Cryogenic performance in STF2 cryomodule tests

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in collaboration with

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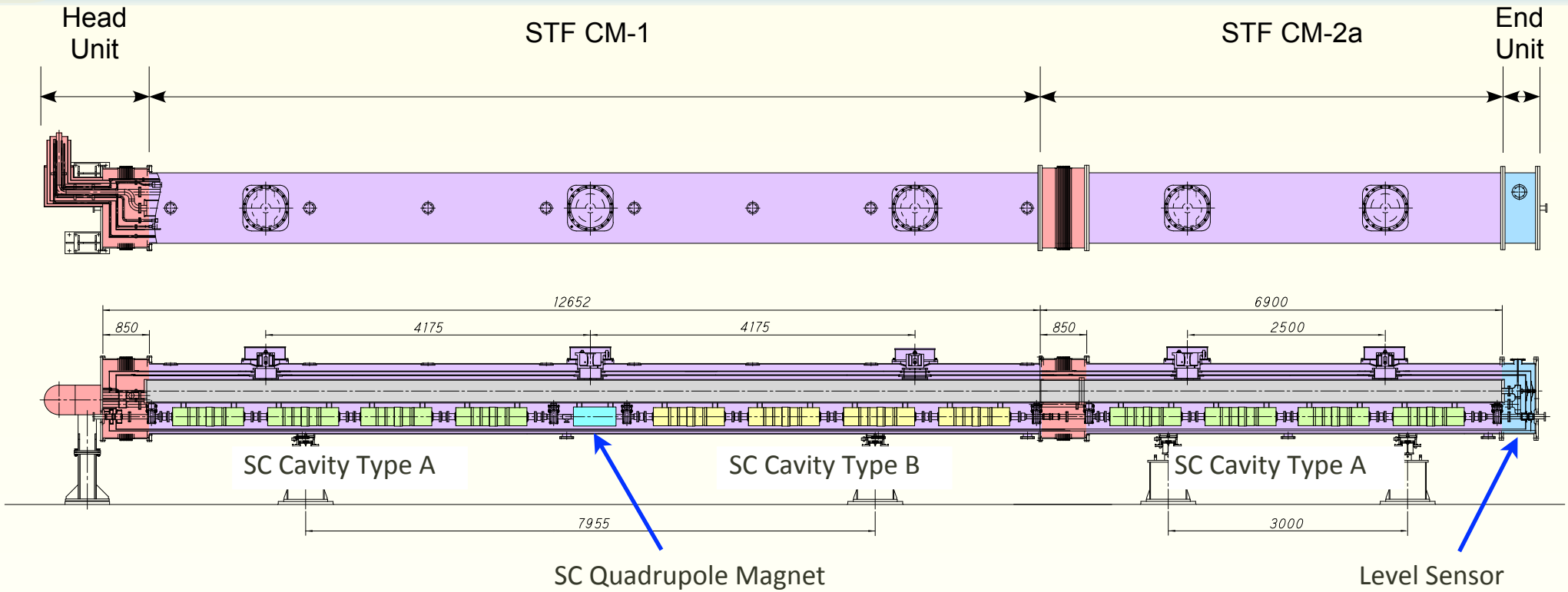
Superconducting rf Test Facility

STF2 CM-1 + CM-2a Cryomodules

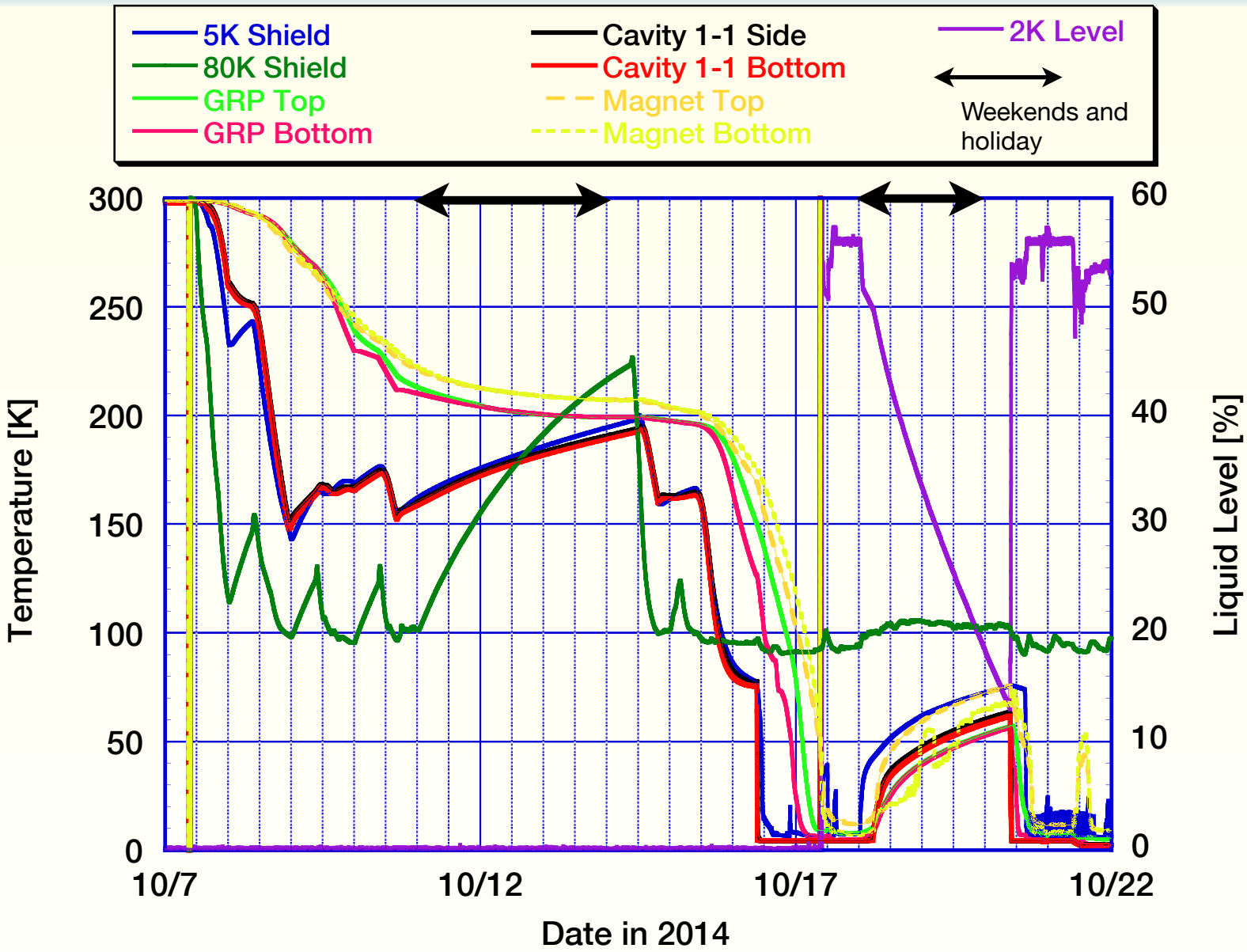


- Head unit : connection to cryogenic system
- STF2 CM-1 : 8 cavities + 1 sc quad magnet fabricated at FNAL
- STF2 CM-2a : 4 cavities
- End unit : liquid helium level detection

Concept of STF2 Cryomodules

- Design of STF2 CM-2a modified to check CW operation feasibility
  - Larger 2K 2-phase supply line (ϕ76.3 → ϕ89.1)
- Electric heaters attached to cavity tanks to simulate dynamic heat load from superconducting cavities
- Usage of liquid nitrogen for 80K thermal shield instead of 40K thermal shield cooled with helium gas
- Conduction cooling of sc quad magnet
  - Aluminum strips from 2K 2-phase pipe

Cool-down Curve



Measured Static Heat Loads

- Total heat load at 2 K : ~ 29.5 W
  - 2K cold box (2K pot) : ~ 1 W (measured in previous test)
  - Cavities + 2K cold box : ~ 19.9 W
  - Cavities : ~ 18.9 W (total of 12 cavities)

    ~ 1.6 W/cavity (average value)
  - SC quad magnet + pipes : ~ 9.5 W

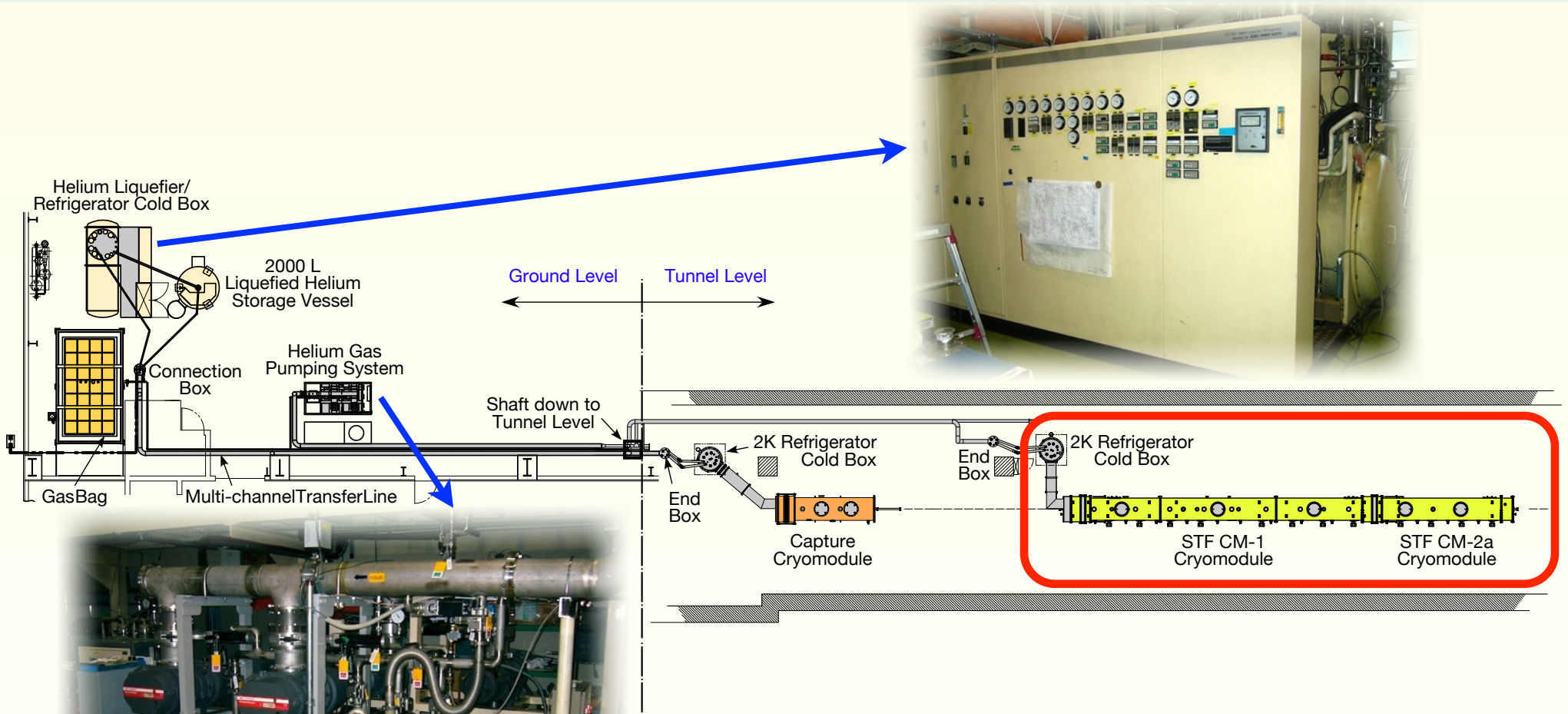
Summary

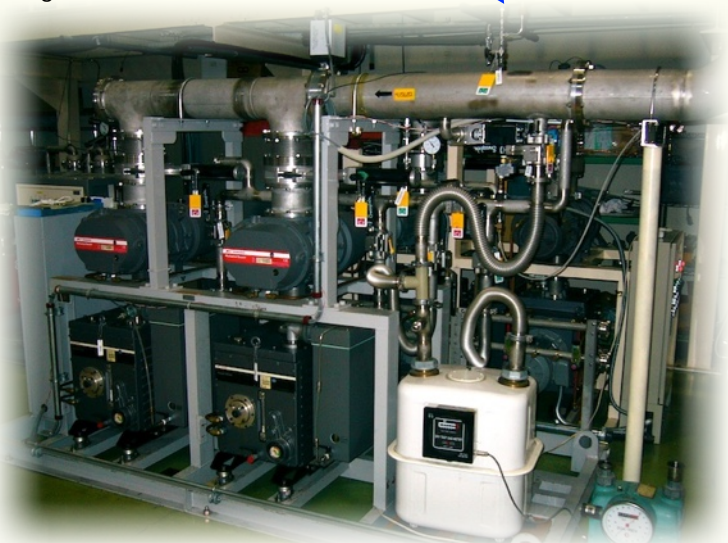
- First cool-down of STF2 CM-1+CM-2a completed
- Cryogenic system did work in cool down of STF2 CM-1and CM-2a cryomodules
- Dynamic heat load from cavities could be simulated with electric heaters up to 30 W
  - Helium pumping system cannot sustain temperature of 2K with simulated heat loads above ~ 20 W
- No difference in cryogenic conditions with simulated dynamic heat loads in STF2 CM-1 and CM-2a in this measurement
- Flooding of superfluid helium into GRP observed occasionally

Extra Slides for Q&A

STF2 CM-1 + 2a

STF Cryogenic System Configuration

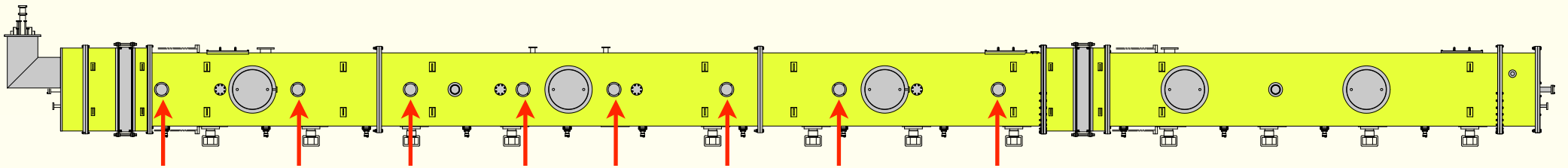




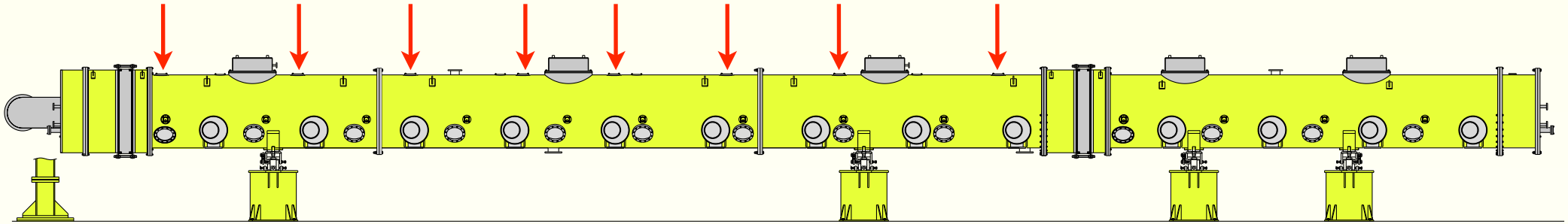
Equipments Installed

- 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



Optical Windows



STF CM-1 STF CM-2a

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

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 and November, 2014 (capture cryomodule excluded)
- First excitation of sc quad magnet with Fermilab colleagues in November, 2014