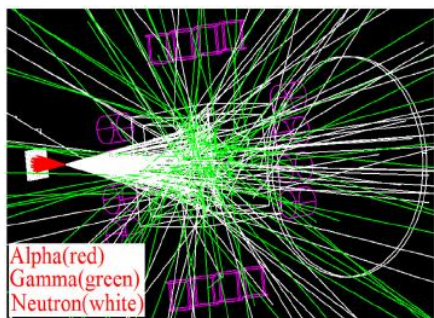


Modeling of tagged neutron method for explosive detection using GEANT4

This research was carried out to facilitate the design and construction of a prototype laboratory based TNM system and a simulation model was developed in the GEANT4 framework. The model has established an environment for (a) simulating production of D-T tagged neutrons, their transport and interactions with an object to induce emission, detection of characteristic gamma-rays and (b) image reconstruction (3D) of the interrogated object using time-of-flight information of neutron and gamma-ray. The geometrical configuration includes 14.1 MeV tagged neutrons, a position sensitive alpha detector and an array of BGO (3" x 3") gamma detectors arranged in a square geometry around the sample to collect the neutron induced gamma-ray spectra. With this configuration of tagged neutron system, a reference data set of pure elements (C, O, N, Al and Fe) neutron induced gamma energy spectra was generated. Simulated spectra of benign (urea, melamine) and explosive (RDX, TNT, ammonium nitrate) samples were analyzed and their elemental compositions of C, N and O were extracted with linear combination of reference data set. Simulation results have shown the system's capability in detecting and imaging of hidden explosives (1 kg RDX) within a metallic matrix is better than that in a wood matrix.



GEANT4 simulated geometry of tagged neutron method full geometry with neutron beam ON.

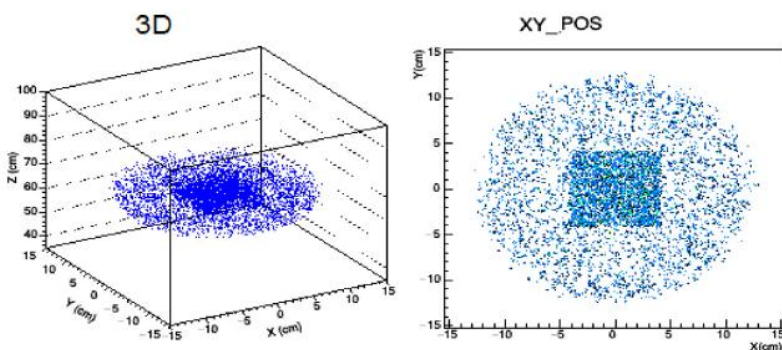
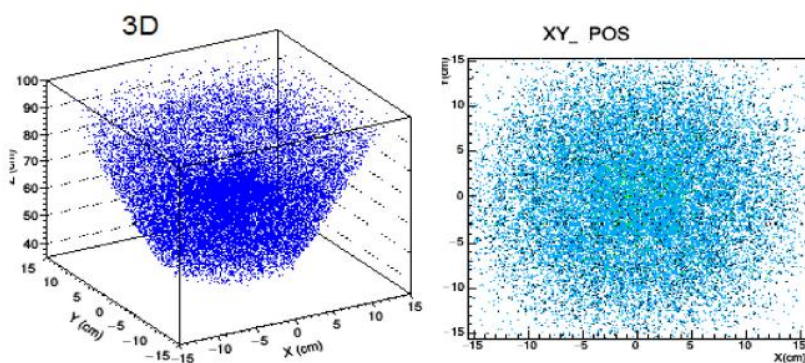


Image reconstruction (3D–2D) of the hidden object (1 kg RDX), revealed its position 65 cm away from the neutron production site in the z direction. Reconstructed images (3D and 2D in x–y plane) represent the neutron interactions inside container corresponds to when (Top) no time window applied and (bottom) a time window of 1.6 ns around sample peak was selected.

Ref. :

Saroj Bishnoi, R.G. Thomas, Arnab Sarkar, P.S. Sarkar, Amar Sinha, Alok Saxena, S.C. Gadkari
Nuclear Inst. and Methods in Physics Research, A 923 (2019) 26–33