LCWS14/20141008

STF Cryomodule Status

LINEAR COLLIDER COLLABORATION

Designing the world's next great particle accelerator

NAKAI Hirotaka

KEK

Rev. 0:

in collaboration with

LINEAR COLLIDER COLLABORATION

Designing the world's next great particle accelerator

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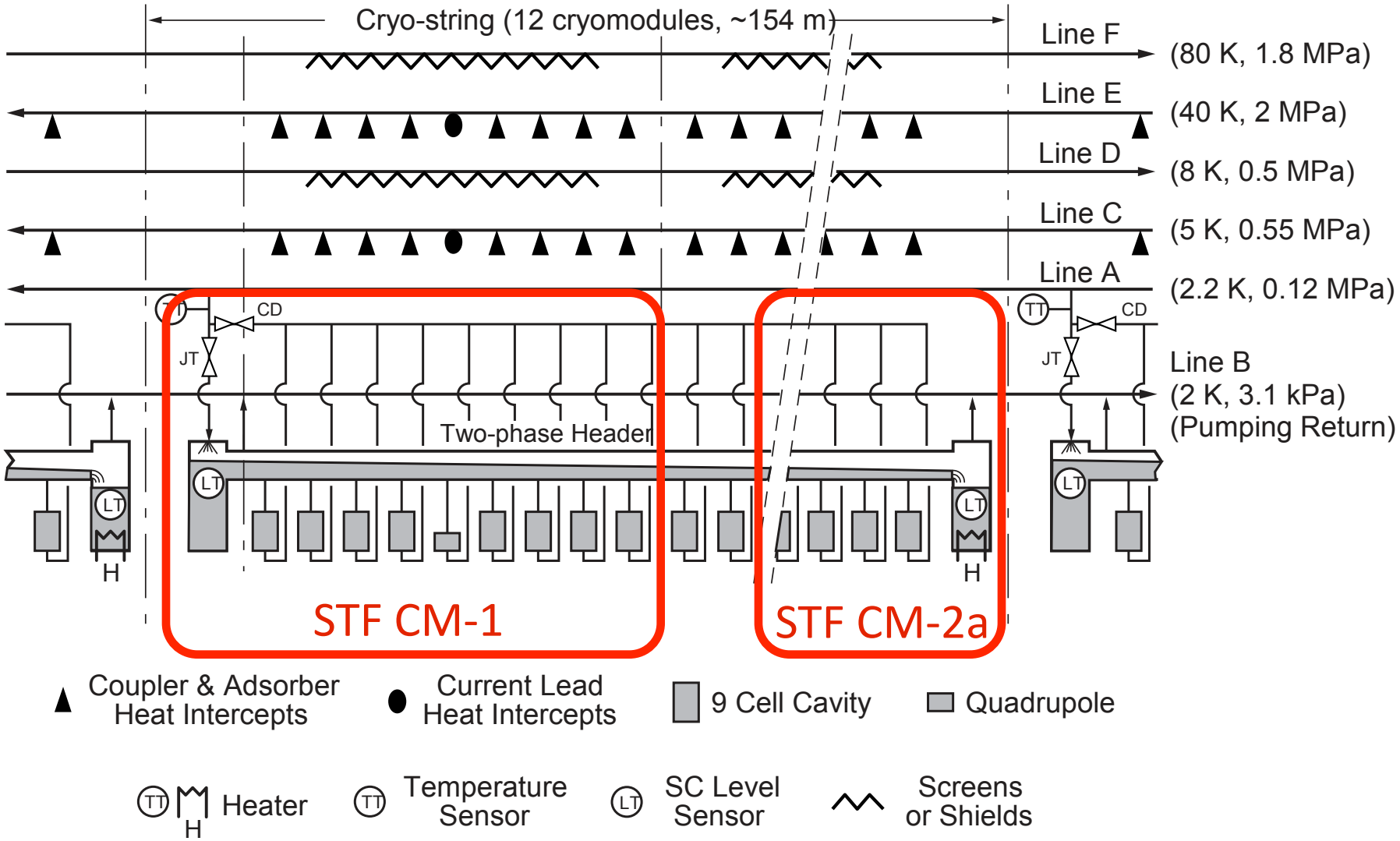
Outline

1. Concepts of STF cryomodules (STF CM-1 + CM-2a)
2. Status of STF cryomodules
3. Current schedule

Cooling Scheme of Cryo-string

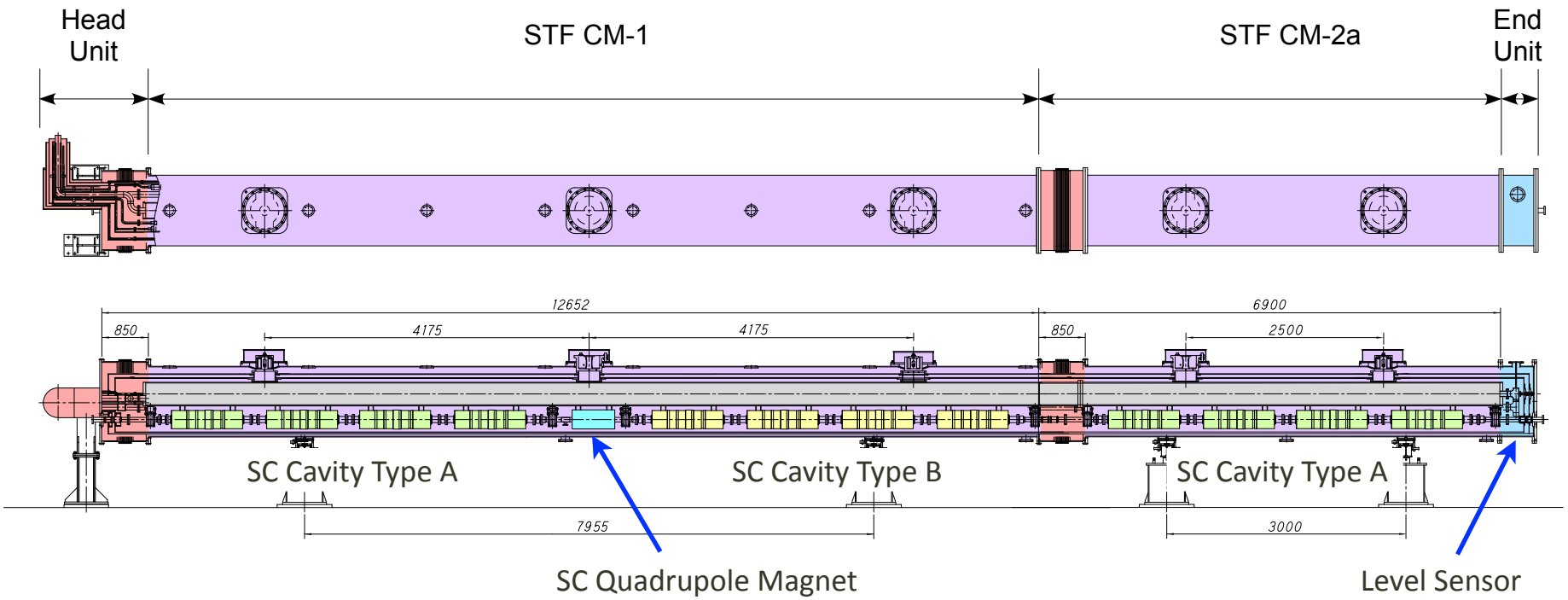


Cited from ILC-TDR

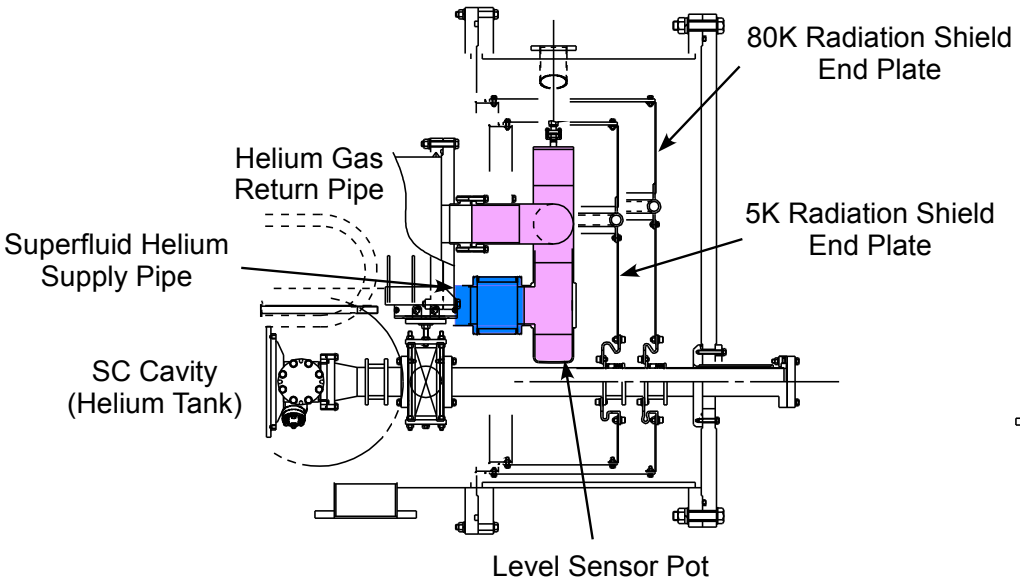
Concept of STF Cryomodules (1)

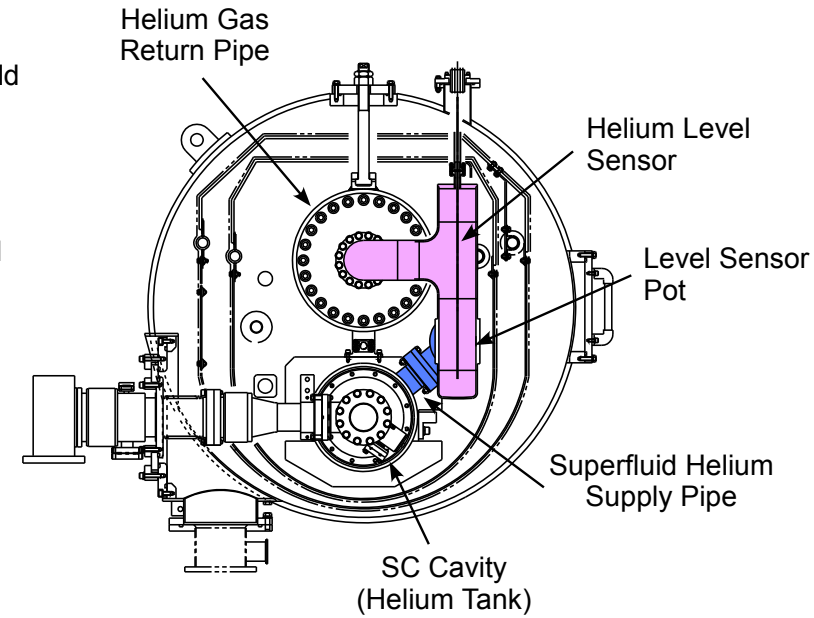
- **Design of STF CM-1 based on ILC-TDR**
- **Two types of cavities in STF CM-1**
  - Deference in tuner position
  - 4 cavities of each type (8 cavities in total)
- **One superconducting quadrupole (sc quad) magnet in STF CM-1**
- **Cryomodules connected with flanges for making various configurations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

STF CM-1 + CM-2a Cryomodules



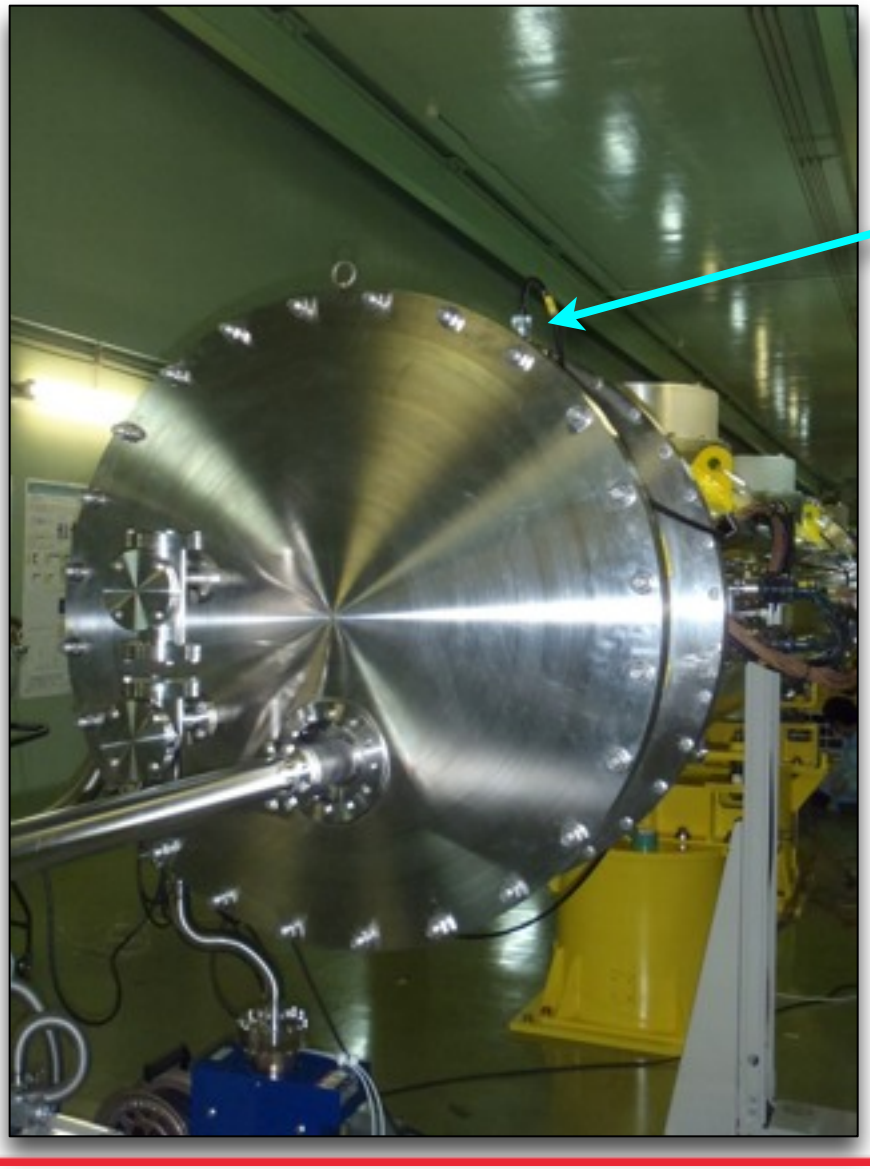
End Unit for Liquid Level Detection





Downstream Side View

End Unit of STF Cryomodule

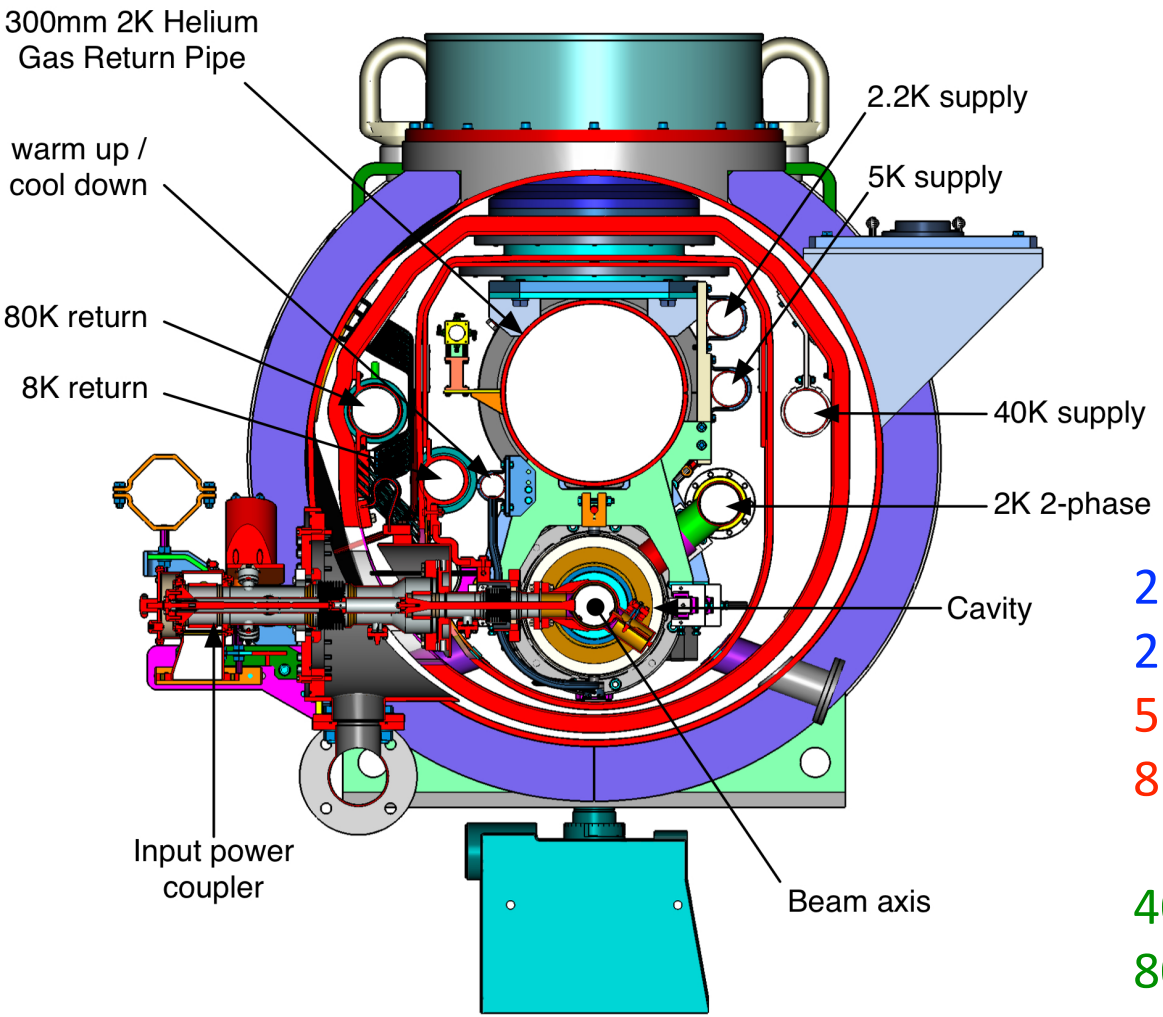


Liquid Helium
Level Sensor
Feed Through

Concept of STF Cryomodules (2)

- **Design of STF CM-2a modified to check CW operation feasibility**
  - Larger 2K 2-phase supply line (ϕ76.3 → ϕ89.1)
  - Electric heaters attached to simulate dynamic heat load from superconducting cavities
- **Usage of liquid nitrogen for 80K thermal shield instead of 40K thermal shield cooled by helium gas**
- **Conduction cooling of sc quad magnet**
  - Aluminum strips from 2K 2-phase pipe

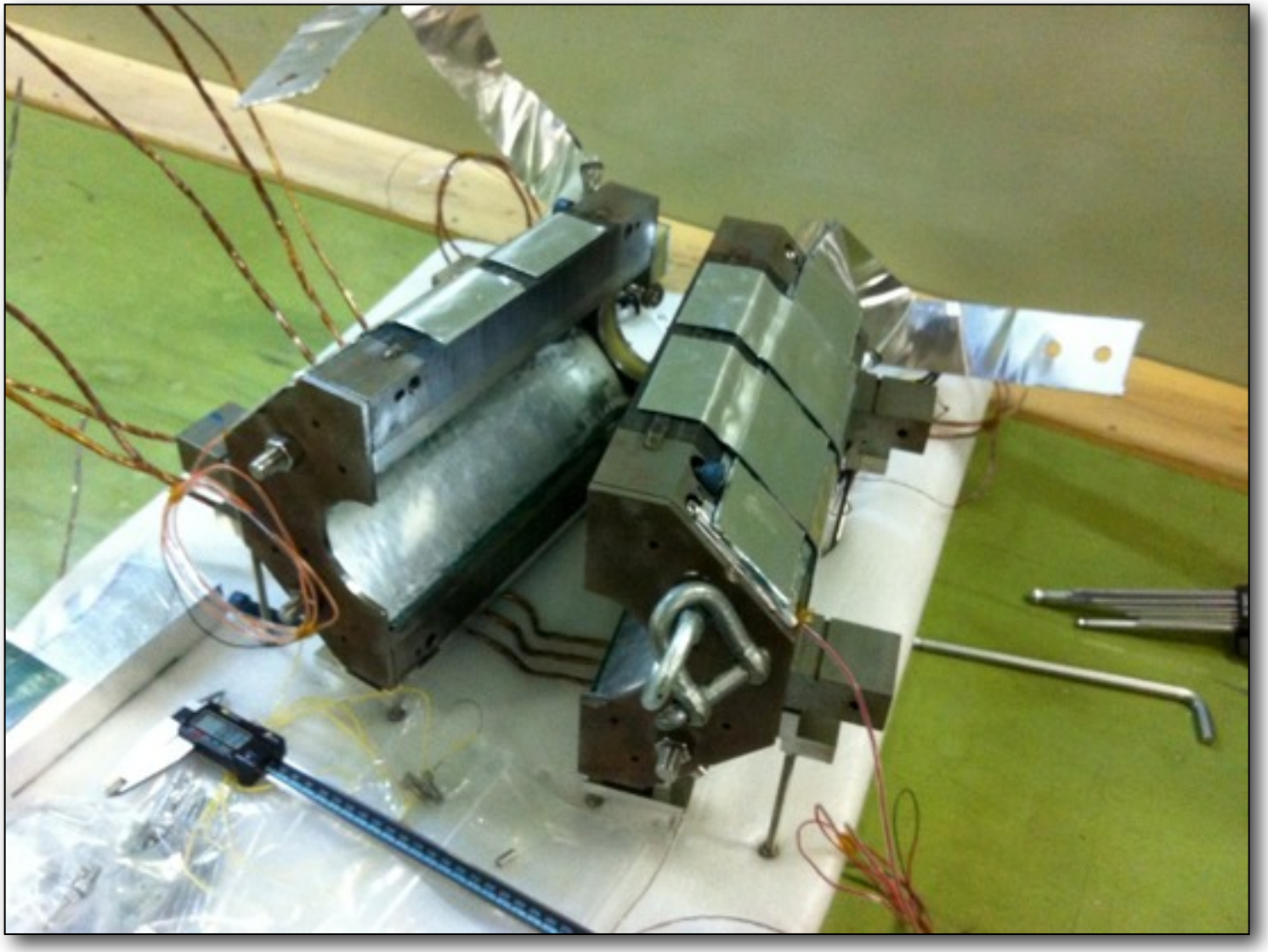
ILC Cryomodule



2K 2-phase pipe
2K helium gas return pipe
5K supply line
8K return line
(5K thermal radiation shield)
40K supply line --> 80K supply
80K return line
(40K thermal radiation shield)

Cited from ILC-TDR

Superconducting Quadrupole Magnet



Heat Loads and Refrigeration Power

- **Estimated heat load at 2K**
  - Capture cryomodule : 8 W (static) + 2 W (dynamic) = 10 W
  - CM-1 : 17 W (static) + 8 W (dynamic) = 25 W
  - CM-2a : 11 W (static) + 4 W (dynamic) = 15 W
  - SC quad magnet : 4 W (static)
  - 2K refrigerators : 2 W x 2 = 4 W
  - Total : 44 W (static)
- **2K refrigeration power**
  - 7 W/pump unit x 4 units = 28 W at 2 K so far
  - 10 W/pump unit x 2 units = 20 W at 2 K added this time
  - Total : ~50 W at 2 K

STF Enhanced Helium Gas Pumping System

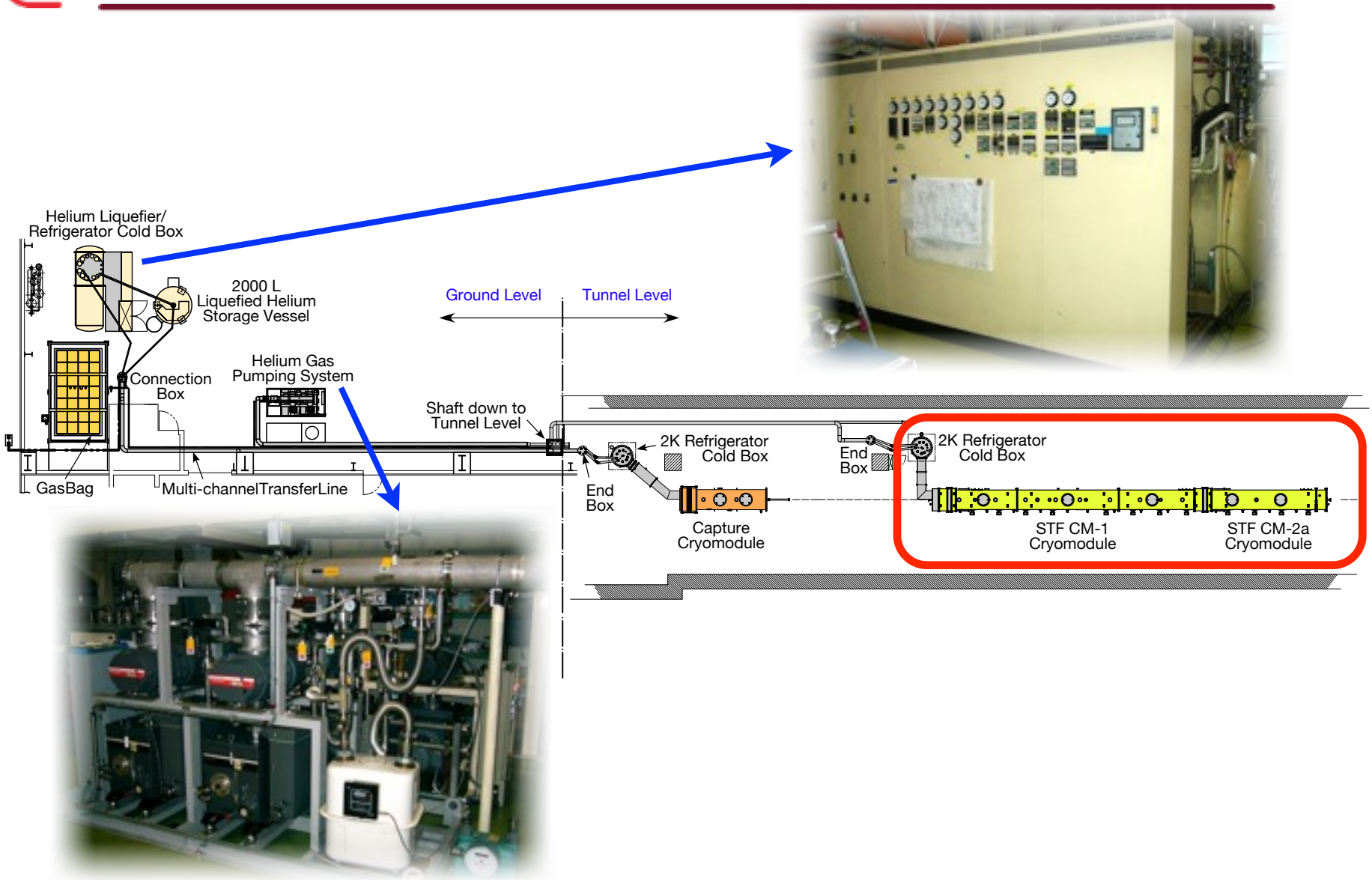
STF CM-1

STF CM-2a

STF CM-1 + 2a (1)

STF CM-1 + 2a (2)

STF Cryogenic System Configuration

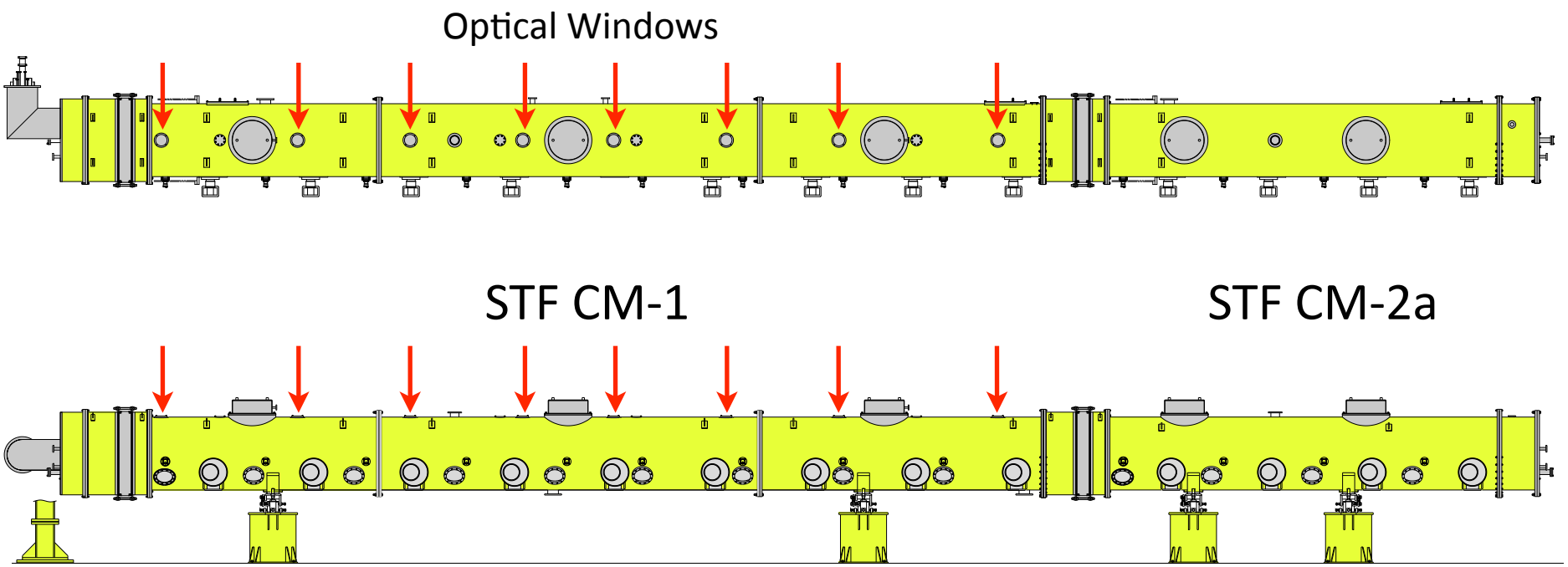


Capture Cryomodule

Equipments Installed

- Two wire position monitors to measure vertical displacement of cavities and gas return pipe (CM-1)
- Eight optical windows for Laser displacement sensors to measure vertical displacement of gas return pipe (CM-1)
- One beam position monitor (CM-1)
- Two potentiometers to measure axial displacement of gas return pipe (CM-1)
- One superconducting liquid helium level sensor in end unit

STF Cryomodules

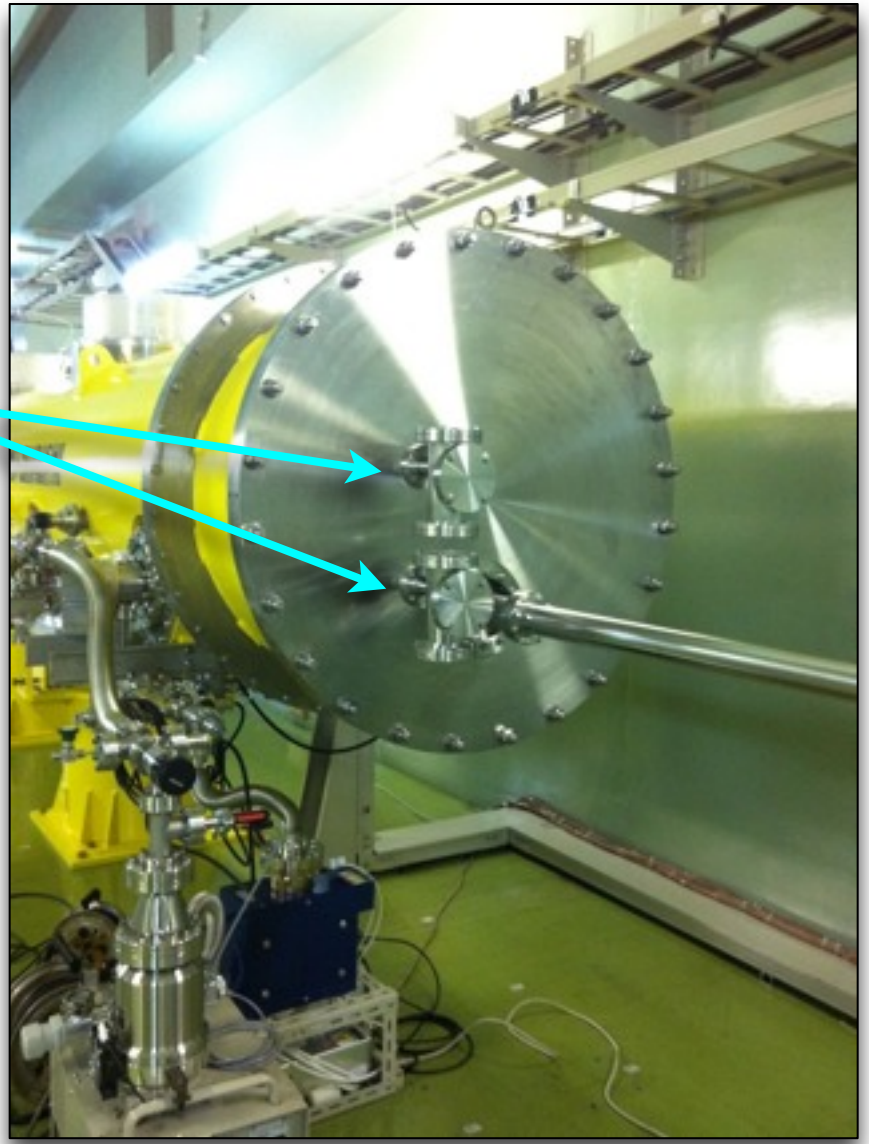


Vacuum vessel of STF CM-1 consists of 3 parts

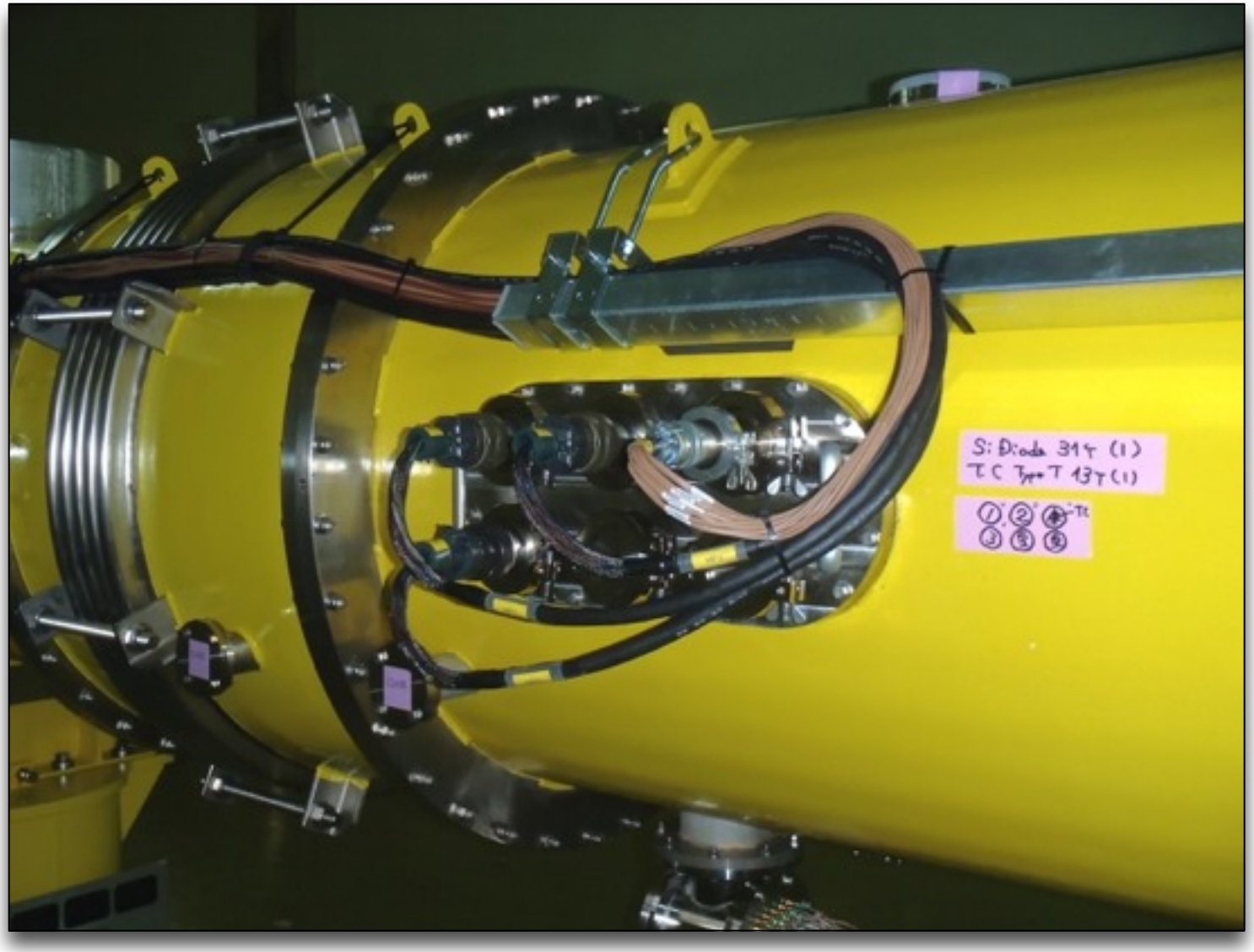
- Established technique and machine tools
- Manufactured in limited period
- Limitation of delivery opening of the tunnel

STF CM-1 Current Leads of SC Quad

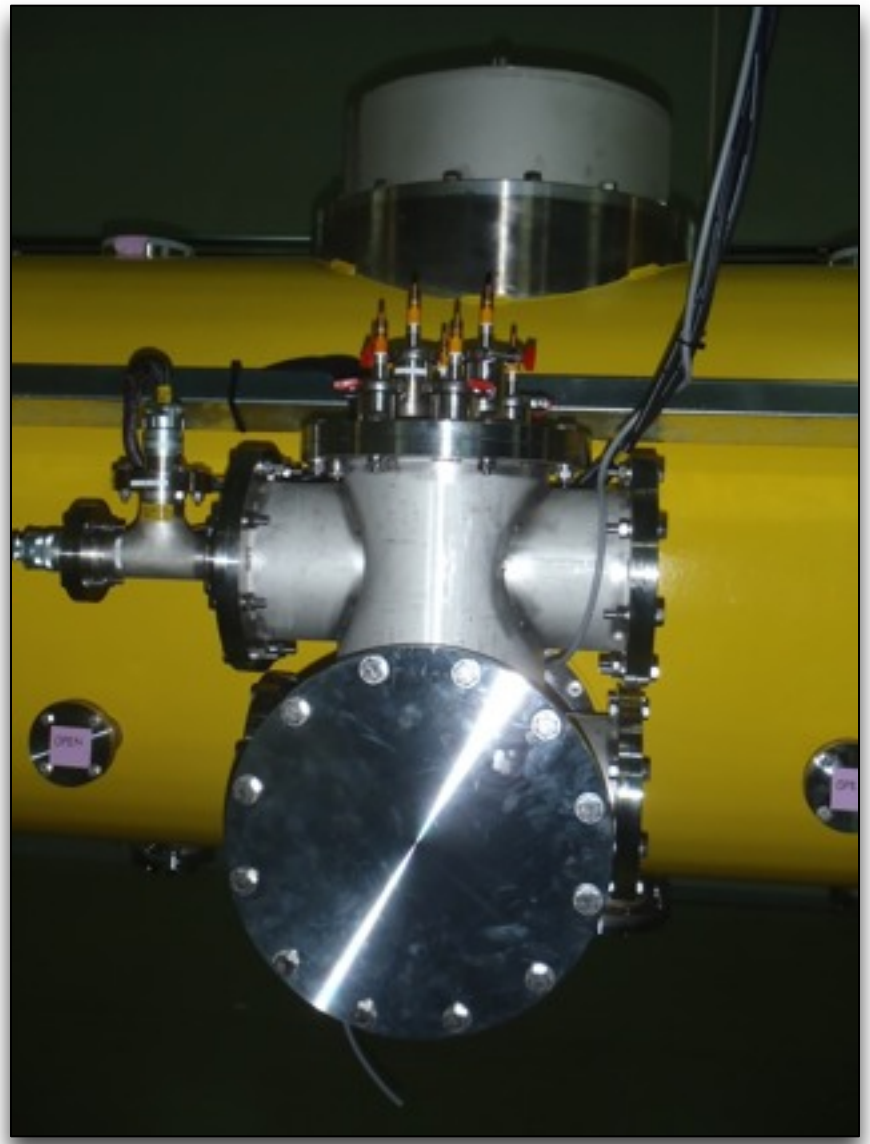
Wire Position
Monitor Ports



Signal Port Feedthroughs



STF CM-1 Current Leads of SC Quad Magnet



Current Schedule

- Assembly of STF CM-1 complete in January, 2014
- Assembly of STF CM-2a complete in May, 2014
- Connection to cryogenic system complete in June, 2014
- Completion inspection by the prefectural government in July, 2014 → Passed already
- First cool down of STF CM-1 and CM-2a in October, 2014 (capture cryomodule excluded)
- First excitation of sc quad magnet with Fermilab colleagues in November, 2014