Radiation evaluation for RILAC irradiation room

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The radiation doses at and around the irradiation room at RILAC facility were measured and evaluated. The permitted maximum intensity is 10 particle μA at 7.0 MeV/nucleon. The maximum energy in the room is 7.5 MeV/nucleon at which the permitted intensity reduced to 5 particle μA. Monte-Carlo simulations, such as PHITS[1)], are often applied for radiation evaluations. However, their accuracy would not be good at these energies in general. Therefore, we measured the neutron dose rates using an ^{18}O beam at 6.8 MeV/nucleon. The ^{18}O beam can provide a higher neutron dose than other beam nuclides in this room. Three types of measurements were performed. Firstly, neutron dose rates near the radiation sources were measured using several target materials. Secondly, the neutron dose rates inside and outside the radiation shield wall of the irradiation room were measured. Thirdly, the high-energy neutron flux was measured using bismuth samples.

The neutron dose from thick targets of aluminum, carbon, copper, and tantalum were measured using a neutron survey meter at GARIS-II. Table 1 lists the preliminary result of measured and calculated dose at a 90 degree direction of beam axis and a beam intensity of 5 particle μA. A TPC-451C neutron survey meter (HITACHI Co Ltd.) was located on the top of the target chamber. Its distance from the beam axis was 31 cm. The width and height of the targets were 25 mm and 25 mm commonly, and the thicknesses are listed in Table 1. Another neutron survey meter is located in the beam direction immediately after the GARIS-II D1 magnet. The beam stopped in the thick targets and then only the neutrons from the targets irradiated the survey meter. Because the neutron scattering at the magnet affects the dose measurement, the analysis of beam direction is ongoing.

Table 1. Measured neutron dose rates and comparison with values calculated using by PHITS code

Target and thickness	measured dose (mSv/h)	PHITS result (mSv/h)	ratio PHITS/measurement
C 150μm	3300	6100	1.8
Al 200μm	3100	5500	1.8
Cu 50μm	2500	4400	1.8
Ta 100 μm	1600	1900	1.2

The distribution of neutron dose rates in and around the shield wall of the irradiation room were measured. The ^{18}O beam irradiated the tantalum beam dump of GARIS and GARIS-II individually. Figure 1 and 2 show measured dose results on the top view of the experimental room. The maximum doses on the roof and basement are also shown. The neutron dose outside the shield wall was less than about 1/1000 of inside dose.

The evaluation for bismuth samples is ongoing.

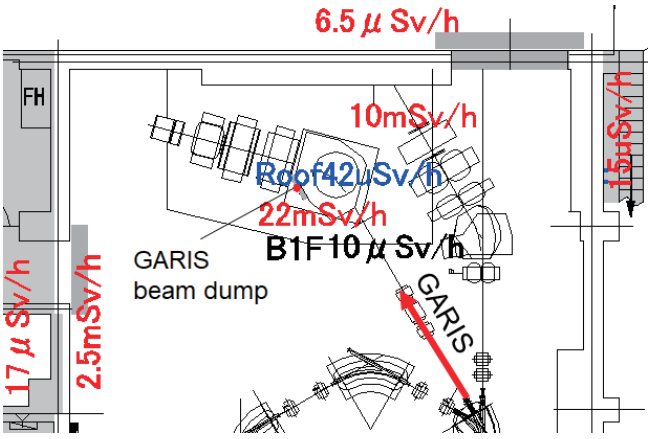

Fig. 1. Measured result for neutron dose rate from the GARIS beam dump. The red values show the dose rates at the beam level of GARIS which was at the first floor. The blue value indicates the maximum measured dose on the roof and the black value indicates that on the first basement level.

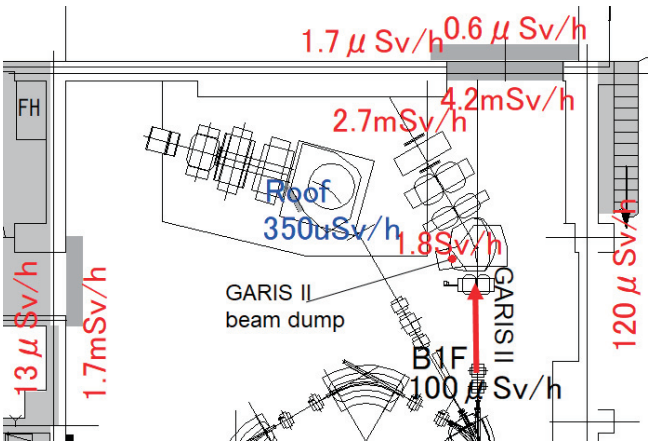

Fig. 2. Measured results for neutron dose rate from the GARISII beam dump.The legendisthe same as for Fig. 1.

Reference

1) T. Sato et al., J. Nucl. Sci. Technol. **50**, 913 (2013).

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