

# A Manual Low Background Alpha and Beta Counting System

S.Levinson, U.German, O.Peled, S.Turgeman,  
U.Vangrovitz, D.Tirosh, S.Piestun, H.Assido  
Nuclear Research Center Negev

An Alpha and Beta counting system consisting of a microcontroller-based electronic unit and detectors assembly was developed. The radiation detection unit consists of two proportional detectors (a main detector and a cosmic-ray guard detector) which can be easily disassembled for decontamination or repair. The detectors are mounted in a manual operating sample changer shielded by 5 cm of lead. Simplicity of maintenance and functional operation were taken into consideration in the design. The electronic unit supplies the high voltage and enables the operational functions including controls and alarms. Calculations of net cpm of Alpha and Beta counting are displayed and can be printed. RS-232 communication option enables connection to a computer and operation of more sophisticated programs for calculations and data storage in the future. The system is shown in Fig. 1.

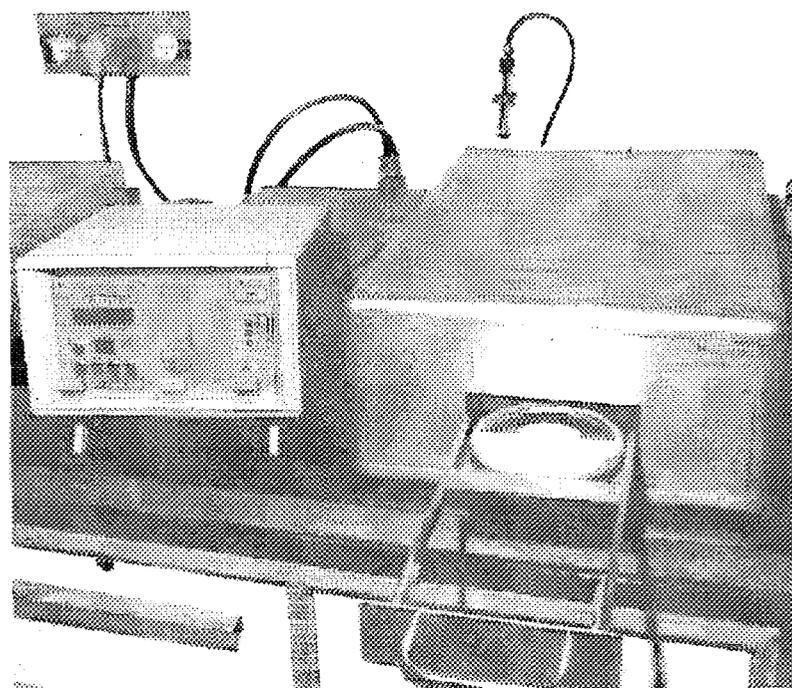


Fig 1: The Alpha and Beta counting system

The counting system is based on a proportional detector with high voltage changing to the appropriate high voltage plateau point. The radiation-detector(1) is 4.5" diameter and is made of oxygen free copper. As the system was designed for a low background, it has a cosmic 7.5" PVC square guard detector(2) and an anti-coincidence circuit to minimize the cosmic and background radiation contributions.

The present version of the detectors structure is based on the principle of one strip of stainless still anode wire. This technique leads to easier manufacturing and assembly and only two solders are needed in the wire's edge. It also improves the detector's response - the high voltage plateau is larger. Fig 2 shows the structure of the two detectors.

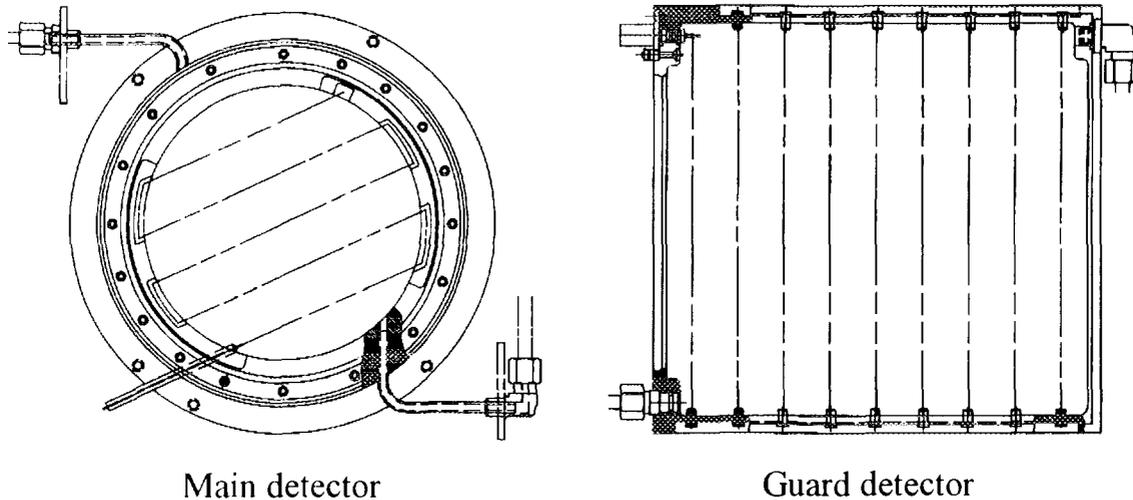


Fig 2: The structure of the main and the cosmic-ray detectors

The detectors are mounted in a manual sample changer(3) that was designed for low background, therefore it has a 5 cm overlapping lead bricks that can easily be taken apart. Most of the changer parts are made of low background copper. The sample is positioned on an aluminum planchette of 4.5" diameter which is placed in front of the detectors by a moving tray. The tray is inserted manually towards the detector and at the end point the sample is lifted towards the detector to improve the counting efficiency.

The electronic unit(4) operates a set of functions selected by two digit switches located on the front panel. Some functions including high voltage adjustments, calibration and background parameters changing and alarm thresholds are enabled only by a switch-key to prevent non permitted setting. Most of the functions lead the operator step by step for simplicity of operation. The counting principle for Alpha and Beta radiation is based on alternate changing of the high voltage supplied to the detectors, counting first in the Alpha mode and then in the Alpha+Beta mode. From the counting data the Alpha and Beta net cpm are calculated after background subtraction and taking into consideration the Alpha rate contribution in the Alpha+Beta one. The final activity results are compared to the system's minimum detectable activity.

Several counting systems were built and are in routine use for about a year at the Health Physics department of the NRCN. Further development is planned as connecting a computer to the system which will enable more extensive calculations and statistical evaluations. In addition, the development and

assembly of a sandwich detector(5) for simultaneous Alpha and Beta detection is considered.

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