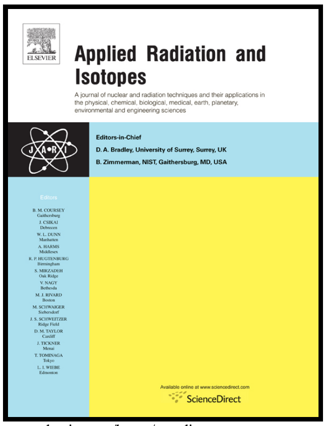

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Development and characterization of a D-D fast neutron generator for imaging applications

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Abstract

The experimental characterization of a pulsed D-D fast neutron generator designed for fan-beam tomography applications is presented. Using Monte Carlo simulations the response of an LB6411 neutron probe was related to the neutron generator output. The yield was measured to be up to ~10^7 neutrons/s. An aluminum block was moved stepwise between the source and a BC400 plastic scintillator detector in order to measure an edge response. This edge response was related to the neutron emitting spot size using Monte Carlo simulations and a simplified geometry-based model. The experimentally determined spot size of 2.2 mm agreed well with the simulated value of 1.5 mm. The time-dependence of pulsed output for various operating conditions was also measured. The neutron generator was found to satisfy design requirements for a planned fast neutron tomography arrangement based on a plastic scintillator detector array which is expected to be capable of producing 2D tomograms with a resolution of ~1.5 mm.

Keywords: D-D neutron generator, fast neutron imaging, neutron tomography

1. Introduction

Neutron tomography is a non-destructive testing technique with applications in a wide range of fields [1]. Fast neutrons in particular are of interest when large amounts (several cm) of hydrogenous material are being imaged in the presence of significant quantities of high-Z material (such as steel). In such cases, cold and thermal neutrons are too strongly attenuated to be of any practical use and X-/gamma rays provide poor contrast in the hydrogenous region due to the much stronger attenuation by the high-Z material. This is the case, for example, in multi-phase flow test loops representing nuclear fuel bundles or oil well environments. For such applications, a fast neutron tomography system is being developed at the Paul Scherrer Institute (PSI) which encompasses activities related to neutron production and detection. An overview of this work can be found in [2]. A conceptual design of a scintillator detector array for this purpose is elaborated upon in [3]. The scintillator array design optimization was performed specifically in the context of the neutron generator (NG) presented here. The result was an array consisting of 100 detectors expected to produce

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