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High Current Proton Beam Extraction for Neutron Production Using RFT-30 Cyclotron

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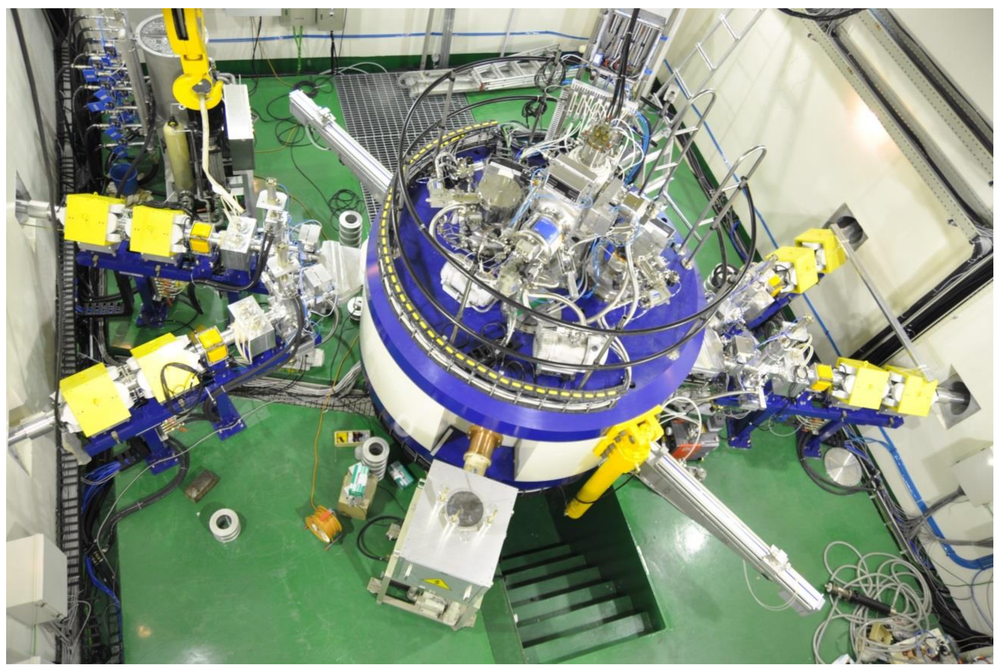
Introduction

RFT-30 cyclotron has been developed not only for the production of radioisotopes (RIs) and their applications, but also for proton beam utilization to various research fields including material science, bio science, and so on. RFT-30 cyclotron has been regularly operated since 2013, and research on the production of radioisotopes has been performed using this cyclotron. ^{18}F, which is the most widely-used positron emitter, has been produced regularly since 2015. In 2018, mass-production of ^{89}Zr is successfully achieved. In addition, long-term proton irradiation for the production of ^{68}Ge, which is one of the typical generator RIs, was also performed. We are also trying to carry out the test production of $^{64,67}Cu$, ^{57}Co, and ^{44}Sc.

In addition, proton beam extracted from RFT-30 cyclotron has been used for neutron production and utilization including soft error rate test of semiconductors, fast neutron measurement, neutron shielding material test, and so on. Now we are trying to extract high current proton beam in order to obtain high flux neutron enough for the neutron imaging. Proton beam extraction experiment with the average beam current of 100 μA has been performed.

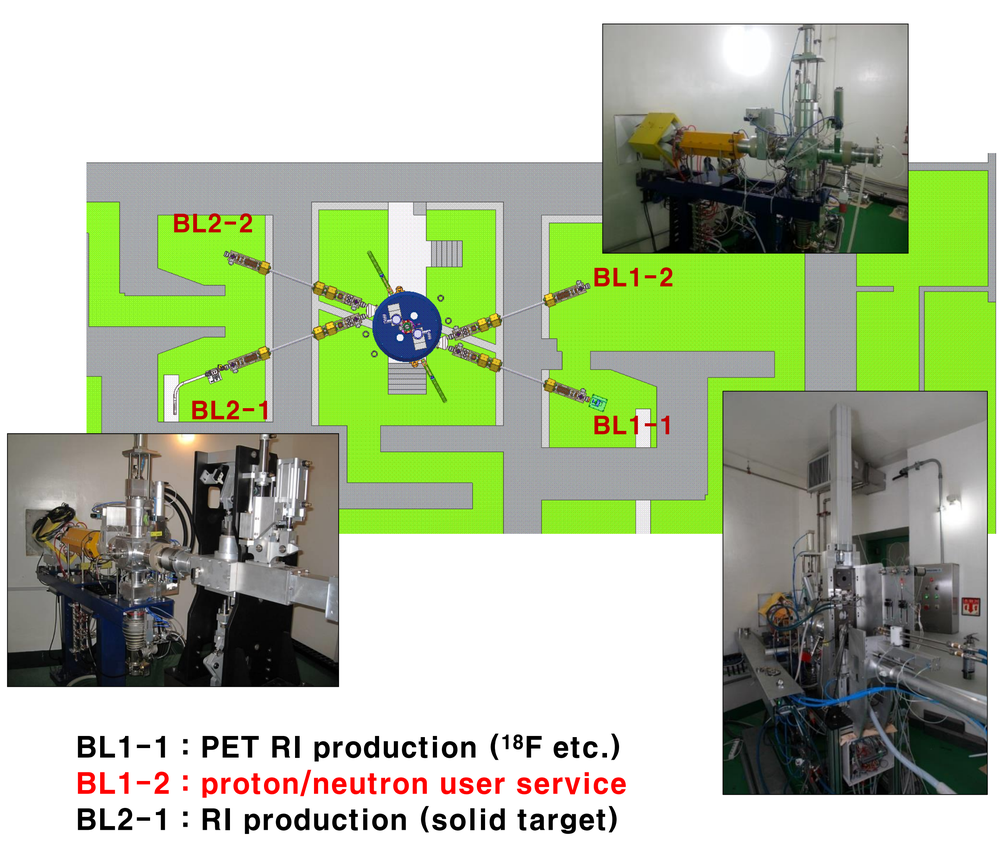
Results

1. RFT-30 Cyclotron



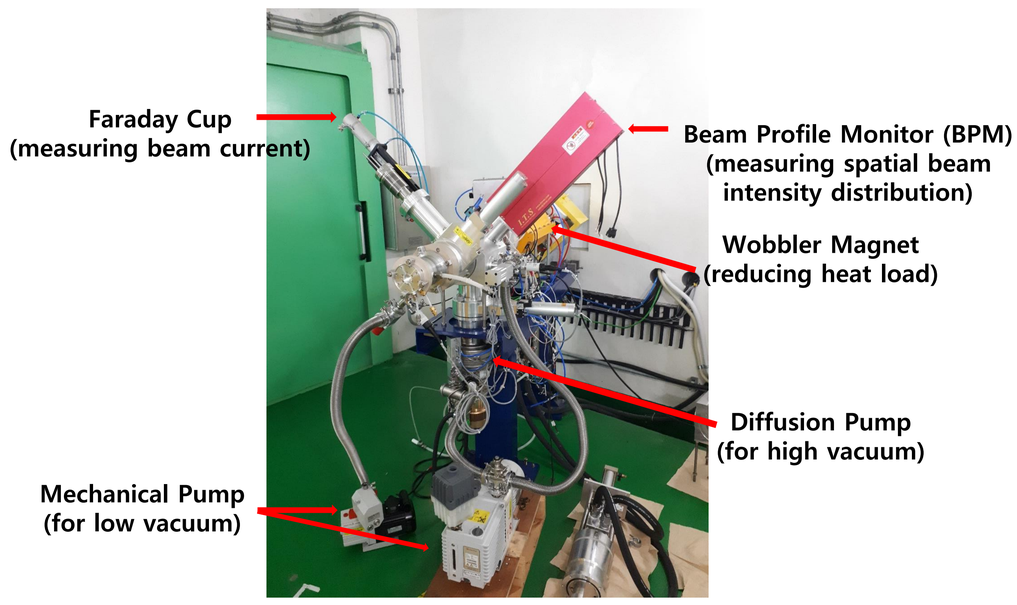
- Ion source : Negative hydrogen ion (H-), 10 mA (Max.)
- RF system : 63.96 MHz
- Extracted beam : proton (H+), using carbon stripper foil
- Beam energy : 15 ~ 30 MeV
- Beam current : ~250 μA (Max.)

2. RFT-30 Cyclotron Beamlines



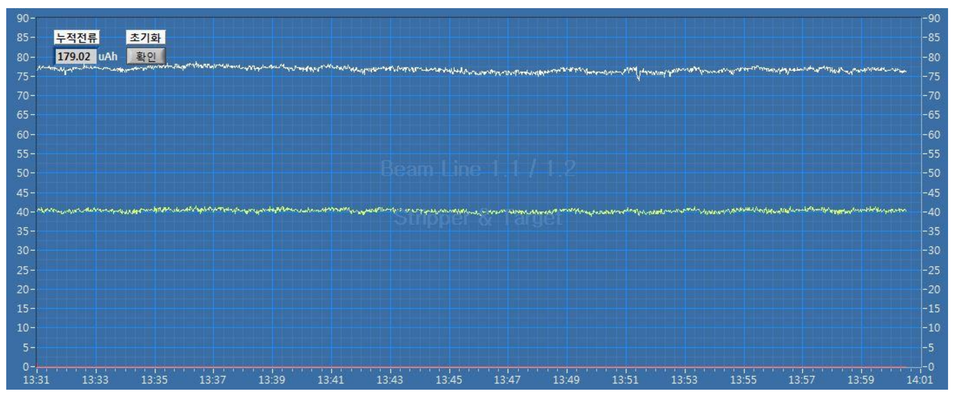
BL1-1 : PET RI production (^{18}F etc.)
BL1-2 : proton/neutron user service
BL2-1 : RI production (solid target)
BL2-2 : under development

3. Beamline for Proton/Neutron Beam Service (BL1-2)



4. Long-Term High Current Proton Beam Extraction for Accelerator-Based Neutron Imaging (> 8 h)

1) Average current ~ 40 μA



2) Average current ~ 145 μA

3) Produced neutron pulse (using Be target, measured by a He-3 detector)