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Baseline Configuration of the Cryogenic System for the International Linear Collider (ILC)

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Content

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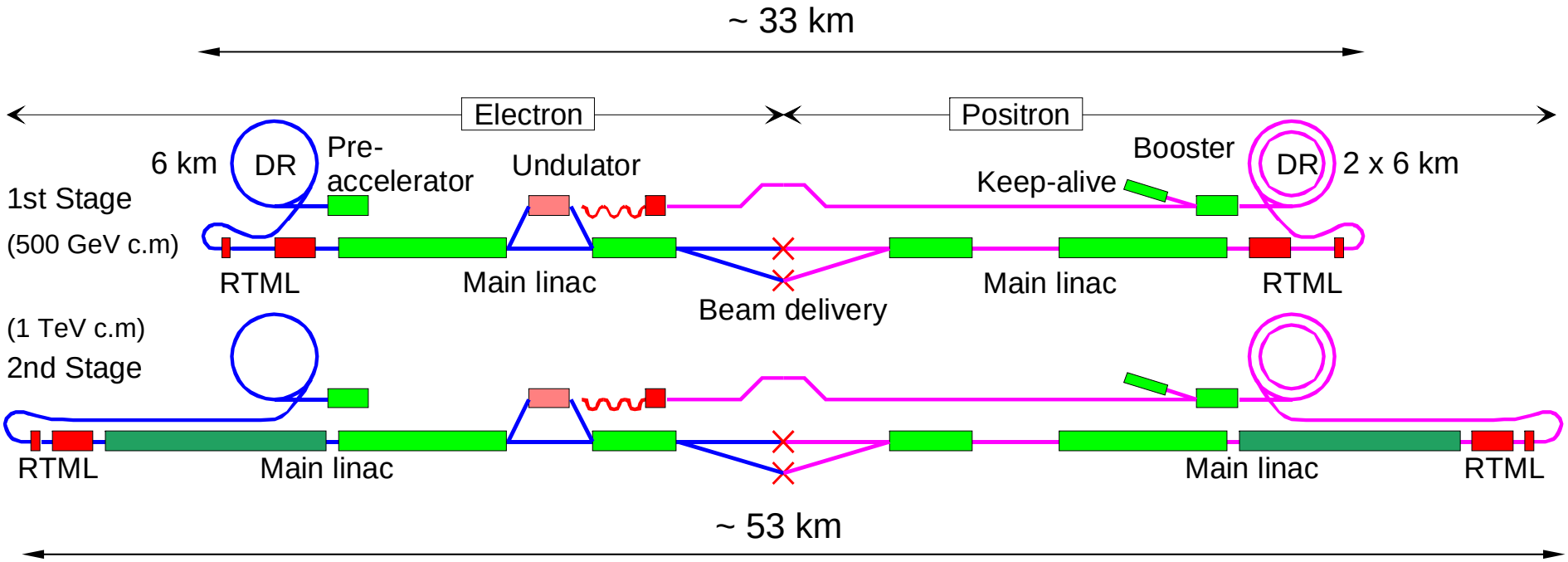
Overall Layout of the ILC



Tunnel constraints:

- Could follow the earth curvature (no slope) or laser-straight (up to 0.6 % slope)
- Could be shallow or deeply excavated (split of cryoplants to deal with large hydrostatic heads)

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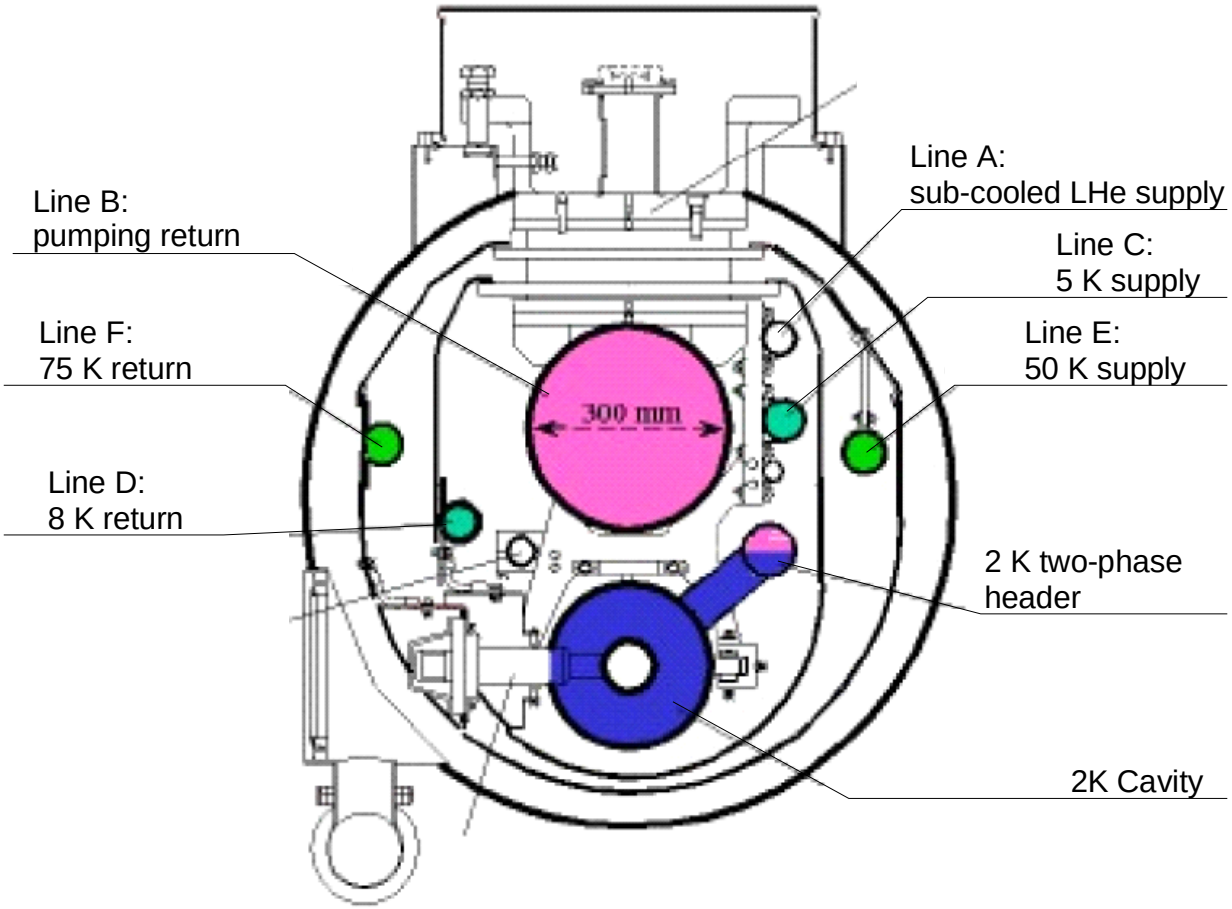
ILC Superconducting Equipments

Area systems		Equiments	Temp. [K]
Sources	Pre-Accelerator, Booster & Keep-alive	1.3 GHz SRF cryomodules, SC quadrupoles	2
	Undulator	1.3 GHz SRF cryomodules, SC undulator & quadrupoles	4.5 or 2
Damping rings		650 MHz single-cell SRF cavities, SC wigglers	4.5
Ring To Main Linac (RTML)		1.3 GHz SRF cryomodules, SC quadrupoles & Solenoids	2
Main linac		1.3 GHz SRF cryomodules, SC quadrupoles	2
Beam delivery		3.9 GHz SRF crab cavities, Final focusing SC doublets	4.5

In total for the first stage:
~ 16400 9-cell TESLA type cavities
~ 2150 SRF cavity cryomodules (all types)
~ 1140 superconducting magnets (all types)

Cross-section of Cryomodule



~11 m-length per cryomodule

Based on the TTF III design

Pipes to be resized w/r to the TTF III design.

Very limited cryogenic instrumentation

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Main Linac Distributed Heat Load [W/m]

CERN

Temperature level	40-80 K	5-8 K	2 K
Static heat inleaks	6.7	1.2	0.4
Dynamic heat load*	8.9	0.4	0.7
Total without contingency	15.6	1.6	1.1
Total with contingency**	26.5	3.1	1.8

*: RF load in cavities and RF losses in input- and HOM-couplers, HOM absorbers

**Contingency: Uncertainty factor on heat inleaks: 1.5
Overall overcapacity factor: 1.4

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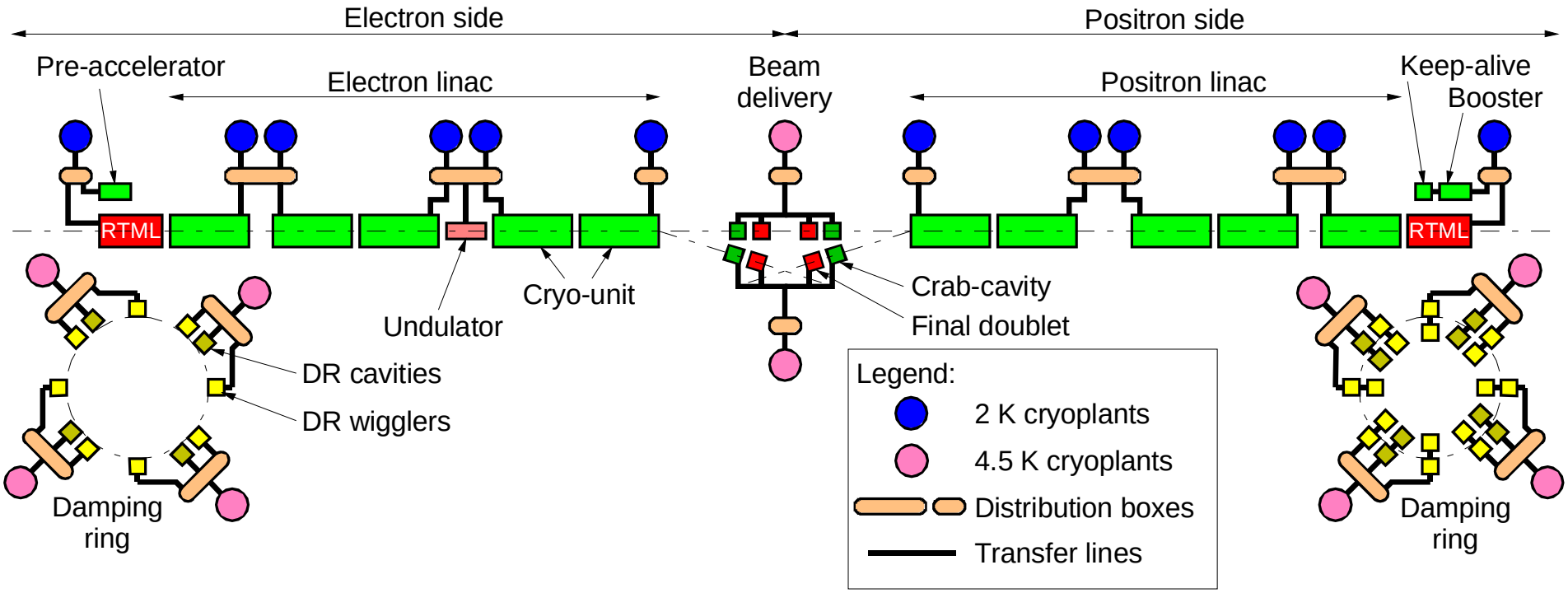
Cryogenic Layout (1st Stage)



Cryo-unit length: 2.1 to 2.3 km

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Cryoplant Inventory and Capacity Requirement in 1st Stage [kW]

CERN

System	Nb	Temperature level				Equivalent unit capacity @ 4.5 K
		40-80 K	5-8 K	4.5 K	2 K	
Main Linac and undulator	10	60	7.0	N/A	4.1	22
Electron RTML and pre-accelerator	1	25	2.9	N/A	1.7	9.2
Positron RTML, booster and keep-alive	1	26	3.0	N/A	1.8	9.5
e- damping ring	4	2.6	N/A	0.6	N/A	1.2
e+ damping ring	4	4.9	N/A	1.1	N/A	2.9
Beam delivery	2	2	N/A	0.6	N/A	0.7

In the first stage:
Total Number of Cryoplants: 22 cryoplants including 12 2-K cryoplants
Total capacity: 254 kW equivalent @ 4.5 K including 45 kW @ 2K

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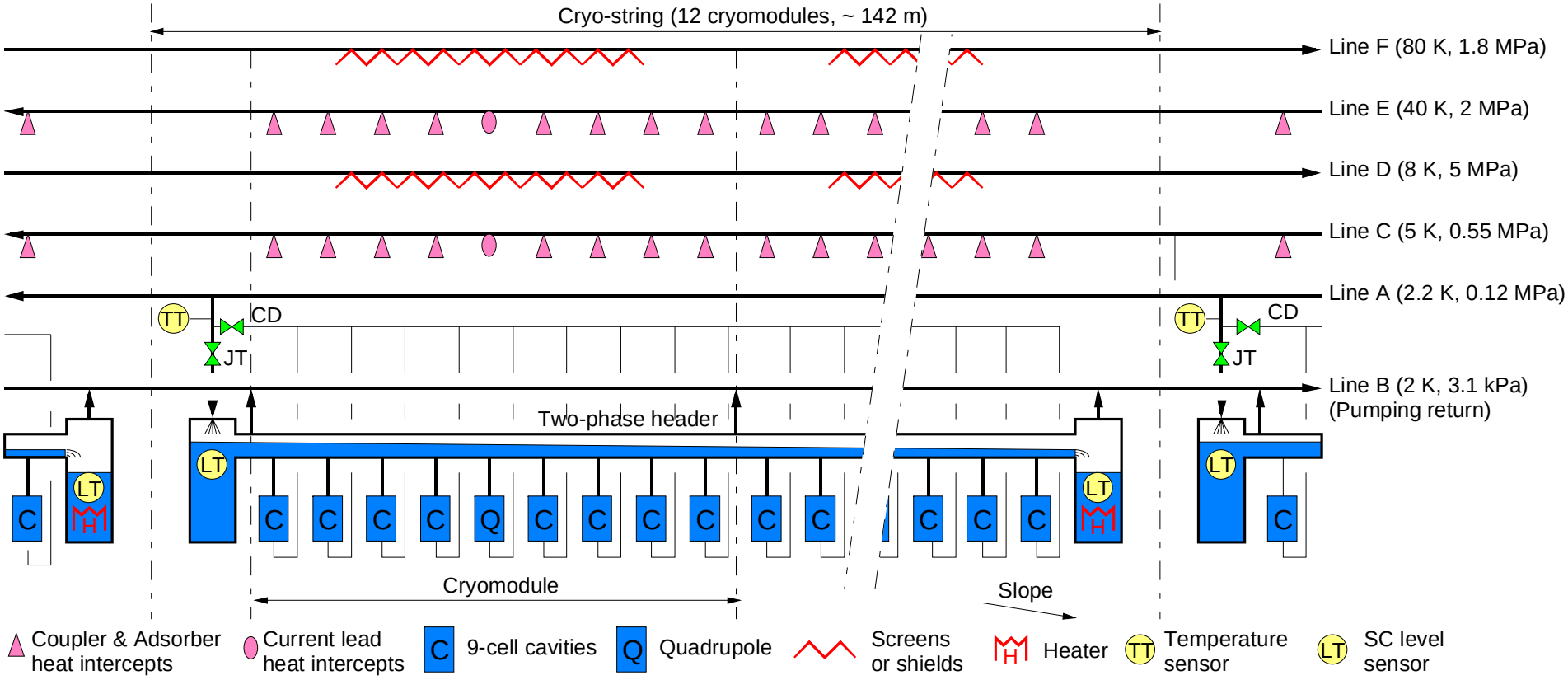
Cooling Scheme of a Cryo-string



Studies and Developments

- S&D for consolidation of the technical choices, reduction of capital and operation costs, increase of the filling factor, improvement of the operation availability and reliability.
- S&D on:
  - » Smaller sub-sectorization to reduce the maintenance unit length,
  - » Thermo-mechanical optimization of the cryomodule,
  - » Mechanical stability of a cryo-string assembly,
  - » Larger cryoplants to increase the cryo-unit length,
  - » Two-phase superfluid helium flow pattern and cooling limitations with respect to slope and string length,
  - » Efficient control strategies to limit the use of electrical heating during transient and steady-state operation.
  - » Sub-cooling heat exchangers with capacity 10 times larger than the present state of the art.

Conclusion

- The baseline configuration of the cryogenic system for the International Linear Collider has been defined in the framework of an international Global Design Effort.

- 22 cryoplants required in the first stage:
  - » Total equivalent installed capacity: 254 kW @ 4.5 K including 45 kW @ 2 K
  - » 10 4.5-K cryoplants and 12 2-K cryoplants distributed over 45 km
  - » Unit Capacity: from 1 to 22 kW equivalent @ 4.5 K
from 2 to 4 kW at 2 K

- Reference and technical design and corresponding S&D will proceed until 2010 which will be a crucial year for the ILC project approval with the confluence of:
  - » the end of the ILC technical design,
  - » the consolidation of the LHC physics results,
  - » the end of the CLIC feasibility study.