site – illustrations of site layouts
  - RF system components (rf source, KCS energy combiners and tapoffs, and local distribution system) – table of properties and illustrations of each
  - Discuss bunch number upgrade
  - Explain 10 Hz operation at low energy and basic upgrade strategy
  - Shaft location and cryo system and loads – illustration and table
  - Parts counts (CM, cavities, rf unit, …) - table
  - Linac power requirements - table

Outline (Cont)

- Beam Components, Instrumentation, Dynamics and Operation
  - Quads, BPMs, Correctors and HOM absorbers – illustration
  - Beam line curvature, lattice (nominal and upgrade), and beam diagnostics
  - Beam dynamics issues (include tolerance table???)
  - Operational issues (energy and position FB)
  - Brief discussion of availability and 1.4% overhead

TABLE 2.6-1
Nominal beam parameters in the ILC Main Linacs.

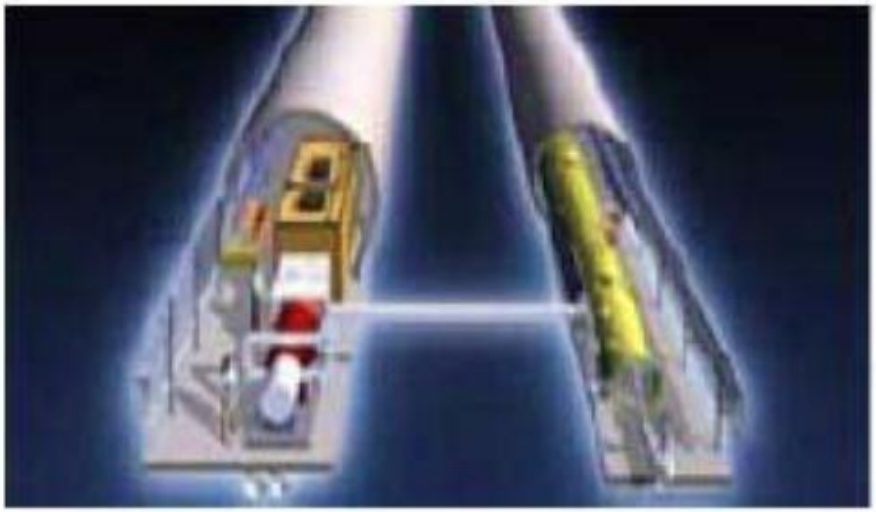
Parameter	Value	Units	Parameter	Value	Units
Initial beam energy	15	GeV	Initial $\gamma\epsilon_x$	8.4	μm
Final beam energy	250	GeV	Final $\gamma\epsilon_x$	9.4	μm
Particles per Bunch	2×10^{10}		Initial $\gamma\epsilon_y$	24	nm
Beam current	9.0	mA	Final $\gamma\epsilon_y$	34	nm
Bunch spacing	369	ns	σ_z	0.3	mm
Bunch train length	969	μs	Initial σ_E/E	1.5	%
Number of bunches		2625	Final σ_E/E (e^-,e^+)	0.14,0.10	%
Pulse repetition rate	5	Hz	Beam phase wrt RF crest	5	$^\circ$

IP and General Parameters

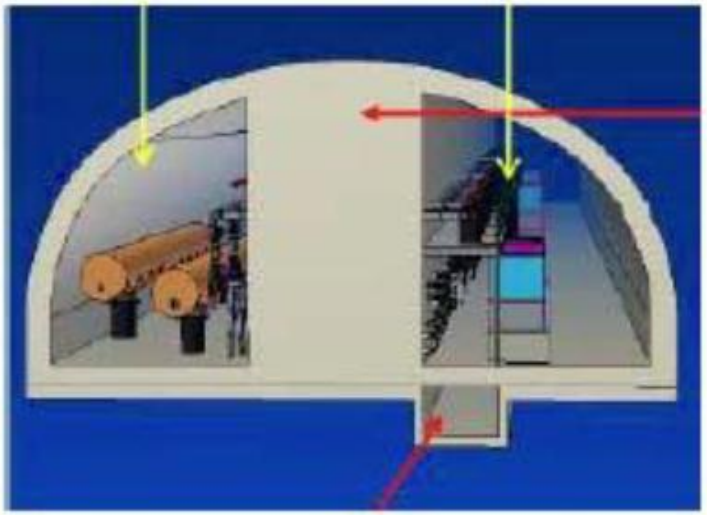
							L Upgrade	E_{cm} Upgrade	
Centre-of-mass energy	GeV	200	230	250	350	500	500	1000	1000
								A1	B1b
Beam energy	GeV	100	115	125	175	250	500	500	500
Collision rate	Hz	5	5	5	5	5	5	4	4
Electron linac rate	Hz	10	10	10	5	5	5	4	4
Number of bunches		1312	1312	1312	1312	1312	2625	2450	2450
Electrons/bunch	$\times 10^{10}$	2.0	2.0	2.0	2.0	2.0	2.0	1.74	1.74
Positrons/bunch	$\times 10^{10}$	2.0	2.0	2.0	2.0	2.0	2.0	1.74	1.74
Bunch separation	ns	554	554	554	554	554	366	366	366
Bunch separation $\times f_{RF}$		720	720	720	720	720	476	476	476
Pulse current	mA	5.8	5.8	5.8	5.8	5.79	8.75	7.6	7.6
RMS bunch length	mm	0.3	0.3	0.3	0.3	0.3	0.3	0.250	0.225

Nick Walker

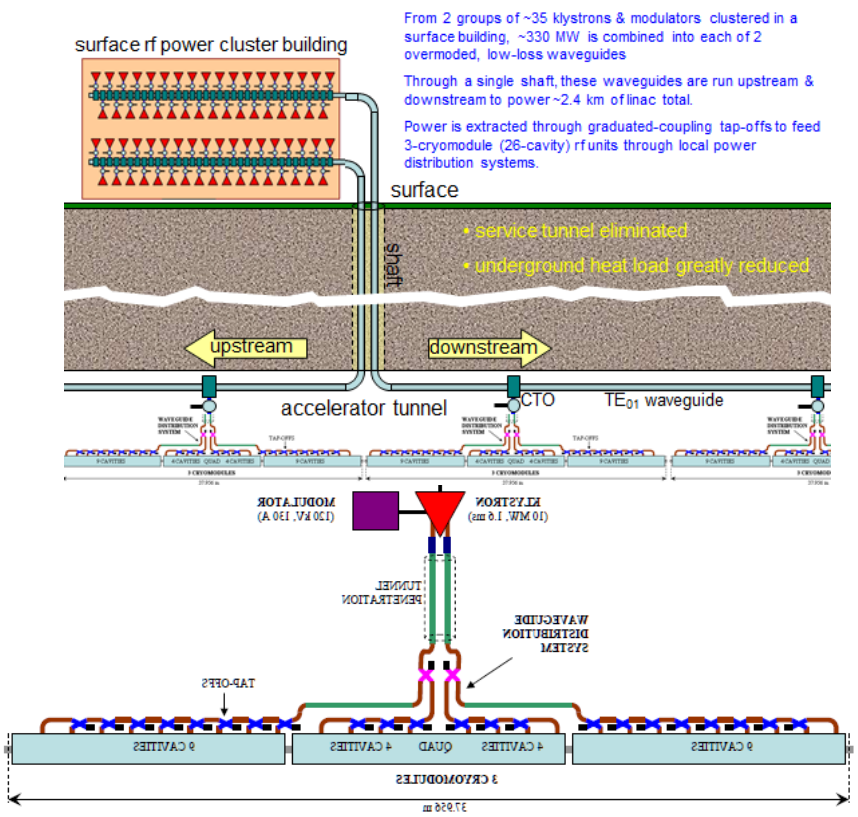
RDR two tunnel design (2007)

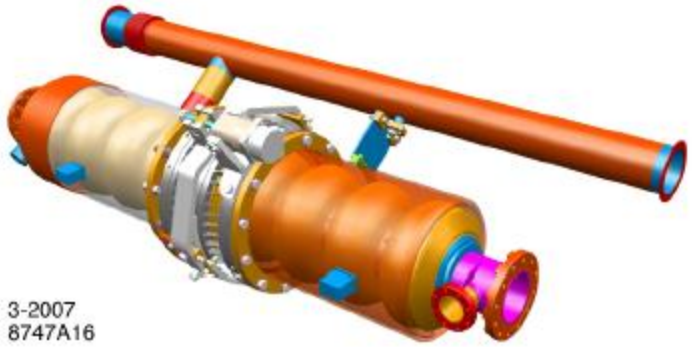


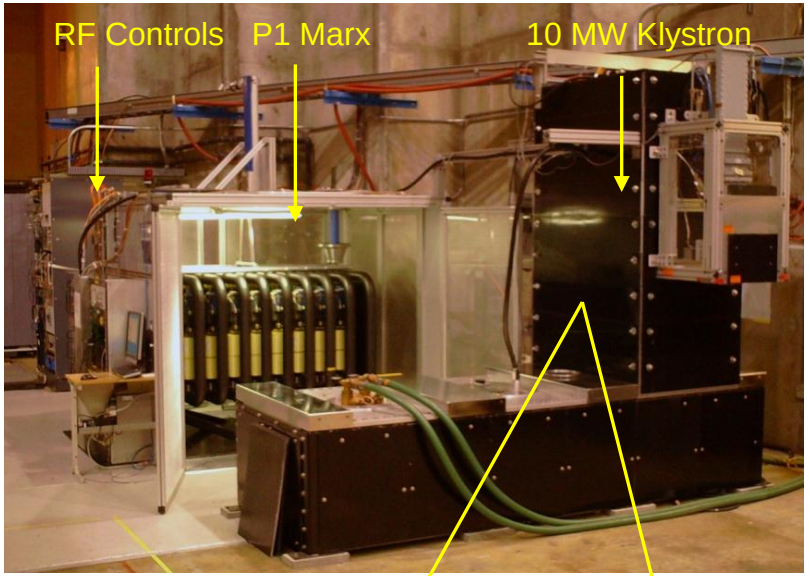
TDR mountain sites



Klystron Cluster Layout







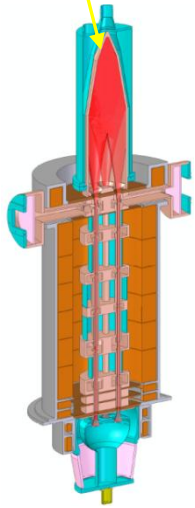


TABLE 2.6-2
RF unit parameters.

Parameter	Value	Units
Modulator overall efficiency	82.8	%
Maximum klyston output power	10	MW
Klystron efficiency	65	%
RF distribution system power loss	7	%
Number of cavities	26	
Effective cavity length	1.038	m
Nominal gradient with 22% tuning overhead	31.5	MV/m
Power limited gradient with 16% tuning overhead	33.0	MV/m
RF pulse power per cavity	293.7	kW
RF pulse length	1.565	ms
Average RF power to 26 cavities	59.8	kW
Average power transferred to beam	36.9	kW

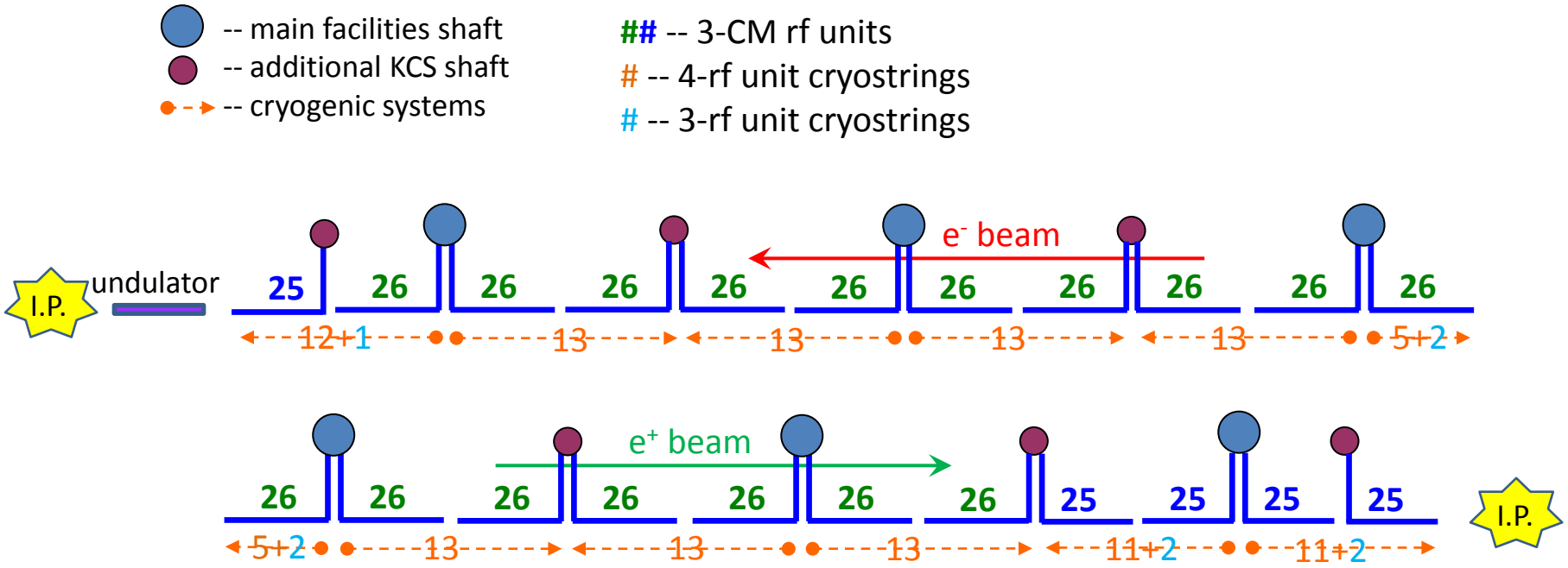


TABLE 2.6-3
RF unit cryogenic heat loads and installed AC cryogenic plant power to remove the heat.

	40–80 K		5–8 K		2 K		Total
	Static	Dynamic	Static	Dynamic	Static	Dynamic	
Heat load (W)	177.6	270.3	31.7	12.5	5.1	29.0	
Installed power (kW)	4.4	6.2	9.6	3.5	8.1	28.5	60.4

12 shafts
22 KCS's
567 rf units (285+282)
1,701 cryomodules
14,742 cavities

TABLE 2.6-4

Subdivision lengths and numbers in the two main linacs. Total linac lengths exclude the length of the positron production insertion and the coasting length at the end of each linac.

Subdivision	Length (m)	Number
Cavities (9 cells + ends)	1.326	14,560
Cryomodule (9 cavities or 8 cavities + quad)	12.652	1,680
RF unit (3 cryomodules)	37.956	560
Cryo-string of 4 RF units (3 RF units)	154.3 (116.4)	71 (6)
Cryogenic unit with 10 to 16 strings	1,546 to 2,472	10
Electron (positron) linac	10,917 (10,770)	1 (1)

TABLE 2.6-5
AC power consumption of the two main linacs.

System	AC Power (MW)
Modulators	81.4
Other RF system and controls	8.4
Conventional facilities	25.7
Cryogenic	33.8
Total	149.3

Quad Package

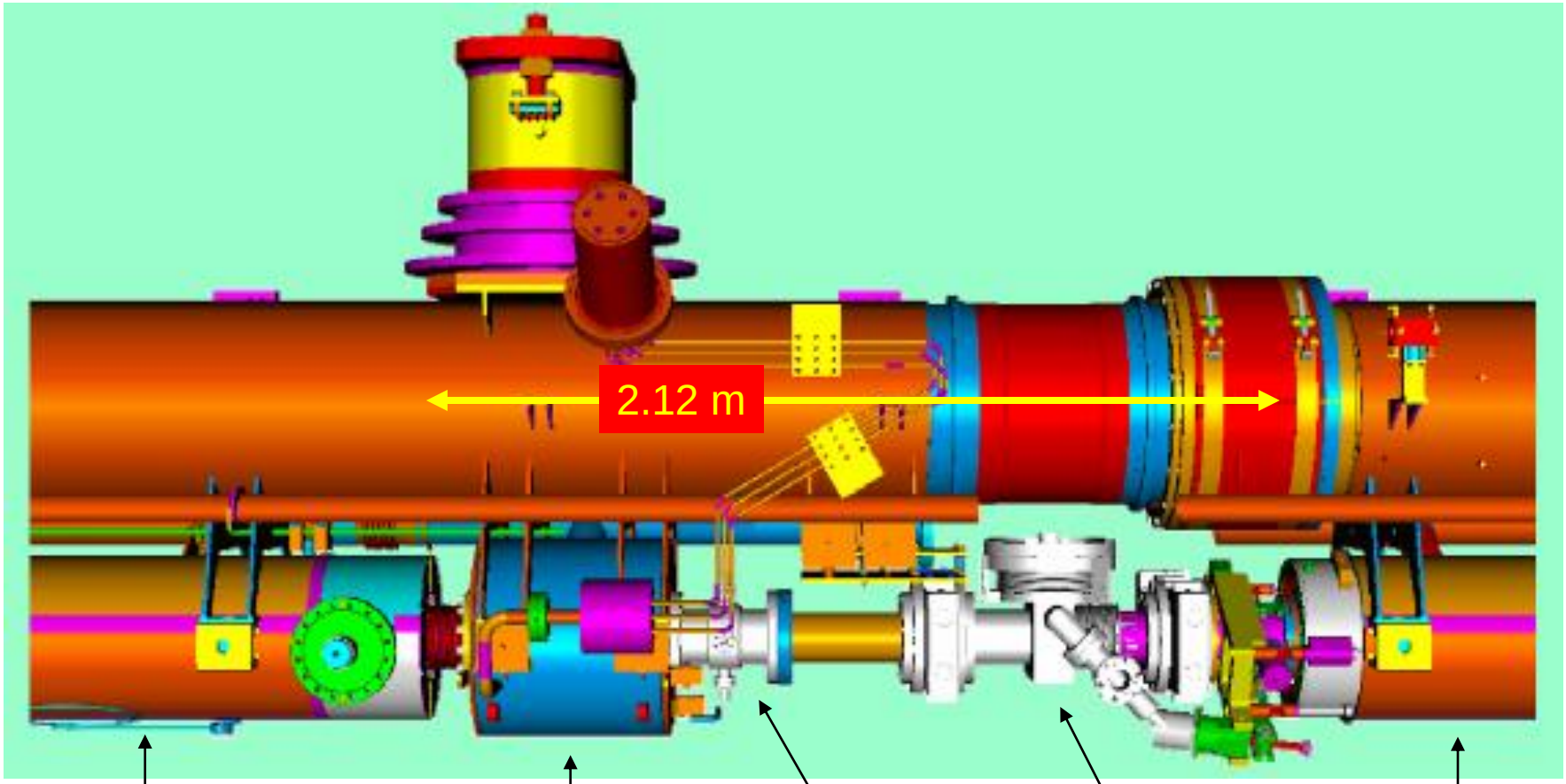


TABLE 2.6-7
Main Linac Beamline Components.

Component	Number (total)
Cavities	14,560
SC quadrupole magnets	560
X-correctors	560
Y-correctors	560
SRF BPMs	560
Laser wire scanners	7