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A Compton spectroscopy technique for quality assurance of synchrotron based stereotactic radiotherapy

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Spectroscopy has the potential to be a powerful tool for the quality assurance (QA) of radiotherapy beams; however, direct measurement using spectroscopy detectors is confounded by pulse pile up effects. This is particularly significant for high dose rate, synchrotron based stereotactic radiotherapy modalities such as microbeam radiation therapy (MRT). We herein investigate a Compton spectroscopy technique to infer the energy spectrum of the primary beam by measuring energies of photons scattered through 90 degrees in air. Compton spectroscopy of an MRT beam was performed using a collimated Amptek CdTe detector at the Imaging and Medical Beamline (IMBL) of the Australian Synchrotron. The response of the system as a function of energy was determined both experimentally, using a monochromator in the energy range 30-90 keV, and by simulation using the Geant4 Monte Carlo toolkit for x-ray energies between 10-300 keV. This response function, along with the Compton equation, can be used to reconstruct the incident energy spectrum for subsequent comparison with the theoretically predicted energy spectrum.

Keywords or phrases (comma separated)

Spectroscopy, Microbeam Radiation Therapy, Radiotherapy, Quality Assurance

Summary

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