

STF CM-1 Status

NAKAI Hirotaka, Accelerator Laboratory, KEK

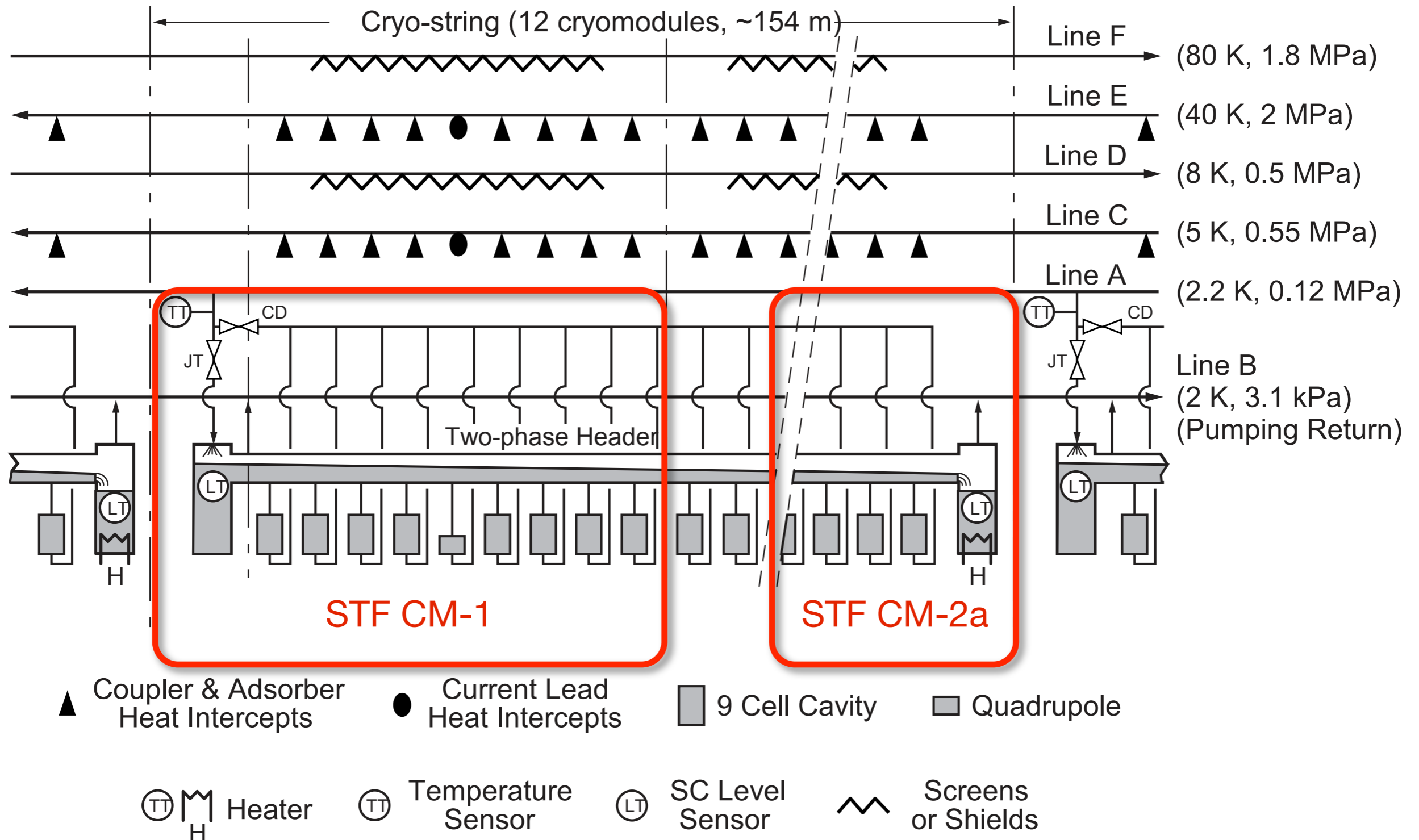
in collaboration with

HARA Kazufumi, HAYANO Hitoshi, HONMA Teruya, HOSOYAMA Kenji,
KAKO Eiji, KIMURA Nobuhiro, KOJIMA Yuuji, NAKANISHI Kota, SAEKI
Takayuki, SHIDARA Tetsuo, YAMAGUCHI Seiya, YAMAMOTO Akira
and YAMAMOTO Yasuchika (KEK)

Overview

- Conceptual design of STF phase 2 (STF2) cryomodules (STF CM-1 + STF CM-2a)
- Current status of STF CM-1 assembly
- Required cooling power estimation
- Schedule of STF CM-1 and CM-2a

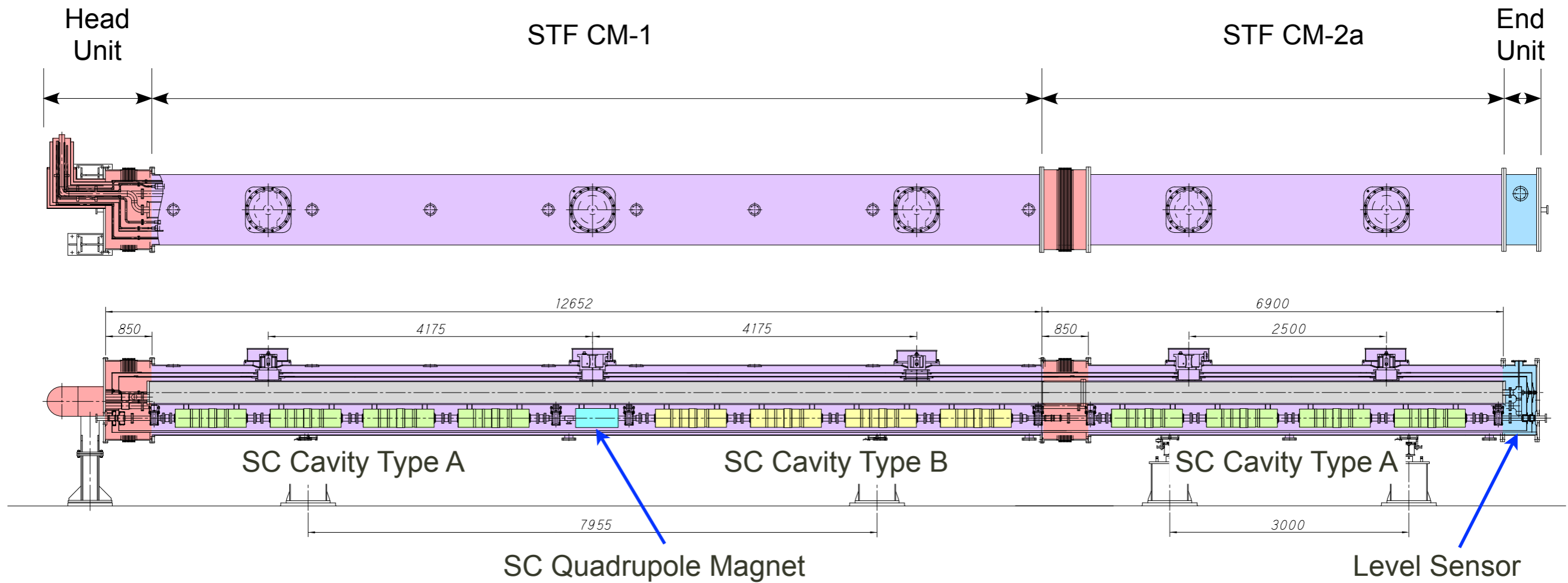
Cryo-string in ILC-RDR



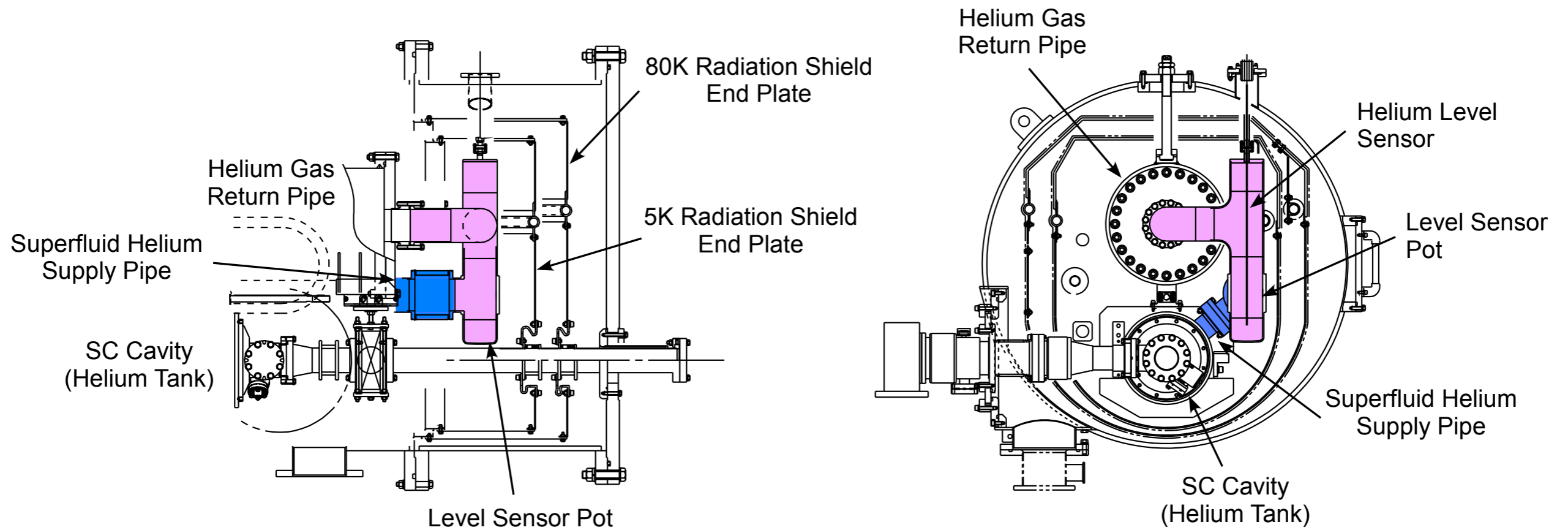
Design Concept of STF2 Cryomodules

- Design of STF CM-1 based on ILC-TDR
- Two types of cavities in STF CM-1
 - Deference in tuner position
 - 4 cavities of each type (8 cavities in total)
- One superconducting quadrupole magnet in STF CM-1
 - Manufactured at FNAL
- Cryomodules connected with flanges for making various configurations possible
 - Head unit : connection to cryogenic system
 - STF CM-1 (8 cavities + 1 quad. magnet dummy)
 - STF CM-2a (4 cavities)
 - End unit : liquid level detection

STF CM-1 + CM-2a Cryomodules

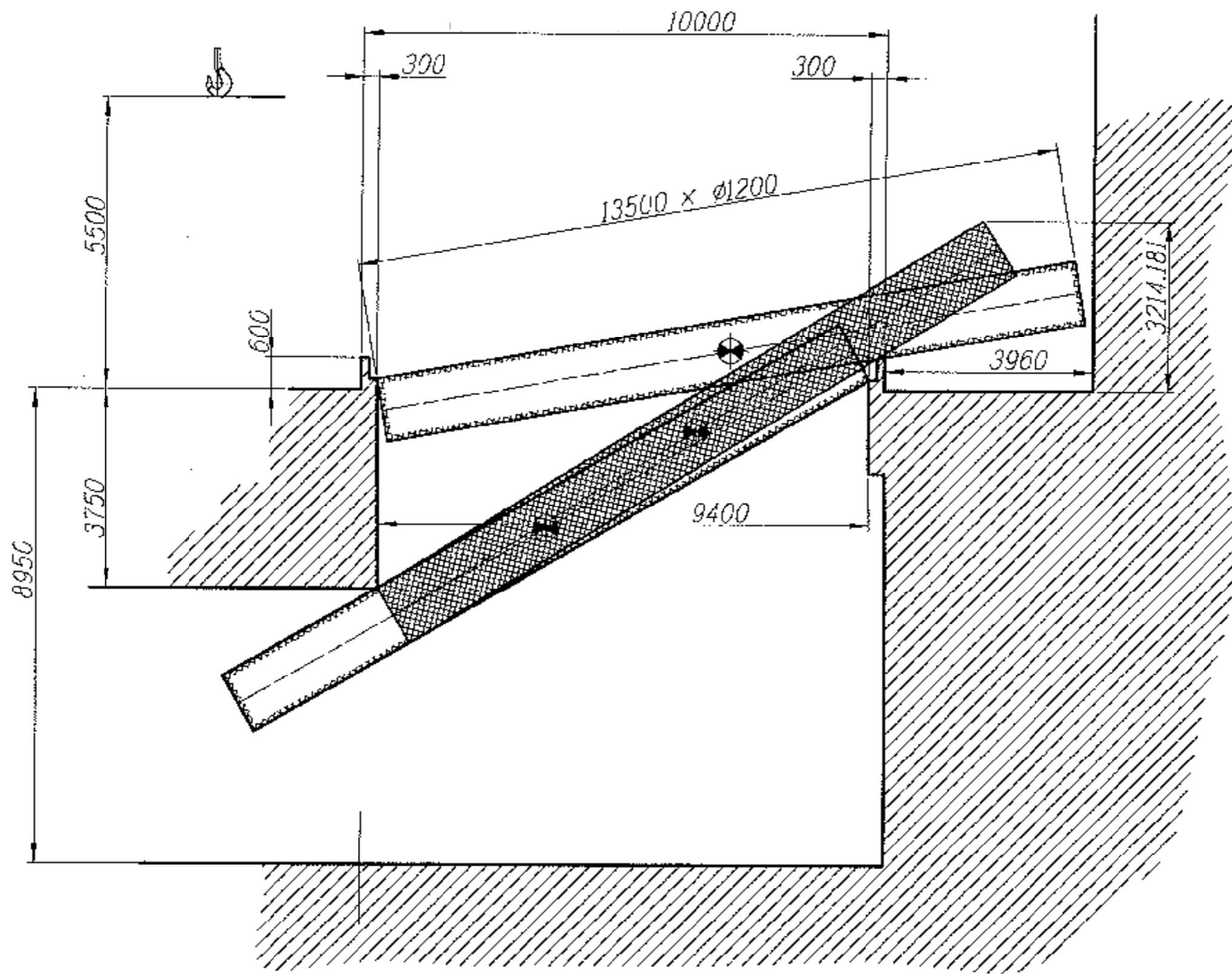


End Unit for Liquid Level Detection



Downstream Side View

Delivery Opening of Tunnel



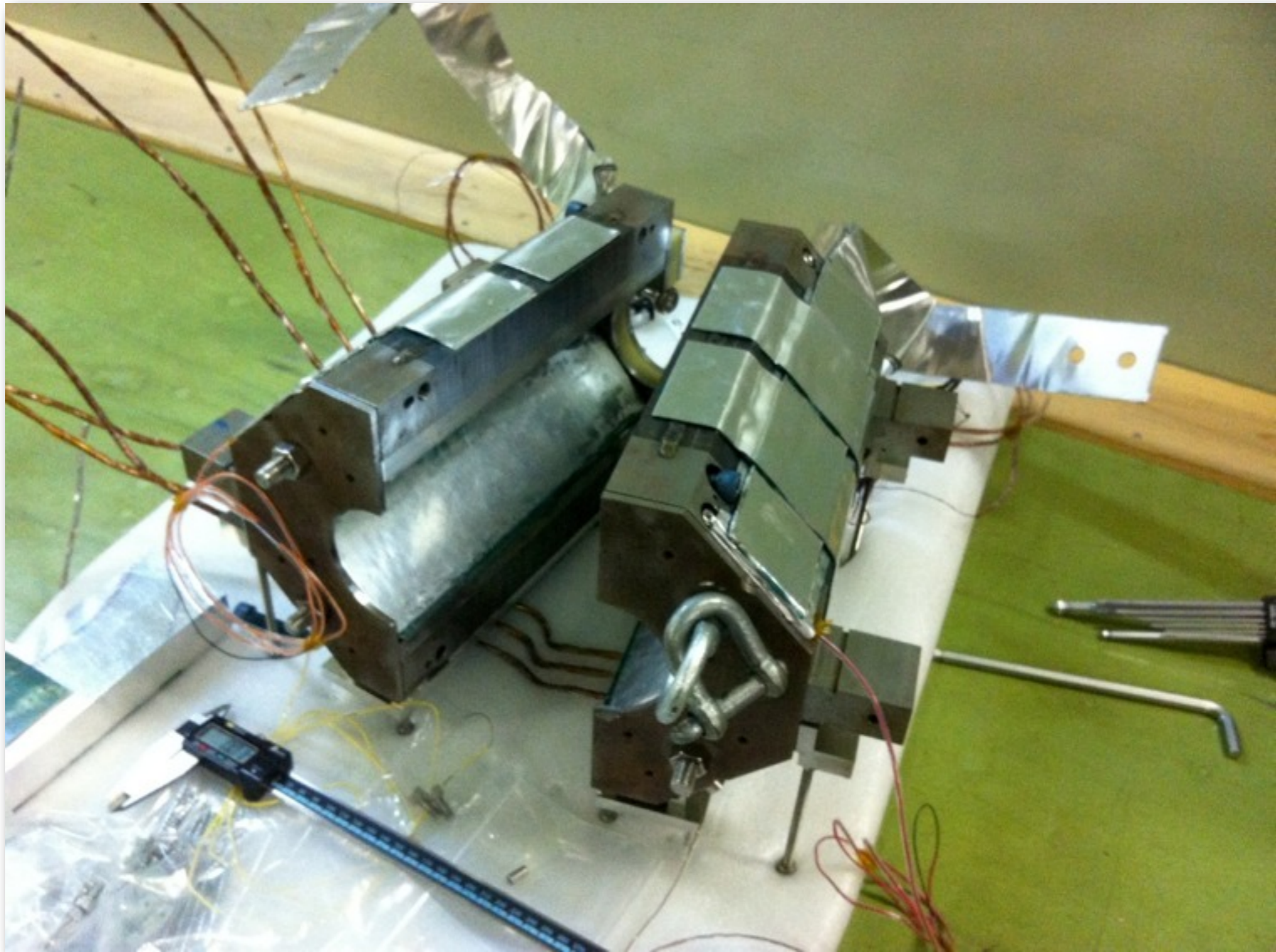
Assembly of STF CM-1

- Limitation of delivery opening of the tunnel
- Delivery into the tunnel after assembly impossible
- STF CM-1 assembly in the tunnel
- Connection of two 4-cavity strings in the tunnel

GRP and 8 Superconducting Cavities



SC Quadrupole Magnet



SC Quadrupole Magnet



Thermometer & Wire Position Monitor



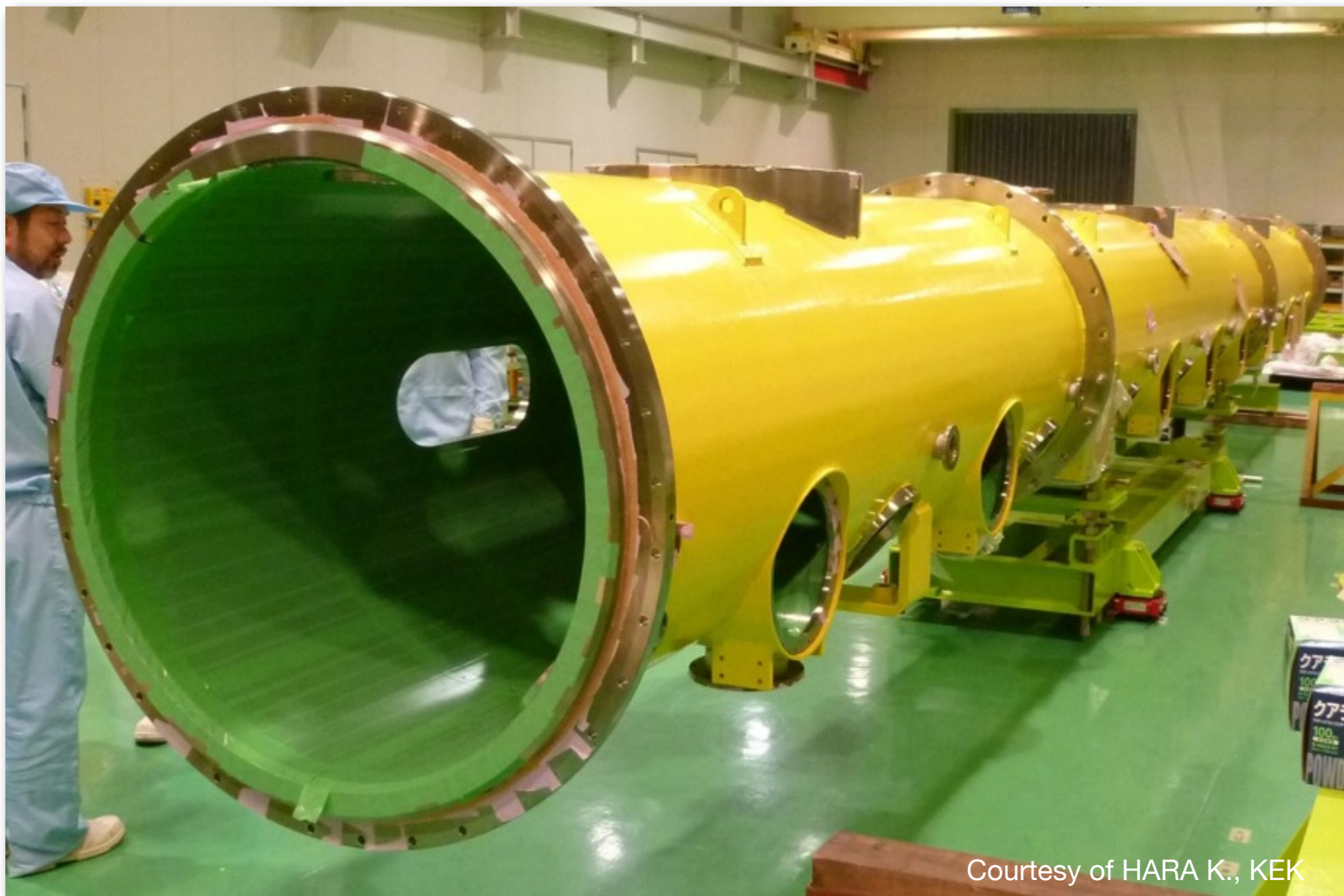
Thermometry

Sensors	Silicon Diode (~ 2 K)	Thermocouple (~ 80 K)	Total
CM-1	84	22	106
CM-2a	38	15	53

Beam Position Monitor

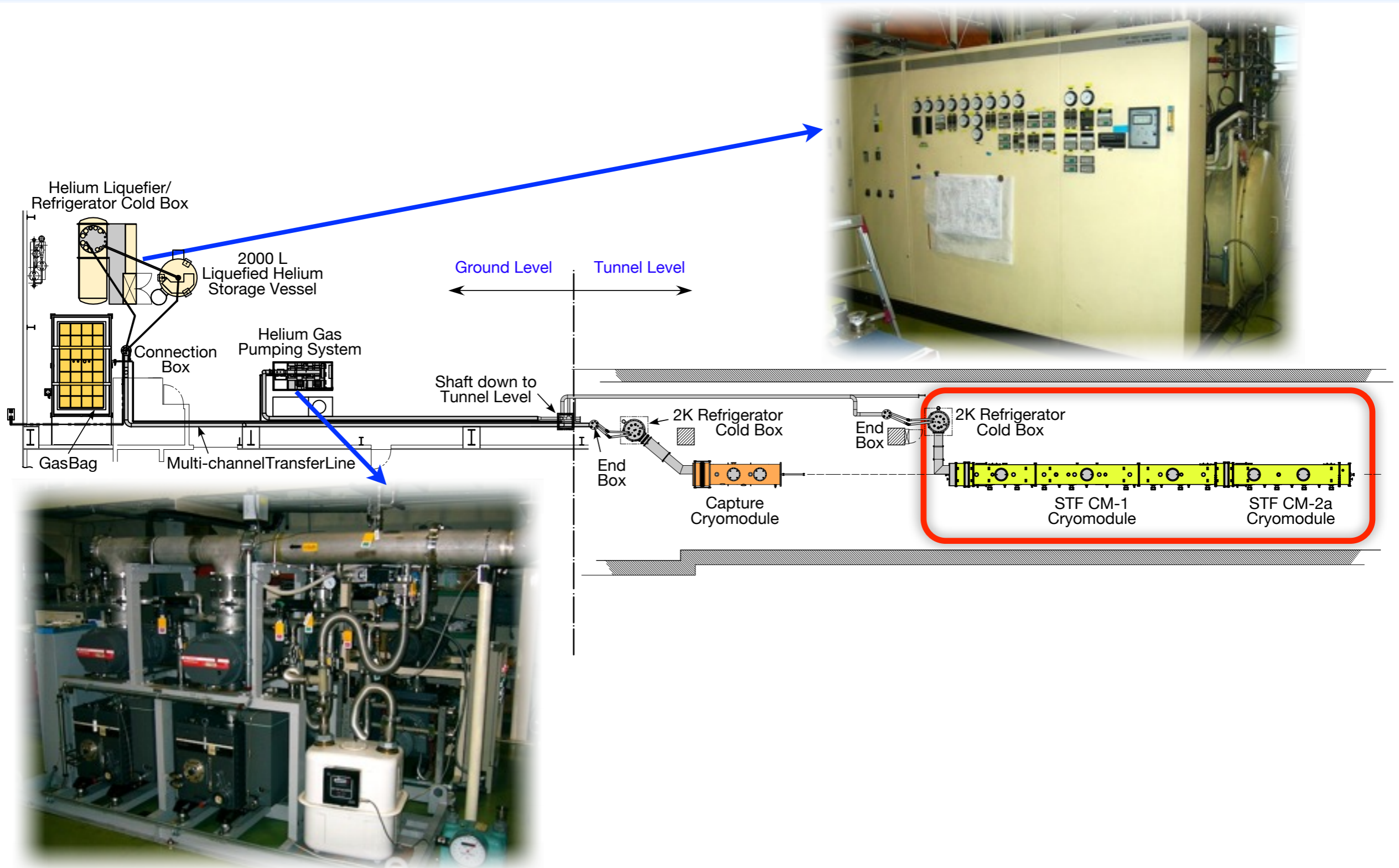


Vacuum Vessel of STF CM-1



Courtesy of HARA K., KEK

STF2 Cryogenic System Configuration



Dynamic Heat Load from Cavities

- Dependence on
 - Cavity performance
 - Operation field
- STF cavities (estimations)
 - Q-factor : 1×10^{10}
 - Operation field: 30 MV/m
 - RF duty : 0.8 %
 - Estimated RF loss (1 cavity) : 1 W
- Estimated dynamic losses
 - Capture (2 cavities) : 2 W
 - STF CM-1 (8 cavities) : 8 W
 - STF CM-2a (4 cavities) : 4 W

Estimated Total Heat Load

Heat Load [W]		2K	4.5K	80K
Capture	Static	8	20	30
	Dynamic	2		
STF CM-1	Static	17	60	90
	Dynamic	8		
STF CM-2a	Static	11	30	50
	Dynamic	4		
Total		50	110	170

Estimated Total Heat Load

Heat Load [W]	2K	4.5K	80K
2K Refrigerators	4	20	60
Transfer Lines	-	35	250
Cryomodules	50 (10+25+15)	110 (20+60+30)	170 (30+90+50)
Total	54	165	480

Cryomodules: Capture + STF CM-1 + STF CM-2a

Required Cooling Power Estimation

- Conversion of heat load to liquefaction rate
 - 2 K : 54 W --> 94 L/h (liquefaction)
 - 4.5 K : 165 W --> 55 L/h (refrigeration)
 - Total liquefaction rate necessary: 150 L/h
- Less than liquefaction rate of TCF 200 (250 L/h)

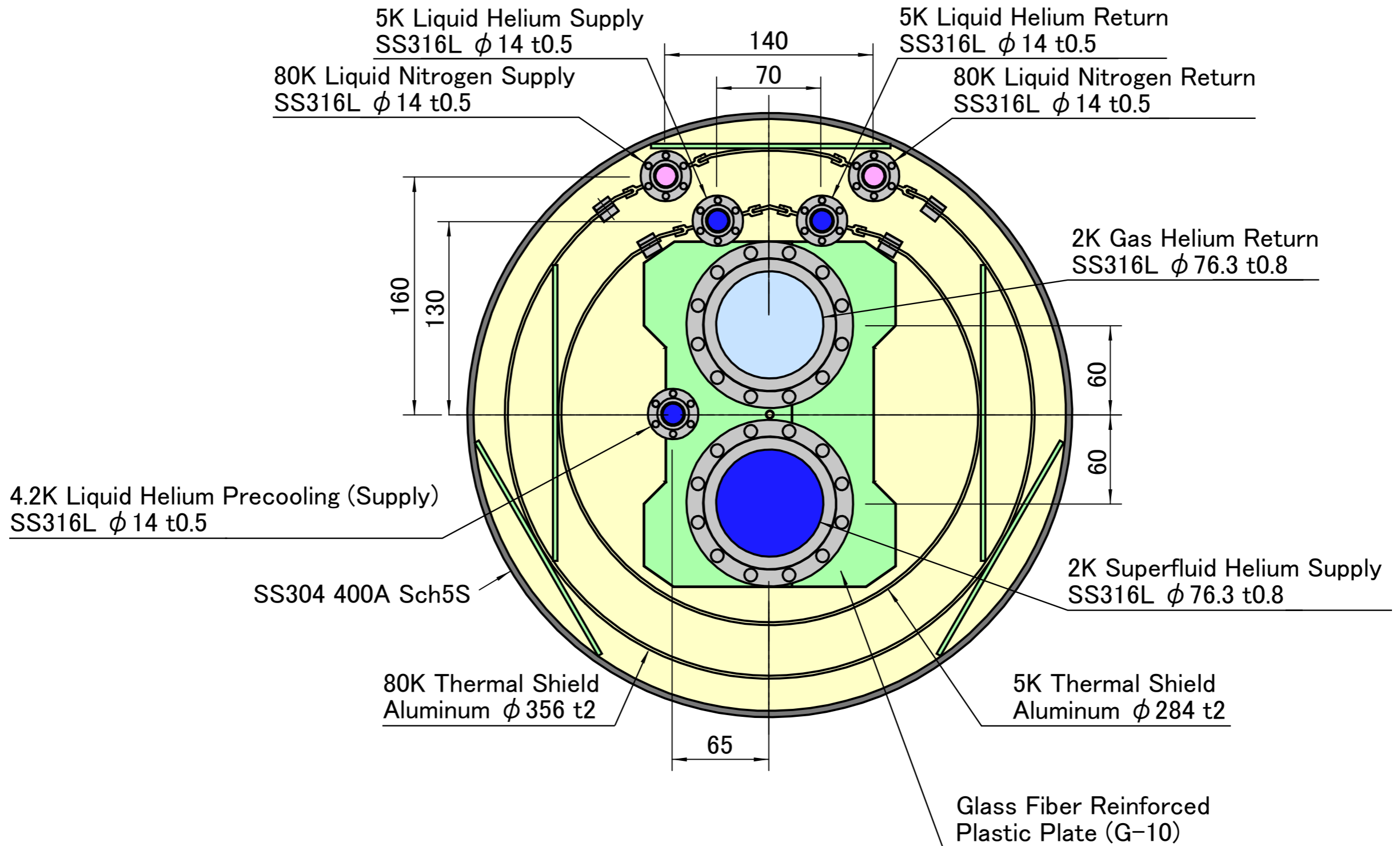
Cooling Power of Cryogenic System

- Helium gas pumping system
 - Total pumping capacity : 40 m³/h with 4 units of pumps
 - Corresponding to about 40 W cooling power (1 m³/h --> ~1 W @ 2 K)
 - 70 % of the cooling power can be used for 2 K refrigeration (30 % for pumping loss)
 - 28 W @ 2K in effect < 54 W (estimated requirement)
- Recovery compressor
 - Maximum capacity : ~100 m³/h
 - 10 units of pumps maximum
 - Corresponding to about 70 W @ 2 K refrigeration power

Current Schedule

- Manufacturer of STF CM-1 and CM-2a selected and contracted
- Completion of STF CM-1 in December, 2013 expected
- Construction of STF CM-2a follows CM-1 completion, and completion in March, 2014
- Connection of cryomodules to the cryogenic system in May, 2014 (for 2 weeks)
- Completion inspection by the prefecture in June, 2014
- Cooldown of cryomodules in September, 2014

Connection Transfer Line



Summary

- Construction of STF CM-1 in progress
- Completion of cryomodules in March, 2014
- To sustain heat loads from capture, STF CM-1 and CM-2a cryomodules, enhancement of helium gas pumping system necessary