

DIGITAL STABILIZATION OF THE 25 MeV γ -RAY SCINTILLATION SPECTROMETER

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Measuring prompt γ -ray spectra from the radiative capture of 14 MeV neutrons with the Telescopic Scintillation Pair Spectrometer (TSPS)¹⁾ one is faced with the problem of photomultiplier (PM) instability caused mainly by high ($\approx 25 \mu\text{A}$) anode current. In this report the stabilizing system consisting of fast (nanosecond) pulsed light emitting diode (LED) and on-line computer CDC 1700, which controls the PM high voltage supply, is presented.

In the literature several stabilizing devices, based as the present one on the feedback control of the reference peak, are described^{2,3,4,5)}. Recently the reference peak in high energy γ -ray spectrometers is obtained from a pulsed light source - LED.

In our case the problem is specific in that the spectrometer consists of plastic scintillator as a pair detector and nanosecond electronics. Therefore the LED pulses must also be fast. Satisfactorily good results were obtained by using Monsanto MV10B light emitting diode and 1900A Hewlett Packard pulse generator. The 20 ns wide pulses corresponding to ~ 30 MeV electron energy resulted from trigger pulses of ~ 200 mA which is the maximum output of the mentioned pulse generator.

The intrinsic stability of the light peak was controlled by comparing its position to the position of the 11.7 MeV line from the reaction $^{11}\text{B}(p,\gamma)^{12}\text{C}$ at 162 keV proton resonance and was found to be $\pm 0.5 \times 10^{-3}$ within 2 hours. The resolution of the line is 5% at FWHM.

To get the signal for the stability control we monitor the number of pulses appearing in the preselected number of channels (window) on both slopes of the LED peak. The sum of pulses appearing in the window drive the integral scaler. A difference scaler records the difference between the number of pulses in the upper and the lower window. If the differential counts reach a pre-established value $\pm D$ before or at the same

time as the integral counts reach their pre-established value I scaler are immediately reset to zero and a gain adjustment of appropriate sign is made. If I is reached before D both scalers are reset without a gain adjustment. According to R. A. Dudley⁶⁾ we put $D = I = 1$.

In our spectrometer circuit, we would like to control automatically also sudden changes, which are too fast for the stabilizing system to be effective. For this reason we use a clock sending interrupts to the computer in constant time intervals (say 30 s) which start a special testing program. The sum of the pulses under the reference peak is compared to the pre-established number of pulses. If the difference is zero or negative, discrete gain drift is recognized and the processor stops the measurement. Before that the special program for recording the digital feedback signal for PM high voltage supply is activated.

The block diagram of the spectrometer and the stabilization system is shown in Fig. 1. The effect of the stabilizing system was studied by the observation of the gain change of the 56AVP at sudden removal of the neutron flux resulting in the reduction of the average anode current from 25 μA to zero. Stabilizing circuit reduces this change from about 5% to much less than 1%.

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