TUPOGE06

Performance Test for Mass-Production of HWR cryomodules by RISP

Youngkwon Kim, Danhye Gil, Hyojae Jang, Hyunik Kim, Yong Woo Jo, Jaehee Shin, Jong Wan Choi, Moo Sang Kim, Min Ki Lee,
Jongdae Joo, Hoechun Jung(IBS), Younguk Sohn (PAL), Myeun Kwon(IBS)

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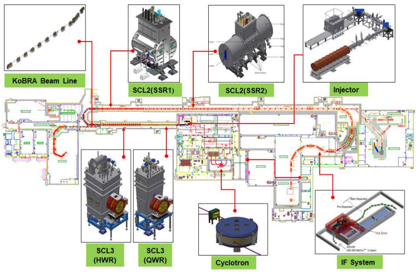

Fig. 1 Layout of RAON

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	QWR	HWR
β_{opt}	0.047	0.12
f [MHz]	81.25	162.5
L_{eff}	173.5	221.5
R/Q [Ω]	469	295
E_p/E_{acc}	5.7	5.2
B_p/E_{acc} [mT/(MV/m)^2]	10.4	9
E_{acc} [MV/m]	6.1	6.6
V_{acc} [MV]	1.06	1.46
QR_s	18.1	36.8

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The low energy superconducting linac (SCL3) of RAON is composed of 22 quarter wave resonator (QWR) cryomodules and 35 half wave resonator (HWR) cryomodules including two bunching HWR cryomodules in a post-accelerator to driver linac (P2DT).

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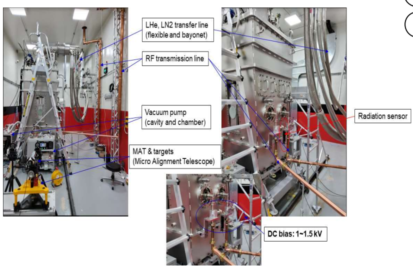
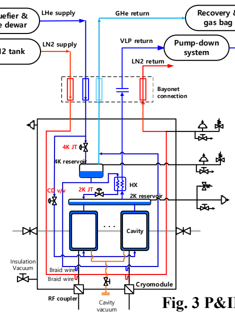


Fig. 2 Test setups in the HT bunker for HWR cryomodules



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- Two JT valve to control the mass flow rate to reservoirs
- Bayonet connection and flexible pipe line for cryogenic fluid
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Cryogenic fluid such as liquid nitrogen and liquid helium were supplied from the helium liquefier and LN2 tanks, respectively through the flexible insulated transfer lines. Two RF transmission lines were installed in the bunkers and connected with power couplers. The solid state power amplifiers (SSPA) were located outside the bunker. The DC biases were utilized to suppress the multipaction of the power couplers. 1.5 kV DC voltage was supplied to the DC bias during the experiments. Two vacuum pumps were used for evacuating cavity string and insulation vacuum. The vacuum pumping station for the cavity string had slow pump-down system that can control the initial pumping speed. The micro alignment telescope and reference targets were utilized to measure the displacement of the cavities. Radiation sensor was installed around the power coupler to monitor the X-ray due to the field emission of the cavities.

Test Procedure and Results

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- Cavity frequency check & tuner operation test
- Leak test and vacuum pumping for cavity
- Leak test and Purging cryogenic pipes
- Connecting cryogenic lines, signal cables, DC bias, RF transmission lines, etc.

Cool-down
- Thermal shield cool-down by LN2
- Cavity cool-down through cool-down line

4 K Test
- **MP conditioning (Fig. 4)**
- RF application (Fig. 5)
- Cable calibration
- **Static and total thermal load measurement (Fig. 6)**
- **Field emission conditioning with pulsed RF power, if necessary**

2 K Test
- 2 K pump-down: df/dp measurement (2~3MV/m)
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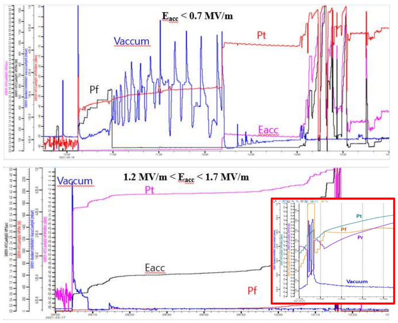

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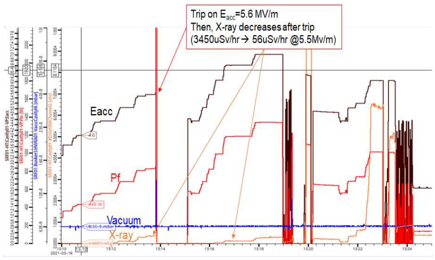

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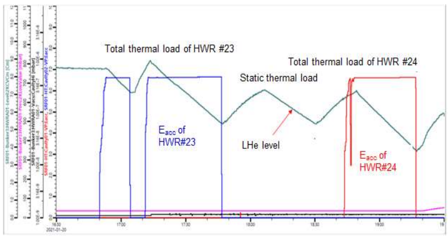

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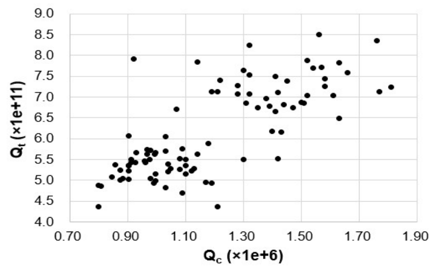

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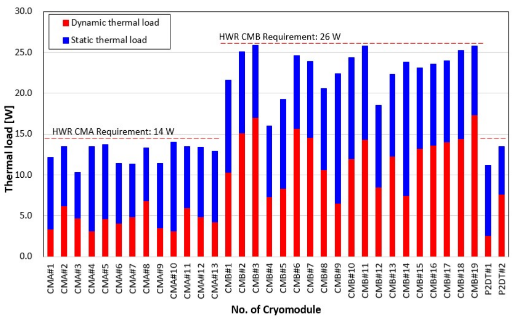
The pickup external Q (Q_t) values are two orders higher than the average Q_0 values of the cavities as expected. The operating bandwidth and the required RF power are affected by the coupler external Q (Q_c) value. The average operating bandwidth is 140 Hz while the minimum is 90 Hz.



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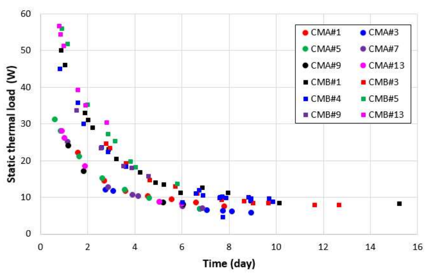

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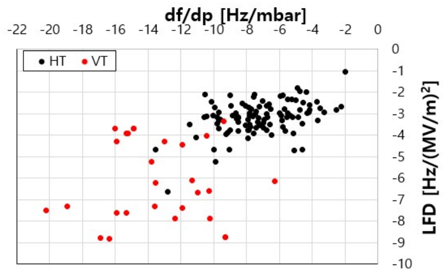

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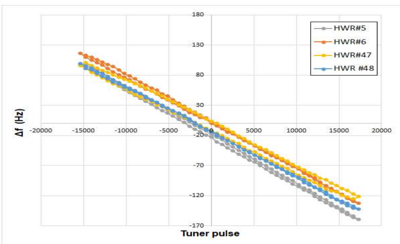

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The 15 HWR CMA and the 19 HWR CMB for low energy linac (SCL32) and bending section (P2DT) were successfully fabricated, tested and installed in the tunnel. The installed cryomodules were connected with the CDS (cryogenic distribution system) including the warm piping and assembled with warm sections. The cryomodules are waiting for the cool-down and commissioning. The performances and the characteristics of 106 HWR cavities were also tested and measured individually after the cryomodule assembly.

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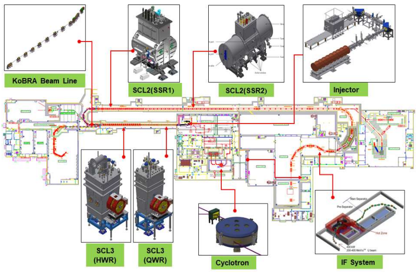

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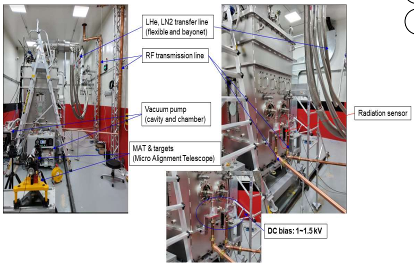

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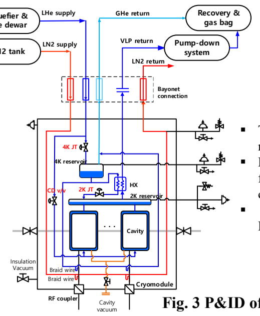

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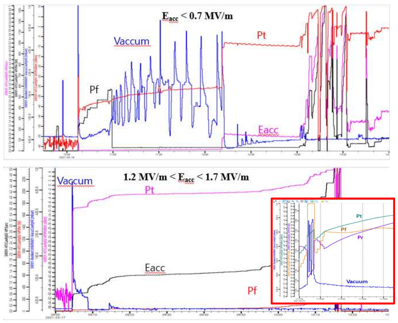

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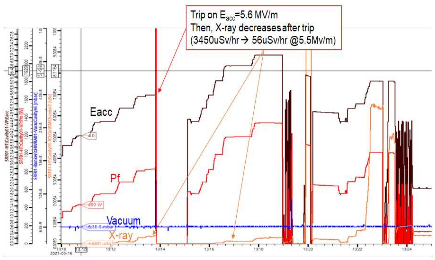

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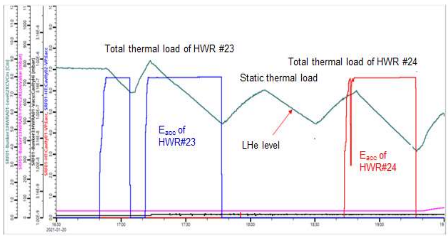

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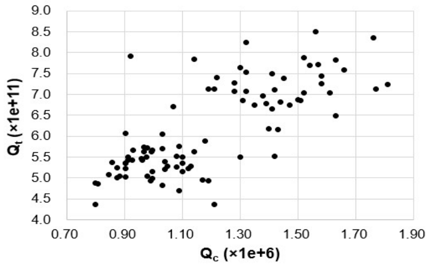

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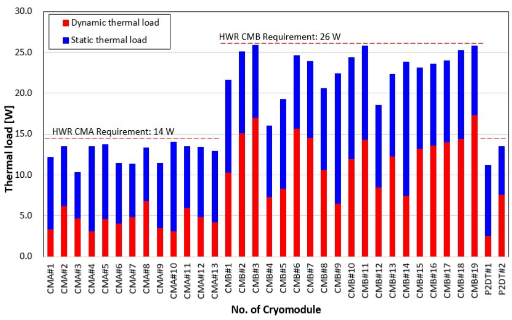

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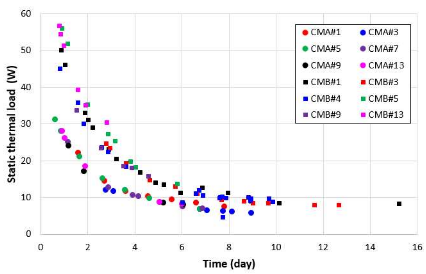

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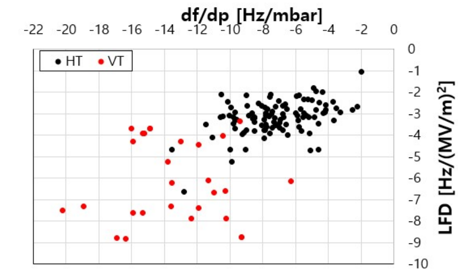

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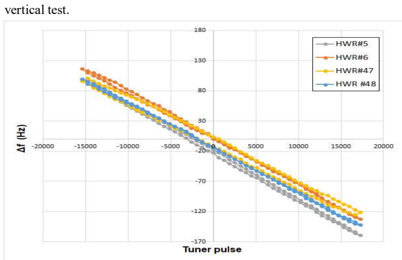

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