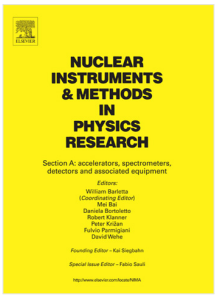
Accepted Manuscript



Temporal measurement of MeV pulsed gamma-ray using a diode laser

Jun Liu, Xiaoping Ouyang, Xiufeng Weng, Zhongbing Zhang, Haoyu Xie, Chunhua Li, Jinlu Ruan, Qing Xu

PII: S0168-9002(17)31420-1
DOI: https://doi.org/10.1016/j.nima.2017.12.030
Reference: NIMA 60371

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date : 11 July 2017
Revised date : 9 December 2017
Accepted date : 9 December 2017

Please cite this article as: J. Liu, X. Ouyang, X. Weng, Z. Zhang, H. Xie, C. Li, J. Ruan, Q. Xu, Temporal measurement of MeV pulsed gamma-ray using a diode laser, *Nuclear Inst. and Methods in Physics Research, A* (2017), https://doi.org/10.1016/j.nima.2017.12.030

Temporal measurement of MeV pulsed gamma-ray using a Diode Laser

Jun Liu [1,2*], Xiaoping Ouyang[1,2], Xiufeng Weng[2], Zhongbing Zhang[2], Haoyu Xie[1], Chunhua Li[2], Jinlu Ruan[2,3]&Qing Xu [2]

[1] *College of Mechatronics Engineering and Automation, National University of Defense Technology, Changsha 410073, China;*
[2] *Northwest Institute of Nuclear Technology, Xi'an 710024, China;*
[3] *School of Nuclear Science and Technology, Xi'an Jiaotong University, Xi'an 710049, China;*

A single-shot temporal measurement of pulsed gamma ray using a diode laser has been carried out with the MeV gamma beams at "Qiangguang-I" facility. The gamma-ray temporal profile is encoded to the power of a diode laser by the carrier variation in laser cavity. We analyze the dynamic process of carriers induced by gamma rays and derive a sensitivity expression for the detector based on a diode laser. It shows that the sensitivity is determined by both the gain of resonant cavity and the efficiency of gamma-ray deposition in the diode laser. And the efficiency of depositing gamma-ray is estimated with Monte Carlo methods. The experimental results demonstrate that the detection method with diode lasers can be used for the temporal profile measurement of a MeV pulsed gamma ray source. The relative gamma-ray sensitivity of the detector is estimated at about $1.27\times10^{-22}\mathrm{C}\bullet cm^2$ from the experimental results, which agrees with the theoretical predictions.

Nuclear radiation detector, Rad-Optic, semiconductor laser, pulsed gamma ray

1 Introduction

The temporal waveform of pulsed radiation field is one of the most important fingerprints to show the dynamic characteristics of a pulsed radiation source. And MeV gamma temporal profile (intensity versus time) is an ideal object to investigate the changes in burning rate and reaction-history, because gamma rays can avoid the time-of-flight dispersion which neutrons always happen. For example, fusion gamma rays detection is designed to measure highly time-resolved bang times and deuterium-tritium (D-T) interaction rates of inertial confinement fusion (ICF) capsules[1-5]. Conventional gamma detectors usually work by converting a gamma-ray pulse to an electric signal, and then transmitting through a coaxial cable to a digital