

Design modification of Birmingham BNCT moderator to produce a highly thermal neutron flux with minimal photon contamination

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The use of the dual ionization chamber method for characterization of a mixed neutron and photon field requires a calibrating measurement to be performed in a highly thermalized neutron environment, with very little photon and fast neutron contamination. For reactor-based BNCT sources, this requirement is readily met by an auxiliary thermal column adjacent to the core. While calibration of the ion chambers for the Birmingham facility could potentially be performed at nearby research reactor facilities, the relative high frequency of calibrations and the potential delay imposed by unavailability have prompted investigation into applying the ${}^7\text{Li}(p,n)$ reaction with modifications to the epithermal moderating assembly for producing a thermal flux. A scoping study was performed with MCNP to determine the optimal thickness of a supplementary graphite assembly. A beam purity equivalent to the LFR beam was sought, with a flux magnitude as close to 10^9 n/cm²s as possible. A final thermal flux of 2.2×10^8 n/cm²s was obtained with relative photon and fast neutron contamination doses below LFR levels. In future work, the final design will be assembled and gold foil measurements will be made to verify calculations.

Energy Calibration of the 3 MV Dynamitron Accelerator at Birmingham

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As part of a quality assurance plan for an accelerator-based BNCT facility, a regular check of beam voltage will be required. In anticipation of these guidelines and in response to recent, wholesale alterations to the system implemented towards improved reliability, a calibration check was performed. Utilizing several resonances of the ${}^{27}\text{Al}(p,\gamma)$ reaction and the threshold of the ${}^7\text{Li}(p,n)$ reaction as calibration points, a new set of machine characteristics was obtained. Facility modifications have been made to allow the full procedure to be performed on a semi-annual basis and for a less detailed check on a monthly basis with minimal interference to a patient treatment schedule.