

PORRA-1: Treatment Facility Design: Accelerator based Boron Neutron Capture Facility at Helsinki University Hospital

Liisa Porra¹, Tiina Seppälä¹, Leila Vaalavirta¹, Lauri Wendland¹, Paul Eide², Hanna Koivunoro², William Park², Noah Smick², Theodore Smick² and Mikko Tenhunen¹

¹ *Comprehensive Cancer Center, Helsinki University Hospital, Helsinki, Finland*

² *Neutron Therapeutics Inc, Danvers, MA, the United States liisa.porra@hus.fi*

Boron Neutron Capture Therapy (BNCT) is a biologically targeted binary radiotherapy method developed to treat patients with certain malignant tumours. Helsinki University Hospital is going to start BNCT treatments in near future using a compact accelerator based neutron source, which can be installed in a hospital environment. The safety and efficacy of the L-BPA-F mediated BNCT, have previously been evaluated in the clinical protocols of head and neck carcinomas and malignant gliomas using the lowenergy neutron beam at the Finnish research reactor FiR 1 as the neutron source [1].

Commissioning of the accelerator-based BNCT facility manufactured by Neutron Therapeutics Inc. started mid 2018 at Comprehensive Cancer Center of Helsinki University Hospital in Finland. The 2.6 MV electrostatic proton accelerator is designed to operate at 30 mA, and the neutrons are produced by a rotating lithium target. The nuBeam treatment suite includes a CT image guided robotic patient positioning system, and a monte carlo based treatment planning software designed for BNCT. The treatment facility is equipped with a high-purity Ge gamma spectrometer for neutron activation analysis, Mg(Ar) and TE(TE) ionization chambers with water and PMMA phantoms, and an inductively coupled plasma optical emission spectrometry (ICP-OES) device for blood boron concentration analysis.

Radiation Safety Authority of Finland, STUK, has approved the facility for neutron beam operation. The first neutron beam measurements were performed with Mn and Au activation foils, and preliminary activation data in a phantom is consistent with design goals. Treatment room activation was measured and recorded by STUK, and continuously after each irradiation by the users. Measurements showed low activation level in the treatment room after the irradiation.

The facility is now at the end of its commissioning phase. When the commissioning of the neutron beam, patient positioning robot and the CT scanner is finished and approved by the local authorities, the first clinical trial will be initiated on patients with inoperable recurrent head and neck cancer.

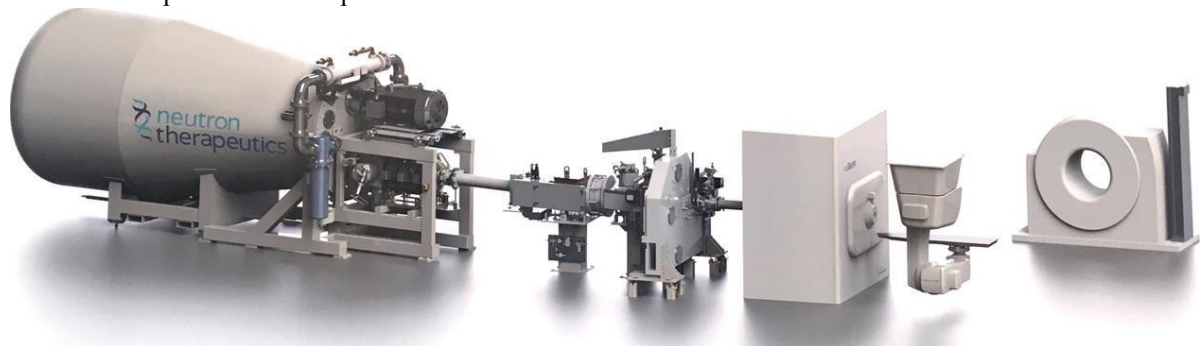


Figure 1. nuBeam compact accelerator based neutron source

[1] Kankaanranta et al. Int J Radiat Oncol Biol Phys. 2012.