

CURRENT DEVELOPMENT STATUS OF THE LINAC-BASED BNCT DEVICE OF THE IBNCT TSUKUBA PROJECT

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Boron neutron capture therapy (BNCT) is the next generation of radiation therapy that combines neutrons and boron drugs. iBNCT project headed by the University of Tsukuba is being currently developed iBNCT001, a demonstration device for the compact linac-base neutron source based BNCT device. The accelerator of the iBNCT001 has adopted an RFQ and a DLT type linac. Fig.1 shows the linac of iBNCT001. The linac had been designed to be able to accelerator protons of the average current of 5 mA or more to 8 MeV. Regarding a neutron target material, beryllium has been adopted. At present, the device has succeeded to drive in the condition of an average proton current of 2 mA and generate epithermal neutron beam from the beam aperture.

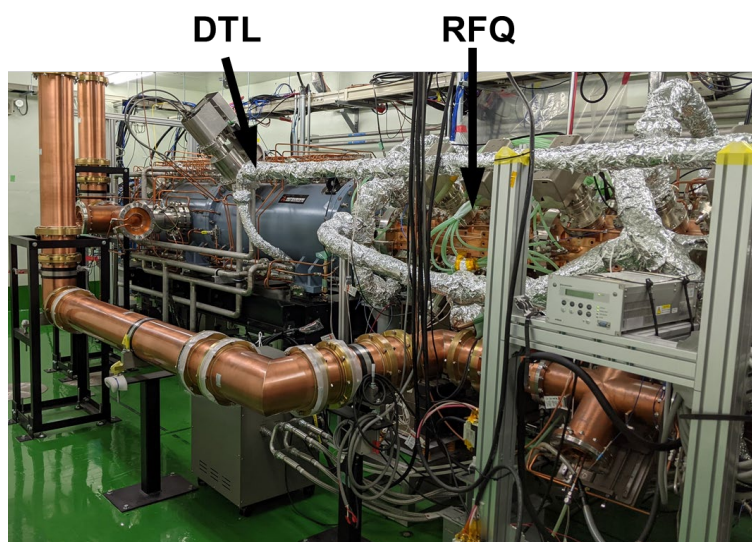


Fig.1 The RFQ and the DTL of Linac of iBNCT001

To confirm the applicability of the beam of iBNCT001 to the treatment, we are conducting several characteristic measurements of the neutron beam generating from the device. In the experiment with a rectangular water phantom, two dimensional distributions for thermal neutron flux and gamma-ray dose rate that are important factors to determine the dose in BNCT, has been measured in the phantom. In the measurement of the thermal neutron flux, some gold wires were set inside the phantom where was set in front of the beam aperture. In the measurement of the gamma-ray dose rate, many TLDs were located irradiation field in the phantom. The phantom for both measurements was irradiated the epithermal neutron beams and then the distributions for thermal neutron flux and gamma-ray dose rate were measured by using each detector. The measurement results demonstrated that the maximum thermal neutron flux in the phantom was approximately 1.4×10^9 (n/cm²/s) in the phantom. The neutron intensity has sufficient performance to complete irradiation within 30 minutes with BNCT for malignant brain tumors and for head-and-neck cancer. One of the features of the device is capable an extended beam collimator to the beam aperture. The extended collimator works to avoid the interference of the patient's shoulder to a wall during the irradiation in the head and neck cancer and a patient can be received the irradiation in a more comfortable posture. In the case that the extended collimator is used to BNCT, neutron flux at the beam aperture drops to about half compared with the conventional collimator. Thus, it is impossible to apply the extended collimator to treatment unless the neutron source

can generate the neutron beam with the higher intensity. Fig. 2 shows a scene of the phantom experiment that was measured the beam performance of the extended collimator. The measurement results for the extended collimator with a water phantom had proven that the irradiation with the collimator can be completed within one hour and the collimator can be applied to treatment. iBNCT001 is currently the only accelerator-based BNCT device that can be combined practically the extended collimator.

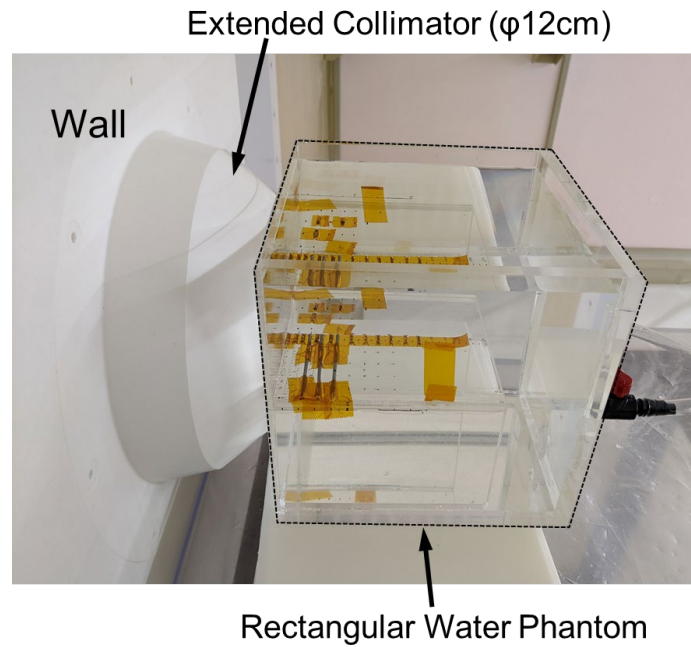


Fig.2 Scene of an irradiation experiment with a water phantom for the measurement of the performance of the extended collimator