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S.I.D.O.M. Detector, Surface Imaging Detector of Matter

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Deformed Space Time (DST) reactions are a new type of nuclear reactions in matter without emission of gamma rays but evident emissions of neutron bursts and alfa rays, both emissions having highly directional features. Our work aims to improve the neutrons detecting equipment adding chronological and spatial informations.

KEYWORDS:

1. NEUTRONS DETECTION

Radiations detections takes place through its interaction with suitable matter in a detecting device. Ionizing charged particles interact with matter and in order to be revealed they must have energy of at least some tens of KeV.

Neutrons interact only through nuclear reactions, being particles able to pierce the nucleus unaware of the Coulomb barrier, since they are devoid of electric charge; the neutrons can be detected even with extremely low kinetic energy such in the case of thermal neutrons.

Efficiency of a Neutrons detector depends heavily both on the material composition of the detector itself and on the Neutrons kinetic energy under detection.

1.1. Reactions of Conversion

Neutrons detection is mainly based on the use of detectors of charged particles coming from the interactions of neutron and matter. We focuse on the process of scintillation due to charged particles coming from the conversion of primary neutrons after the interactions in matter, and it is clear that a good converter must have the following features:

- Large cross section for detector efficiency and reduction of spatial size;
- Great value of Q energy released, in order to have products able to leave in the detector signals well distinguishable from the background noise.

The converters more often applied are:

- ^{6}Li $(n, \alpha)T$, with an energy Q equal to 4.78 MeV;
- ^{10}B (n, α)Li with an energy Q equal to 2.79 MeV (7%) and energy Q equal to 2.31 MeV (93%).
- ^{3}He $(n, p)T$ with an energy Q equal to 0.76 MeV.

The cross sections for the three reactions above mentioned are shown in figure:

Cross section values of ^{6}Li, ^{10}B and ^{3}He, in the case of thermal neutrons, are 940 barn, 3840 barn and 5330 barn respectively, values useful also in situations where the flux of thermal neutrons is not very rich (0.025 eV), see Figure 1.

The reaction ^{10}B(n, α)Li is esoenergetic and it has an energy release equal to 2.78 MeV. Since in most cases Lithium is formed in an excited state followed by emission of a 0.48 MeV gamma ray, the kinetic energy effectively available to the reaction products is (for thermal neutrons) 2.30 MeV, see Figure 2.

The charged particles produced by these reactions can have an energy really higher than that owned by an incident neutron. In this table we show the reactions of interest, the Q-value and the relevant cross section:

The energy acquired by the particles coming from the reactions and exploitable for detection is hence:

$$E = E_n + Q$$

where E_n is the neutron kinetic energy and Q, the energy released in the reaction, is equal to or lower than Q_o depending on whether the nucleus goes to the fundamental state or it stays in an excited state.

1.2. Boric Acid as Neutron Detector

In past works performed by others authors has been demonstrated that the coupling of a suitable acid boric powder with the well known CR-39 ADC plastic sensor realize a good detection of neutrons.[2–4]

The actual devices, CR39 (PADC), plastic sensors made from a polymer ($C_{12}H_{18}O_7$), are integral detectors and do not offer the signal evolution over time. In fact these devices need to be "developed" (i.e., to be subjected to a

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