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# A convenient verification method of the entrance photo-neutron dose for an 18MV medical linac using silicon p-i-n diodes

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#### HIGHLIGHTS

- ▶ Investigation of the effect of different p-i-n diode geometry for neutron detection.
- Development of a detector readout system for quick estimation of the neutron dose, that can be used for real time measurements.
- Geant4 simulation of the p-i-n diode response to electrons and neutrons, positioned on the surface and with depth inside a cubic solid water phantom.
- ▶ Study of the photo-neutron dose equivalent on the surface and with depth inside a cubic solid water phantom.

#### A R T I C L E I N F O

ABSTRACT

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Keywords.

Silicon diode; Neutron displacement damage KERMA; Medical linac; Geant4

#### 1. Introduction

It has been well known that when a linac is operated at energies above 10MV, photo-neutron production will result, with average energy of approximately 1MeV. [1, 2, 3] Inside the gantry, fast neutrons are primarily produced via giant dipole resonances in the target, flattening

Electron Linear Accelerators (linacs) used in radiotherapy treatments produce undesired photoneutrons when they are operated at energies above 10MeV. [1] These photo-neutrons contaminate the therapeutic beam and increase dose equivalent delivered to patients. In this work, the neutron entrance dose for an 18MV Varian Medical linac was measured using passive silicon p-i-n diodes. These detectors were calibrated in separate photon, electron and neutron fields. The silicon p-i-n diode detectors have shown excellent discrimination between fast neutron and photon radiation, with sensitivity to fast neutrons being  $\approx$ 4000 times higher than to photons from a <sup>60</sup>Co source in terms of absorbed dose to tissue. The neutron tissue absorbed dose was studied both on the surface and inside a cubic solid water phantom, both experimentally and also using Geant4 Monte Carlo simulations. The silicon p-i-n diodes were found to be useful for quick estimation of the fast neutron tissue dose and dose equivalent in pulsed, mixed radiation fields produced by a medical linac.

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filter and collimators [4]. Photo-neutrons interact with the gantry components before they escape from the collimators or leak-out through the linac head [5, 6], presenting possible risk for both patients and clinicians working at the hospital. The photon-neutrons contaminate the therapeutic beam and increase the dose equivalent to patients both in and out of the treatment field. The peripheral neutron and photon doses have been increasing for Intensity Modulated Radiation Therapy treatment delivery due to higher monitoring units

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