The status of Vertical Test Facility for HWR and QWR at RISP

Juwan Kim

Accelerating System team,
Rare Isotope Science Project (RISP)

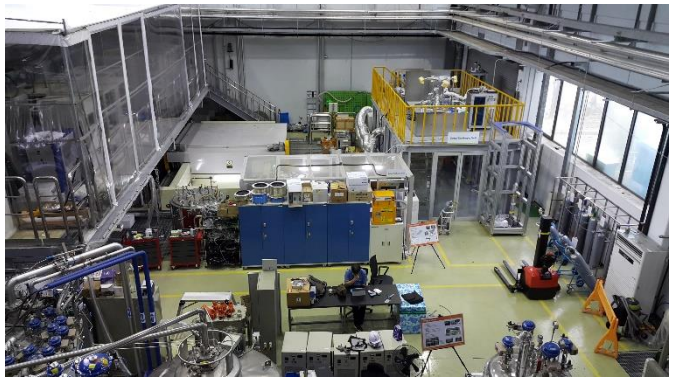
RAON Rare isotope Accelerator complex for ON-line experiments

Contents

Introduction

Though thy beginning was small, thy latter end shall greatly increase

- 2014
  - Vertical Test with no PLL RF system at 2014
- 2016
  - RF System preparation
  - Hanging booth construction, Top Plate update
  - Magnetic shield of mumetal outside the cryostat.
  - SRF test facility was constructed in
  - Vertical Test of SSR2 prototype in Sep, 2016.
  - Vertical Test of HWR 1st prototype in Dec, 2016.
- 2017
  - Cleanroom assembly updated in procedure, in equipment
  - Variable couplers were prepared
  - Magnetic shield(cryophy) was added
  - 2 cavities were tested simultaneously
  - Reached up to the order of 10^{10} of Q factor in HWR



1st SRF test facility : KAIST Munji Campus

2nd SRF test facility: Sindong LINAC site in progress

Introduction

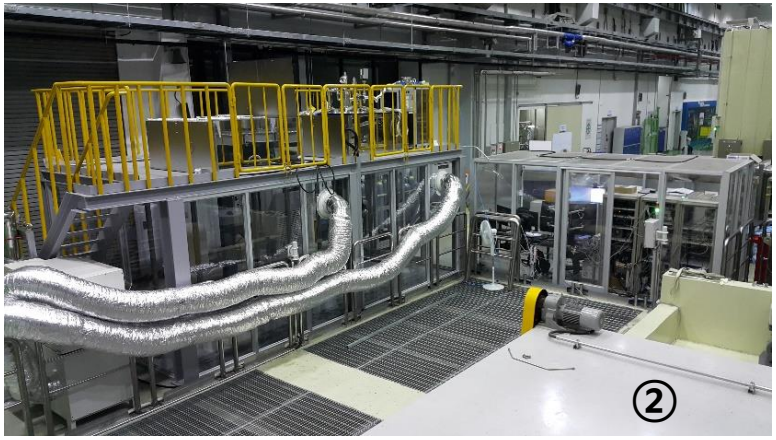
For Higher Q factor, Low particles, Low Magnetic fields

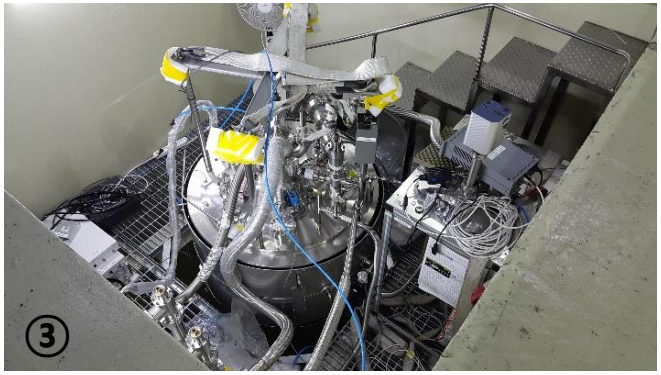
1. Materials
   - RRR>300 3mm Nb sheets, tubes
   - EDM-wire cutting
2. Welding
   - Welding vacuum chamber: low 1E-6 torr Vacuum, Oil trap
   - Welding voltage ~ 100kV, less current, narrow welded seam
   - Welding line is slow machined to 2mm thick, etched
3. Chemical etching
   - More than 120um Buffered Chemical etching
4. High pressure rinse
   - More than 100Bar DI water
5. Assembly at Class 10 room
   - Slow Venting and Slow Pumping for preventing particle movemnets
6. Magnetic shield
   - around 15mG @ Cryostat
7. Q-disease
   - High temperature baking(~650 degree) for HWR cavities

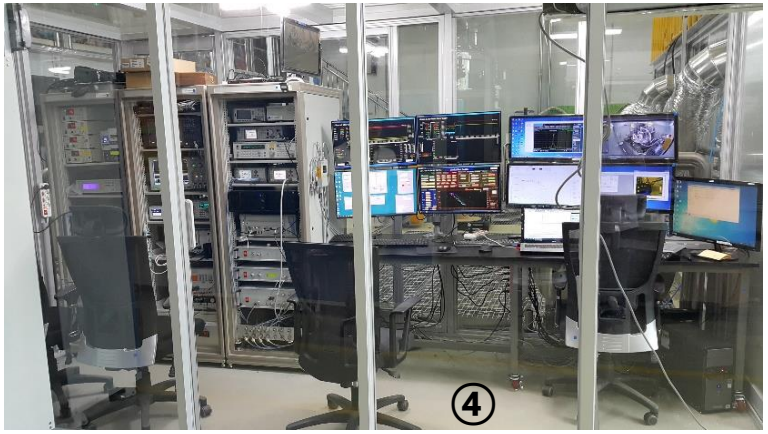
Vertical Test Facility

Vertical Test Facility (KAIST Munji camp.)

① clean room ② Hanging Booth/Control Room ③ Vertical Test Stand ④ RF System







Vertical Test Facility

Cleanroom Assembly

- Class 100 Area : preparation for assembly
  : 10.85x8.25m
- Class 10 : assembly
  : 6x4 m
- Class 100 HPR room
  : 3.55x7.55m
  : 3 Axis HPR machine
  : DI Water - 18 MΩ·cm
- Class 10000: BCP , High Temp. Baking furnace, USC(Ultrasonic Cleaning)

- Slow pumping by Mass Flow Controller (160 sccm(Standard Cubic Centimeters per Minute))
- Slow venting by Mass Flow Controller (in progress)
- Leak Detector

Vertical Test Facility

Hanging booth / Control Room/ Top Plate

- Hanging booth : Class 10,000 , 3.5x7m, 2nd floor with 2 Hanging Stand
- 1st Hanging stand(cryostat 1)
- 60 liter/s (pumping speed) of Ion Pump on the top plate
- Top plate can accomodate 2 Cavities of HWR or QWR
- pressure at the vacuum line of the top plate before move to the cryostat : in the order of 10^-8 torr

Vertical Test Facility

Cryostat

- Cryostat 1
  - 900mm(ID)x2860mm(H)
  - For HWR or QWR 2 cavities
  - Static Heat loss ~ 8 W
  - Magnetic shield
    - Mumetal 1600mm(D)x3300mm(H)
    - Cryophy 900mm(D)x2860mm(H)
    - <15mG in cavity position

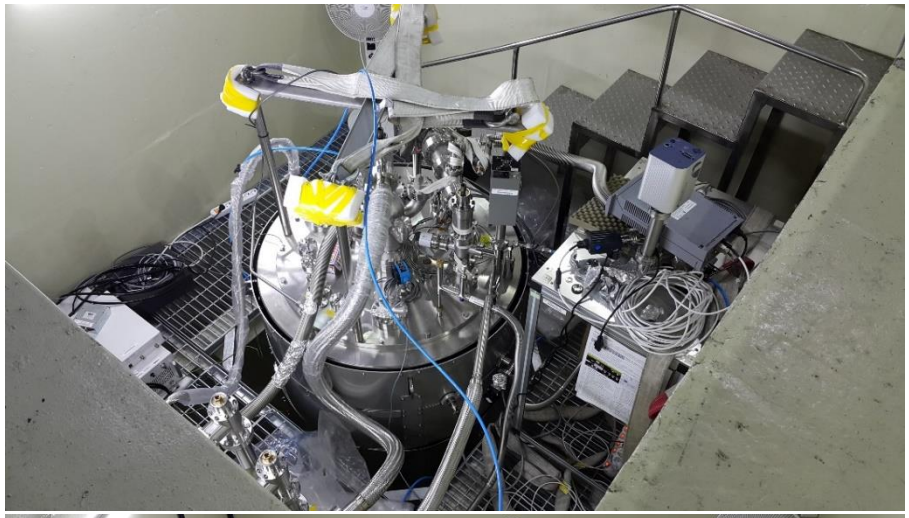
- Cavity 2 (in progress)
  - 1200mm(ID)x3600mm(H)
  - For HWR or QWR 3 cavities
    or SSR 2 cavities
  - Static Heat Load < 10W(goal)
  - Magnetic shield
    - Mumetal 1600mm(D)x3300mm(H)
    - Cryophy 900mm(D)x2860mm(H)
    - <15mG in cavity position

900mm(ID)x2860mm(H)

1200mm(ID)x3600mm(H)

Vertical Test Facility

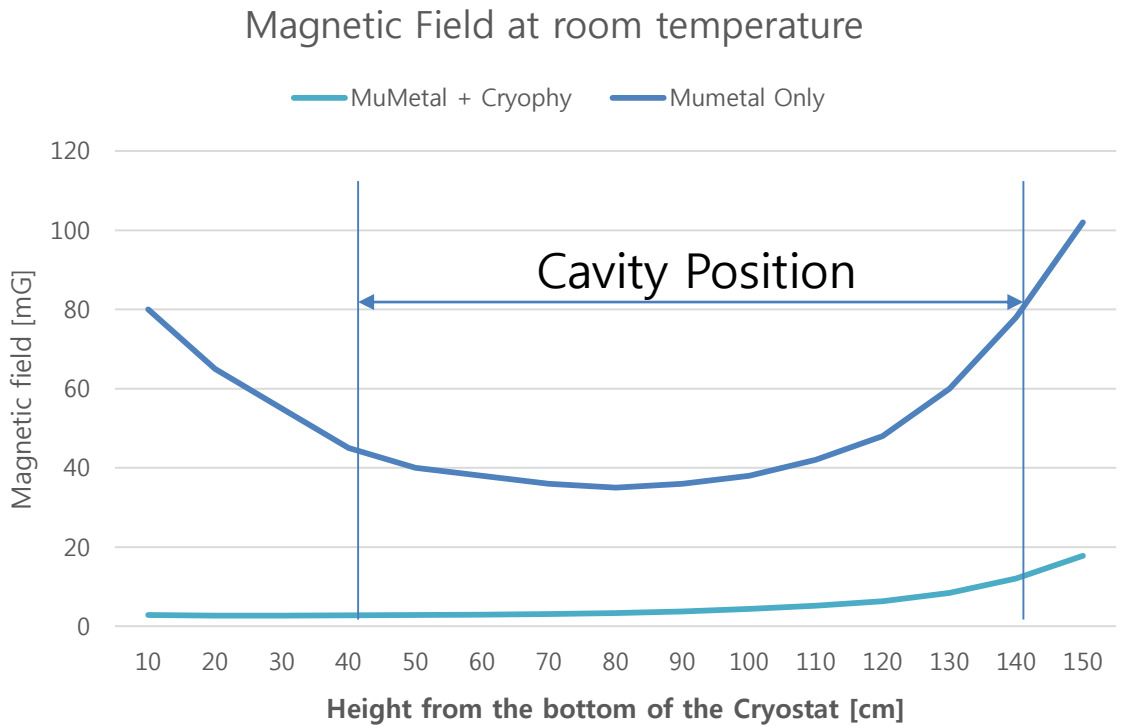
Vertical Test Stand

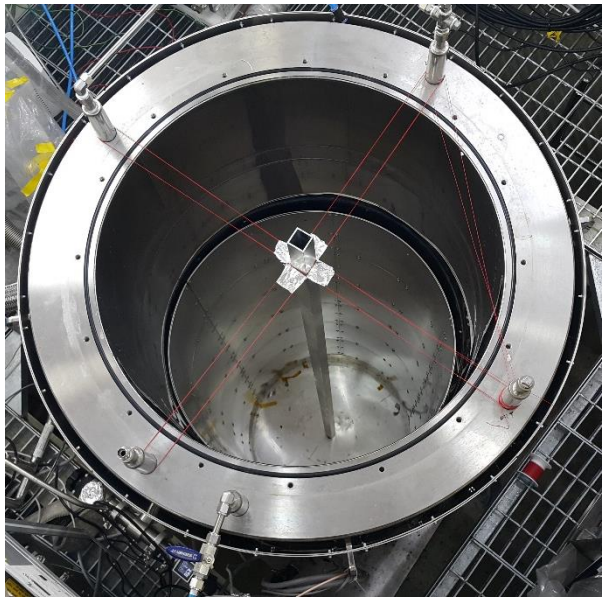


- 1 He Inlet Port, 1 LN2 Inlet Port, 4K return Line, 2K return Line, GN2 return Line
- SSPA 200W
- 1 set of Pumping Station to support the Ion Pump in top plate if needed. Dry Pump 1set.
- Radiation sensor

Vertical Test Facility

Magnetic Shield
: Mumetal (Outer Wall) + Cryophy(Inner Wall)

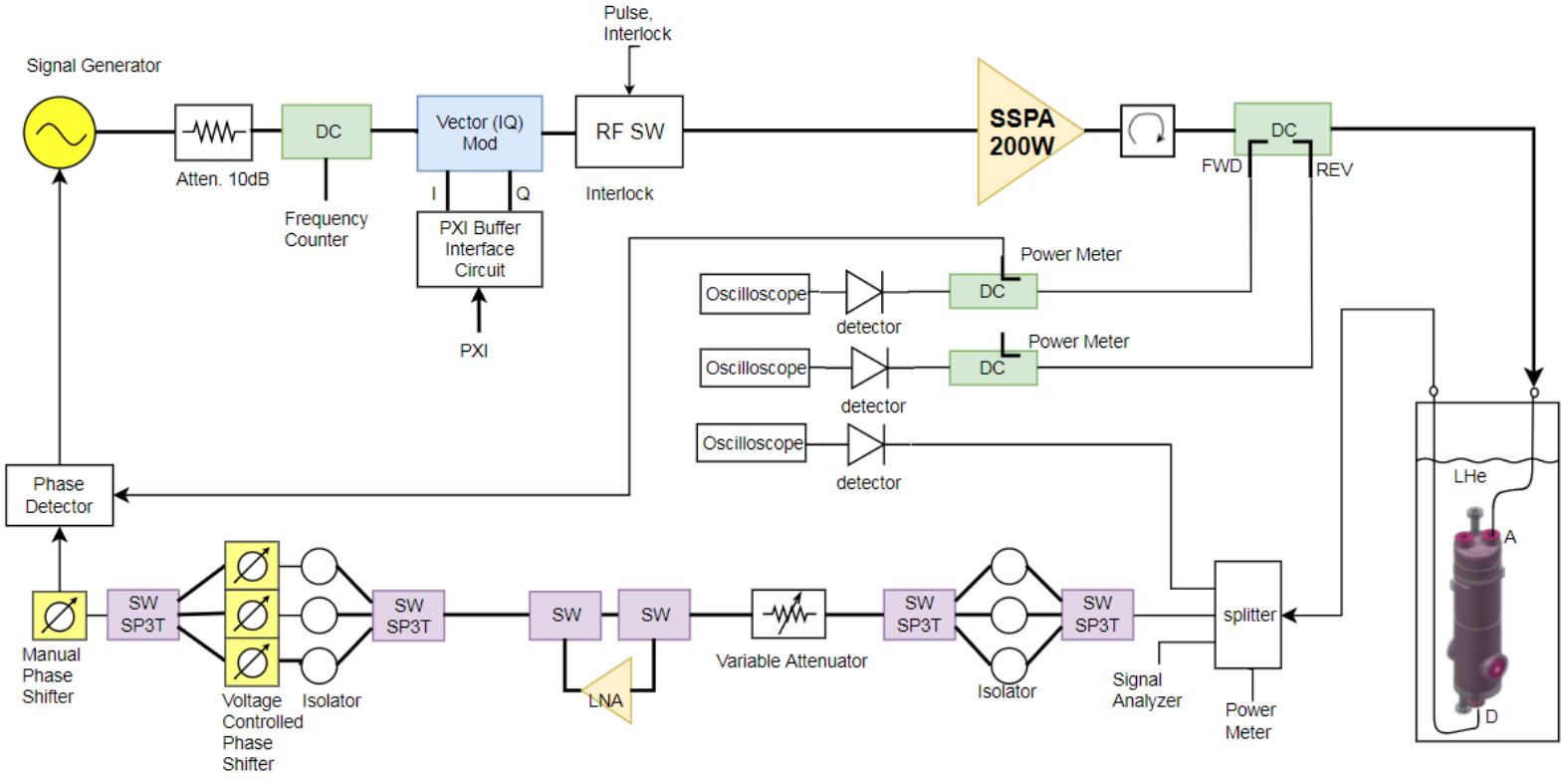




- Strong Magnetic field over 1000mG measured in the pit
- Resolved through adding magnetic shield in the helium reservoir

Vertical Test Facility

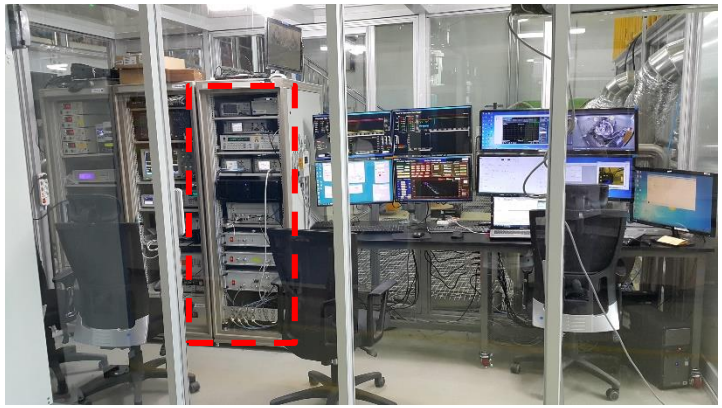
VCO PLL(Voltage controlled Phase Locked Loop) RF System



QWR : 81.25MHz
HWR : 162.5MHz
SSR : 325 MHz

Vertical Test Facility

VCO PLL(Voltage controlled Phase Locked Loop) RF System



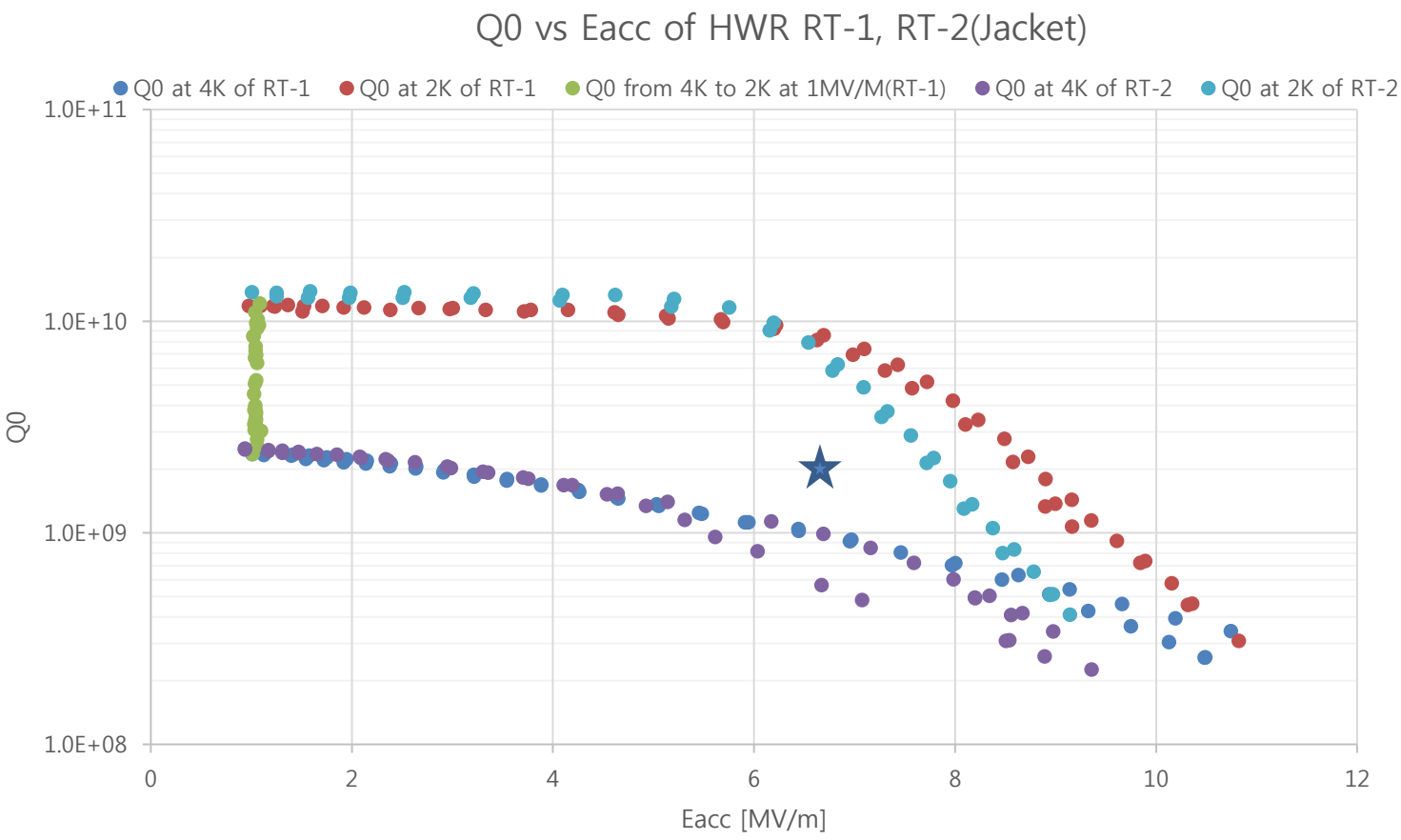
- Prototype cavities of HWR, QWR has been tested by 1 Set of VCO PLL RF system successfully
- RF conditioning for 2 cavities was performed simultaneously last December.
- One more Vertical Test RF system will be added in preparation for mass production of QWR cavities scheduled in 2nd half of 2018
- 2X6 Switching network to distribute RF Power up to 2 cavities simultaneously
- 2 set of VCO PLL RF Systems are to start to be built in sindong main SRF Facility in 2nd half of 2018.
- RF Drive Module, Phase Detecting Module, RF Measurement Module, Power Meters, RF signal generator, Signal Analyser, equipments for diagnostics etc.

Recent Tests for SRF Cavities at RISP

Stage	QWR	HWR
Performance Test (Bare cavity)	#2-2 prototype(RI) #3-1 prototype(VZ) #3-2 prototype(VZ)	#1-1 prototype(VZ) #3-1 prototype(VZ) #3-2 prototype(VZ)
Performance Test (Jacketed cavity)	-	#3-1 prototype(VZ) #3-2 prototype(VZ)
Total	One 2nd Prototype(RI) Two 3rd Prototype(VZ)	One 1st Prototype(VZ) Two 3rd Prototype(VZ)

RI: Research Instrument(Germany), VZ: Vitzro Tech(Korea)

HWR Jacket Cavity Test Result



Conclusion

- Vertical Test has been successfully performed in KAIST Munji Campus SRF Test Facility.
- Vertical Tests for Jacketted cavities using new cryostat of 1200mm of inner diameter will be installed this month.
- One more set of RF system for Vertical Test in Munji Campus Vertical Test Facility.
- Sindong SRF Test Facility will be constructed in 2019.


Thank you.