

KIYANAGI-1: Neutron sources for accelerator-based BNCT facilities

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Accelerator-based neutron sources for BNCT have been constructed and planned in the world [1]. An accelerator power of few 10 kW is required for BNCT and this power is rather high compared with powers practically adopted for compact accelerators for neutron scattering applications. Although the high power had caused difficulty to construct the accelerator-based BNCT, intensive efforts have been devoted to develop high power accelerators for BNCT for more than 10 years. The first neutron source was C-BENS at Kyoto University. A cyclotron with an energy of 30 MeV and a current of 1 mA was adopted and a Be target was used for the neutron production. The high proton energy enables to make a stable and blistering less target. Two similar systems were constructed in hospitals in Japan. The system obtained medical device approval for manufacturing and sales of accelerator based BNCT system in Japan in March 2020. Medium proton energy around 10 MeV combined with a Be target was adopted at Ibaraki BNCT (iBNCT) system in Japan and then A-BNCT project in Korea. iBNCT adopted a linac with 8 MeV and 10 mA proton beam and succeeded in obtaining neutron intensity sufficient for treatment. At low proton energy around 3 MeV, a Li target is a good candidate since it has much higher neutron production efficiency than Be. An electrostatic accelerator based BNCT system with 2.6 MeV and 30 mA was constructed at Helsinki University Hospital in Finland and a different type of the electrostatic accelerator with 2.8 MeV and 15 mA was installed in Nagoya University in Japan for a BNCT fundamental study. A linac with 2.5 MeV and 20 mA was used for BNCT at National Cancer Center in Japan. The low energy proton accelerators are under planning and constructed in China, Argentina and Italy.

In this presentation, neutron production reactions relating to target materials, accelerator types and their characteristics are introduced for the BNCT facilities.

[1] Y. Kiyangai, Y. Sakurai, H. Kumada, H. Tanaka, Status of accelerator-based BNCT projects worldwide, AIP Conf. Proc., 2160, 050012 (2019); <https://doi.org/10.1063/1.5127704>