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A MODIFIED ALPHA COUNTING SYSTEM

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Introduction.

Papers by Huntley (1977 and 1978) discussing the effect of reflectivity of samples and by Sasidharan et al. (1978) discussing the Th/U ratio indicate some of the current problems in thick-source alpha counting of pottery. This paper describes a modified alpha counting system which is being used to avoid the former problem and investigate the latter.

Apparatus.

A conventional single channel system, similar in many respects to that described by Huntley (1977) has been modified by the addition of a four channel counter in parallel with the existing discriminator. This means that the count-rates at different electronic thresholds can be measured simultaneously. The unit comprises four discriminators and counters operating in parallel and multiplexed to the same seven segment display. Switching has been incorporated to move all four counting thresholds by a preset amount, giving a further set of four points. A pairs counter was also built into the unit. Schematic diagrams of the unit are shown in figures 1 and 2. In one set of measurements we are able to obtain the count-rate at five discriminator settings. The zero threshold count-rate is obtained by extrapolation of a least squares fit to the data.

Results.

Figure 3b shows the effect of variation of photomultiplier EHT on the count-rate observed. Figure 3c shows the effect of using phosphors with different light yields. The count-rate axis intercept is independent of both these factors.

The unit is currently undergoing tests with standard radioactive sands (figure 3a; NBL dunite-based standard sands kindly supplied by Dr. M.J. Aitken). As with Huntley, we found good agreement (within several percent) between our measured and theoretical count-rates. (Internal Lab. Report No. 9).

In addition, we attempted to manufacture a series of thorium sources (ranging in thorium concentration from 0.2% to 4.5% by weight) utilizing a support matrix with an effective Z nearer to that of pottery. The sources were manufactured by the evaporation of a solution of aged thorium nitrate onto a form of powdered silica. The correlation between thorium concentration and count-rate was not good enough (linear within $\pm$ 15% limits) to distinguish any systematic difference between measured and theoretical count-rates. We attribute the scatter in the results to the difficulty in producing a homogeneous source.

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The counter is being used to investigate a method of determination of Th/U ratio proposed by Pierson (1951). In studying a number of radioactive ores he found a linear correlation between a 'count-ratio' function (derived from the gradient of a count-rate vs discriminator voltage plot) and Th/U ratio. Using such an energy discrimination method he was able to determine Th/U ratio's within ± 5% in normal counting periods. Our preliminary results from pottery samples indicate that there is a correlation between Th/U ratio and intercept on the discriminator voltage axis.

Conclusion.

The four channel counter can be built at moderate cost (< £100) and uses components readily available. The results are independent of electronic gain and figure 3c indicates that the method is independent of sample reflectivity as would be expected.

References.

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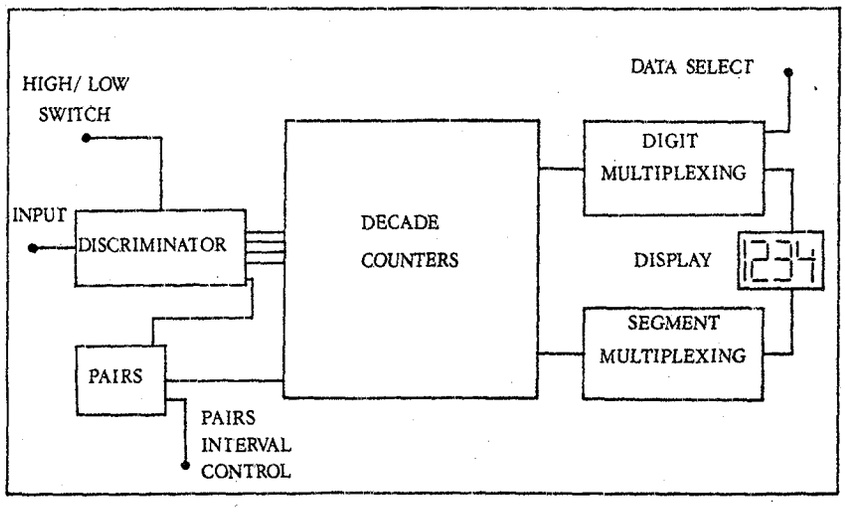

Figure 1 Schematic diagram of Four Channel Counter

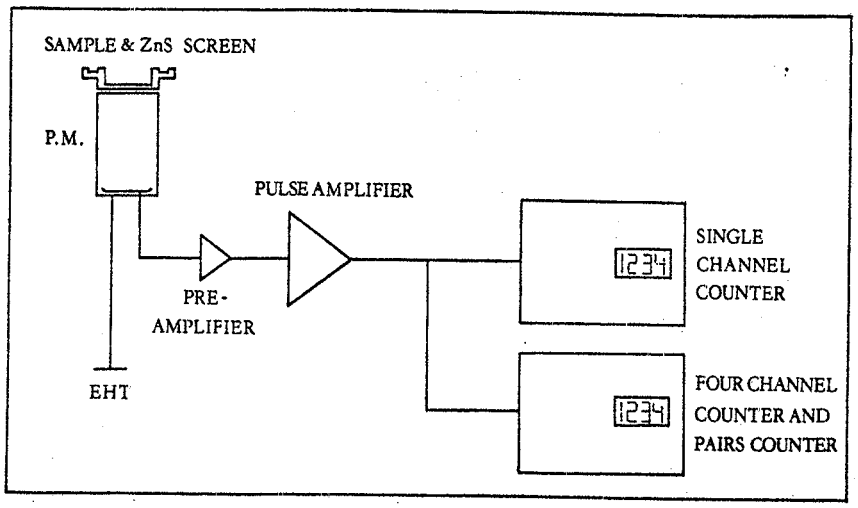

FIGURE 2 The modified Alpha counting system

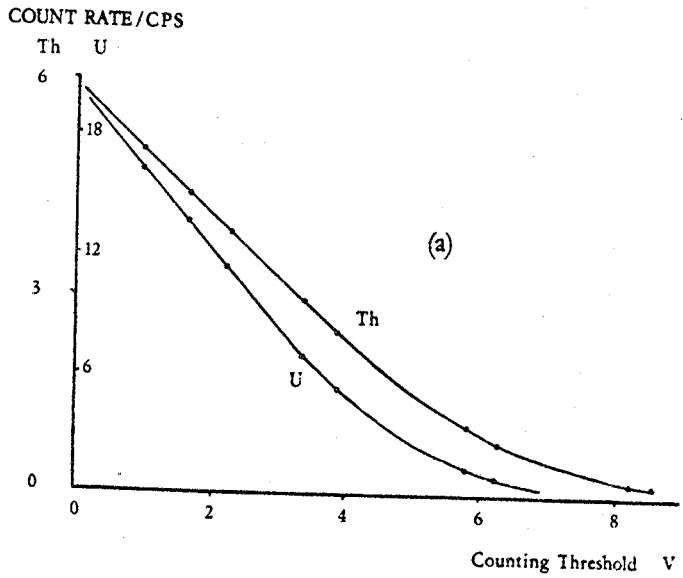

Fig. 3.

(a) Thorium and uranium spectra from standard sands using Levy-West G345 ZnS on sellotape.
(b) The effect of E.H.T. changes in the photomultiplier supply: thorium source.
(c) Different phosphors have different light yields: a comparison of Levy-West G345 ZnS using an epoxy resin encapsulated thorium source.