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Feasibility of the utilization of BNCT in the fast neutron therapy beam at Fermilab

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Introduction

The Neutron Therapy Facility at Fermilab has treated cancer patients since 1976. Since then more than 2,300 patients have been treated and a wealth of clinical information accumulated. The therapeutic neutron beam at Fermilab is produced by bombarding a beryllium target with 66 MeV protons. The resulting continuous neutron spectrum ranges from thermal to 66 MeV in neutron energy. It is clear that this spectrum is not well suited for the treatment of tumors with boron neutron capture therapy (BNCT) only. However, since this spectrum contains thermal and epithermal components we are investigating whether BNCT can be used in this beam to boost the tumor dose. There are clinical scenarios in which a selective tumor dose boost of 10—15% could be clinically significant. For these cases the principal treatment would still be fast neutron therapy but a tumor boost could be used either to deliver a higher dose to the tumor tissue or to reduce the dose to the normal healthy tissue while maintaining the absorbed dose level in the tumor tissue.

Clinical rationale

The clinical rationale for this study is based on the poor prognosis of certain brain tumor patients. Following diagnosis the expected survival time for patients diagnosed with glioblastoma multiforme is around 8 months and can be extended by another 4 months with radiation therapy. There is no difference in survival between fast neutron and photon therapy patients, but the cause of death does depend on the treatment modality. A regrowth of the tumor is the primary cause of death in photon patients whereas with fast neutron therapy one achieves tumor control but patients sustain a high degree of normal tissue damage that causes death [1]. These clinical results indicate a small therapeutic ratio of glioma

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