Energy Discrimination using a Phoswich for Material Separation in X-ray Transmission Imaging

Alexander Kippax[1], David Sharp[1,2], Mark Proctor[2], Adam Barr[1]

[1]*Nuclear Physics Group, University of Manchester, Manchester, United Kingdom*
[2]*Cargo Division, Rapiscan Systems Ltd, Stoke-on-Trent, United Kingdom*
Corresponding Author Email: Alexander.Kippax@postgrad.manchester.ac.uk

The energy discrimination ability of x-ray detectors is important for a range of applications from x-ray spectroscopy in fundamental science to medicine and industry. One such industrial application is in x-ray security scanners, where material identification is highly dependent upon the ability of a system to determine the energy of the transmitted x-rays, as different materials attenuate the x-rays by different amounts. Though typically detectors used in industry are energy integrating, and so details on the detected spectrum are lost.

Material discrimination is currently achieved through the use of two different energy x-ray sources. This project investigates the use of a phosphor sandwich (phoswich) of two different scintillators, lutetium-yttrium oxyorthosilicate (LYSO) and cadmium tungstate ($CdWO_4$), to provide a level of differentiation between detected energies.

LYSO has a fast response time and high light yield, whilst $CdWO_4$ responds much more slowly and produces around half the photons per keV than LYSO. The different temporal response of LYSO and $CdWO_4$ should allow for the depth of interaction, thus energy, of the detected x-rays to be classified.

This will ultimately enable faster, more accurate identification of materials, resulting in fewer, more targeted manual searches and faster throughput at customs.

This contribution will report on early proof-of-concept studies utilising GEANT4 simulations of a Phoswich device responding to realistic x-ray and gamma-ray spectra that are validated by measurements made in the lab using a gamma ray source.

Supported by EPSRC and Rapiscan Ltd