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THE EFFECT OF THICKNESS OF THE URROUNDINGS ON THE TOTAL AND PHOTO PEAK RELATIVITY EFFICIENCY FOR THE NAI (TL) DETECTORS.

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ABSTRACT

To study the effect of the shield thickness of the surrounding on the total and photo peak relativity efficiency for the NaI(Tl),two NaI(Tl) detectors (3" × 3") and (1.5" × 1.5") crystals are used and the radioactive source is Cs-137 which emits (0.662) MeV photons at distance of(25)cm from the detector and (146.8µci) activity.

The Surrounded materials represented by cylinders of (35) cm. long, and different thicknesses (2.5, 4.4, 5.6and8.9) mm. and different diameters (11, 16 and 21.5) cm. for the steel (Iron) cylinder.

For (1.5" × 1.5") and (3" × 3") detectors without cylinder, the total and Photo peck Relativity efficiency are (100%) relative to it selves.

While, increasing of the thickness of the cylinder, the total and Photo Peak Relativity efficiency decrease for the two-size detector

Introduction

Scintillation counters, in general, and NaI (Tl) in particular are widely used in various fields of nuclear radiation detection, such as environmental studies [1, 2], nuclear medicine [3], health physics [4] and high energy physics experimental [5]. The efficiency of the NaI(Tl) was Studied by many researcher [6-11] , So the experimental applications: for the detectors surrounded with different materials of different types and thicknesses like the shielding from the background for low count rate experiments [12,13]. Then, the contribution of scattered Photons from the surroundings will be affected energy spectrum result from NaI (Tl) detector, which this contribution depends on gamma energy [14].Total and photo peak relative efficiency were measured for NaI(Tl). Two radioactive sources(Co-60 and Cs- 137) with detector NaI(Tl) by size(3"×3") were used.

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The range of angles (10º-90º) and the range of distance between the sources and crystal (10-30) cm by [15]. Effect of the distance of surroundings material on the signal / noise ratio of the NaI (Tl) detectors are studied by Fadhil and et. al.[16], The experimental results shows that the Signal to the noise ratio (S/N %) are increasing in both the distance and photons energy increasing. The effect of size of NaI(Tl) on the ratio of (S/N %) as well as the type of materials dependence was present too.

Experimental

The description of the detector and electronics systems used in this work, are given in Table (1).The arrangement geometry is shown in figure (1). The cylindrical shapes were chosen to represent the surrounding materials. The Cs-137 radioactive source is chosen which emits photons of energy (0.662MeV) and (146.8µci)activity at (25cm) away from the detector face.

Results and Discussion

1- The effect of the surroundings thickness on the photo peak relativity efficiency.

Figure (2) show the results of the effect of the surroundings thickness on the photo peak relativity efficiency, with increase the thickness, the photo peak relativity efficiency decrease for the two detectors, but the relativity efficiency for (1.5" × 1.5")detector is lower than that for (3" × 3") because the solid angle for (1.5" × 1.5") is less than that for (3" × 3") [15,16], i.e. the number of photon interaction with the detector (1.5" × 1.5")is less than that for (3" ×3") detector.

2- The effect of the surroundings shielding thickness on the total relativity efficiency.

Figure (3) shows the results of the effect of surrounding materials thickness on the total relativity efficiency with increase the thickness, the total relativity efficiency decrease for the two detectors. But this relativity efficiency for (1.5"×1.5") detector is lower than that for (3"×3"), i.e. the number of photon interaction with the detector (1.5"×1.5") less than that with (3" ×3") detector because the solid angle for (3" ×3") detector greater than (1.5" × 1.5") detector.

Conclusion

With increase the thickness of the surrounding materials, the photo peak relativity efficiency decrease.

With increase the thickness of the surrounding materials, the total relativity efficiency decrease.

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Tabel.1. Detector and Electronics

Detector	**Dimensions**	**Manufactory**
	(3" × 3") (1.5" × 1.5")	**Harshaw Harshaw**
Electronics	**ECTGO RTEC**	
	Photo multiplier base with Preamplifier (226) High voltage power supply (478) M.C.A. NUCLEUS(Q.8)	

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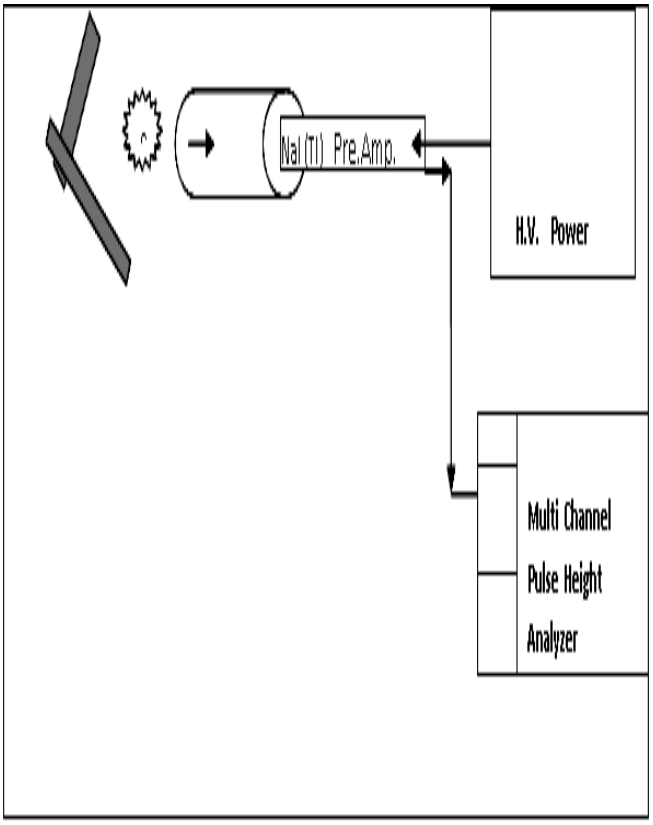

Figure (1): the experimental arrangements

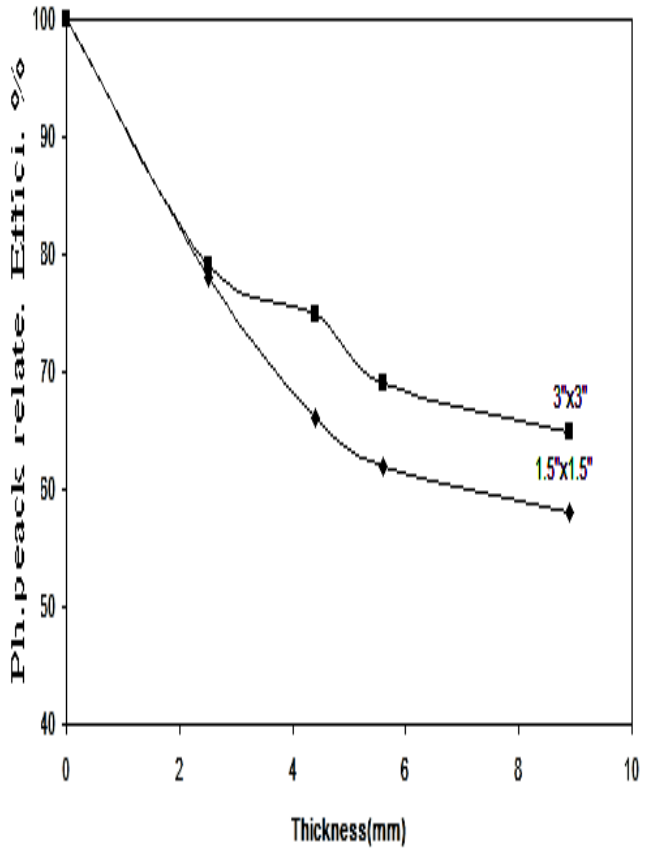

Fig (2) Relation ship between photo relat. Effic. % and thickness

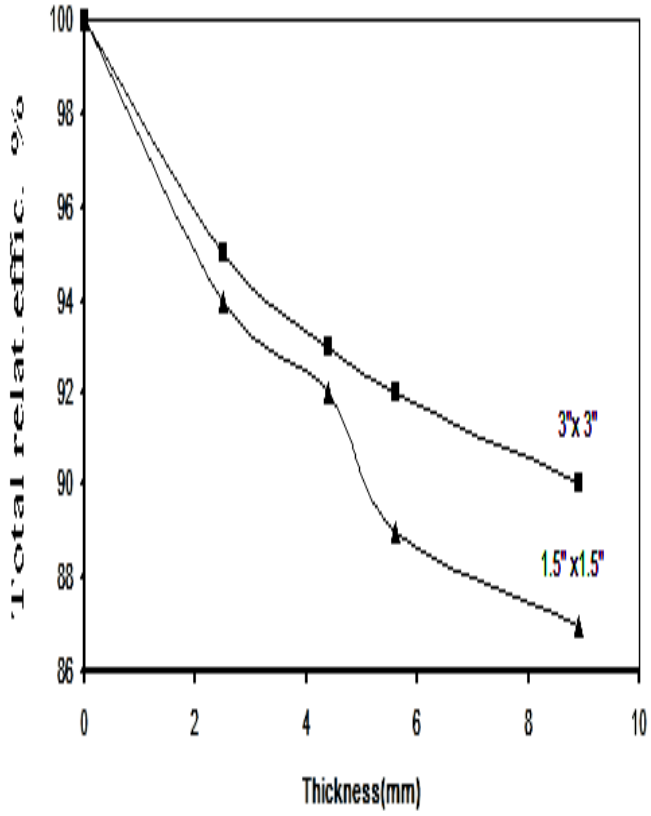

Fig (3) Relation ship between Total relat. Effic. % and thickness.

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تأثير سمك المواد المحيطة على الكفاءة الكلية وكفـاءة القمة الضوئية النسبية للكاشف الوميضي يوديد الصوديوم المنشط بالثاليوم NaI(Tl)

فاضل إسماعيل شراد الطائي

الخلاصة

لدراسة تأثير سمك المواد المحيطة بالكاشف على الكفاءة الكلية وكفاءة القمة الضوئية النسبية للكاشف الوميضي يود يد الصوديوم المنشط بالثاليوم NaI(Tl) استخدم الكاشف NaI(Tl) وبحجمين("1.5×1.5") و("3×3") والمصدر المشع السيزيوم –137 الباعث للفوتونات بطاقة (0.662Mev) وعلى مسافة (25cm) من الكاشف. المواد المحيطة المستخدمة هي اسطوانات بطول (35cm) وبسمك مختلف (8.4,5.6,4.4,2.5)mm وبأقطار مختلفة (21.5,16.11)cm لمادة الحديد وكانت النتائج كالآتي : عند زيادة سمك المواد فأن الكفاءة الكلية وكفاءة القمة الضوئية النسبية تتناقص ولكلا الكاشفين("1.5×1.5") و ("3×3") وكذلك يكون التناقص بالنسبة للكاشف ("1.5× "1.5) اكثر من الكاشف ("3×3") .