

5K shield removal experiment in STF cryomodule

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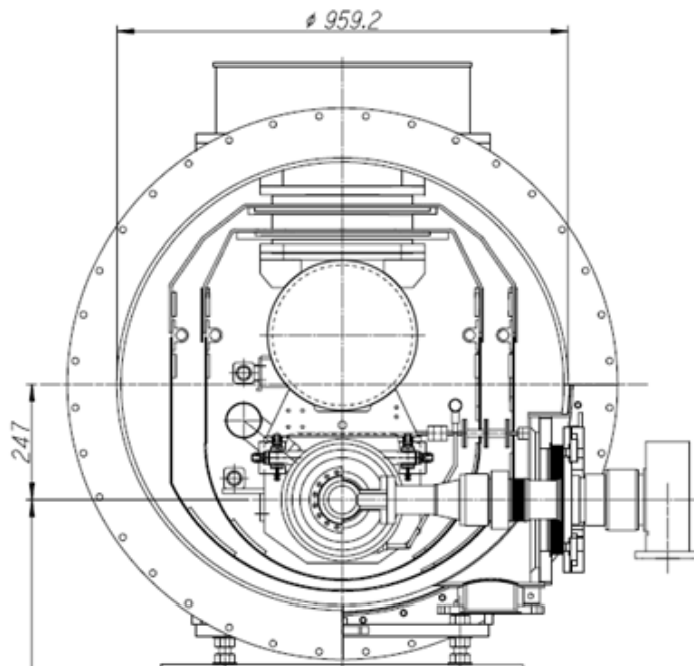
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Introduction

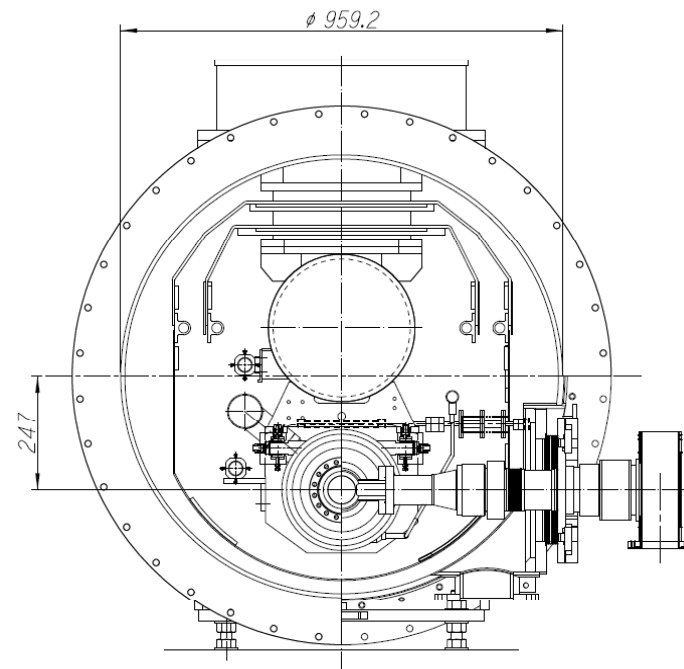
SCRF meeting at FNAL (April 2008)

From the study of the balance between the cost of 5 K shield and the operation cost with and without 5K shields , the bridge part of 5K shield can be removed with keeping the plug-compatible design.

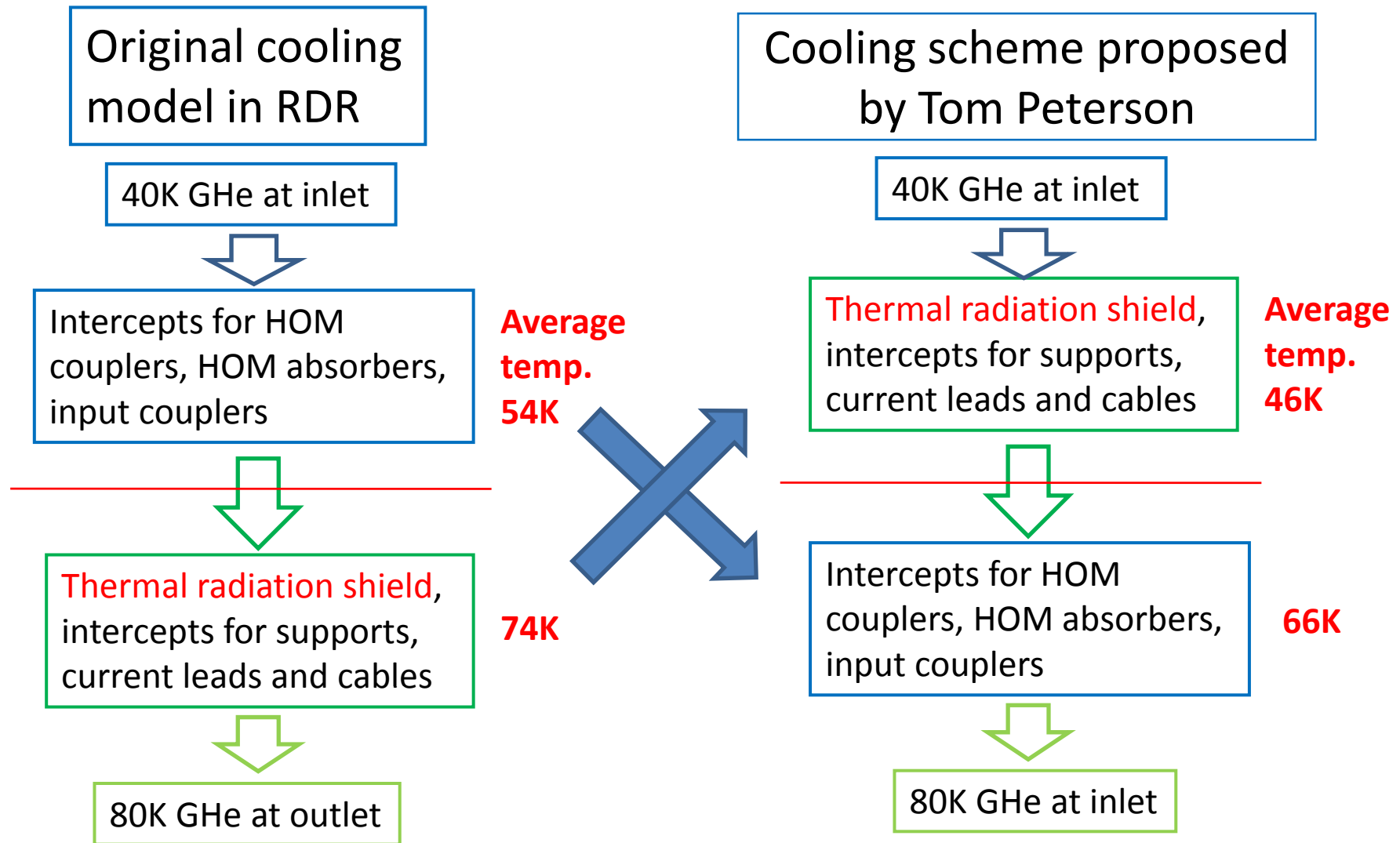
**Cross section
with 5K shield**



**Cross section
without 5K shield**

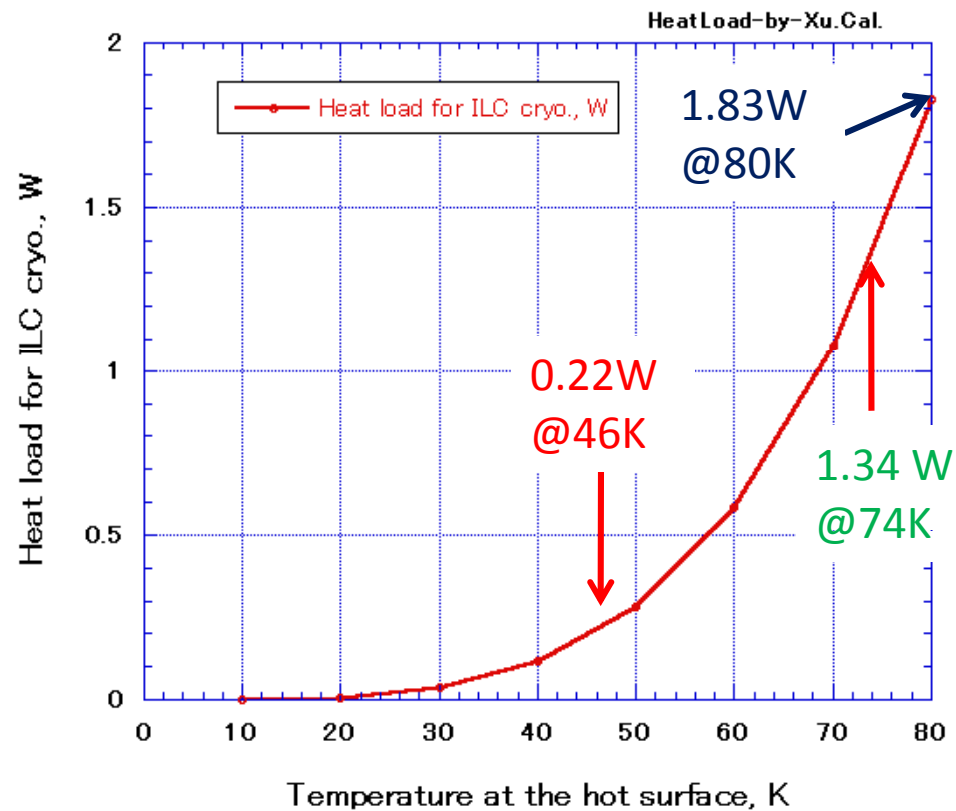


Considerations for cooling method

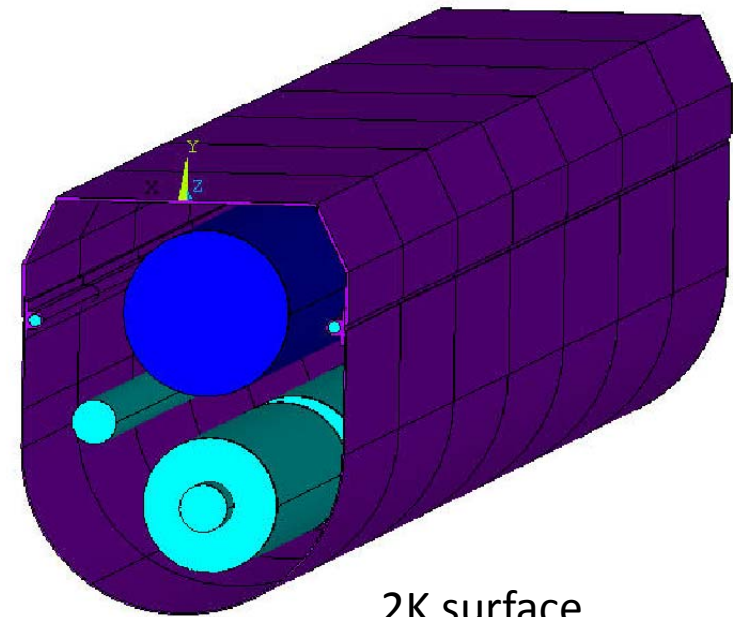


Thermal radiation heat load

Heat load at 2K components by thermal radiation as a function of shield temperature by ANSYS



80 K shield surface
Emissivity=0.2



2K surface
Emissivity=0.03

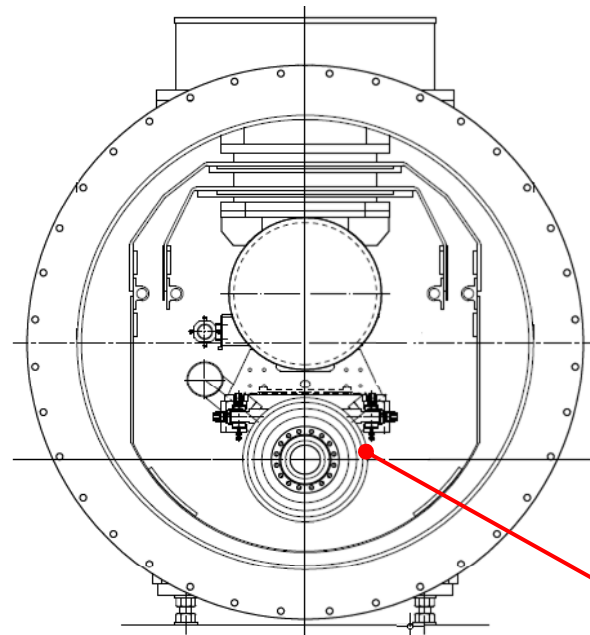
This calculation includes the geometrical factor of GRP, cavity vessel and LHe supply pipe.

Test plan of 5K shield performance in STF

Target : making the effect of 5K shield on the heat load at 2K clear
(heat load measurement at 2K with and without the 5K shield)

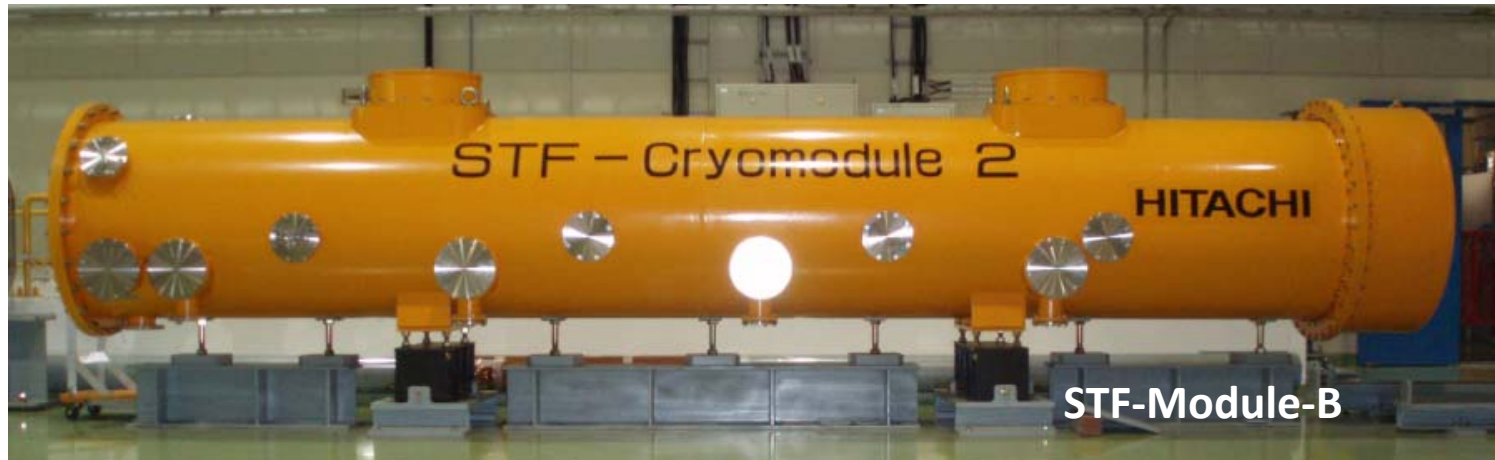
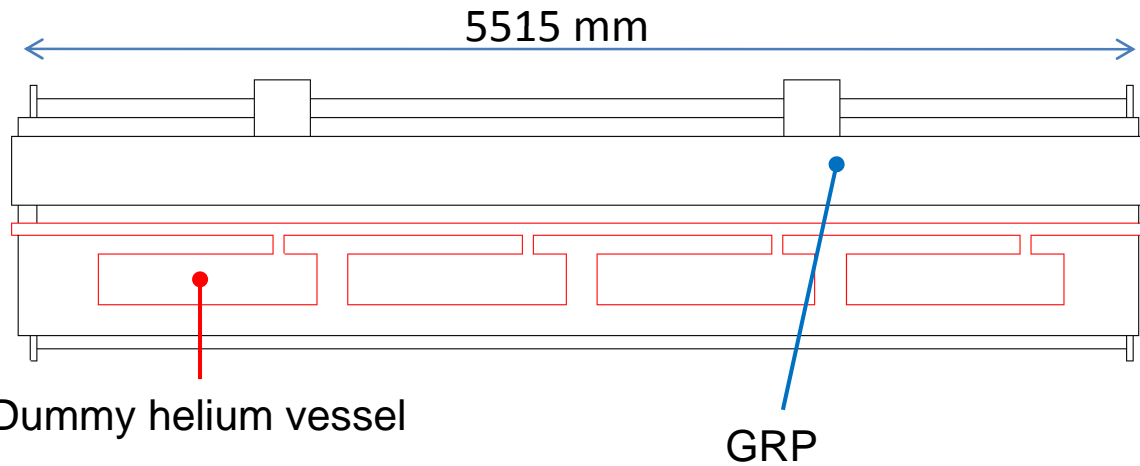
1. 4 dummy helium vessels as same size as the cavity jackets are installed in the STF-Module-B.
2. No input couplers.
3. Penetrations for the input couplers are closed with Al plates.
4. The outer shield (80K) is cooled by LN_2 , and the inner shield (5K) is cooled by LHe.
5. Heat load at 2K is measured by the evaporation rate of 2K LHe in the dummy vessel.
6. In the previous experiments, the average temperature of 80 K shield was 86.5 K. For this shield temperature, the difference between the heat loads with and without 5K shield is calculated to be 1.14 W.

STF-Module B for 5K shield test

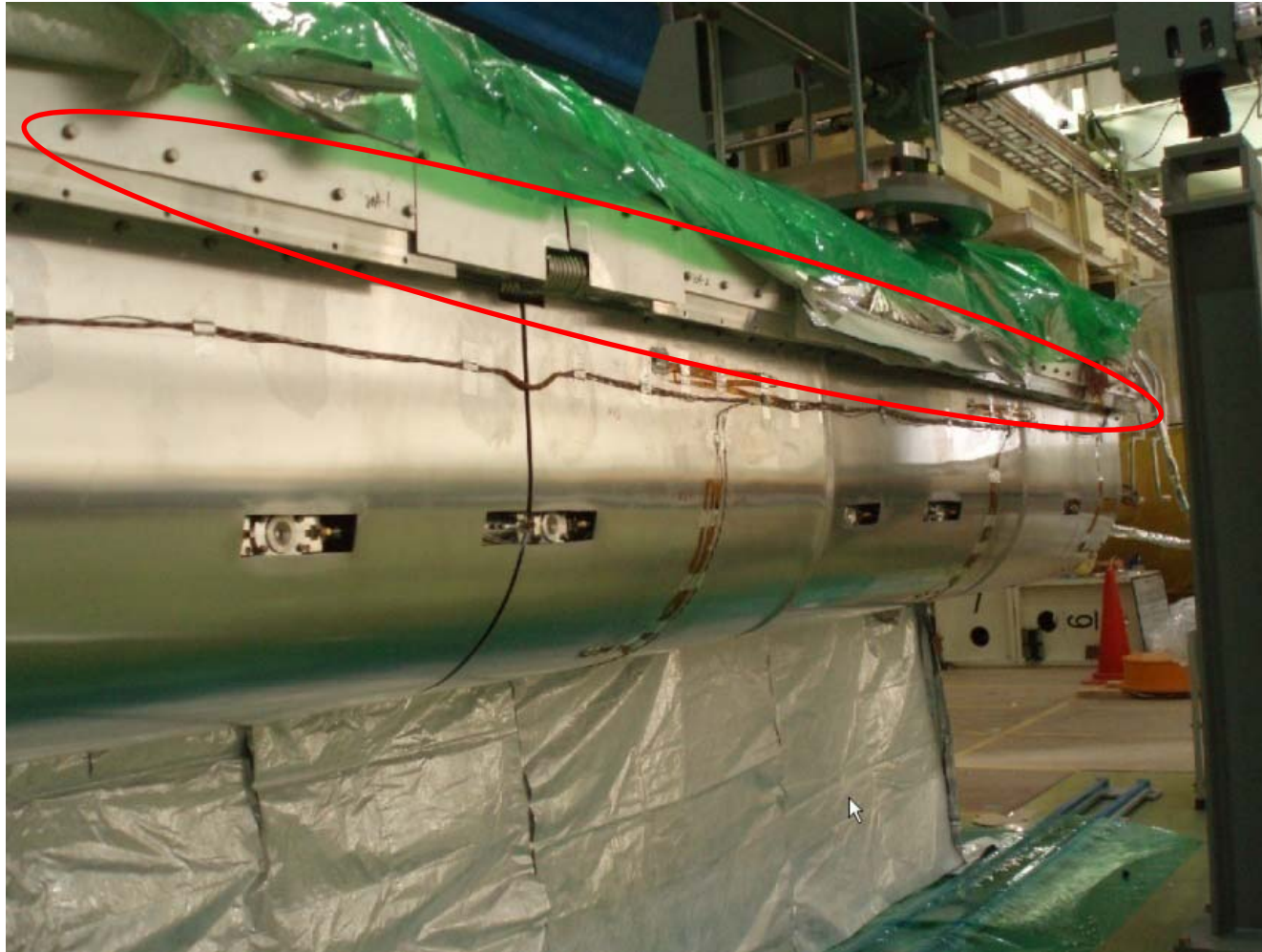


Input couplers are not installed.

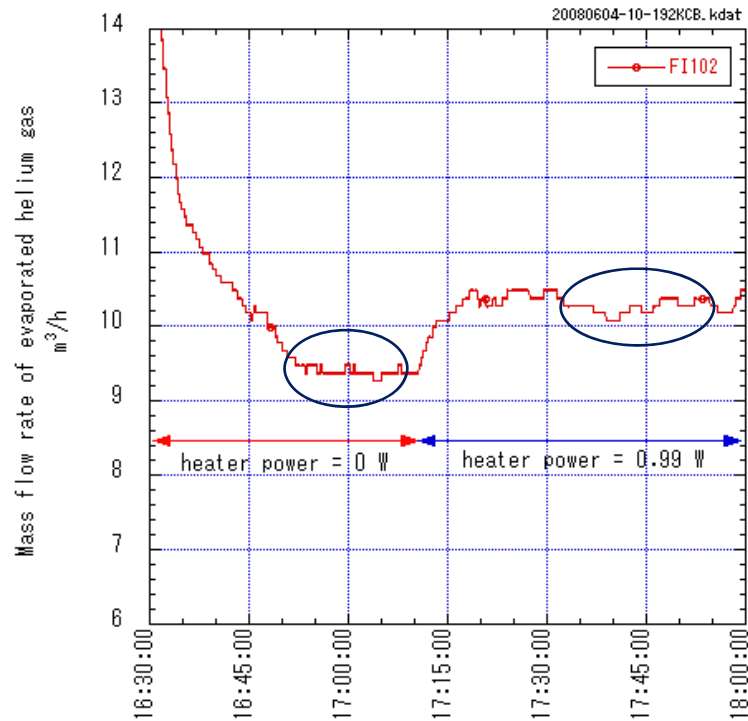
Length of the module-B= 5515 mm
(Module length in the spec. table=11829.6 mm)



Thermal shields of the STF module

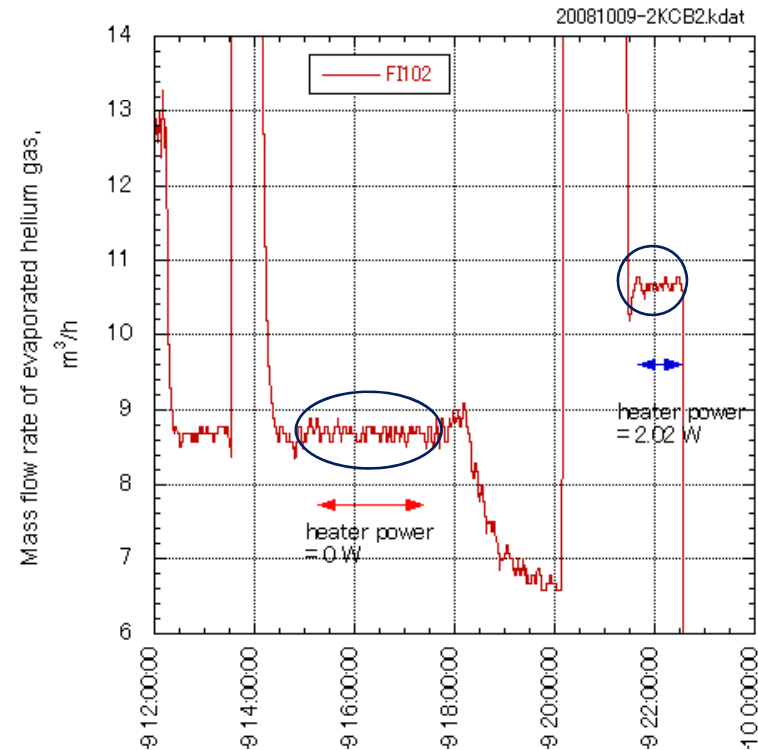


Thermal calibration of the measurement system by STF-Module-A



0 W : Mass flow rate= 9.37 m³/h (16:55-17:10)
 0.99 W : Mass flow rate= 10.25 m³/h (17:35-17:55)







$\Delta = 0.88 \text{ m}^3/\text{h}$ (0.146 g/s) \rightarrow 0.93 W
 (94% of heater power)



0 W : Mass flow rate= 8.69 m³/h (16:55-17:10)
 2.02 W : Mass flow rate= 10.66 m³/h (17:35-17:55)

$\Delta = 1.96 \text{ m}^3/\text{h}$ (0.326 g/s) \rightarrow 2.09 W
 (103 % of heater power)

Test schedule

	2009									
	1	2	3	4	5	6	7	8	9	10
Modification of Module-B										
Test of the components in the module										
Preparation for thermal test										
Heat load measurements with 5K shield										
Preparation for thermal test										
Heat load measurements without 5K shield										

- **April : component tests**
 - Deformation measurement of GRP during cold test (WPM and laser position monitor)
 - BPM
 - Thermal anchor and temperature sensor
- May : disassembling Module-B, completeness of 5K and 80K shields against the thermal radiation and reassembling Module-B in the tunnel
- **June : heat load measurement of Module-B with 5K shield**
- July to August : disassembling Module-B, removing 5K shield bridge and reassembling Module-B in the tunnel
- **September to October : heat load measurement of Module-B without 5K shield**

Summary

1. Thermal performance test of 5K shield in the module is scheduled from May to Oct. 2009 .
 - The subject of this test is the measurement of the heat load by the thermal radiation to the cryo-components at 2K in the module.
 - The calculated heat load from 80 K shield is 1.14 W for the STF system, and this value can be detected from the test results of the STF Module-A.
2. The test results will lead to the confirmation of the proposed cooling scheme in module.