ILC Cryogenic Systems BAW2

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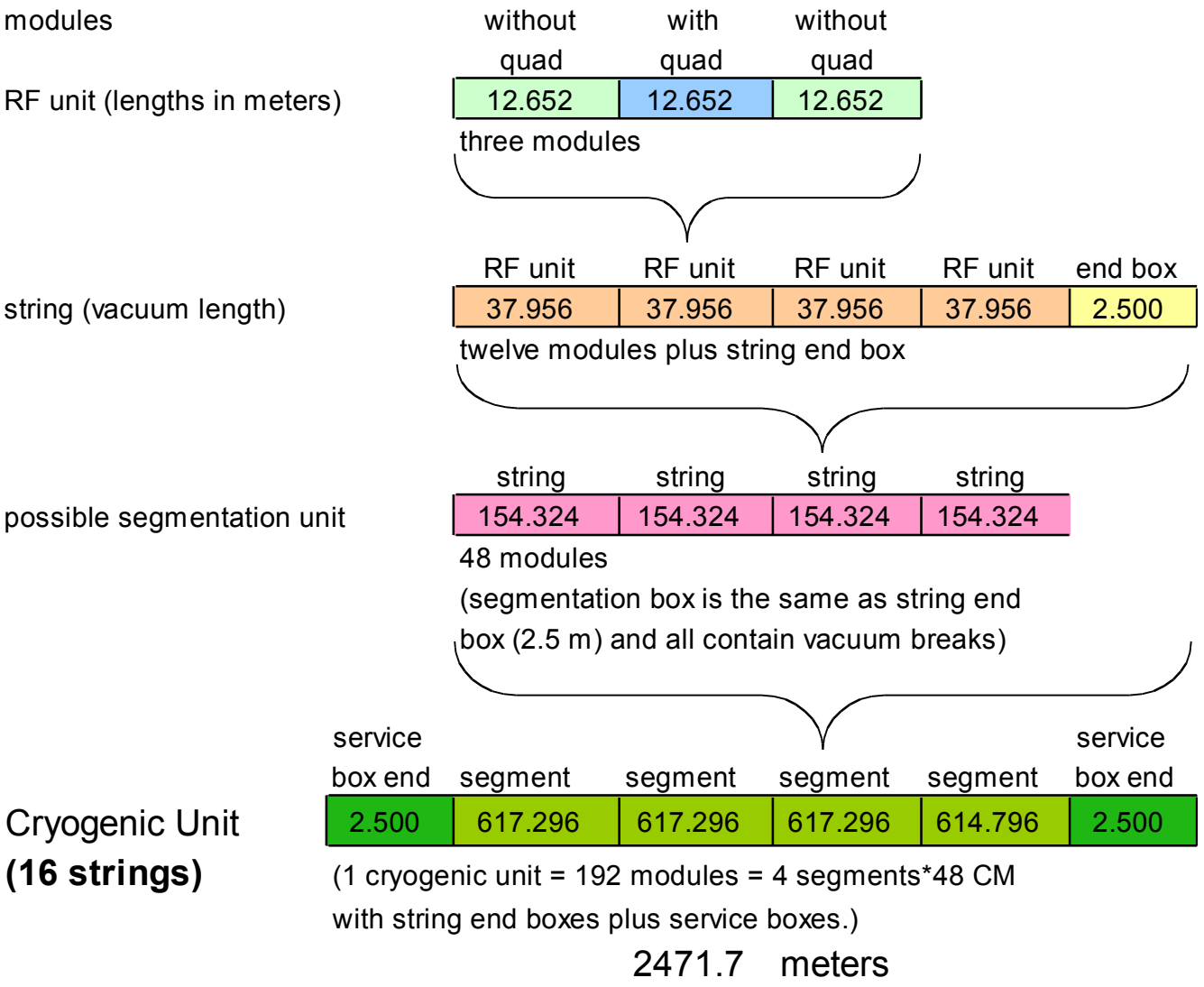
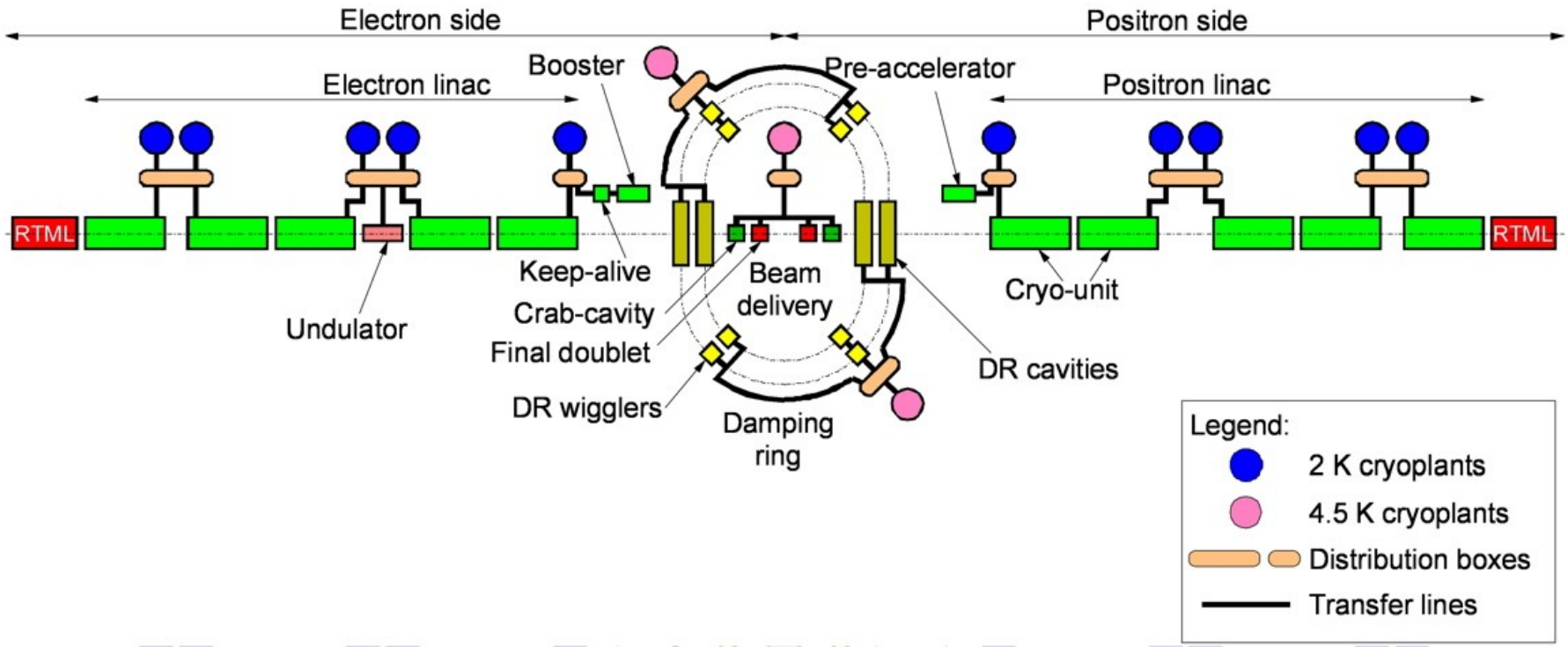
Main Linac Cryogenic Unit-RDR



Cryogenic plant arrangement-RDR



10 large, 2 Kelvin cryogenic plants
3 or more, smaller, mostly 4.5 Kelvin cryogenic plants
Significant distribution systems

Heat loads and cryoplant power

Heat and power calculated from				
info provided by Peter Garbincius in	2 K total heat	5 K total heat	40 K total heat	Installed power
CryoPower-PHG-12Jan2011.xls	(Watts per cryomodule)			(MW per cryoplant)
RDR	11.37	14.93	153.48	4.29
RDR revised	11.37	17.87	157.99	4.48
Full Power	11.36	17.84	145.68	4.42
Low Power KCS	10.71	15.99	135.00	4.12
Low Power DRFS	13.70	15.66	133.41	4.72
10 Hz LP KCS pos side	4.54	14.45	113.96	2.65
10 Hz LP KCS elec side	7.29	17.33	142.51	3.53
10 Hz LP DRFS pos side	5.26	14.11	112.33	2.77
10 Hz LP DRFS elec side	8.60	16.65	139.22	3.74

- Low power DRFS 2 K heat is higher due to having both the full 969 msec beam pulse and the long 1190 msec fill time
- 10 Hz cases have low 2 K heat loads due to the reduced cavity gradients
- The largest standard cryoplant based on heat exchanger sizes and transportation limits would be roughly 5.5 MW.

Cost comparisons

			new cost per plant	per plant cost	total cost impact on
Peter Garbincius provided input in	power ratio	plant cost ratio	(portion which scales^0.6)	difference from RDR	two main linacs
CryoPower-PHG-12Jan2011.xls	new/RDR	new/RDR	(2006 M$)	(2006 M$)	(2006 M$)
RDR	1.00	1.00	22.40	0.00	0.00
RDR revised	1.05	1.03	23.00	0.60	6.01
Full Power	1.03	1.02	22.81	0.41	4.06
Low Power KCS	0.96	0.98	21.88	-0.52	-5.23
Low Power DRFS	1.10	1.06	23.72	1.32	13.22
10 Hz LP KCS pos side	0.62	0.75	16.77	-5.63	
10 Hz LP KCS elec side	0.82	0.89	19.92	-2.48	-40.55
10 Hz LP DRFS pos side	0.65	0.77	17.23	-5.17	
10 Hz LP DRFS elec side	0.87	0.92	20.65	-1.75	-34.59

- Of the total estimated $450M (2006 $) for the 10 ILC Main Linac and RTML plants and cryogenic distribution, essentially exactly half is relatively independent of plant size (end boxes, distribution boxes, transfer lines, helium storage, etc.)

Upgrading cryogenic plant capacity

- The ideal upgrade path is first to install one of two cryogenic plants with space for a second, then later install the second unit
  - **In the RDR layout, each linac had two pair of plants where such a staged upgrade of capacity could be done**
  - **These could be unequal size, for example 60% / 40% of final total required provided the larger plant fits within practical size limits (~5.5 MW)**
  - **Such a scenario looks possible for upgrading from the 10Hz scenarios to full power on the positron side**
- Upgrading from an 82% plant to 100% involves providing a full-sized plant initially, and adding compressors and expanders later
  - **Not as effective in cost savings as separate plants but does save some initial costs**