Development of an Active Interrogation system of Special Nuclear Materials By use of Tensioned Metastable Fluid Detector and Compact Neutron Source Based on Inertial Electrostatic Confinement Fusion

Mahmoud A. BAKR, Kai MASUDA, Tsuyoshi MISAWA, Yoshiyuki TAKAHASHI, Yasunori KITAMURA, Masaya YOSHIDA, Norio YAMAKAWA, Atsushi MATSUDA, Kiyoshi Yoshikawa

Abstract:

In order to fight against the global nuclear terrorism, interrogation of special nuclear materials (SNMs), such as U-235 and Pu-239, is receiving high attention. The passive detection systems are inadequate, however, several active detection systems have been proposed for U-235 detection in seaports and airports. Those systems, however, require highly intense sources and/or heavy shielding materials surrounding the detectors for blocking the background neutrons and/or gamma-rays. We are developing the world’s first portable interrogation system, comprising a compact and lightweight D-D Inertial Electrostatic Confinement (IEC) fusion neutron source [1-2] coupled with Tensioned Metastable Fluid Detector (TMFD) technology [3]. The major obstacle facing the neutron-based active interrogation systems is to identify the secondary neutrons that indicate the existence of SNMs from the probing neutrons. To overcome this obstacle, our team have recently developed an advanced neutron-in neutron-out technique, the Threshold Energy Neutron Analysis (TENA) technique [4]. In this technique, mono-energetic neutrons from D-D fusion, 2.45 MeV, used as probing neutrons, while the secondary neutrons above 2.45 MeV, from SNMs, are detected using TMFD. The TMFD has been showed capability to reject the 2.45 MeV probing D-D neutrons and all background gamma-rays. Experiments have been carried out to show the ability to detect 10 g of HEU by use of a DD-IEC neutron source, and TMFD. The conditions and experimental results will be presented with the extremely compact and intense D-D IEC neutron source developed for this purpose.

Published In:

journal, JPS Conference Proceedings, NULL, NULL