

FABRICATION AND LOW TEMPERATURE TEST PLAN FOR RARE ISOTOPE SCIENCE PROJECT*

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Abstract

Quarter-wave resonator (QWR), half-wave resonator (HWR) and single-spoke resonator (SSR) cryomodules are used for RAON accelerator. The layout of RAON accelerator and three types of cryomodules such as QWR, HWR and SSR are shown in the linac. SRF test facility which consists of cryoplant, cleanroom, vertical test facility and horizontal test facility is constructed. Cleanroom has high pressure rinsing (HPR), ultrasonic cleaning (USC), buffered chemical polishing (BCP), high vacuum furnace and cavity assemble place. The test plan for cavity and cryomodules is presented.

INTRODUCTION

N-dimensional thermal radiation was studied [1] and the size effect of the thermal radiation was predicted [2, 3]. Properties of superfluid helium fog were studied [4-6] and RAON superconducting radio frequency (SRF) test facility was designed [7]. The RAON SRF test facility consists of cryogenic system, cleanroom, vertical test facility and horizontal test facility. Cavity process and assemble can be performed in the cleanroom. Residual resistivity ratio (RRR) of Nb was measured and the conditions of e-beam welding (EBW) for Nb were studied [8, 9]. Helium leak detection techniques were shown for cryogenic system [10] and a half-wave resonator (HWR) cryomodule was test in low temperature [11].

In this paper, we show the layout of RAON accelerator in which QWR, HWR and SSR cryomodules are installed. Progress of the cryomodules' development is presented and SRF test facility is shown. Cleanroom, vertical test facility and horizontal test facility can be used in the SRF test facility.

RAON ACCELERATOR

RAON accelerator consists of SCL1, SCL2, and SCL3. The layout of the RAON accelerator and the cross-sectional view of cavities are shown in Fig. 1. The types of cavities are QWR, HWR, SSR1, and SSR2. Radio frequencies to drive QWR, HWR, and SSR cavities are 81.25, 162.5, and 325 MHz, respectively. Beta is 0.047, 0.12, 0.30, and 0.51 after QWR, HWR, SSR1, and SSR2 cryomodules from SCL1 through SCL2. Beam energy for

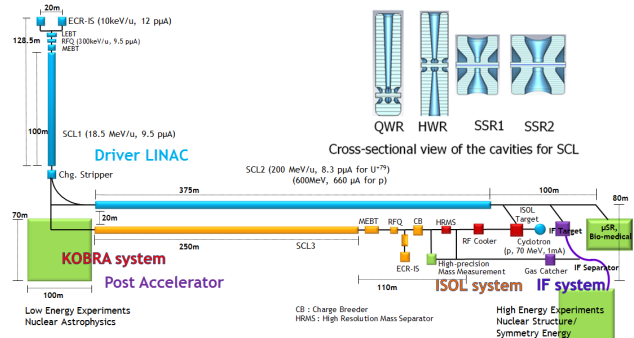


Figure 1: Layout of RAON accelerator.

H⁺ is about 600 MeV and beam energy for U⁺⁷⁹ is about 200 MeV. Power on target is about 400 kW. It is expected to construct the RAON accelerator in 2021.

TYPES OF CRYOMODULES

Prototypes of cryomodules are fabricated and tested. Fabricated prototypes of the cryomodules are quarter-wave resonator (QWR), half-wave resonator type 1 (HWR1), half-wave resonator type 2 (HWR2), single-spoke resonator type 1 (SSR1), and single-spoke resonator type 2 (SSR2) cryomodules. The types of the cryomodules are shown in the layout of RAON accelerator in Fig. 2. SCL1 and SCL3 are the same, which have QWR, HWR1, and HWR2 cryomodules. SSR1 and

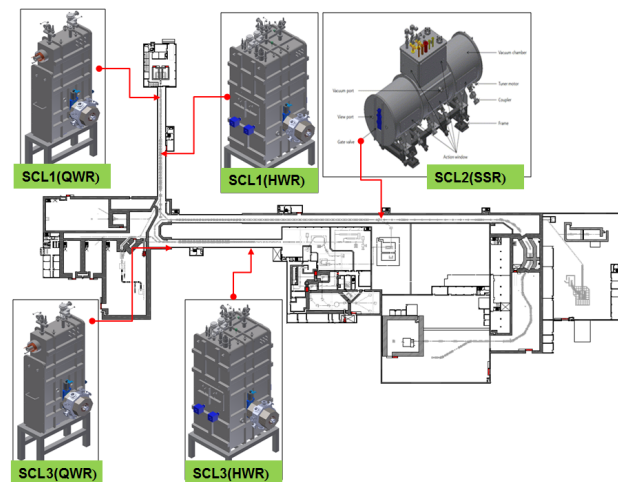


Figure 2: Types of cryomodules in RAON accelerator.

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SSR2 cryomodules are installed in SCL3. Static heat load is measured for QWR and HWR1 cryomodules.

SRF TEST FACILITY

SRF test facility has cryoplant, cleanroom, vertical test bench, and horizontal test bench. Cleanroom has high pressure rinsing (HPR), buffered chemical polishing (BCP), ultrasonic cleaning (USC), high vacuum furnace, and cavity assemble place. The classes of the cleanroom are 10, 100, 1000 and 10000. Figure 3 shows the layout of cleanroom and the pictures for buffered chemical polishing (BCP), ultrasonic cleaning (USC), high pressure rinsing (HPR), and class 10 and 100 assembly rooms. Cavity is assembled in the room of class 10.

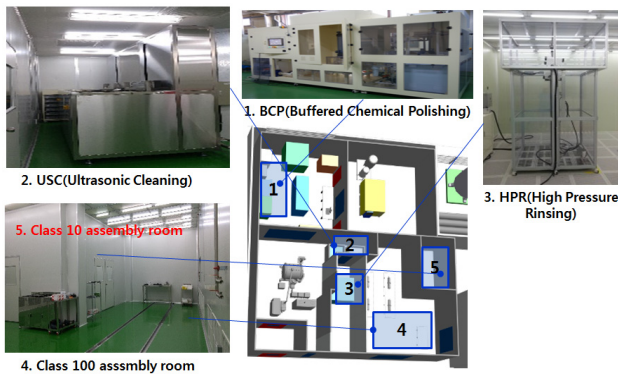


Figure 3: Layout of cleanroom in SRF test facility.

test control room, vertical insert hanging booth, and vertical test pit are shown in Fig 4. Vertical test is ongoing.

Figure 5 shows the horizontal test facility. Radiation shielding door is also installed. Two rooms for the horizontal tests are constructed in the facility. The low temperature test for HWR1 cryomodule was performed at the horizontal test facility. Horizontal test for QWR linac demonstration will be prepared.

The vertical test and horizontal test to make RAON accelerator will be performed at the SRF test facility. Local control system for HWR1 cryomodule was developed and the control system for QWR linac demonstration is under development. Local control system for vertical test will be developed in near future.



Figure 5: Horizontal test facility.

SUMMARY

We have shown the developed cryomodules which include QWR, HWR, and SSR cryomodules. Layout of RAON accelerator was shown and goals of the accelerator were briefly introduced. SRF test facility was constructed. Cleanroom, vertical test facility and horizontal test facility are used in the SRF test facility. Cleanroom has high pressure rinsing (HPR), buffered chemical polishing (BCP), ultrasonic cleaning (USC), high vacuum furnace and cavity assemble place. Vertical test and horizontal test will be performed in the SRF test facility.

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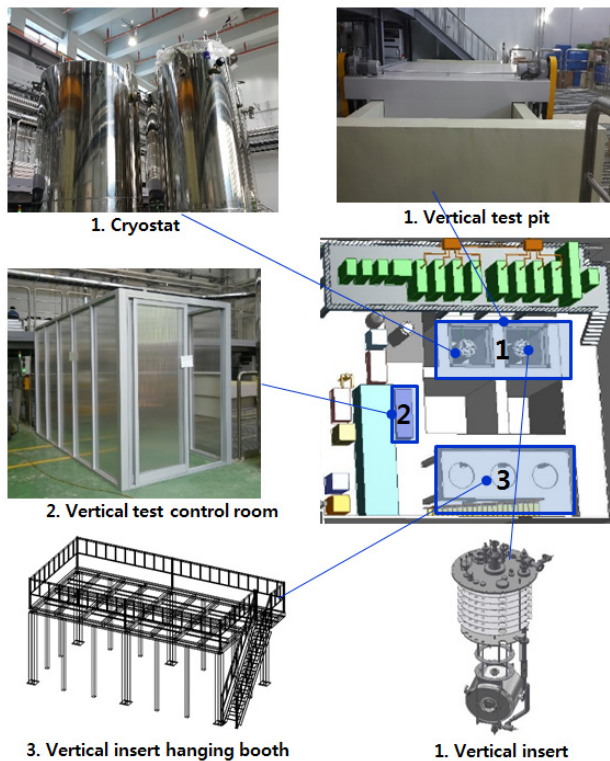


Figure 4: Vertical test facility.

Vertical test can be performed at two vertical test pits. Radiation shielding door is installed. Cryostats, vertical

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