Modal Analysis and Vibration Test for Quarter Wave Resonator for RAON

Myung Ook Hyun, Minki Lee, Youngkwon Kim, Hoechun Jung
Rare Isotope Science Project (RISP), Institute of Basic Science (IBS), South Korea

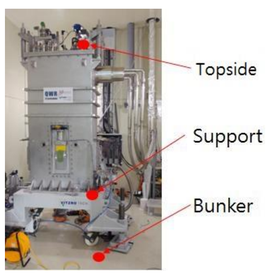
▷ Abstract

The Rare Isotope Science Project (RISP) in the Institute of Basic Science (IBS), Korea, is developing and constructing the multi-purpose linear accelerator at the north side of Daejeon, South Korea. RISP accelerator (RAON) is composed of low-energy region (SCL3) and high-energy region (SCL2) [1]. Low-energy region is made with quarter-wave resonator (QWR) and half-wave resonator (HWR) while high-energy region is made with single spoke resonator type-1 (SSR1) and type-2 (SSR2). This paper presents the initial resonance issues of QWR superconducting (SC) cavity occurred during cold test and disturbance measurement in the Munji SRF test facility. Also, this paper shows the modal analysis and vibration test of QWR SC cavity.

▷ QWR Cryomodule Test & Disturbances

● QWR Cryomodule Test at Munji SRF Test Facility

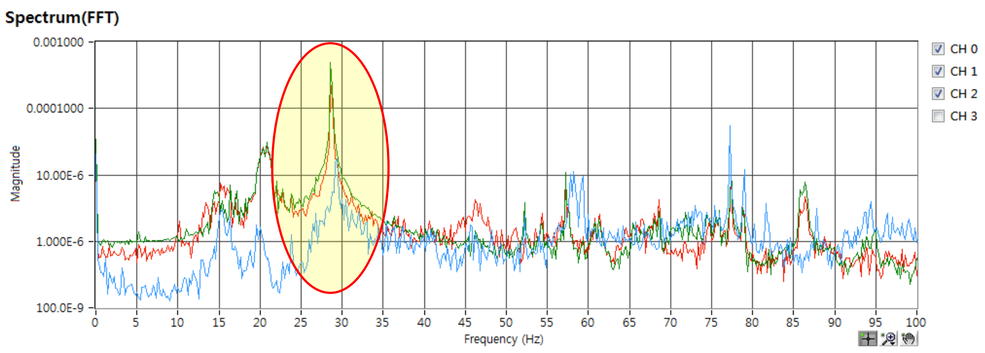
- QWR CM Test & RF Uncontrollable Issue



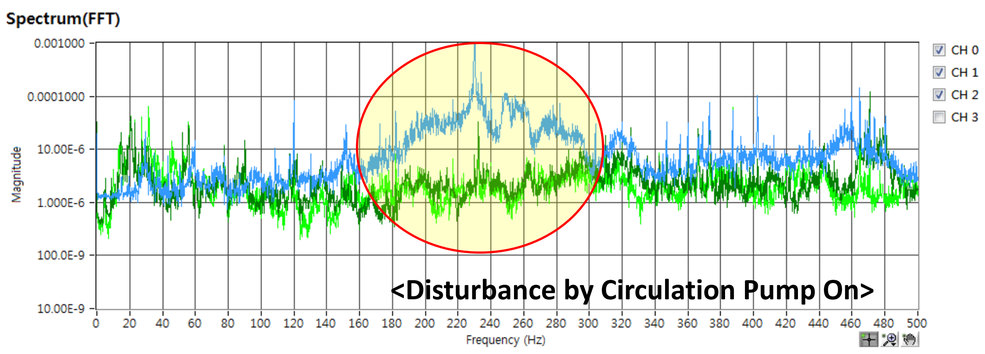
During cold test, there were some failures for RF phase control of QWR cavity due to unexpected disturbances. After finishing cold test, we measured the vibration level on the several points of Munji SRF test facility. By repeating turn-on and turn-off of all devices including general utilities, we found that there were two main outer disturbances, one came from the cold box of cryogenic system and the other came from the water circulation pump connected to the utility water supply line. Figure 2 and 3 show the disturbances from both vibration sources corresponding to the device on and off.

● Disturbances by SRF Utilities

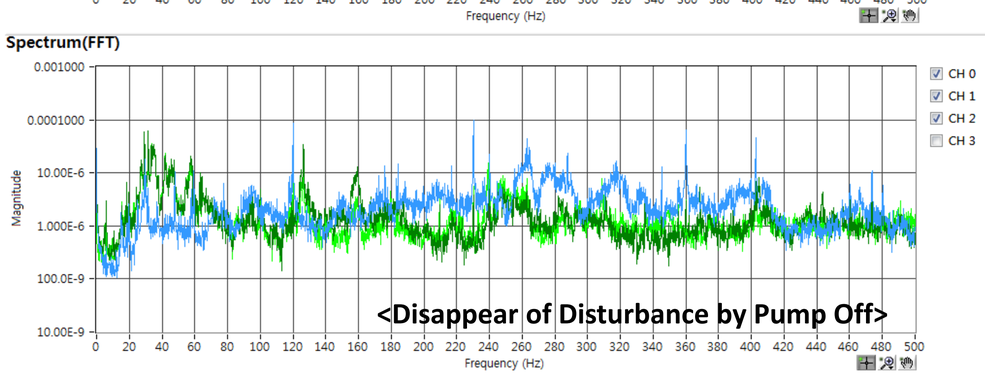
- Disturbance from Cold-Box (around 27Hz)



- Disturbance from Circulation Pump (between 200 and 280Hz)



<Disturbance by Circulation Pump On>

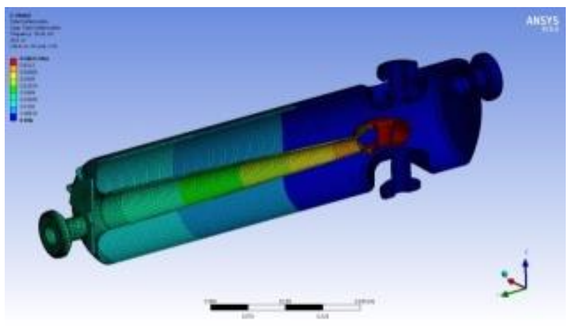


<Disappear of Disturbance by Pump Off>

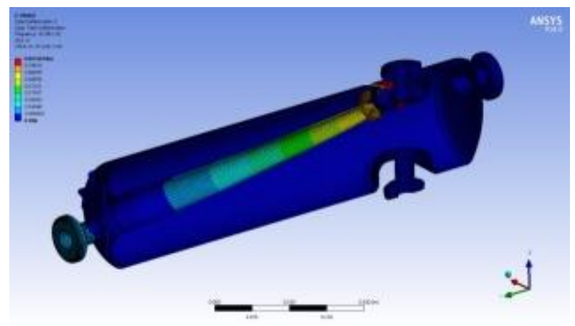
▷ Modal Analysis and Vibration Test of QWR

● Modal Analysis and Vibration Test

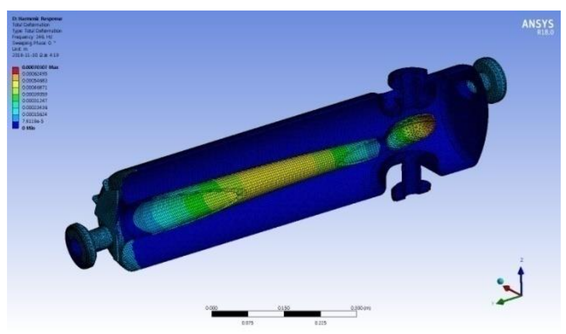
- QWR Unjacketed Cavity Modal Analysis



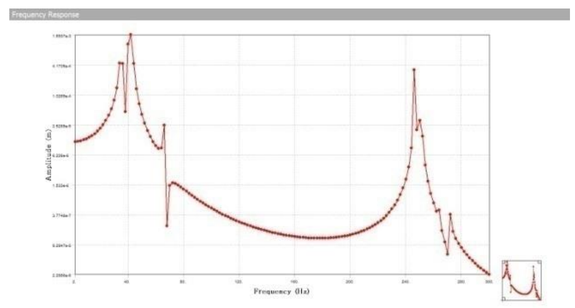
<QWR 1st Bending Mode – 35Hz>



<QWR 1st Bending Mode – 42Hz>

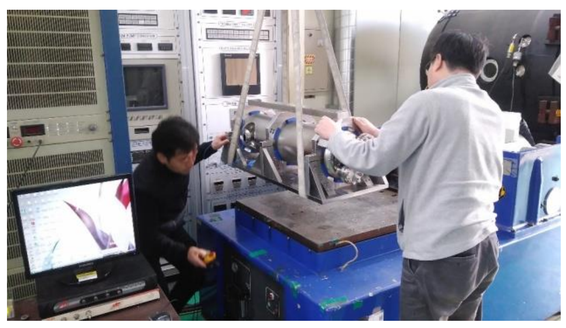


<QWR 2nd Bending Mode – 246Hz>

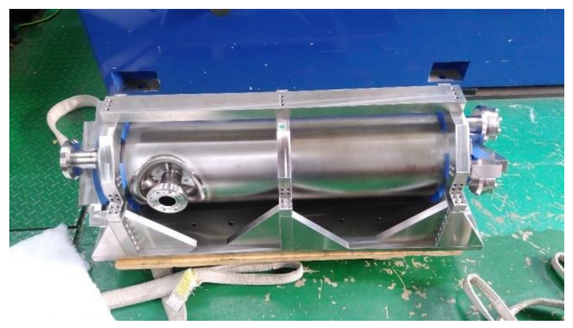


<Bode Plot of QWR Cavity>

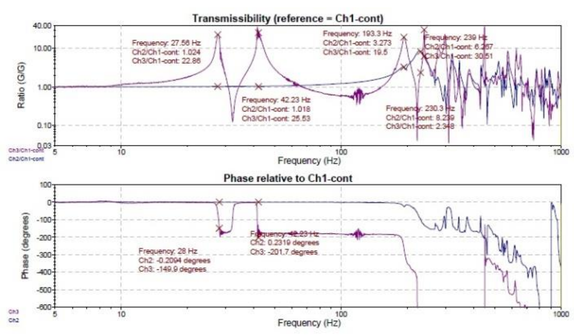
- Vibration Test of QWR Cavity



<Vibration Test Setup at KIMM>



<Fixture for QWR Cavity Vibration Test>



<Vibration Test Results – 27.56Hz & 239Hz>

▷ Conclusions & Acknowledgment

From the cold test of QWR cryomodule and the vibration test of unjacketed QWR SC cavity, we could find a clear resonance issue of QWR cavity due to the outer disturbances which could be generated by surrounding devices such as cold-box, circulation pump, other motors or generators. Our SRF utilities at the Munji site is a little unstable without clear root causes, so we requested to our cryogenic system team for reducing liquid helium pressure fluctuation below 1 mbar. Also, we requested to RF engineer for increasing control bandwidth for better RF power input. We will also check the background vibration level of our main SRF site, Sindong, for avoiding disturbance problems.

This work was supported by the Rare Isotope Science Project (RISP) of Institute for Basic Science (IBS) funded by Ministry of Science and ICT and NRF of South Korea (2013M7A1A1075764)

▷ References

[1] D. Jeon et al, "Design of the RAON accelerator systems", Journal of Korean Physical Society, Vol. 65, No. 7, Oct. 2014, pp. 1010-1019.
[2] H. C. Jung et al, "SRF Cavities for RAON", Proceedings of IPAC2016, Busan, South Korea, pp. 2200-2201.
[3] H. Kim et al, "Development of RAON QWR Cryomodule for Linac Demonstration", Proc. of LINAC2016, East Lansing, MI, USA, pp.622-624.
[4] H. C. Jung et al, "Prototyping of TEM-like Mode Resonator in the RAON", Proceedings of IPAC 2013, Shanghai, China, pp. 2384-2386.