Current Status of Superconducting Linac for the Rare Isotope Science

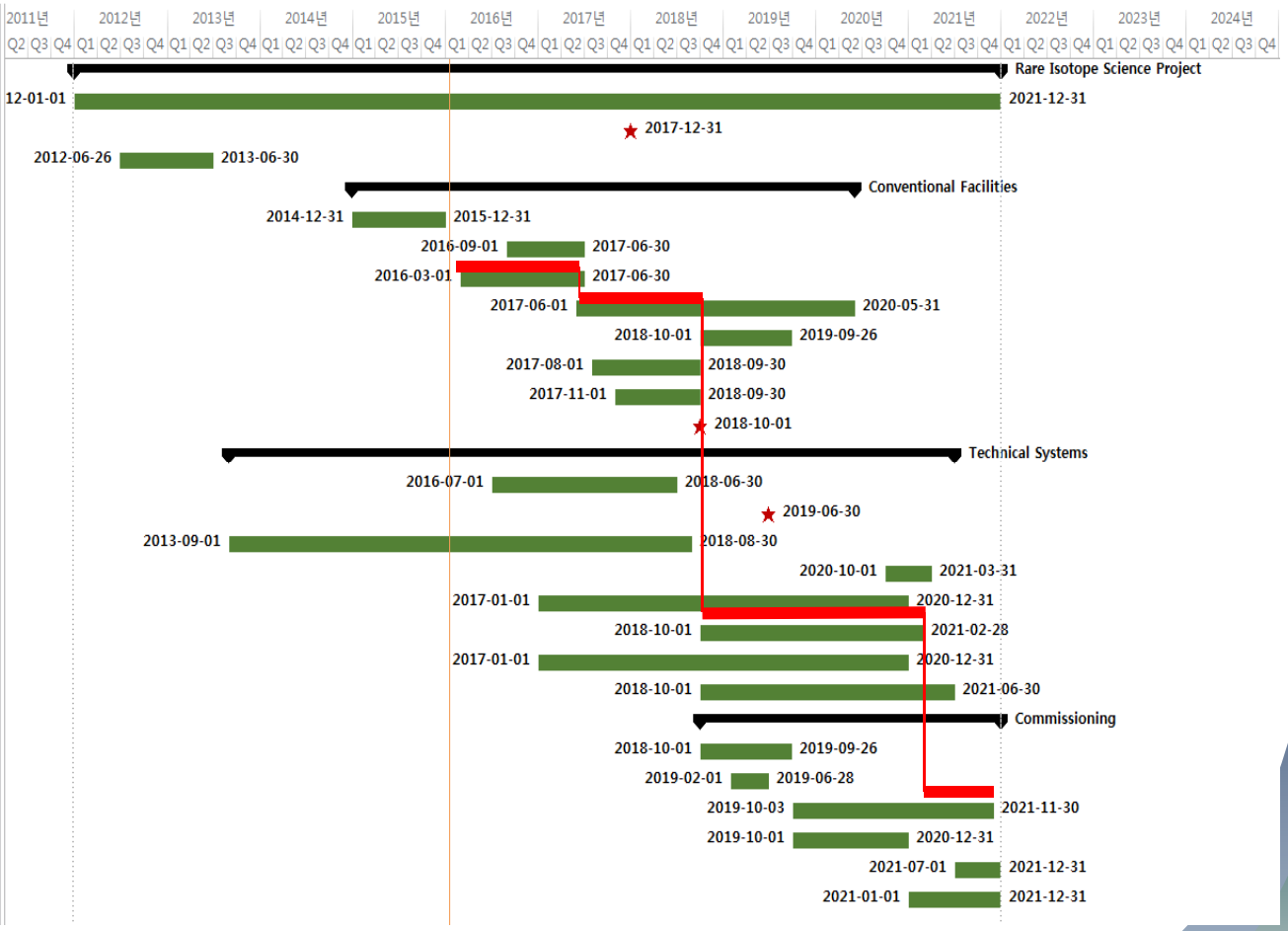
Hyung Jin Kim

Rare Isotope Science Project
Institute for Basic Science

28th Linear Accelerator Conference
September 25-30, 2016, East Lansing, MI USA

Project Schedule Summary

Task Name	시작
Rare Isotope Science Project	**2012-01-01**
Project Completion	2012-01-01
KINS License Application Approval	2017-12-31
Technical Design	2012-06-26
Conventional Facilities	**2014-12-31**
CF - Preliminary Design	2014-12-31
CF - Final Design	2016-09-01
CF - Site Prep. And Pilings	2016-03-01
CF - Linac Tunnel Construction	2017-06-01
CF - Experimenatal Hall Construction	2018-10-01
CF - Support Area, Utility Supply	2017-08-01
CF - Cryoplant Area Constrcution	2017-11-01
CF - Early Occupancy Date	2018-10-01
Technical Systems	**2013-09-01**
Cryogenic Plant & Distribution	2016-07-01
Cryogenic Plant Operational	2019-06-30
Linac Injector - Fabrication, Assembly, & Test	2013-09-01
Linac Injector - Installation & insitu Test	2020-10-01
Cryomodules - Fabrication, Assmebly, & Test	2017-01-01
Cryomodules - Installation & in situ Test	2018-10-01
Experimental Systems - Fabrication & Assembly	2017-01-01
Experimental Systems - Install & Test	2018-10-01
Commissioning	**2018-10-01**
Preoperations	2018-10-01
Linac Injector Commissioning	2019-02-01
Linac Commissioning	2019-10-03
ISOL Commissioning	2019-10-01
IF Commissioning	2021-07-01
Integrated Commissioning	2021-01-01



Layout of RISP

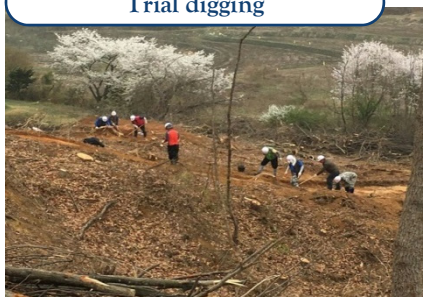
Status of Site Preparation

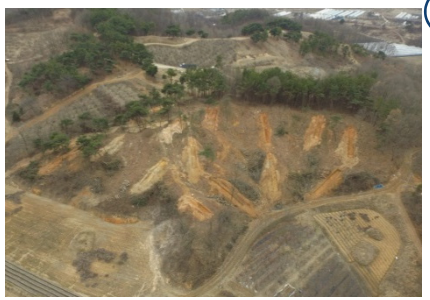
Status of site (Excavation survey & Site grading)

Sales contract (`14.12.26.)	➡	Land compensation (`15.10.01.)	➡	Expropriation decision (`16.06.14.)	➡	Site grading (`16.06.15.)

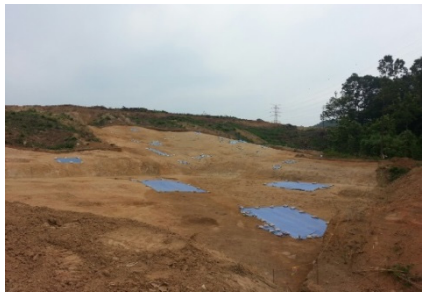
- Excavation survey: Acc. bldg Site(Dec. 2015~Jul. 2016),
  Support bldg Site(Jun. 2016~Nov. 2016)

Trial digging





Excavation



- Site grading : Acc. bldg Site(Jul. 2016~Jan. 2017),
  Support bldg Site(Aug. 2016~Jun. 2017)

Obstracle demolish

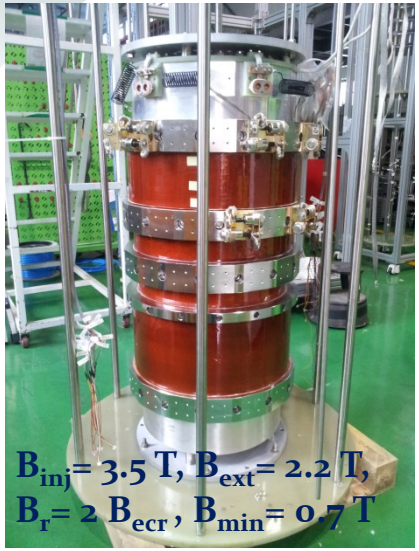
Cutting & fill-up ground

Design Validation, Procurement and Fabrication

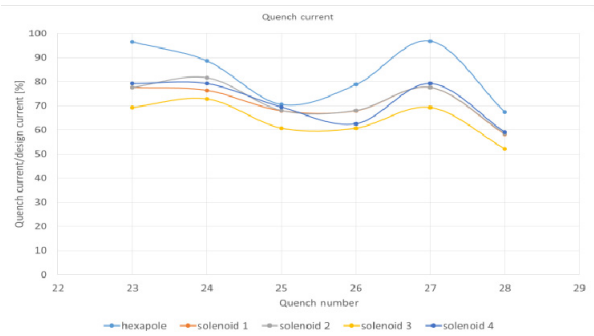
Description	ECRIS	RFQ	β=0.047 cavity	β=0.047 cryomodule	β=0.12 cavity	β=0.12 cryomodule	RF amplifier	4.5K coldbox
Requirement/Specification	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prototyping	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
Design	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
Procurement/fabrication plan	Yes:[1] Completed	Yes:[2] Completed	Yes:[3] Partially contracted	Yes:[4] Partially contracted	Yes:[5] Partially contracted	Yes:[6] Partially contracted	Yes:[7] Partially contracted	Yes[8] Bidding

1) Fabrication completed and under beam test
2) Fabrication completed and under tuning
3) Contract with international vendor, and domestic vendor
4) Contract with domestic vendor
5) Contract with international vendor, and domestic vendor
6) Contract with domestic vendor
7) Contract with domestic vendor
8) Contract with domestic and international vendor

28GHz ECR Ion Source

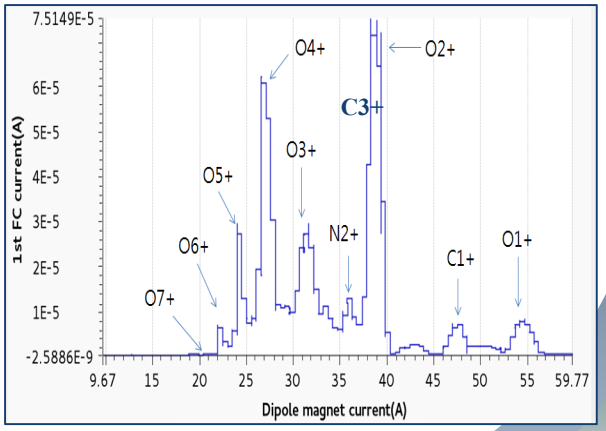


- Superconducting sextupole and solenoid prototypes were tested and achieved > 30% margin.
- Superconducting magnet assembly (sextupole + 4 solenoids) was completed.
- 28 GHz ECR ion source was installed in test facility.
- Beam test is in progress(O5+, 100uA beam is generated).



SC Magnet training

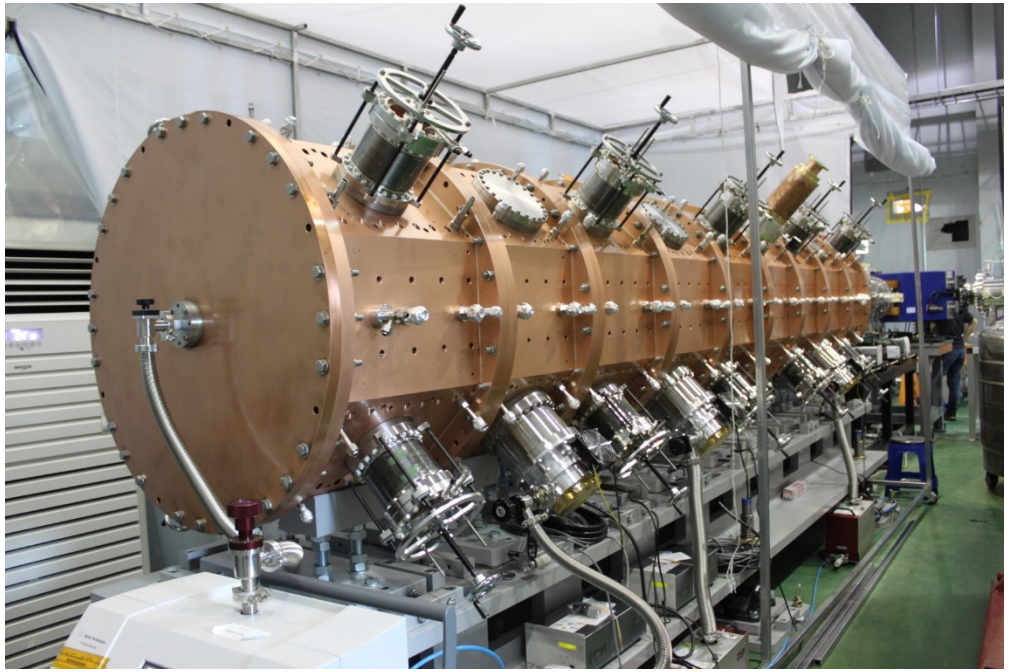
Inside Shielding Block



Beam extraction

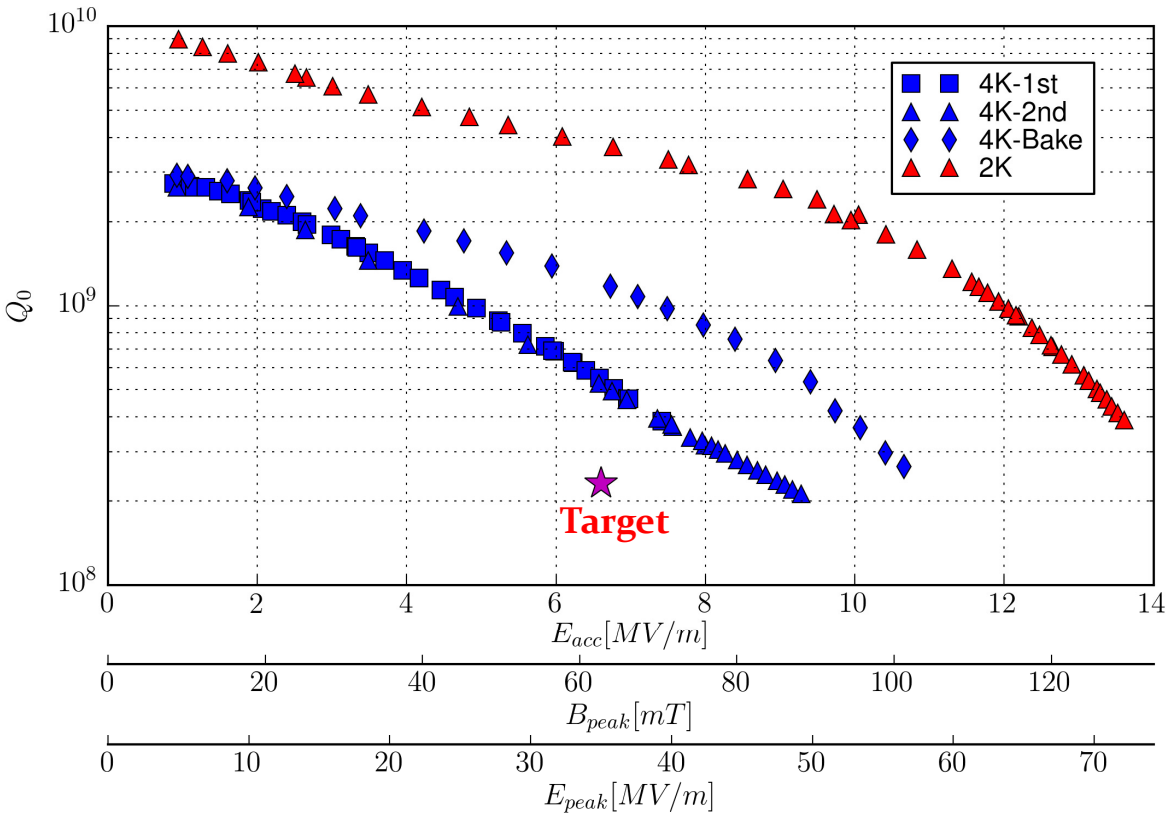
Radiofrequency Quadrupole

PARAMETER	VALUE
Beam Properties:	
Frequency	81.250 MHz
Particle	H^{+1} to U_{238}^{+33}
Input Energy	10 keV/u
Input Current	0.4 mA
Input Emittance	0.012 .cm. mrad
Output Energy	0.507 MeV/u
Output Emittance	0.0125 .cm. mrad ~26 keV/u-Degree
Transmission	~98 %
Total Power	94 kW
Duty Factor	100%



- **The RFQ is designed to accelerate beams from proton to uranium from 10 to 500 keV/u. One feature is that this RFQ can accelerate two different charge states of uranium beams (for an example, 238U+33 and 238U+34 of 12 pμ A) simultaneously.**
- **The RFQ has been fabricated.**
- **The nine segments of the RFQ were aligned and installed in a test facility.**
- **The field tuning is underway with a bead-pull.**

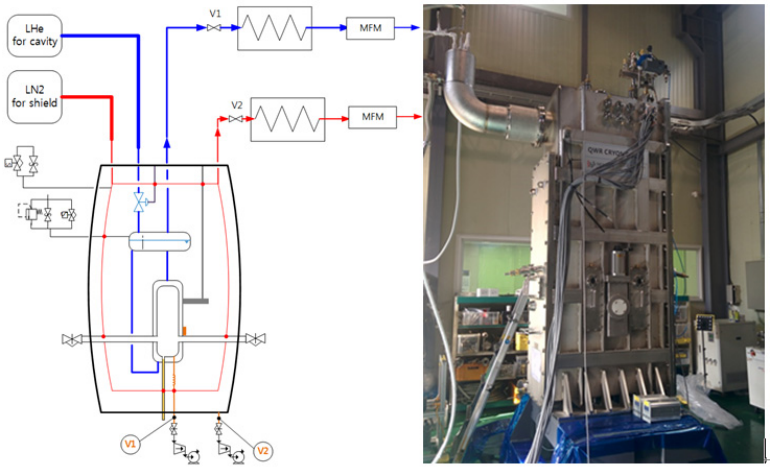
Superconducting Cavity

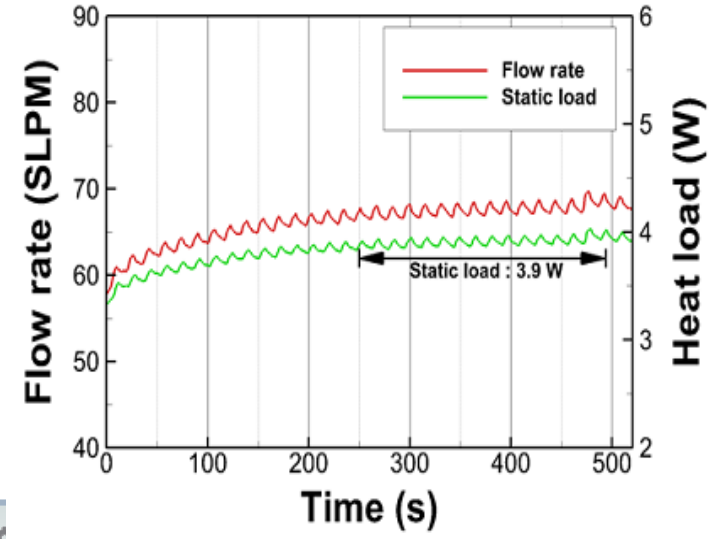


(TRIUMF SRF Facility)

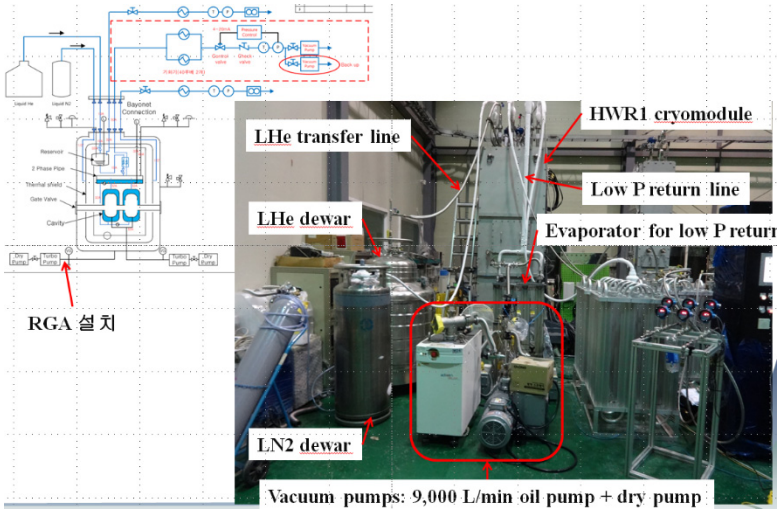
Cryomodule

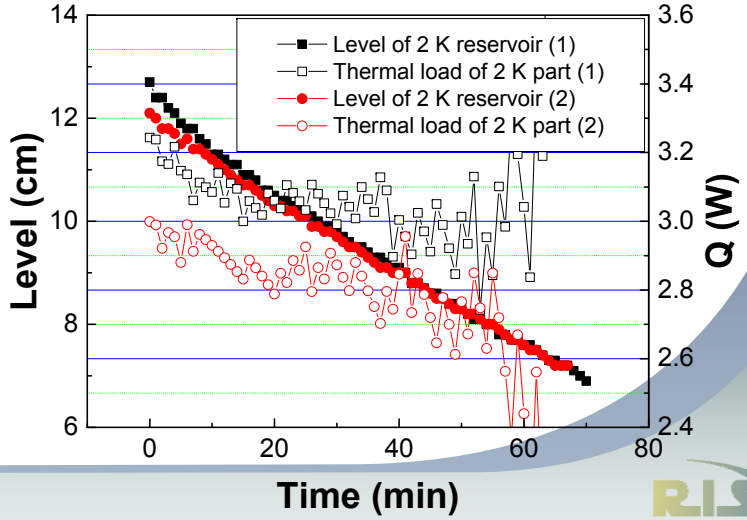
- QWR static load: 3.9 W (expectation: 5 W)





- HWR static load: **11.4** W (expectation: 12 W)





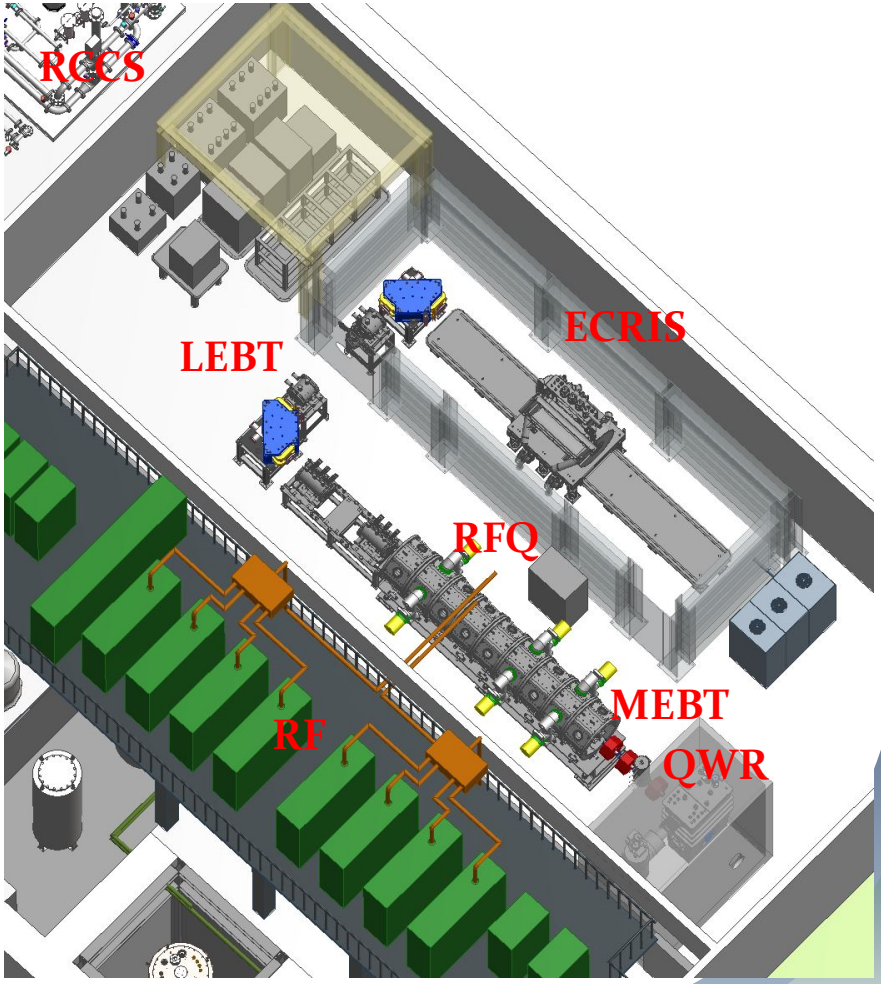
Superconducting Linac Demonstration

Specification

A/q = 7.2, beam energy = 530 keV/u

- ECRIS beam energy : 10 keV/u
- RFQ beam energy : 500 keV/u
- QWR beam enegy : 530 keV/u

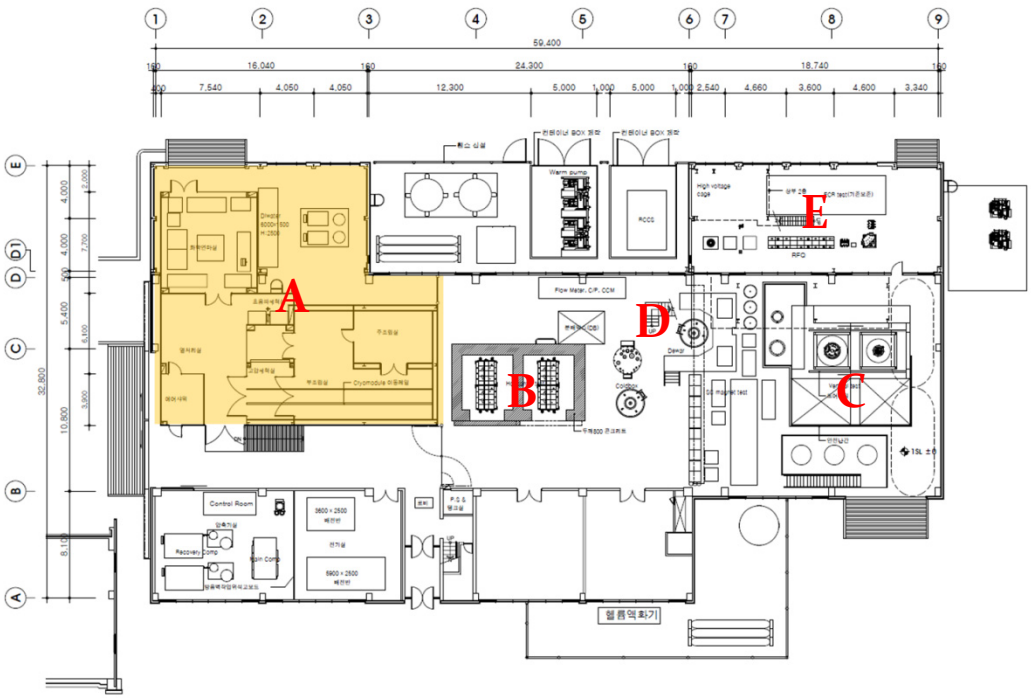
Beam spec.	Detailed action item
Oxygen 0.01 mA (A/q ~ 3)	SCL Demo : Hardware installation ECRIS : beam extraction (Oxygen ~1 mA)
Oxygen 0.01 mA (A/q ~ 3)	SCL Demo : Beam acceleration (Oxygen) ECRIS : metal ion extraction (Bismuth 0.1 mA)
Metal 0.01 mA (A/q ~ 7.2)	SCL Demo : metal ion acceleration



SRF Test Infrastructure

RAON

Layout of SRF Test Facility
Operational since July, 2016



Cleanroom area | **Horizontal test area** | **Vertical test area**

(A) Cleanroom area, (B) Horizontal test area, (C) Vertical test area, (D) Cryoplant area, (E) SCL demo area

RISP Presentation List in Linac16

- (ID) TUP106001
- (Author) Hyuk Jin Cha, et al.
- (Title) Magnetic Field Measurements in a Cryomodule with Nearby Warm-Section Quadrupole Magnets of RAON Heavy Ion Accelerator

- (ID) TUP106004
- (Author) Yoochul Jung, et al.
- (Title) Status of RRR Analysis for RAON Accelerator

- (ID) TUPLR072
- (Author) Wookang Kim, et al.
- (Title) Fabrication and Low Temeperature Test Plan for Rare Isotope Science Project

- (ID) TUPLR073
- (Author) Heetae Kim, et al.
- (Title) Development of RAON QWR Cryomodule for Linac Demonstration

Thank you !
감사합니다 !