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The Development of Proton ECRIS for Boron Neutron Capture Therapy

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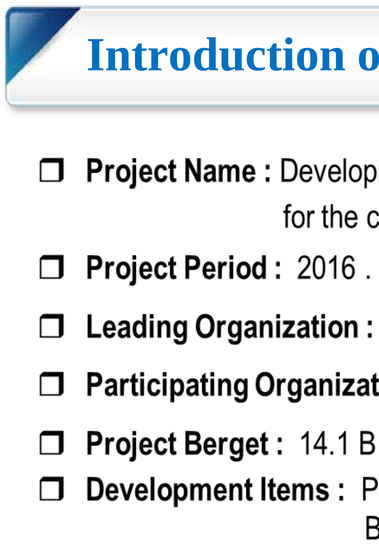
Abstract

For overcoming limitation of convectional particle therapy, the development of Accelerator-based Boron Neutron Capture Therapy (A-BNCT) is in progress by Dawonsys Co. Ltd. Dawonsys developed a duoplasmatron ion source for A-BNCT and KBSI (Korea Basic Science Institute) is developing an Electron Cyclotron Resonance Ion Source (ECRIS) as alternative candidate of duoplasmatron. The proton ion source of A-BNCT must satisfy some requirements such as high voltage platform over 50 kV, small emittance below 0.2 πmm.mrad, and high current over 50 mA. In this paper, we will report results of design study and manufacturing issues.

Needs & treatment effect of BNCT



❖ Treatment Effects

❒ **Overcoming limitations of convectional particle therapy**

- Clarity of therapeutic principles
- Treatment of unit cell size
- Minimization of radiation exposures for normal tissues
- Reduction of side effects
- Treatment of malignant cancers which are not effective with conventional treatments (Brain Tumor, Head & Neck Cancer, Malignant Skin Cancer, Recurrent Cancers, Radiation Resistant Cancers)

❖ Cost Prospective

- Low construction cost (about 1/3 of proton therapy facility)
- Low fractional treatment (1-2 times)
- Low treatment cost (about 1/3 of proton therapy facility)

❖ Limitation of BNCT & Issues

- Increasing Treatment depth
- Improving the boron capture ratio of cancer cells / normal cells
- Improving boron drug delivery method

Introduction of A-BNCT project

❒ **Project Name :** Development of the accelerator based Boron Neutron Capture Therapy system for the cancer treatment within 1 hour therapeutic time

❒ **Project Period :** 2016 . 4 ~ 2020 . 12

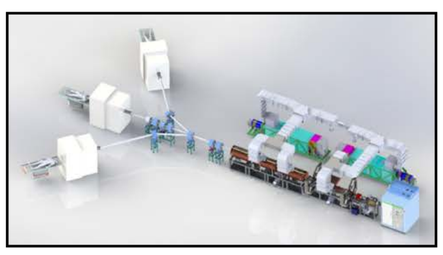
❒ **Leading Organization :** Dawonsys Inc.

❒ **Participating Organization :** Gil Hospital, Gachon Univ., PAL, KAERI and **KBSI**

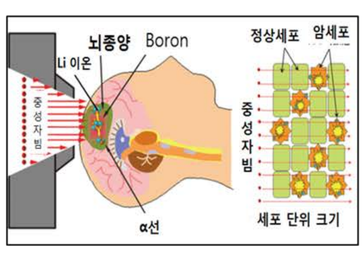
❒ **Project Berget :** 14.1 B Won (excluding building & utility costs)

❒ **Development Items :** Proton Linac, Be Target Assembly, Dosimetry, Radiation Safety, Boron Compounds TPS(Treatment Planning System), Clinical Trials, Government Permission of B Drugs & BNCT Treatment

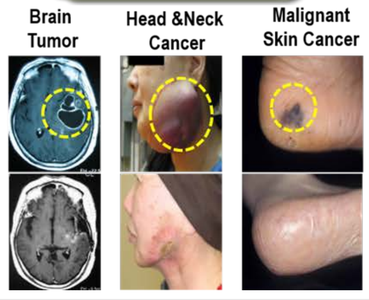
A-BNCT Facility



BNCT TPS



BNCT Treatment

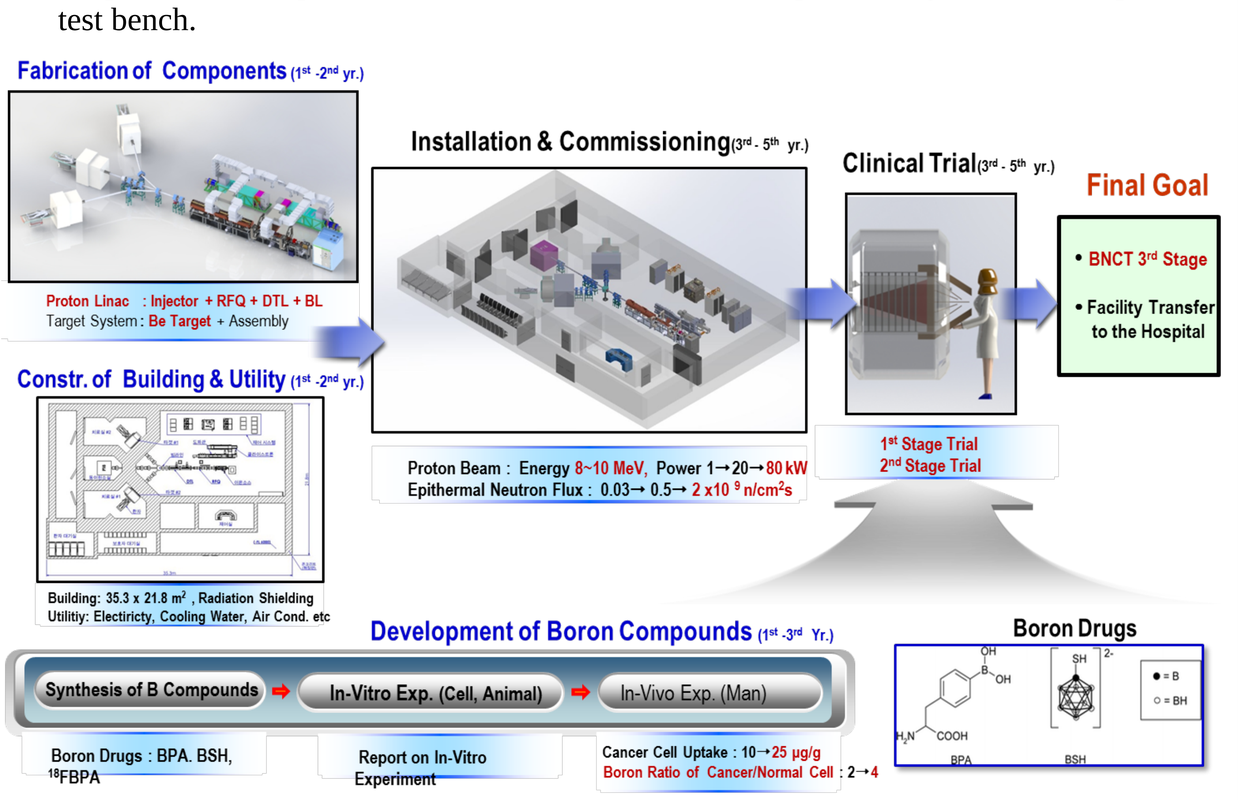


Development of test bench and duoplasmatron

- The duoplasmatron and test bench for A-BNCT was developed by Dawonsys in last year. Also, plasma was ignited and beam extraction was performed. The duoplasmatron source will be modified to extract beam of 50mA and 0.2 πmm.mrad during this year.

Project Schedule and design issues

- We had plan to change proton ECR ion source instead of duoplasmatron at 2nd year (2018) but our plan was changed for installation schedule and development schedule of dueplasmatron. A proton ECR ion source will be developed at 3rd year with independent test bench.



- In this year, new design issues generate space limitation related on high voltage platform and diagnostic system. The magnet design must be changed due to space problem

Magnet design results

- We are designing compact type magnet in this year.
- Current design results have small ECR zone due to space problem. Also, another issues are generated related on microwave transfer. we need confirm about microwave transfer.