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Measurement of the Environmental Radiation At The Physics Department Of Tishreen University

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□ ABSTRACT □

We present here some results obtained from the measurements of the environmental radiation at the Physics Department of Tishreen University, in the energy range 50KeV - 2.8MeV, by using a compact scintillation NaI(Tl) detector, low-time recovery and reliable. The detected radiation is essentially due to cosmic radiation and to the airborne radioactivity, but no radiation from other sources have been found.

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قياس الاشعاعات البيئية
في قسم الفيزياء في جامعة تشرين

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(قبل للنشر في 2003/1/22)

□ الملخّص □

نقدم هنا بعض نتائج قياس الاشعاعات البيئية المأخوذة في قسم الفيزياء بجامعة تشرين، ضمن المجال الطاقي الواقع بين 50 كيلو الكترون فولط (50 keV) و2.8 ميغا الكترون فولط (2.8 MeV)، وذلك باستخدام كاشف ومضي NAI(Tl) مدمج (موثوق) وزمن الاستعاده له قصير. إن الاشعاعات المكتشفة ناتجة بشكل أساسي عن الاشعاعات الكونية والنشاط الاشعاعي البيئي المحيط بمكان القياسات، والاشعاعات المنقولة جواً، ولم يُلاحظ أي اشعاعات ناتجة عن منابع أخرى.

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I - Introduction:

We identify the “Environmental Radiation” (ER) especially g radiation with energy greater than 50 keV [1-9], that can be detected by scintillation counter based on a NaI(Tl) mono-crystal (10 mm´ 20f mm). Its main components are low energy secondary cosmic rays and the g-rays from airborne natural radio-nuclides transported to the atmosphere from the surface of the earth. Under special conditions and with appropriate operations on the data one can also separate the occasional contribution to radio-nuclides abundance coming from nuclear reactor accidents, nuclear bombs or from other unexpected events [1].

II - Experimental Dispositif:

The detector used is described in Cecchini et al [1]. It is based on a NaI(Tl) mono-crystal having the dimensions (10 cm´ 20f cm) and 1 cm of Pb, 0.1 cm of Cu and 0.3 cm of Al shaped around the crystal and the Photomultiplier Tube (PMT) (see figure 1); The whole set has a small volume (» 65´ 65´ 130 cm^3 and » 80 kg). It is provided with shells for easy movement on smooth surface. It can be easily dismounted and assembled. The upper shield surrounding only the NaI crystal can be easily removed. The PMT High Voltage (HV) supplied by the ACQ card coupled to a Personal Computer (PC) is very stable. It can accumulate 2048-channel spectra every minute (or more) with tunable energy resolution. On-line programs allow a quick-look analysis and graphical inspection of data collected in different pre-set energy bands. In figure 2 we present the data acquisition the period 21/03/2001 to 20/05/2001.

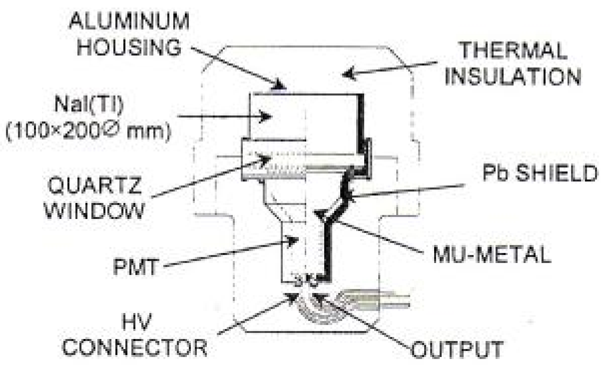


Figure (1): Drawing of the detector. The NaI(Tl) mono-crystal, together with its PMT are embedded in a box of thermal insulator [1,5,6].

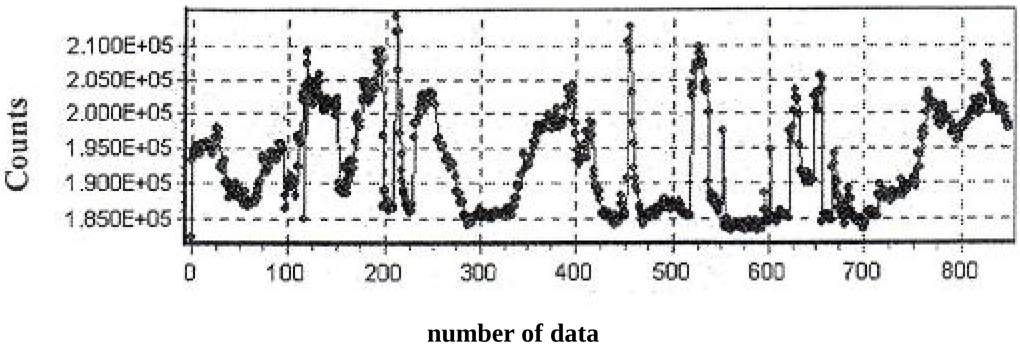


Figure (2): Plot of the data acquisition quick-look for the period 21/03/2001 to 20/05/2001, each point present a spectrum, and each data for 15 minutes..

III - Calibration of the detector:

The scintillations of the crystal are seen through a light guide by a Photomultiplier Tube (PMT) of (127 mm). The output signals the PMT are sent to a charge pre-amplifier and then amplified and energy analyzed. The energy analysis is obtained through a multichannel analyzer 2048 channels of variable width 2.8 keV/channel.

In order to calibrate the detector we used two sources: the first ^{40}K and the second ^{208}Tl were positioned on the detector to allow adjustment of the ^{40}K photopeak and ^{208}Tl photopeak positions in the spectrum by means of the feedback device which provided adequate correction to possible deviations of the HV of the phototube. It has therefore been possible to keep the ^{40}K photopeak (^{208}Tl photopeak) absolutely stable at the same channel of the spectrum for the entire duration of the experiment. The NaI(Tl) scintillation of ER has a free air statistics at sea level of ~ 8´ 10^5 counts/hour.

V - Results and discussion:

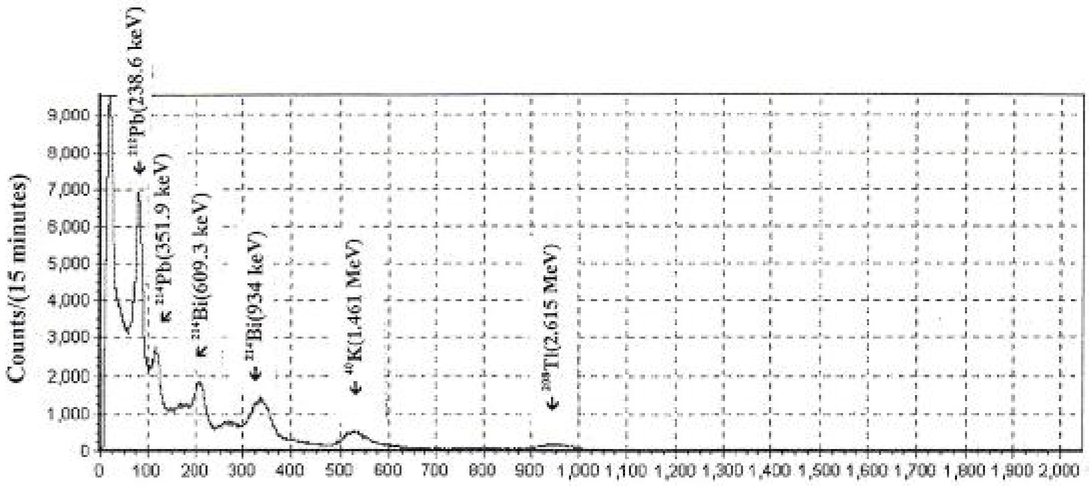
It should be noteced that the detector was located on the roof of the building of the Physics Department of Tishreen University.

In figure 3 we show the differential spectrum in the energy interval 0 MeV < Eg < 3 MeV.

We can notice:

- In our experiment we have considered the peak corresponding to the 1.461 MeV gamma line of ^{40}K naturally present in the surrounding solid material.
- The peak corresponding to the 2.615 MeV gamma line of ^{208}Tl (from the Thorium chain) is mainly due to the building material.

- All photo-peaks corresponding to the ^{214}Bi (934 keV, 609.3 keV) and ^{214}Pb (351.9 keV) daughter products from the ^{238}U (Radon daughters) are easily identifiable.
- Channel 80 is due to ^{212}Pb (238.6 keV) and/or backscattered Compton photons.
- Channel 20-25 are propably due to the counter Pb-flurescent X-Rays at 77 keV. This may be possible because the low-energy scale is not linear.



chan. no. (2.8 keV/chan)

Figure (3): Energy spectrum of the gamma radiation detected by the detector, 2.8 keV/channel.

IV - Conclusion:

The detector we have used for the continuos monitoring of the ER has provided its reliability being able to work continuously, but with the few interruptions due to human interference.

The analysis of the data collected is at present very preliminary and we hope to present an updated and more complete analysis in the future.

The radiation detected is essentially due to cosmic radiation and to the airborne radioactivity, but no radiation from other sources have been found.

Our future objectives are to study the temperature and pressure effects on low energy secondary cosmic radiation and transport effects on airborne radionuclides related to changes in weather conditions. Together with similar observations at different latitudes and lower altitudes these types of measurements appear as a powerful tool for the studying of cosmic ray variation related to solar activity and for the investigation of the atmospheric circulation of radionuclides of natural and artificial origin.

Finally the observations of the ER can provide useful information for the studies of human physiology at great altitude and the influence of the environment on men.

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