Defector resolution

Student’s Name

Institution

Course code

Date

**Introduction**

The radiation is applied in several areas of life for scientific studies, research and to run industries. The production of energy through the nuclear technology and weapons has been closely associated with radioactive activities (Milam, 2014). Recently, it has emerged to be an important aspect for the treatment of cancer patients. However, radiation is regarded has one of the dangerous things and of late it has caused a serious health problem in industries. Exposure to high radiation can result to cancer diseases and radioactivity condition, which can result to death. The common sources of radiation are smoke, nuclear weapon donation, natural radiation and cosmic arrays. And therefore, detectors are the best solutions to the problems caused by radiation. Gamma rays are also one the dangerous electromagnetic radiations which produce high energy and short wavelength and cause a serious damage to the body. The gamma rays are produced by various nuclear interactions which include nuclear reactor or fission. According to Diacon (2017, p. 21), the radioactive exposure can either be internal or external and therefore, necessary actions must be taken to avoid serious tissue damage resulting from such reactions.

The external exposure of radiation is regarded as the emission which comes from the external environment and the internal exposure is termed as the emission from within the body. It is important to point that the exposure from the external factors can be controlled and prevented using different scientific methods. As stated by Cherry & Phelps (2012, p. 25) the contamination, which originates from the external environment can be controlled using different shield methods and through increasing the distance which exist between the radiation sources. The detectors provide assistant in establishing the source of each radiation. And therefore, they offer the best method, which can be applied to control radiation hence limit the effect of the radiation (Steinberg & Rasmussen, 2014, p. 23). SCA and other defectors are powerful tools for analysis the radiation and therefore, used to prevent radiation exposure effect. It is therefore, important to study how defectors can applied in detecting and prevention of radiation of causing danger to people. This study therefore, focuses on the comparison of four different types of defectors such as Nai (TI), Ge (Li) and MCA and single channel analyser.

**Objectives of the study**

The objectives of the study are to ccompare the detector resolution of the NaI (Tl) detector using a Single Channel Analyser (SCA) and a Multi Channel Analyser, and a Germanium Detector. It is also conducted to plot the pulse counts against the radiation and determine how each defector reacts when exposed to amount of radiation. The study was also done to calculate the detection resolution among the detectors, which are used in various fields.

**Method and Equipment**

In order to complete the experiment several laboratory equipments were used in the lab professionally to achieve the objectives of the experiment. Laboratory equipments used are NIM Bin and power supply, high voltage power supply, Nal (TIL) Crystal and phototube assembly, preamplifier, multi channel analyzer, counter or time, 137 Cs gamma source, and cathode ray. Each of these equipments had specific role to play to ensure that the experiment was complete successful. First, all the equipments were connected with high voltage power supply. For safety precaution the points of connection were checked to confirm the power is off to avoid electrocution. All the connections were done using signal cables which use standard BSN types of connector. The PM- Tube was then connected to Pre-amp using of one the shortest signal cables of about 20-30 cm. The pre-amp was also connected to the Amplifier using any of the length cable, which is very convenient. The other components was the connected using the best and suitable cables to ensure that the connection is perfect for the experiment to occur.



Diagram 1: The layout of Electronic setup for NaI detector (detector lab note, 2019)

In order to achieve accuracy and success of the experiment 137 Cs source was placed in front of the Nal (TI) detector crystal. It was placed in a such a way that the source detector cannot change the measurement between to make sure that it does not interfere with the count rate. The amplifier unipolar output was then observed using the CRO. The observation was made and then the out of pre-amp was sketched. The CRO settings were also recorded for usage in the future.

It is important to point that the fine gain control of the amplifier and the course were adjusted to 662 keV photopeak, which are the most intense pulses. The amplitude (Vp) was also set to be used to lock and gain control. It is essential to ensure that gain setting remain the same during the entire experiment period. And therefore, the setting and the adjustment were made tight to for the accuracy of the experiment. After this had been done, the equipment settings were all recorded. The equipment settings recorded were HV and Amp because the experiment was to be repeated. The changes were also made to the settings of the course to keep the uniformity. However, the width of the channel was then set to 0.2V and the baseline was adjusted below the photopeak amplitude of (egVp-0.1) to ensure that it counts in the photopeak area. The appropriate time was determined to record about 2000 counts, and this time was used for all the measurements which were being done. The baseline was then set to 9.8V to count for the time. The 0.2V was then repeated to the interval down to zero volts, the adjusted was manual to reduce the readings. The background count was also done by removing the source and then the value was divided by 5 (i.e. 1.0 /0.2) and the subtraction made from the counts, which was early obtained. In the final stage, the amplifier and SCA were then disconnected and then the SCA was connected to MCA as indicate in the diagram 2 below. The MCA was then calibrated with the appropriate calibration source and then 137Cs spectrum was then accumulated. And finally the ROI was set for the main photopeak so that the peak report could be generated and then the experiment was saved.



**Diagram 2:** Electronic setup for NaI detector with **Multi-Channel Analyser**

**Discussion and conclusion**

In order to obtain a better result, the number of electric pulses of each experiment was plotted against the number of counts registered. It is essential to point that the pulses indicated the energy established to register counts which is in seconds. Indicated in the figure 1 to 4, the result shows a variation in the number of counts registered in every experiment conducted. Since the purpose of the experiment was to establish the different among the three components detector resolution of Nal (TI), Single Channel Analyzer and Multi channel analysis and Germanium Detector the number of counts registered by each of these components illustrates the different, which exist. The equipments, which were setup, were able to record various numbers of counts per minutes, and the count and the time were used to plot the four graphs. The figures were plotted after the conversion to a kev was done to make it easier to plot and visible as well.

The experiment indicates that there are general differences among the defectors and in Nal (TI) as indicated in figure 1, the array are long in the Y-axis. This could be as result of semiconductor detector, which permits the separation of the Y rays with the energy. In figure 1, the number of counts of Nal (TI) moves upward straight few minutes after the experiment started, and that is when Nal (TI) receives a lot of heat. It projected straight and then lowers but the arrays are up at on the Y-axis compared to other defectors. It is possible that there is utilization of high energy resolution during the experiment process, which is a very critical factor in a small size of the semi conductor and this could be the result of the long arrays on the y-axis registered with Nal (TI).

**Figure 1: Nal Single CA experiment**

Figure 1, shows an experiment result of Nal single CA. the experiment indicates that single channel analyzer registers high photopeak compare to the rest of the defectors. The photopeak of the single channel analyser is 750 and the pulses are 49. However, it is noticed that the pulse count of the single channel analyzer falls on the same condition as its peak amplitude and its falls height. It has also a window, which is established with similar threshold. It is therefore, important to note that there are two SCA, which can be applied, the SCA with and without timing. According to Markson (2014, p. 21, timing SCA usually produce logic output signals, which are associated to the time of the occurrence and therefore the SCA used in this experiment was non timing because the time does not exist at the end of the experiment. In this experiment, can be stated that the pulse counts of the defectors change when the heat or the amount of radiation changes. The pulses and the photopeak depends on the radiation, it is likely that after the nine pulse count a lot of heat or radiation was received by Nai and this prompted a sudden change of photopeak. It has several counts of 1025 and the mean of the entire count is 56.36, which can mean that it registered several value counts throughout. The mode is and therefore, many of the pulse counts made by the Nai MCA are zero. Though the counts were made by the zero but zero value was registered in major counts throughout the experiment.

**Figure 3: Multi Channel Advisor experiment result**

The MCA registered dwindle and pulse counts and this means it has few pulses cunts compared to the rest of the defectors.

**Figure 4: Germanium Experiment of radiation counts**

However, it is noted that the four spectrum registered different photopeak heights and the registered by each spectrum could be based on the radiation intensity applied in each case. In figure 1 to 4 the number of counts registered in each case is directly proportional to the quantity of the radiation, which was used to accomplish the experiment. Based on the four experiments, it is evident that Nal (TI) recorded the highest radiation. Nal (TI) has the photopeak with the longest height of approximately 7500 counts compared with the rest which registered less than 5000 counts. In this case, Nal (TI) utilizes a lot of energy of radiation. However, the experiment established that Ge (Li) detectors register several counts compared to Nal (TI) and the rest of the defectors. The experiment shows that Ge (Li) registered an estimated 5410 counts; Nal (TI) registered 49, MCA registered barely 1000 counts. It is therefore, evident that Ge (Li) has many counts compare to the rest of the defectors. It is therefore, can be concluded that Ge (Li) has a high resolution compared to the rest of the defectors. This experiment therefore, agreed with the hypothesis, which have been made by several scientists regarded the resolution of defectors. According to Cherry & Phelps (2012, p. 31), Ge (Li) has superior resolutions and because of the resolution, it registers several counts compared to other defectors with less resolution. This therefore, means that in terms of resolution Ge (Li) has a higher resolutions among the four defectors. The result of high resolution could be as the result of the application of different component during the reaction with heat. Cherry and Phelps (2012, p. 32) pointed that the Ge (Li) defectors deploys themigration of the electrons. It also utilizing the holes which exist between the valence and condcution bands during the radiaton detection and Nai (TI) uses the scintillation. This is the reason the two defectors registers different counts and arrays. Though Nai (TI) has the longest photopeak height, it registers few electron pulse counts estimate to be 49 compared to Ge (Li), which registers almost 5241 counts.

 The experiment also shows that that a Ge(Li) registered a long straight photopeak and several of them throughout the recording. It also registered several pulse counts compared to Multi channel analyser and single channel analyser. The fact that the experiment registered a several pulses indicates its resolution and therefore, it is evident that Ge (Li) has a high resolution compared to Single Channel Analyser and Multi Channel Analyser. The pulse height of Ge (Li) is higher than the MCA and SCA and therefore, it means that it requires a lot of radiation. The voltage of the MCA and SCA is also less, which means that less radiation was used during the experiment process.

**Conclusion**

The experiment shows that there is a clear variation among the four defectors in terms of radiation utilization, and how each defector react when exposure to radiation. It is noted that the high resolution registered by Ge detector was as a result of detection techniques, which were used to conduct the experiment. But the studies have established that Ge detector has the high resolution compared to NaI (TI) and other defectors. In the comparison between Multi channel Analyser and Single channel Analyser, the MCA has proven to be clearer and accurate compared to SCA. It is therefore, worth noting that MCA produce more accurate result than SCA and therefore, it is advisable to use MCA for radiation detection. MCA should also be deployed rather than SCA because of its techniques to resolve complex conditions using multiple emission and several radionuclides as indicated in figure 2 above. It is also established that NaI (TI) has a higher photospeak and small background window and therefore, it can be used to high energy. It is therefore, important to point that the experiment was done in the laboratory, to to ccompare the detector resolution of the NaI (Tl) detector using a Single Channel Analyser (SCA) and a Multi Channel Analyser, and a Germanium Detector and experiment discovered that there is a clear distinction among the four defectors and how they are applicable. Their differences are based on resolution, wavelengths, photopeak and radiation required for each defector reaction.