Board No.4

CUSTOMER SATISFACTION IN RADIONUCLIDES PRODUCTION -present and future-

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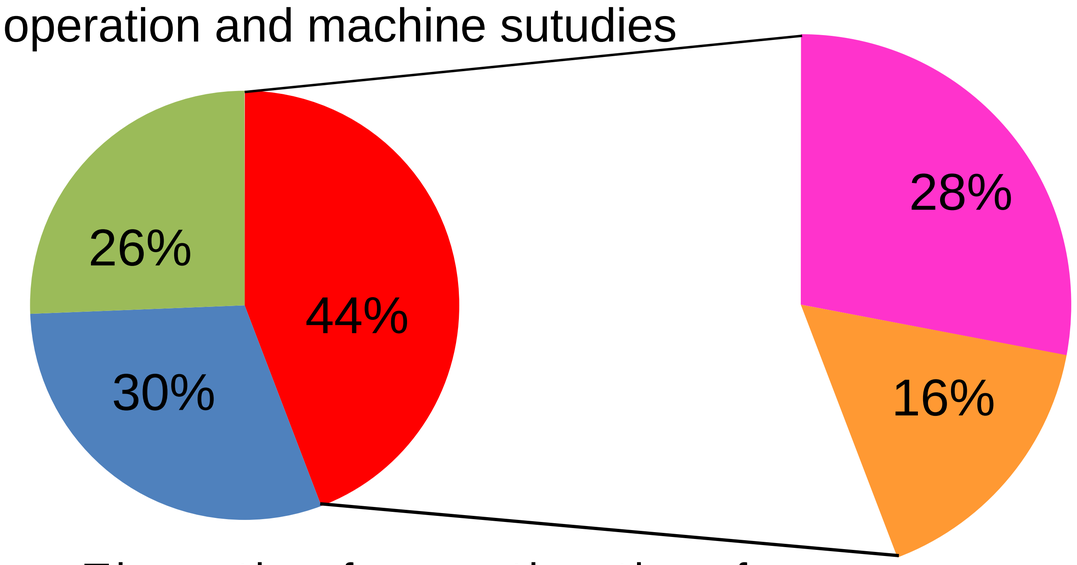
Abstract

A NIRS-930 cyclotron has been used for the various purposes since the first beam in 1973. Among others, radionuclide production has been one of the most important purposes at the NIRS-930. It is necessary to fulfill the demands from the users of a higher intensity beam such as protons and helium with various energies for radionuclide production. In order to respond to such demands from users, a future conceptual upgrading plan oriented for higher intensity beams and stable operation is now under development based on our operation experiences and hopefully also on the ones at other world front-running facilities.

- Production Radionuclides
- Phisics & bio experiment
- Tuning operation and machine sutudies
- R&D for production of radionuclides
- Supplies of radiopharmaceutical



The ratio of operation time for purposes of NIRS-930 in 2013 business year

The example of irradiation for radionuclide production

Production	Particle	Energy [MeV]	Beam intensity [μA]	Irradiation time [h]
^{64}Cu	Proton	12	10	2.7
^{89}Zr	Proton	15	15	2.5
^{62}Zn/^{62}Cu	Proton	30	20	9
^{124}I	H_2^{+}*	27	10	4
^{28}Mg	He^{2+}	75	15	4

*Act for 13.5 MeV proton

PRESENT DEMAND

R&D for production of radionuclide experiment

1st = Intensity
2nd = Uniformity
3rd = Stability
4th = Accuracy of the beam energy
5th = Beam size

Supplies of radiopharmaceutical

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Beam stability [Experiment 3rd , Supplies 1st

Beam stop by discharges. Beam stop time
Deflector down → ~5 min.
Dee voltage auto tuning off → ~3 min.
The NIRS-930 cyclotron is too old for long time stable operation.

Beam Uniformity [Experiment 2nd , Supplies 3rd]

Present beam spot size : φ8-20 mm Demand: φ30 mm
Beam scanning system was examined
(Proceedings of IPAC2014, Germany, WEPRO088 2162)

Accuracy of the beam energy [Experiment 4th , Supplies 4th]

Beam energy was adjusted less then ±1 MeV
(Proceedings of cyclotron comference2004 18P02)

Beam size [Experiment 5th , Supplies 5th]

A beam collimator used at places upstream of the target.
Attentions are required in operator's point of view
Beam loss and the unnecessary radioactivity

Beam Intensity [Experiment 1st , Supplies 2nd]

If beam intensity was increased …
- Irradiation time can be shortened.
- The production rate was increased.

New demand for radionuclide therapy
(beta particle emitters and alpha particle emitters)
Such as ^{211}At, ^{47}Sc

Present beam intensity		Demand
60 MeV Proton 10 μA	⇒	70 MeV Proton 50 μA
35 MeV Helium 20 μA	⇒	40 MeV Helium 50 μA

If **present NIRS-930 cyclotron** is operated for this operation will exceed the capacities.
- Regulation by law
- Protection by a building of this cyclotron facility.

Therefore, the plan of a new facility is considered.

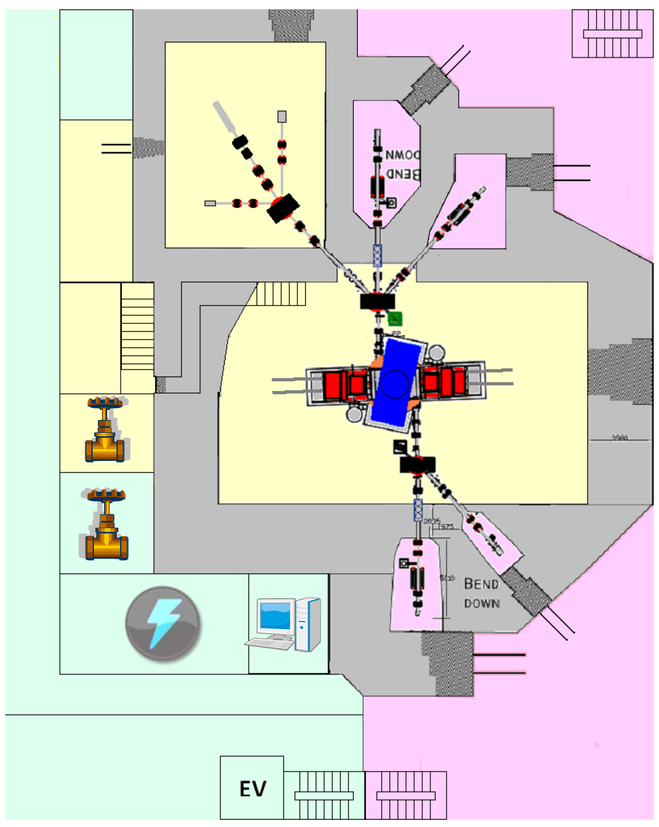
CYCLOTRON
K=110
70 MeV Proton 100 μA
by acceleration to H^-
40 MeV helium 50 μA
Radio frequency 10～22 MHz

Negative ion acceleration:
- Two out put port (Simultaneous)
- Multicusp ion source(H^-, D^-)
- Foil stripping extraction

Positive ion acceleration:
- One output port
- ECR ion source (H^+, He, C, Ne, etc.)

Beam line
For production of radionuclide
- Horizontal irradiation line x4
- Vertical irradiation line x3

Other experiment
- Horizontal irradiation line x3



The target processing areas (hot cells, etc) is located on the second floor or a basement.

- Primary radiation control area (Sealed and un-sealed radio isotopes)
- Secondary radiation control area (Sealed radio isotopes)
- Ordinary area

NIRS CYCLOTRON

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