LH2 Absorber R&D

MUTAC Meeting
LBNL
April 25-26, 2005

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(1) 1st Test Results of KEK Absorber at MTA
(2) Plan of 2nd Test of KEK Absorber at MTA
(3) Mucool/MICE Absorber R&D

LH2 Absorber R&D

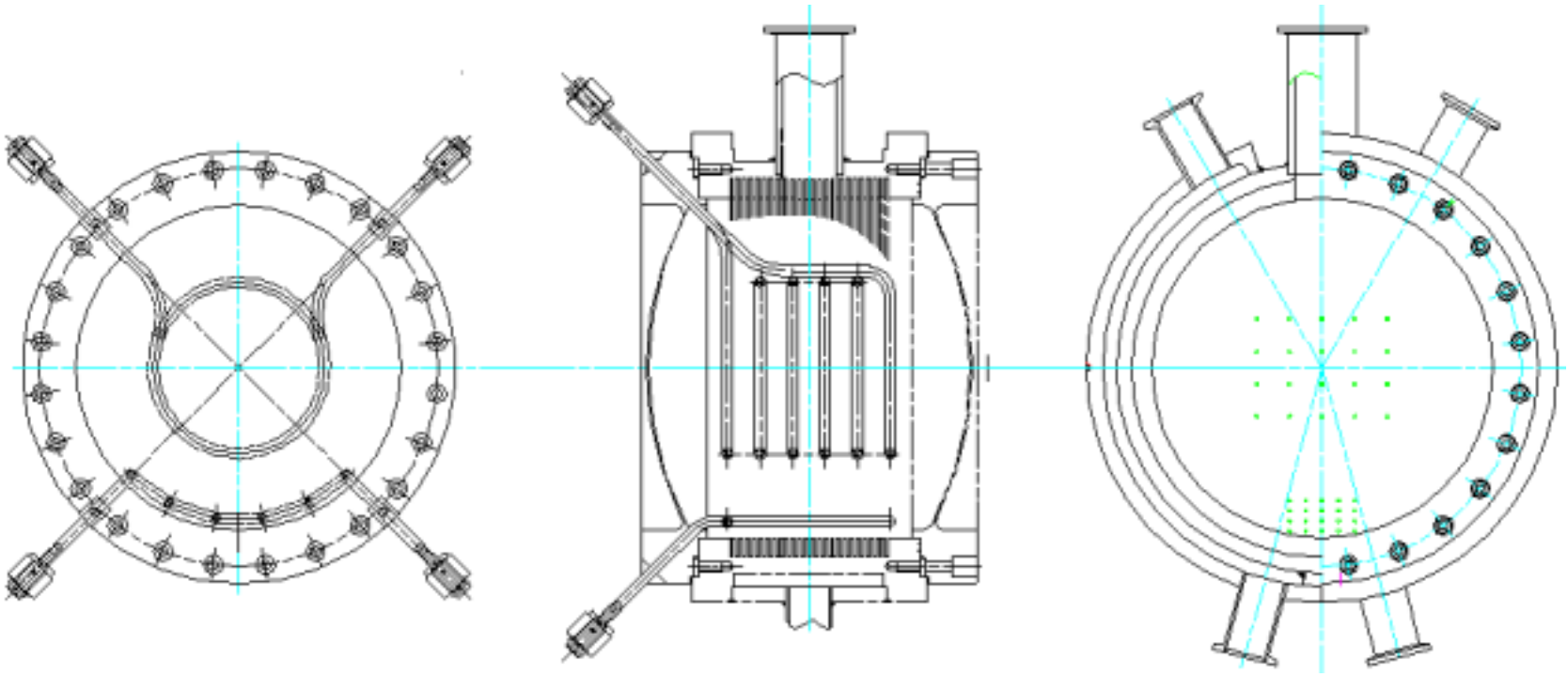
- **Forced Flow Type** — **~ 350 W**
  - **Mucool (FNAL)**
- **Convection Type**
  - **Cooled by Cold He Flow** — **~ 50 W**
    - **Mucool (KEK, FNAL)**
  - **Cooled by "Cryocooler"** — **~ 10 W**
    - **MICE (KEK, RAL, Oxford)**
- **Seal Method**
  - **Indium** — **Mucool/MICE (FNAL, KEK)**
  - **Helicoflex** — **MICE (KEK)** — --- back up
  - **Welding** — **MICE (Oxford)** — --- back up

Absorber heat deposit tests

Absorber type	Where	Size (cm diam.)	Heat deposited	Date for test
Convection (Mucool test)	MTA	21	~ 50 W (1) G-He + ambient (2) electric + ambient (3) LINAC p beam + ambient	Jun 2004 (thick windows) Sep 2005 (thick windows) Sep 2006 (thin windows)
Convection (MICE 1st article)	KEK	30	~ 10 W electric + ambient	Oct 2005 (thick windows)
Convection (MICE experiment)	RAL	30	~ 10 W (MICE Stage 4)	June 2006 (thin windows)
Force-flow (Mucool test)	MTA	21	~ 350 W (LINAC p beam + ambient)	July 2006 (thin windows)

→ Neutrino factory absorber heat loads ~ few hundred watts

1st Test of KEK Absorber at MTA



PtCo #1 - #8

G-He Heater

V=6.2 L

D=200, L=200

1st Test of KEK Absorber at MTA

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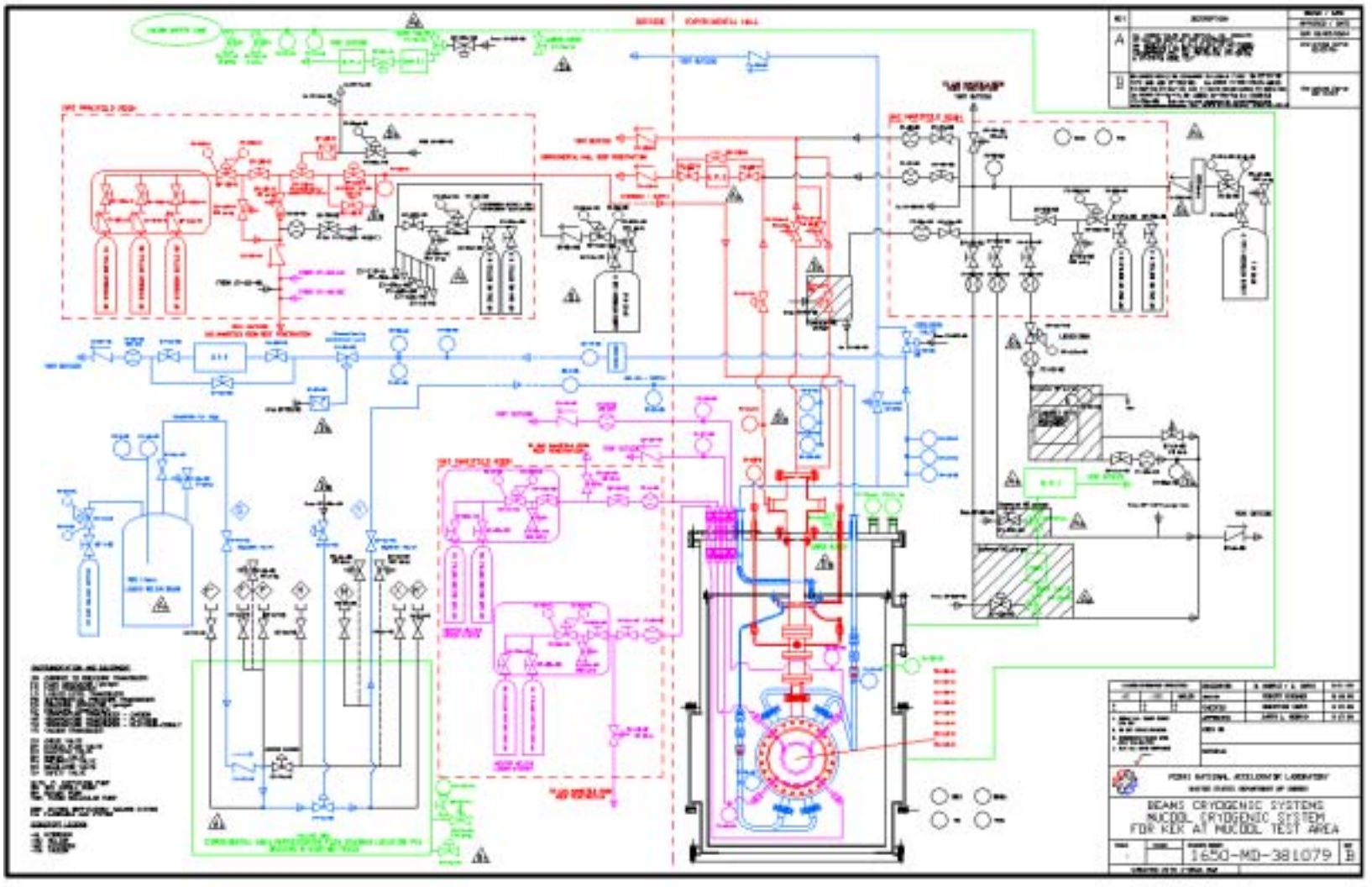


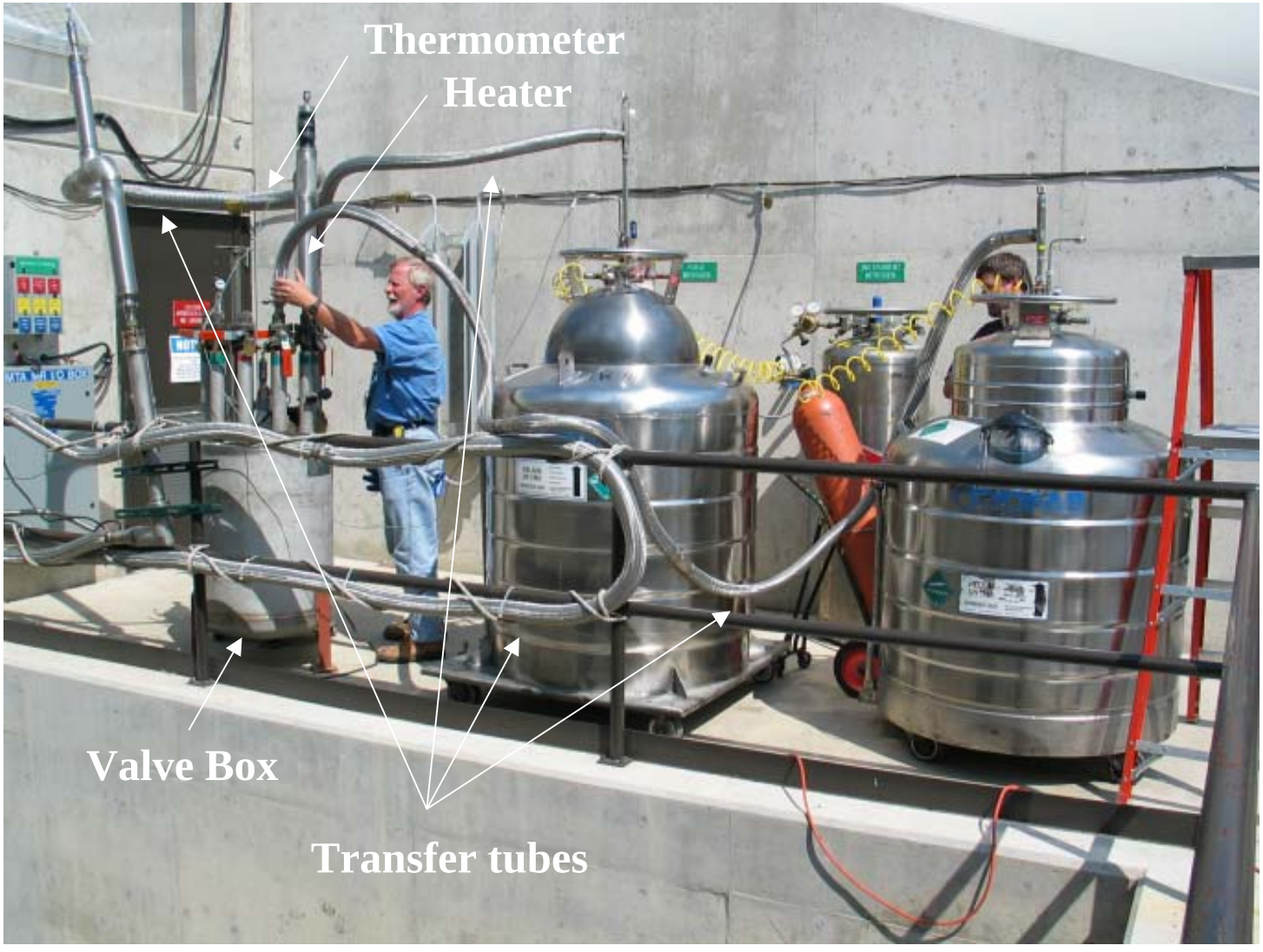
1st Test of KEK Absorber at MTA

Electric cabinet purged by G-N_2

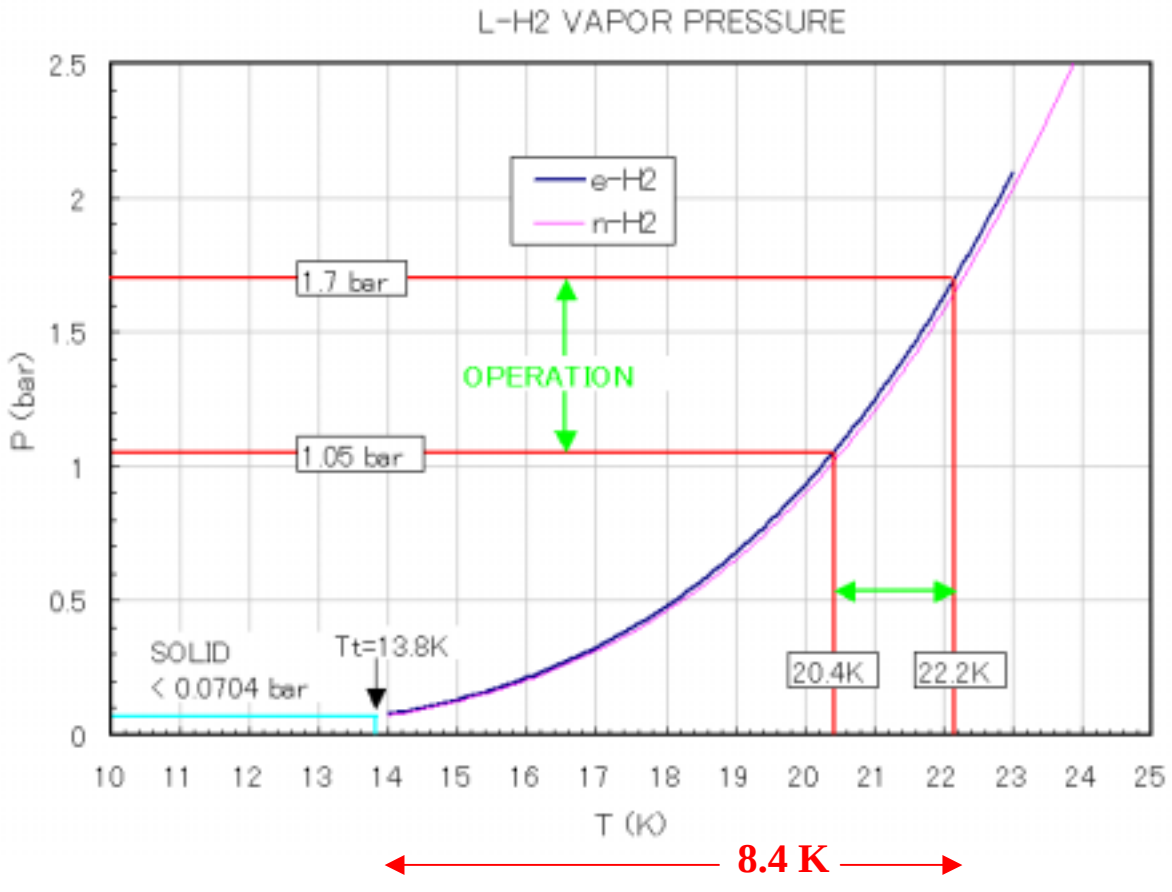
Top flange of absorber test cryostat

Set-up of absorber test cryostat

1st Test of KEK Absorber at MTA



L-H_2 Control



Normal Hydrogen
(Ortho-75%, Para-25%)

Equivalent Hydrogen

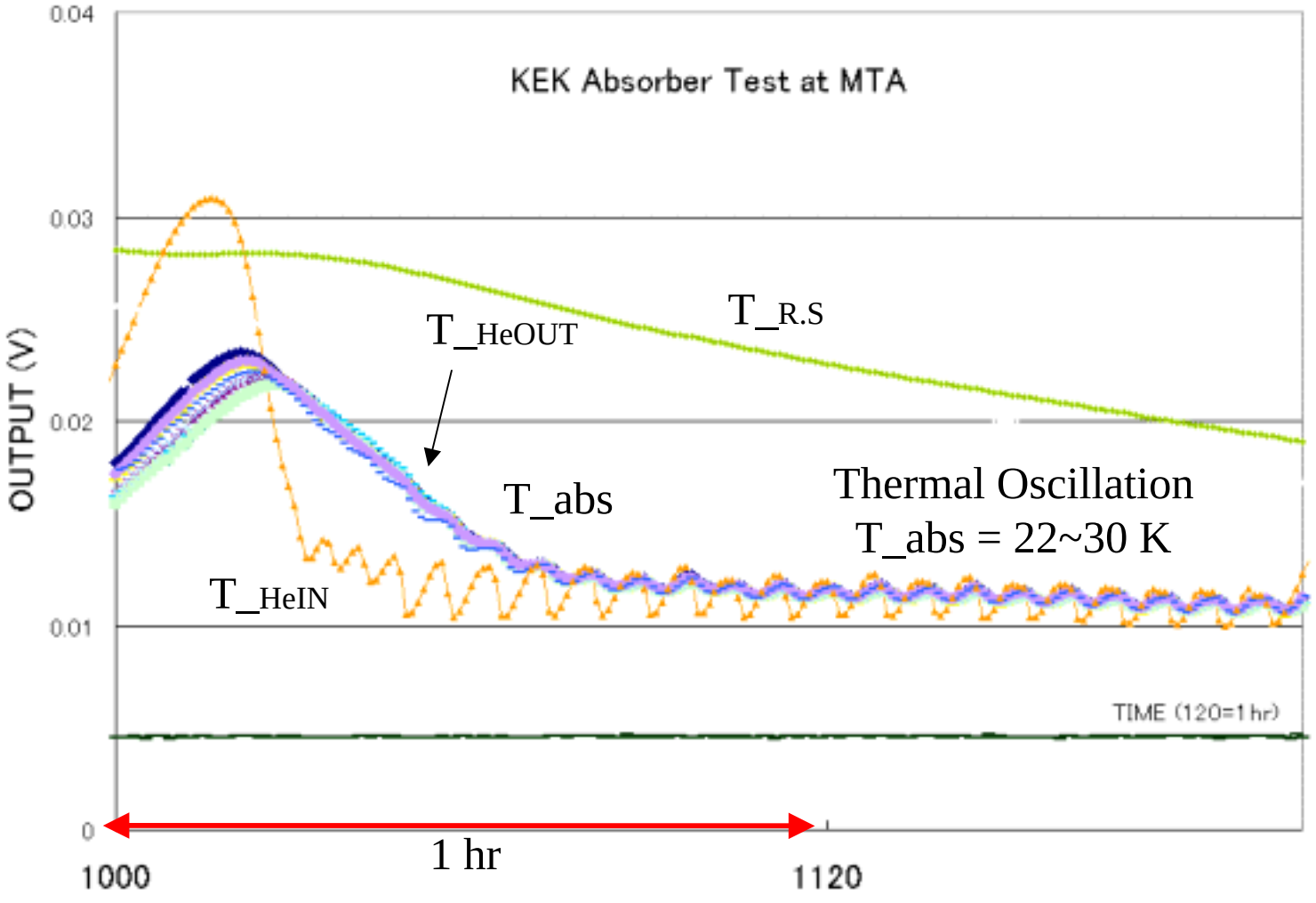
<Limits of L-H2 Temperature and Pressure>

*Tmin > 13.8 K; no solid-H2 to avoid blocking

*Ta < 22.2 K, P < 1.7 bar; from the operation pressure, Pmax=2.5 bar

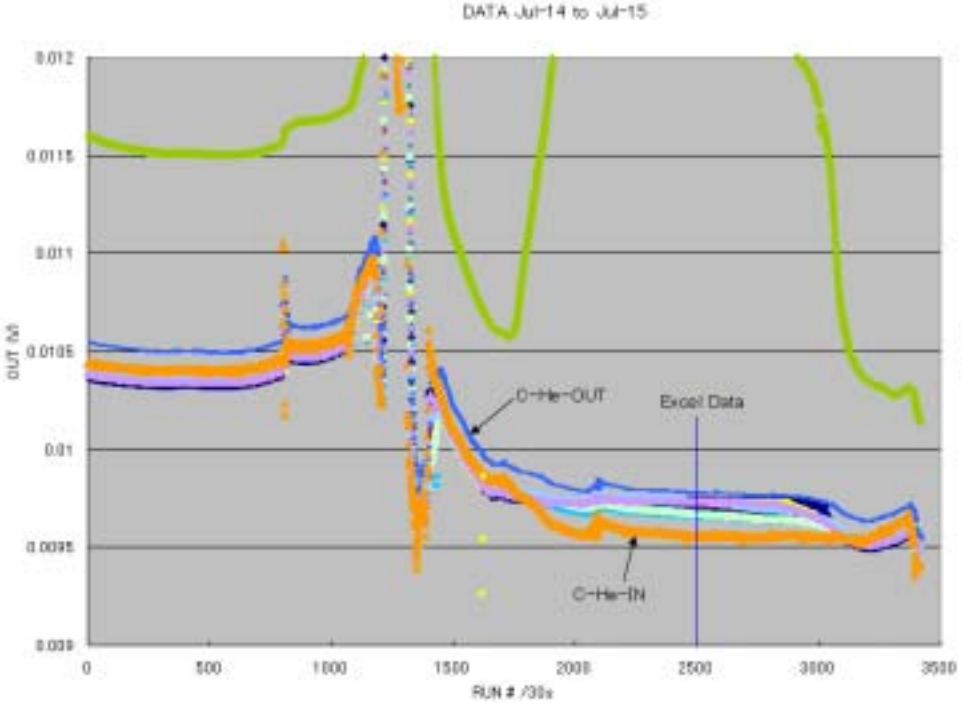
*Ta > 20.4 K, P > 1.05 bar; over pressure than atmosphere

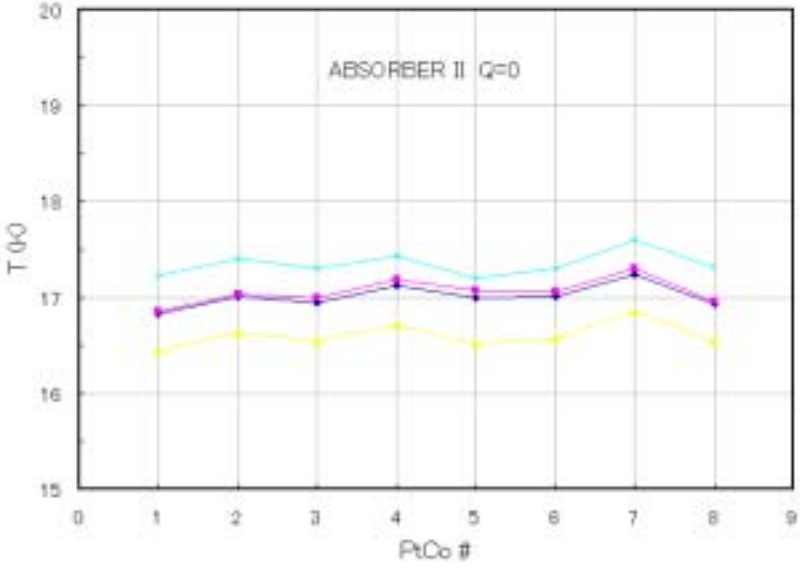
Test Results of KEK Absorber at MTA



Test Results of KEK Absorber at MTA

Q = 0 W Data





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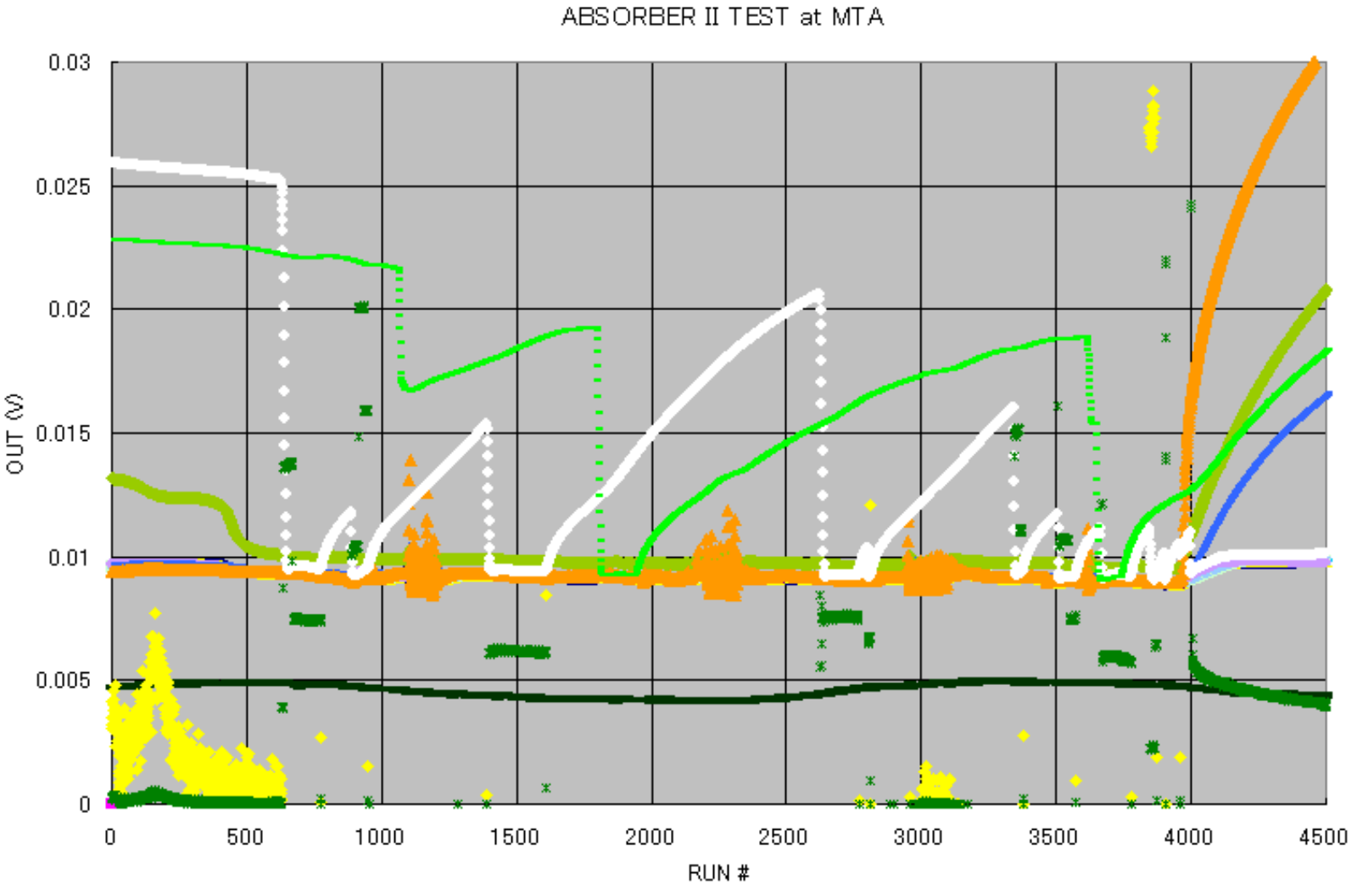

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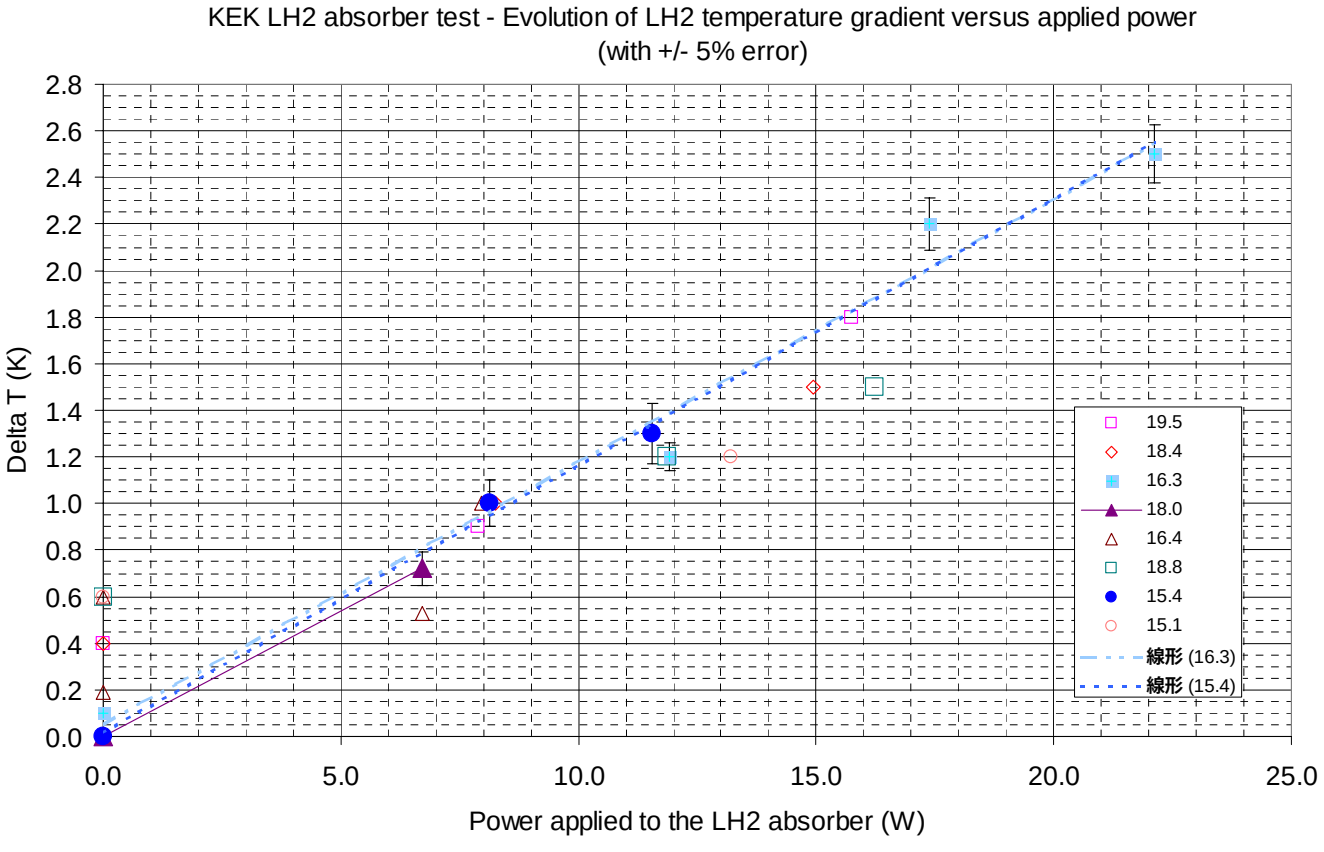


Expected cooling power from 1st test

dT=2.45K at 22.1W → if dT=8.4K then 77W ?
(T_{max}=22.2K, T_{min}=13.8K)

Test Results of KEK Absorber at MTA

and Plan for the 2nd Test

Test results of the 1st cooling test

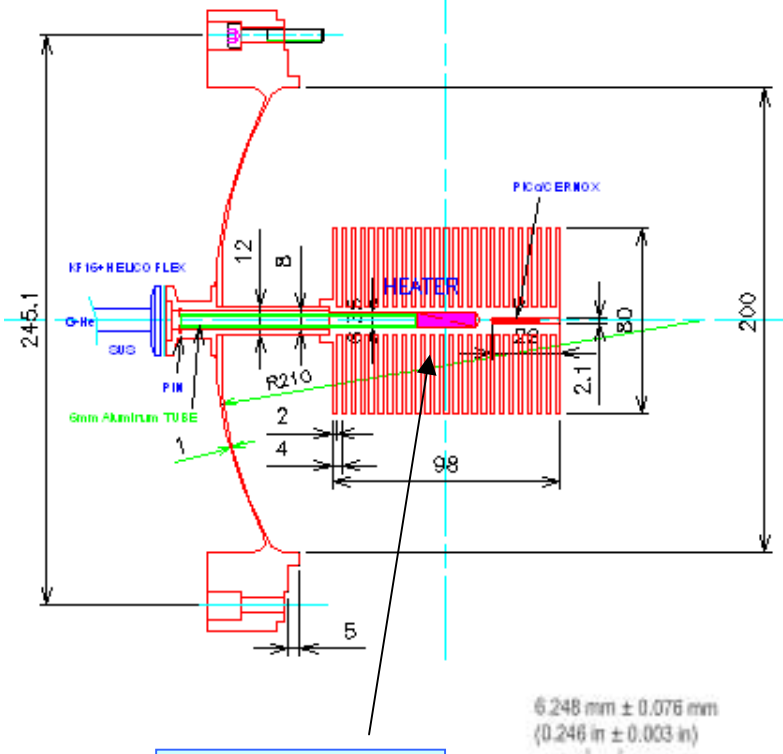
(1) Succeed the 1st absorber cooling test with full LH2.
No H2 leak to vacuum was found.
(2) Succeed to stabilize the cold helium gas flow
(3) Measured the LH2 temperature distribution in absorber.
(4) Measured the cooling power with G-He heater until ~22W.

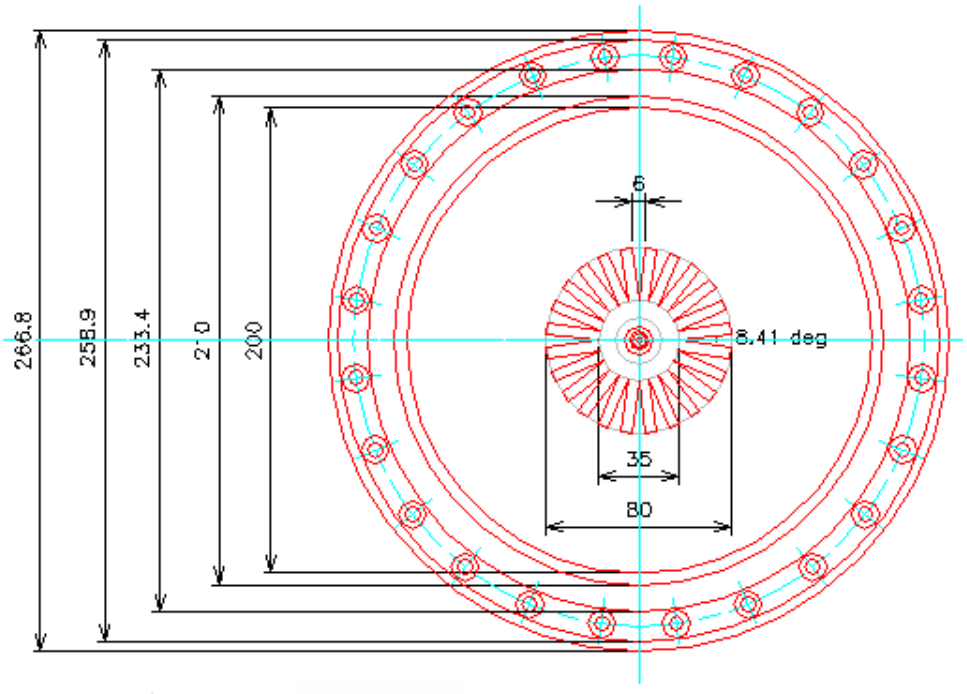
Plan for the 2nd cooling test

Aim; Test the maximum cooling power by tuned condition

(1) Short cut the LHe-transfer line to reduce the heat-leak and stabilize the flow and temperature.
(2) Change the G-He heater to an electric heater
(3) 4 wired Cernox thermometers
(4) L-H2 level sensor

Plan of the 2nd Absorber Test at MTA





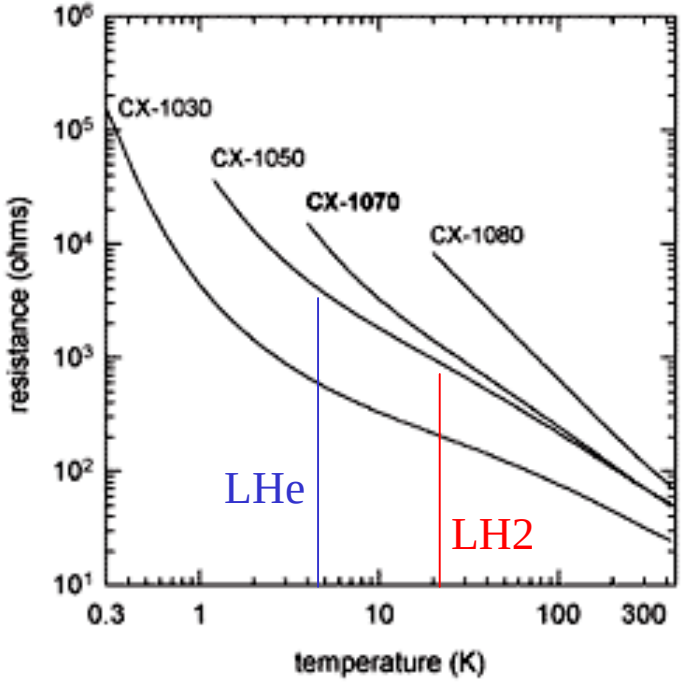
Lake Shore
HTR-25-100

Cartridge Heaters

- Precision-wound nickel-chromium resistance wire
- Efficient magnesium oxide insulation
- UL and CSA component recognition
- 2 solid pins
- Non-magnetic package

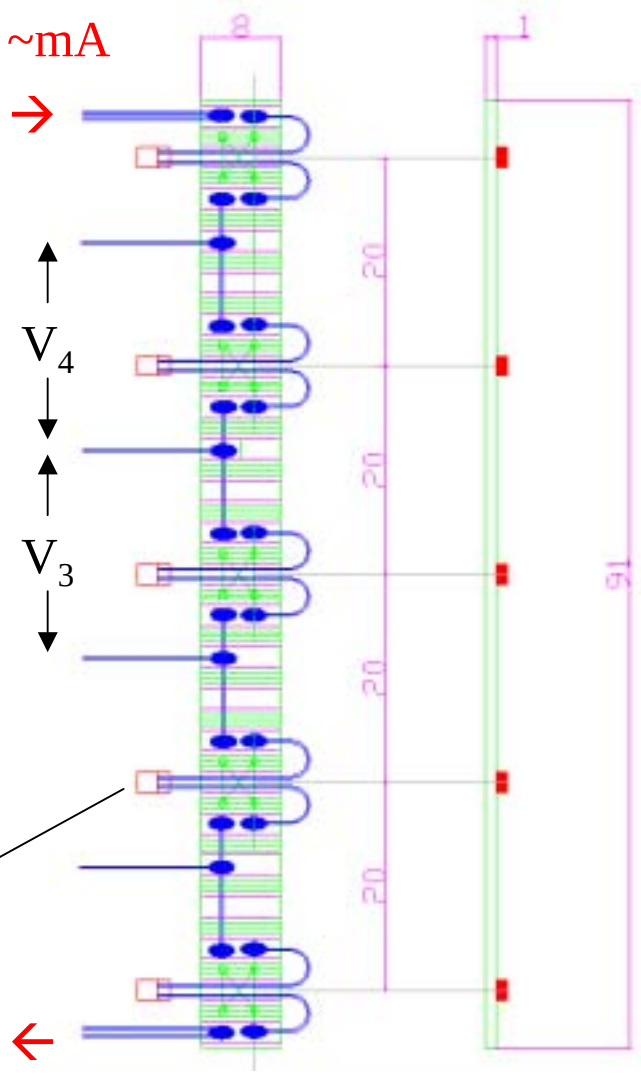
Plan of the 2nd Absorber Test at MTA

DC Current for L-H2/LHe should be optimized (KEK R&D).

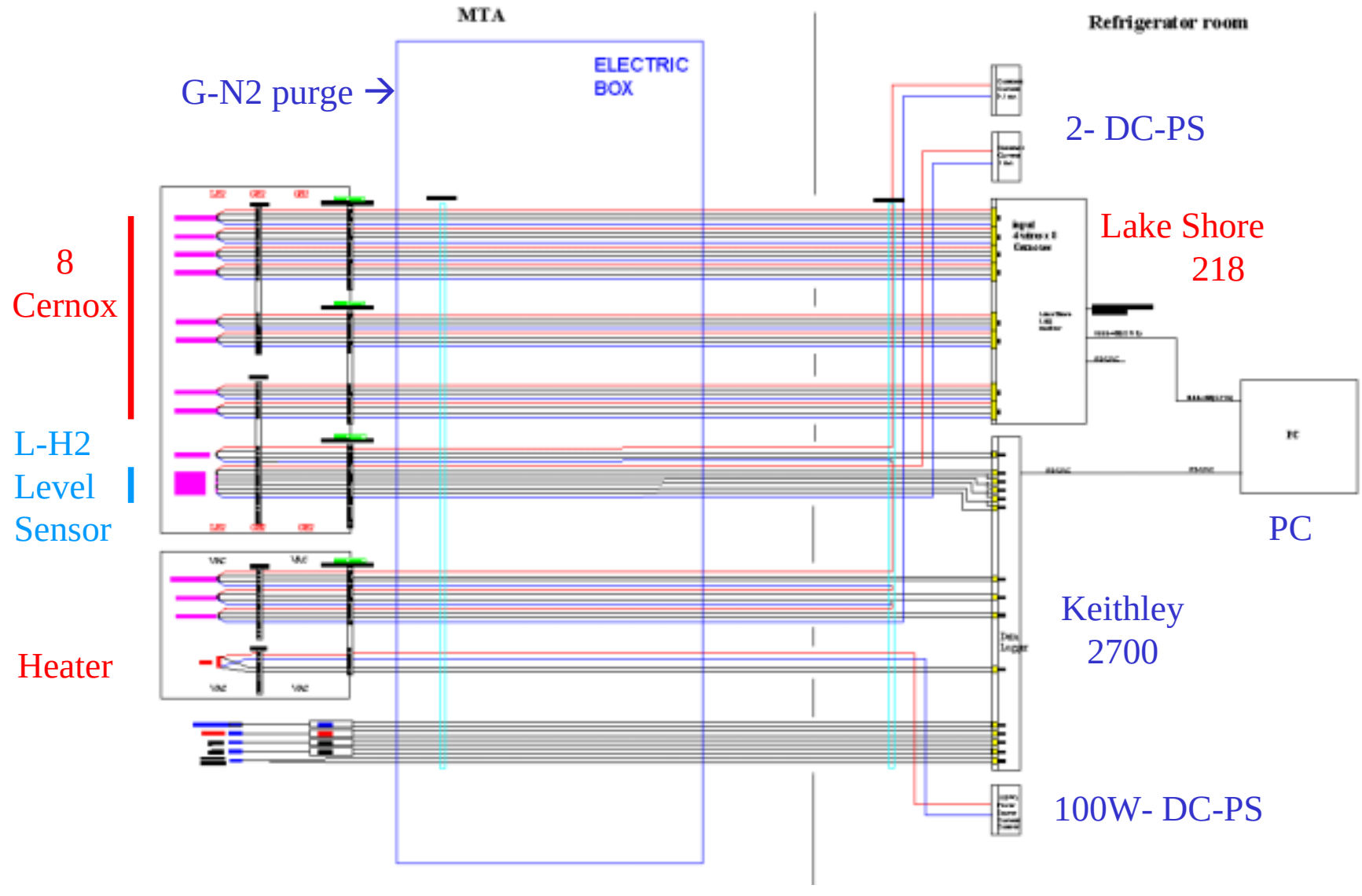


Lake Shore CX-1050-SD

DC ~mA

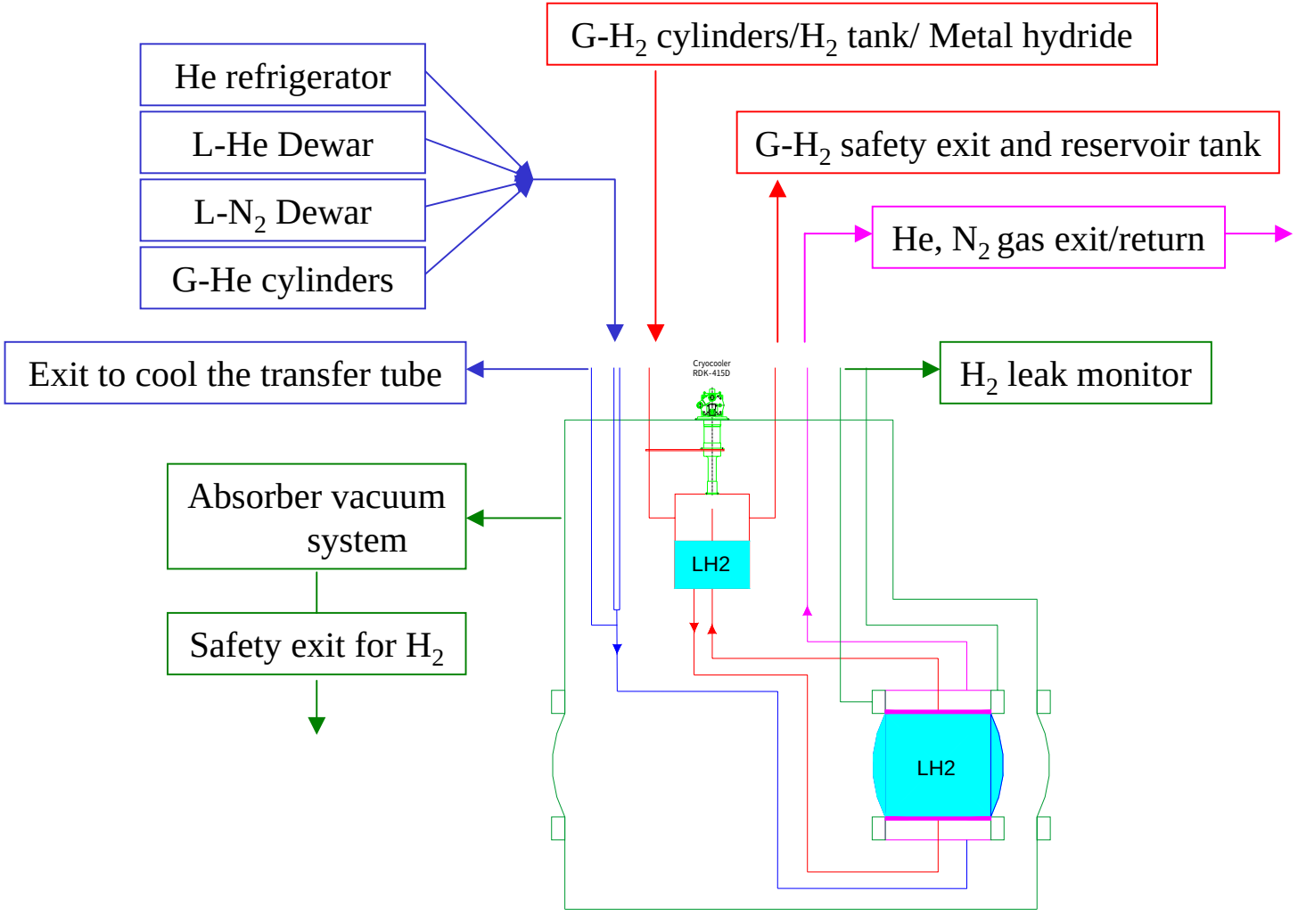


Plan of the 2nd Absorber Test at MTA

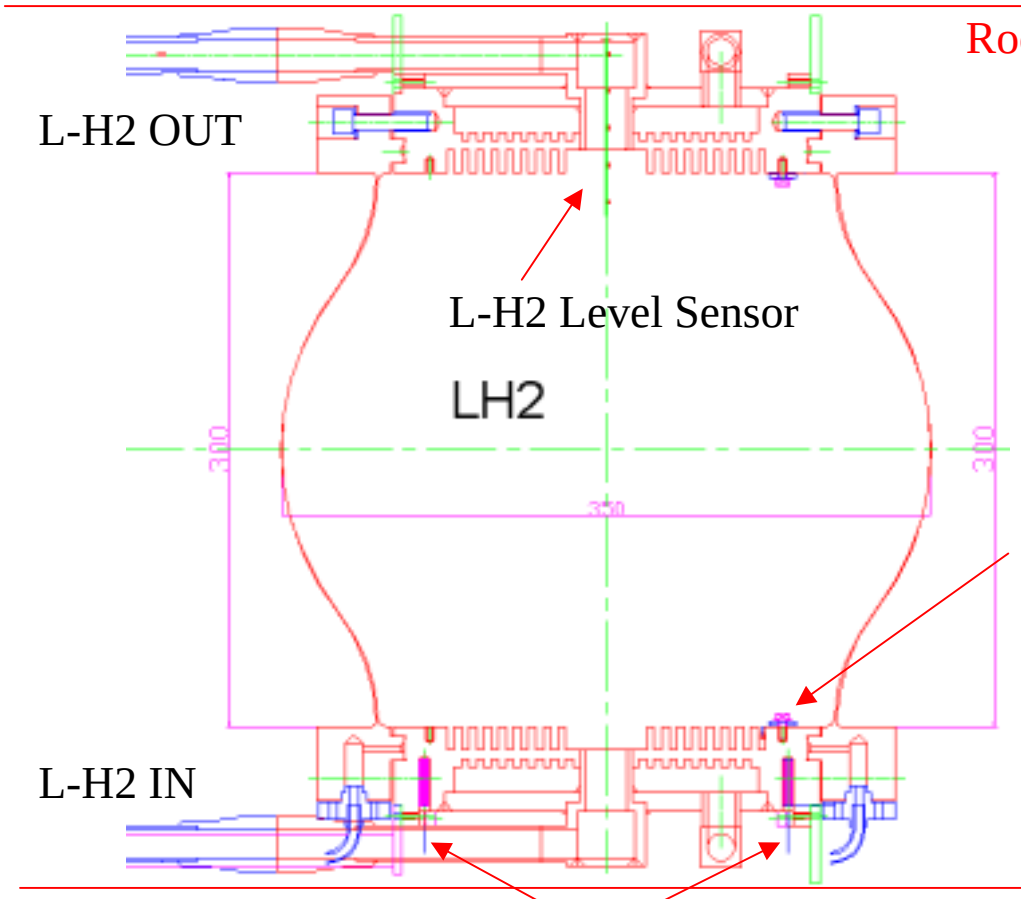


(3) Mucool/MICE Absorber R&D

MICE absorber system with Cryocooler



MICE Absorber

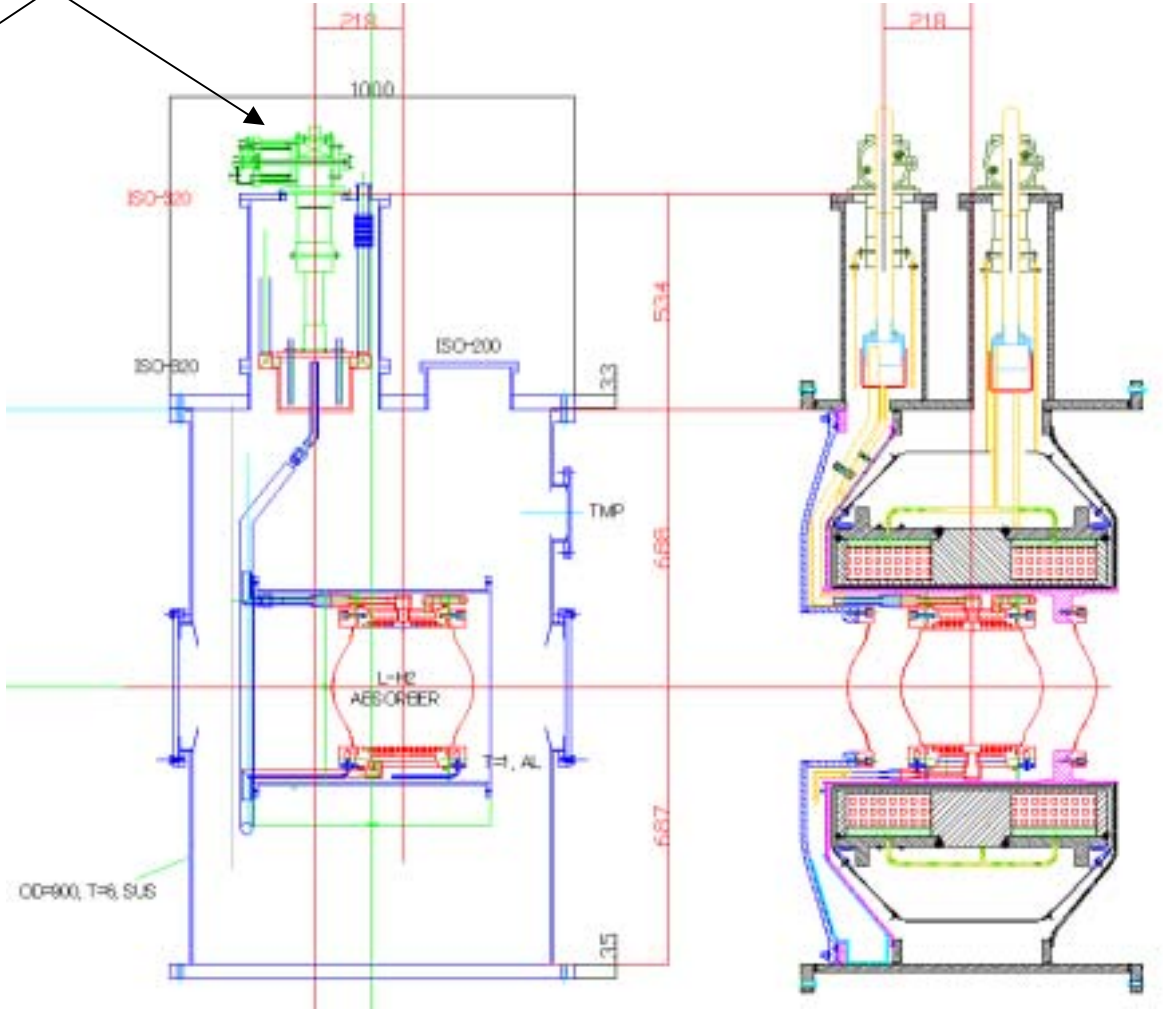


Mucool/MICE Absorber Test Cryostat at KEK

Cryocooler RDK-415D

MICE 1st Absorber

MICE



Mucool/MICE Absorber Test at KEK

Cryostat for thermometer/LH2 level sensor calibration

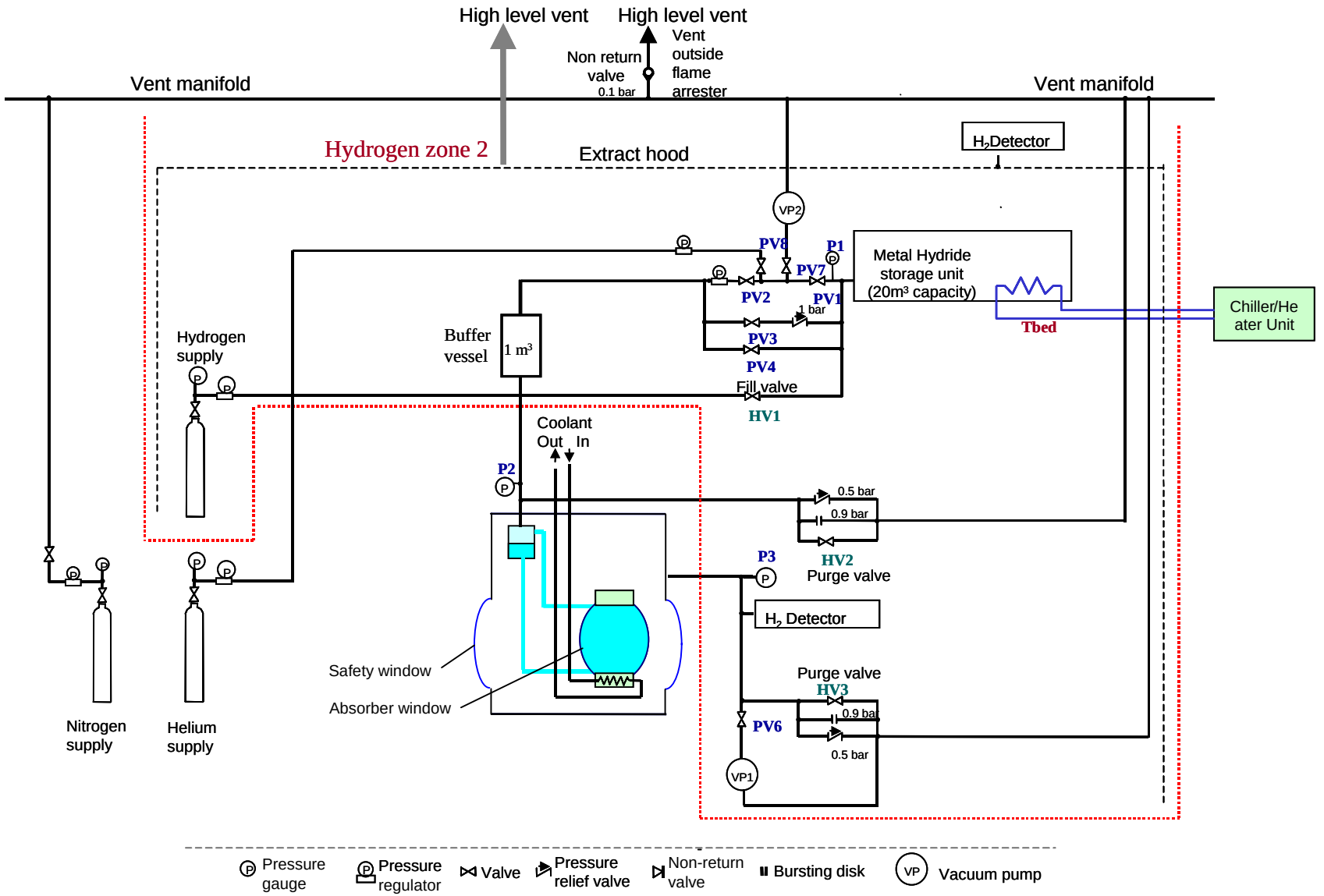
Cryocooler

KEK East Counter Hall

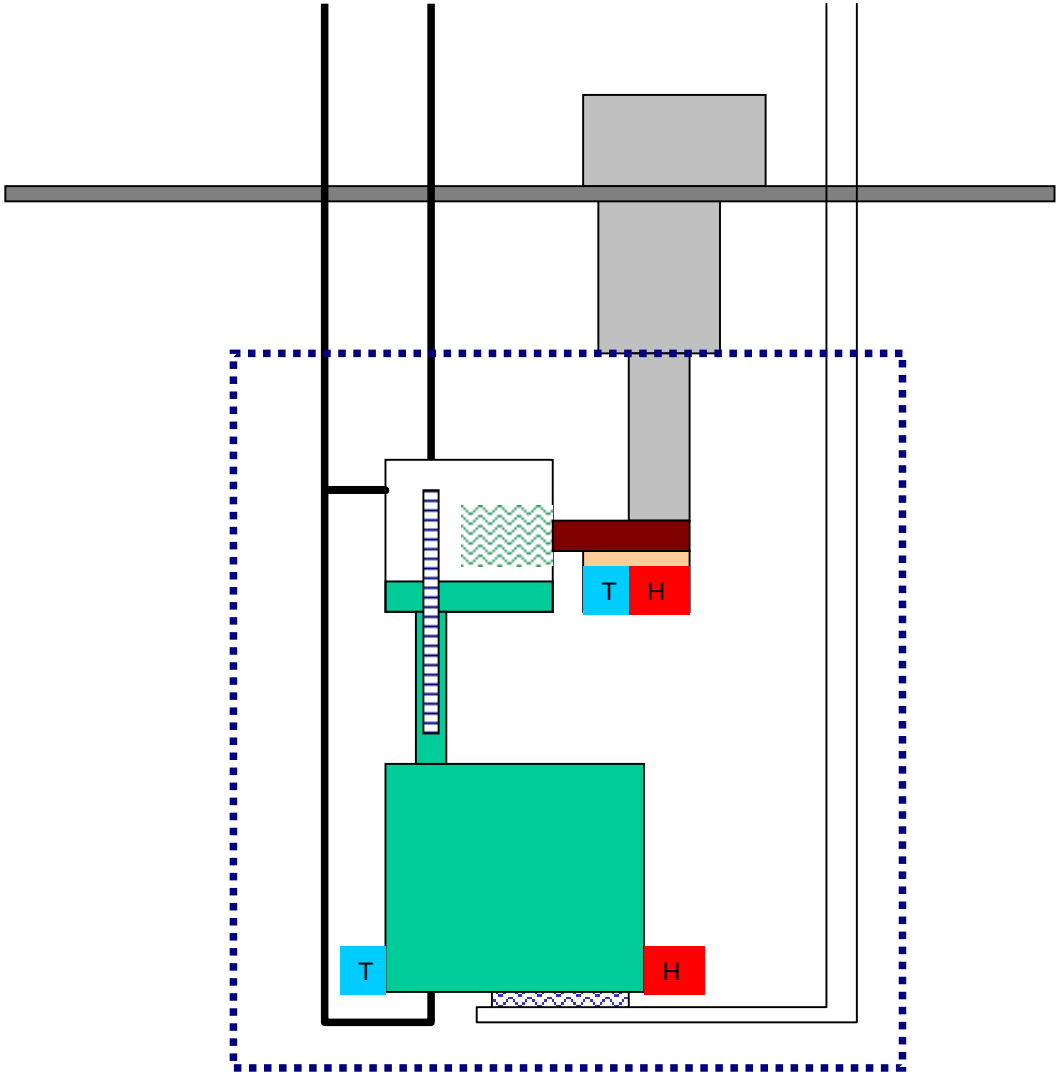
Cryocooler

Mucool/MICE Absorber Test Cryostat

Hydrogen System Baseline layout (RAL)



R&D Test Cryostat (RAL)



- Instrumentation mimics what we will need on the absorber for the control system and interlocks
- Heater will regulate temperature of cryocooler – need redundancy and interlock with compressor
- Dia. reservoir=height=290mm

Summary

(1) 1st Test Results of KEK Absorber at MTA
- *First absorber test with full LH2
- *No H2 leak by Indium seal
- *Learned a lot

(2) Plan of 2nd Test of KEK Absorber at MTA
- *Discussion and preparation are going
- *L-He transfer tube, electric heater, thermometer, DAQ will be modified.
- *We will try higher power as much as possible.

(3) Mucool/MICE Absorber R&D
- *MICE Absorber with Cryocooler design was almost fix
- *MICE Absorber R&D is going at KEK and RAL