Development of cryostat

K. Tsuchiya
KEK

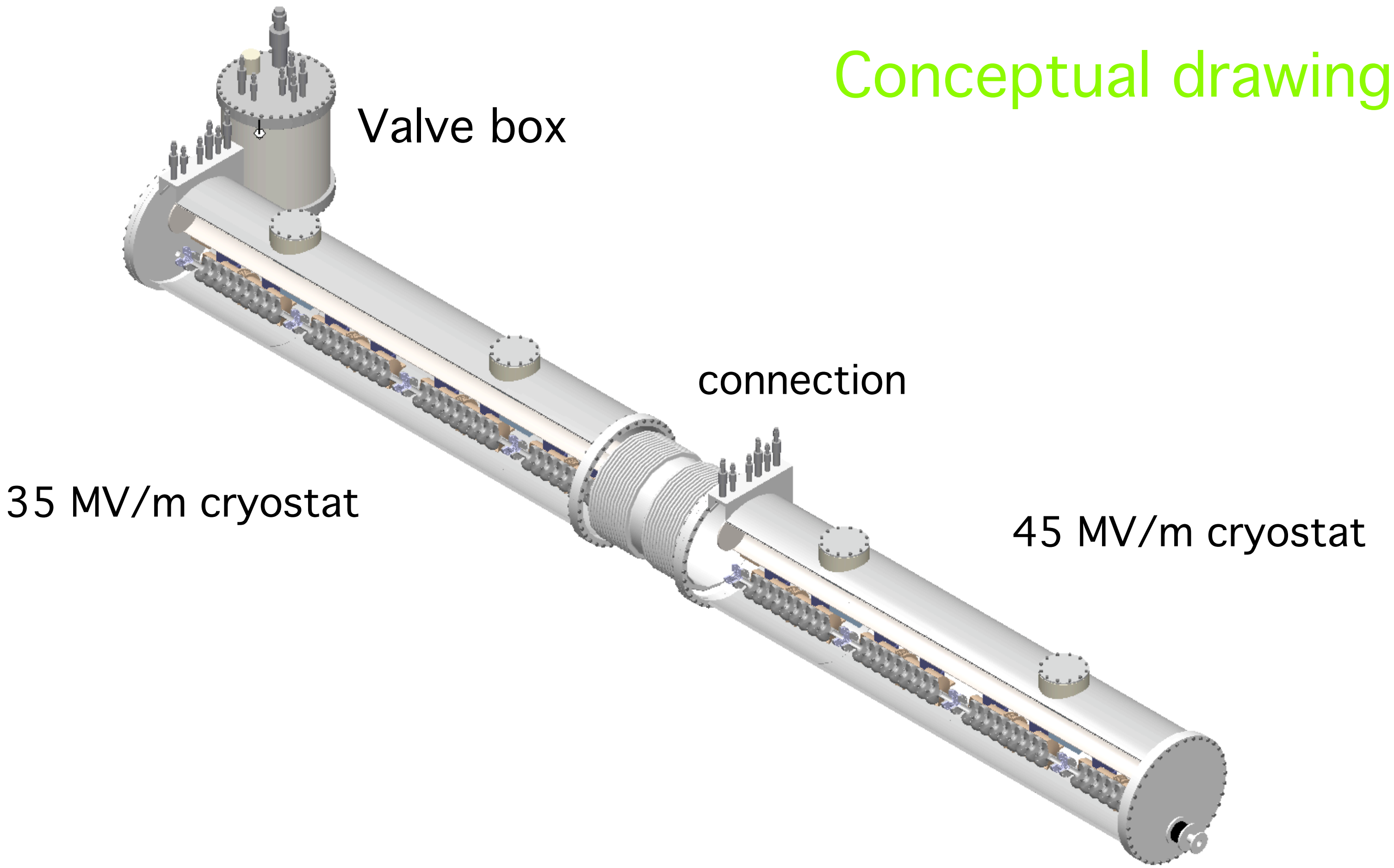
Final goals of the ILC cryostat

- Low cost
- Low heat load
- High reliability

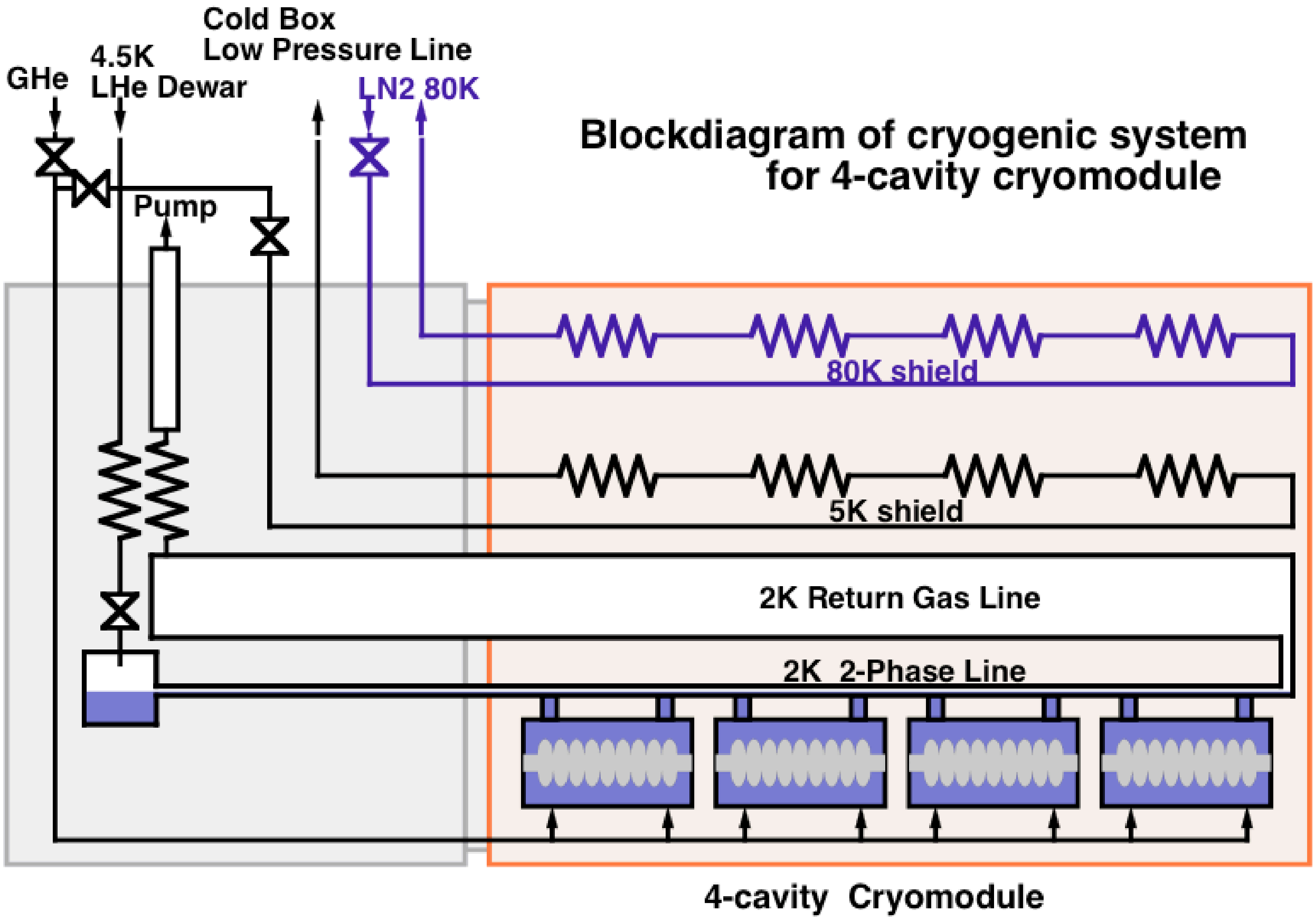
- TESLA cryostat design is already well developed and tested.
- However, there is a space for further improvement.
- In order to contribute to this improvement, we have to learn about the cryostat through the experience of design, fabrication and test.

STF phase 1 cryostat

two 5m long cryostats for 35 and 45 MV/m cavities



Cooling scheme



Objectives of the cryostat

- to prepare the cryostat in which the high power test of the cavities can be done at 2 K.
- to gain experience of fabrication and operation of LC-type cryostat. (although the length of the cryostat is somewhat shorter than ILC full size cryostat)

Design basis

TESLA design concept

Items considered in the cryostat design

- **Mechanical Item**
  - Material
  - Support structure
  - Alignment method
  - Thermal contraction
  - Leak tightness
- **Cryogenic Item**
  - Pipe size :   flow rate, pressure
  - Heat load
  - Instrumentation
- **Magnetic shield**
- **Safety code**
  - high pressure gas safety law   rigid law
  - How to cope with the law?

Other design criteria

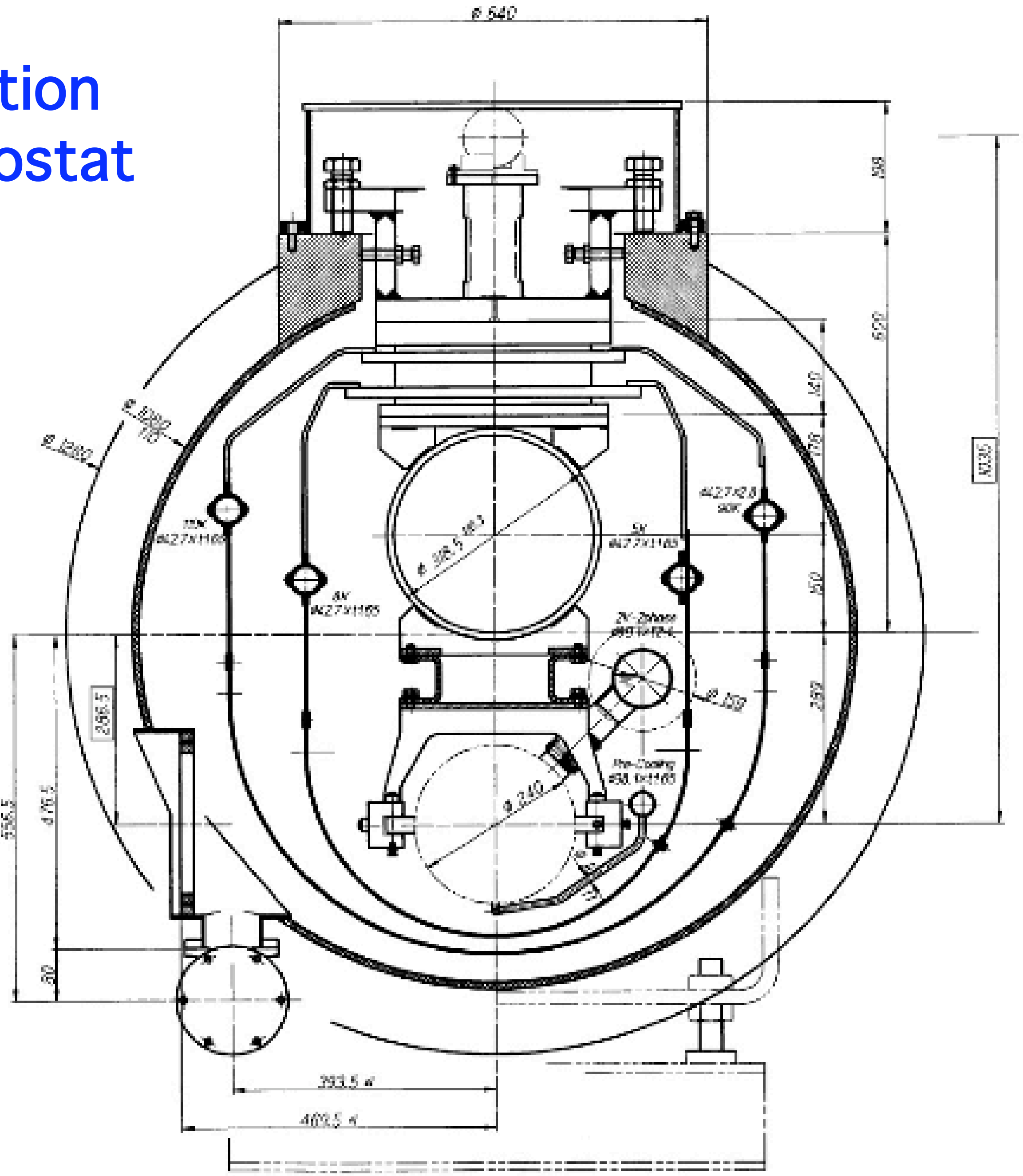
Shipping and handling loads

Direction	Load
Lateral	1 G
Vertical (weight + 1G)	2 G

Alignment criteria

Position	Criteria
Precision of the cavity	± 0.2 mm

Cross section of the cryostat



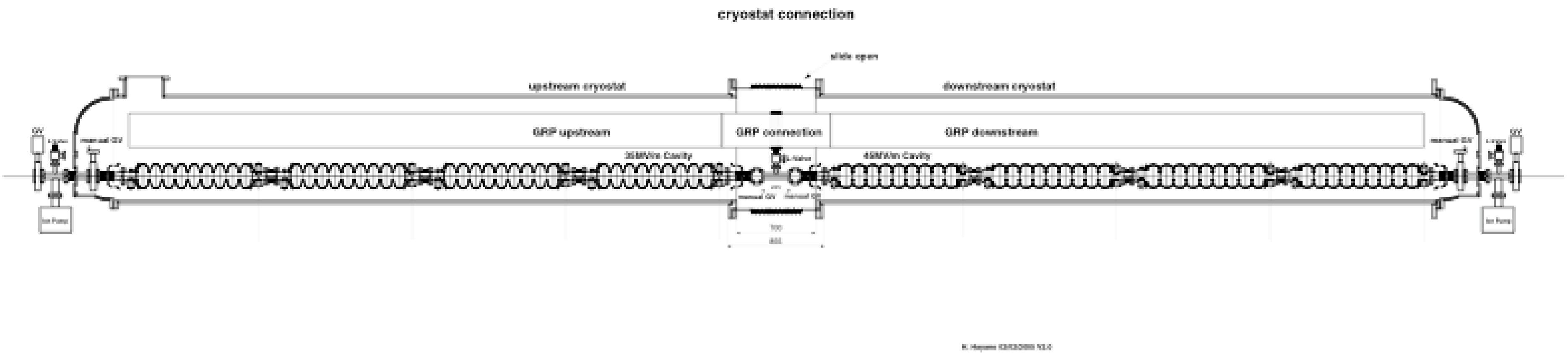
Cryostat pipe size

Description	OD (mm)		Δt (mm)		Notes
	STF	TESLA	STF	TESLA	
Vacuum vessel	1016	965.2	9.5	9.52	carbon steel
2 K gas return	318.5	300	10.3	8	stainless steel
2 K two-phase supply	89.1		2.1		Ti or stainless steel
Cool down/ warm up	38.1	42.2	1.65	1.65	stainless steel
5 K shield supply	42.7	60.3	1.65	2.77	stainless steel
5 K shield return	42.7	60.0	1.65	5	stainless steel
90 K shield supply	42.7	60.3	1.65	2.77	stainless steel
90 K shield return	42.7	60.0	1.65	5	stainless steel

Cryostat piping flow parameters

Description	Fluid	P_{design}(atm)	T (K)	Flow (g/s)
2 K gas return	GHe	1.3	2	TBD
2 K two-phase supply	LHe+GHe	1.3	2	
Cool down/warm up	GHe	1.3	4	
5 K shield supply	GHe	6.1	5	
5 K shield return	GHe	6.1	6	
90 K shield supply	LN2+GN2	6.1	80	
90 K shield return	GN2	6.1	90	

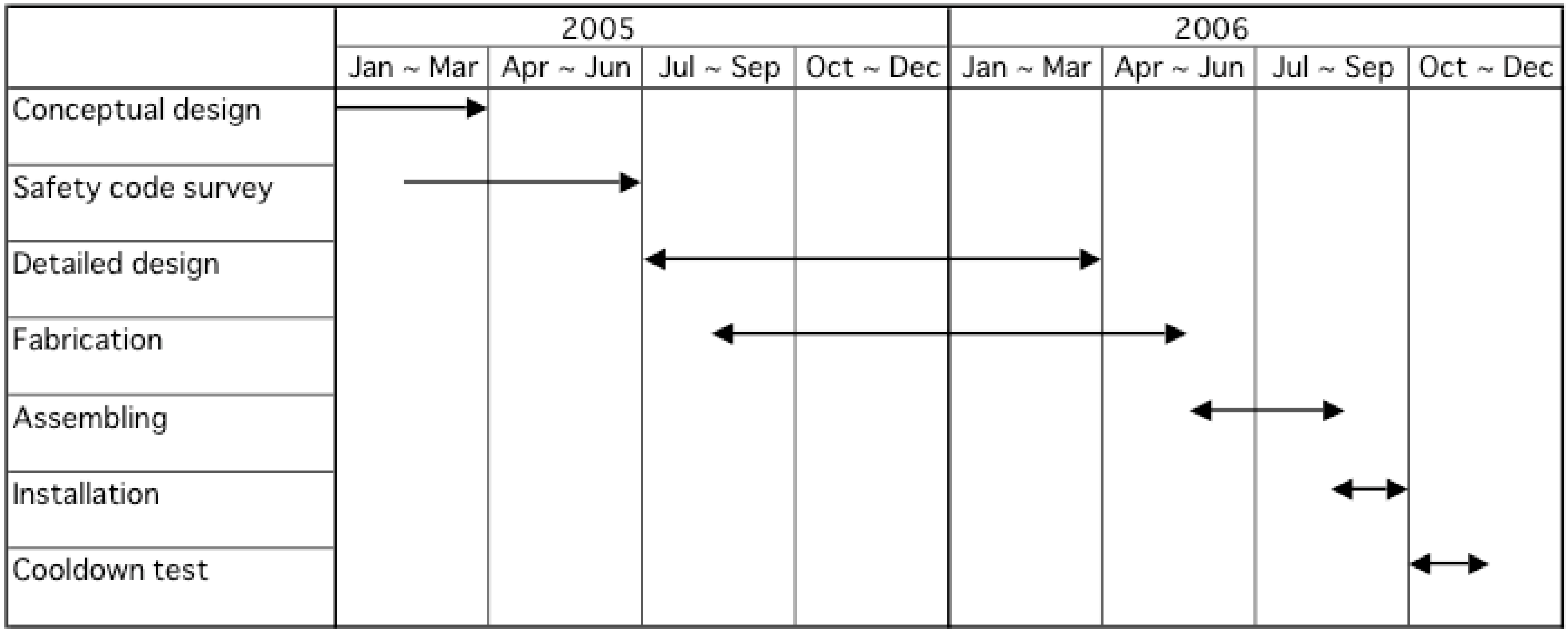
Lateral cross section



Heat load (preliminary)

		static (W)	dynamic (W)
2 K	Cavity RF load		8.4
	Couplers (8)	0.7	1.0
	Supports (4)	0.4	
	Others	1.2	
	sum	**2.3**	**9.4**
5 - 8 K	Couplers (8)	4	16
	Supports (8)	1.6	
	Others	4.4	
	sum	**10**	**16**
80 - 100 K	Couplers (8)	14	165
	Supports (8)	4	
	Others	38	
	sum	**56**	**165**

Schedule of STF cryostat development



Summary

- For STF phase 1, two 5 m long cryostats will be developed and constructed within 2 years.
- The basic design will follow the TESLA design.

  But small modification will be done mainly due to the difference of the size.
- Through this development, we could have an experience of LC-type cryostat fabrication.