Prague, Czech Republic June 21-25, 2021

Contribution ID: **166** Type: **Oral presentation**

#07-166 Simulation and Development of Prototype Simplified Neutron Scatter Camera for Nuclear Safeguards Applications

Tuesday, June 22, 2021 2:40 PM (20 minutes)

Key in the international safeguards regime is the use of radiation detectors to track and characterize nuclear material. A relatively new area of interest in detector design is directional detectors: detectors that can report information on radiation source location and distribution along with data on source strength and identity. Neutron scatter cameras are a type of directional neutron detectors that rely on multiple neutron scatters to generate images that can reveal the direction and distribution of neutron sources. Fast neutron cameras which have recently been developed rely on multiple detector volumes and make use of neutron time-of-flight measurements. These designs, though effective in localizing the source direction, relies on a large amount of detection and electrical equipment, thus increasing size, cost, and complexity of the systems to unreasonable levels for some applications. This project seeks to develop a compact scatter camera that is less expensive than systems relying on multiple detector volumes. Crucially, two components and capabilities are needed to achieve this: fast scintillation detection materials and picosecond electrical pulse timing. Utilizing such electronics, distinguishing between scintillation light pulses generated by the same neutron within one detector volume is possible. An MCNPX-PoliMi model of such a system has been developed to guide prototype designs. A cube of EJ230 fast plastic scintillator and six photomultiplier tubes (PMTs) were used to construct the prototype camera that localizes neutron sources based on the principle of cone back projection. Neutron scattering positions within the detector volume are found by comparing the timing and quantity of light arriving at PMTs mounted to opposing faces of the scintillator volume. The use of a digitizer with a sampling rate of 5 GSPS allows for the identifications of secondary features on light pulses, indicative of secondary scattering events. Prototypes of the system in one, two, and three dimensions have shown promising initial results when coupled with a script that algorithmically identifies candidate neutron double scatter events and back projects probability cones in the direction of possible sources. Imaging resolution/quality, double scatter efficiency, and cost for the system are quantified. Paths forward for further improvement of a future system based on this camera'operating principles are discussed.

Primary authors: HARVEY, Taylor (University of Florida); Dr ENQVIST, Andreas (University of Florida)

Presenter: HARVEY, Taylor (University of Florida)

Session Classification: 07 Nuclear Fuel Cycle, Safeguards and Homeland Security

Track Classification: 07 Nuclear Fuel Cycle, Safeguards and Homeland Security