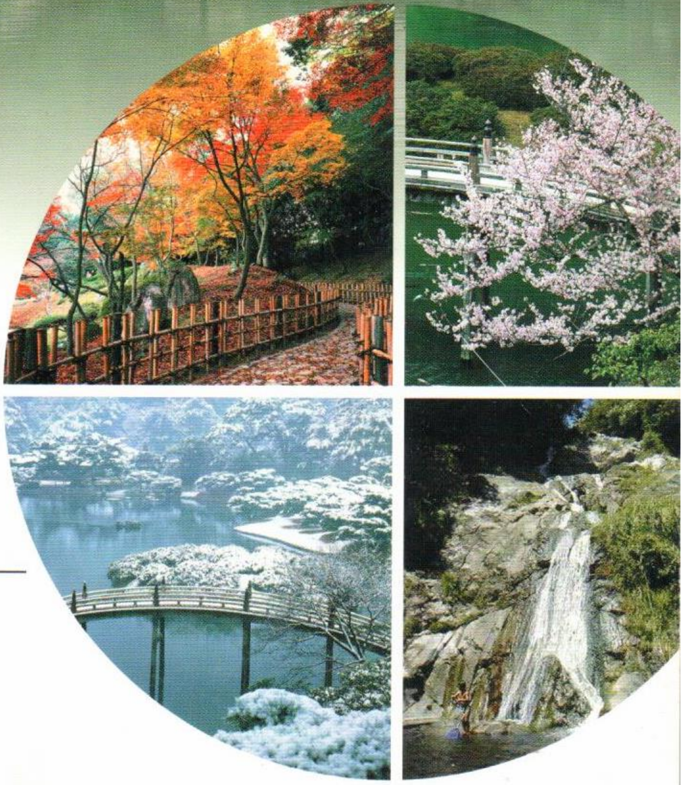
12th International Congress on Neutron Capture Therapy

" From the past to the future "

Program & Abstracts



October 9-13, 2006

Takamatsu, Kagawa, Japan

- Kagawa International Conference Hall
- Sunport Takamatsu

S6-4

Development of lithium target for accelerator based neutron capture therapy

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Pilot innovative accelerator based neutron source for BNCT [1] is now on the threshold of its operation at the BINP. One of the main elements of the facility is lithium target producing neutrons via threshold $^7Li(p,n)^7Be$ reaction at 25 kW proton beam with energies 1.915 MeV or 2.5 MeV.

The main problems of lithium target were determined to be as follows: ^7Be radioactive isotope activation, keeping lithium layer solid, presence of photons due to proton inelastic scattering on lithium nuclei, and radiation blistering. The results of thermal testing of target prototype were presented at previous Congress [2]. It becomes clear that water is preferable for cooling target, and that the lithium target 10 cm in diameter is able to run before melting.

In the present report, the conception of optimal target is proposed: thin metal disk 10 cm in diameter easy for detaching, with evaporated thin layer of pure lithium from the side of proton beam exposure, its back being intensively cooled with turbulent water flow to maintain lithium layer solid. Design of target for the neutron source constructed at BINP is shown. Conceptions of radiation protection and diagnostics of neutrons, γ-rays and α-particles are presented. The results of investigation of radiation blistering and lithium layer are presented. Target unit of facility is under construction now, and obtaining neutrons is expected in nearest future.

[1] B. Bayanov, et al., NIM A **413** (1998) 397.
[2] B. Bayanov, et al., Applied Radiation and Isotopes **61** (2004) 817.

S6-5

Study on Practical Conditions about Target Thickness and Gaussian Proton Energy using Near Threshold 7Li(p,n)7Be Neutrons for BNCT

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The practical conditions for the usage of near threshold 7Li(p,n)7Be reaction by 1.900MeV proton were studied as following two topics; (1) Acceptable target thickness from the view point of gamma rays production of Li target and backing material, (2) the influences of the deviation of incident proton energy having Gaussian distributions of averaged 1.900 MeV proton energy using the indexes of PD(hcp), PD(gamma) and TPD. Lithium targets up to about 7 times the minimum thickness of 2.43 micron meter required to slow a 1.900MeV proton down to the threshold energy of the 7Li(p,n)7Be reaction were found to have generated a constant TPD. The target thicker than this value yielded shallower TPDs. For Gaussian proton beams, the acceptable limit for the energy stability in terms of the energy standard deviation of the spectrum would be about +-10keV. At this deviation in the proton energy BNCT irradiation using neutrons from the near threshold 7Li(p,n)7Be reaction will still be feasible as shown in the TPDmax obtained from this proton energy spectrum. However, if this deviation in the proton energy is to be expected, introducing a suitable Boron Dose Enhancer (BDE) in the irradiation field will be necessary in order to make sure that the achieved TPDmax would be comparable to that of an ideal a mono-energetic proton beam.

S7-1

Boron neutron capture therapy for recurrent head and neck malignancies

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Introduction: To avoid severe impairment of oro-facial structures and functions, it is necessary to explore new treatments for recurrent head & neck malignancies (HNM). Boron neutron capture therapy (BNCT) is tumor-cell targeted radiotherapy that has significant superiority over conventional radiotherapies in principle. When ^{10}B absorbs thermal neutrons, the α and ^7Li particles generated by the $^{10}B(n, \alpha)^7Li$ reaction are high LET particles, and carry high kinetic energy (2.34MeV), and have short ranges (4-9μm) of approximately one-cell diameter, resulting in a large relative biological effectiveness and selective destruction of tumor cells containing ^{10}B. **Material and Methods:** So far for 4 years, we have treated with 37 times of BNCT for 21 patients (14 squamous cell carcinomas (SCC), 4 salivary gland carcinomas and 3 sarcomas) with a recurrent HNM since 1991. **Results:** (1) ^{10}B concentration of tumor/normal tissue ratios (T/N ratio) of PET studies were SCC: 1.8-5.7, sarcoma: 2.5-4.0, parotid tumor: 2.5-3.7. (2)Regression rates (volume %) were CR: 6cases, PR: 11cases, PD: 3cases NE (not evaluated):1case. Response rate was 81%. (3)Improvement of QOL were recognized, such as disappearance of tumor ulceration, covered with normal skin, a relief of severe pain, bleeding, trismus and dyspnea, improvement of PS and elongate their survival period. (4)Survival periods after BNCT were 1-51 months (mean: 9.8 months). 4-year survival rate was 39%. (5) A few side-effects such as transient mucositis and alopecia less than Grade-2. **Conclusions:** These results indicate that BNCT represents a new and promising treatment approach for advanced HNM.