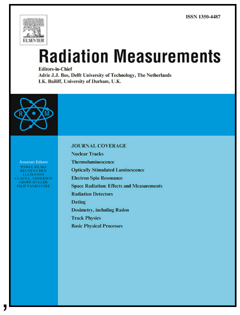
Accepted Manuscript



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

Vanja Gracanin, Susanna Guatelli, Dean Cutajar, Iwan Cornelius, Linh T. Tran, David Bolst, Rhys Preston, Rashmi Gupta, Johnson Yuen, Marco Petasecca, Michael Lerch, Vladimir Prevertaylo, Anatoly Rosenfeld

PII: S1350-4487(17)30015-X

DOI: 10.1016/j.radmeas.2017.01.004

Reference: RM 5688

To appear in: *Radiation Measurements*

Received Date: 30 September 2016

Revised Date: 20 December 2016

Accepted Date: 11 January 2017

Radiation Measurements 00 (2016) 000–000

Contents list available at ScienceDirect

Radiation Measurements

journal homepage: www.elseviercom/locate/radmeas

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

Vanja Gracanin[1], Susanna Guatelli[1,6], Dean Cutajar[1,2], Iwan Cornelius[3], Linh T. Tran[1,6], David Bolst[1], Rhys Preston[4], Rashmi Gupta[2], Johnson Yuen[2], Marco Petasecca[1,6], Michael Lerch[1,6], Vladimir Prevertaylo[5], Anatoly Rosenfeld[1,6]

[1] *Centre for Medical Radiation Physics, University of Wollongong, NSW,Australia* [2] *St George Cancer Care Centr, St George Hospital, Kogarah ,NSW, Australia*
[3] *2MRD, 196 Faraday St, Carlton, Victoria, Australia* [4] *Commonwealth Scientific and Industrial Organisation (CSIRO), Lucas Heights, NSW Australia*
[5] *SPA BIT, Kiev, Ukraine* [6] *Illawarra Health Medical Research Institute, Wollongong, NSW, Australia*

H I G H L I G H T S

- 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

Article history:
Received 888
Received in revised form Revised date
Accepted Accepted date
Available on line On-line date

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

A B S T R A C T

Electron Linear Accelerators (linacs) used in radiotherapy treatments produce undesired photo-neutrons 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 ≈4000 times higher than to photons from a ^{60}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.

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 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

1350-4487 © Copyright Year,
doi: 10.1016/…