SHORT COMMUNICATIONS

PERFORMANCE OF 56 AVP PHOTOMULTIPLIER

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Nuclear particle detection requires usually a good energy resolution as well as a high detection efficiency[1]. A high time resolution is essential in fast coincidence experiments which require fast scintillator, fast photomultiplier, and fast discriminator. Fast coincidence system using 56 AVP photomultiplier and Natan 136 plastic scintillator was studied by Swarzschild[2]. Bellettinie *et al*[3] have studied the effect on the gain and linearity of the 56 AVP of the variation in the inter-dynode voltages. Hyman *et al*[4] have given the technique of optimising the pulse shape and linearity of the tube.

In our present experiment, we have used 56 AVP photomultiplier with equiangular spiral light guide and NE 104 plastic scintillator. The performance of the light guide has been described by Mishra[5]. The photomultiplier circuit as shown in figure uses damping resistors in the anode and the last dynode chain. These resistances were required for optimising the pulses and avoiding their ringing. The fast detection system was used in recording coincidences of ^{144}Ce, the results of which are described elsewhere[1].

Theoretical calculations[6] indicate that the major time-spread originate in the region between the scintillator and the first dynode, where the number of the photo-electrons is small. The circuit was therefore designed to investigate the low energy beta-rays.

The current flowing through the potential divider chain was nearly 1.25 mA. The voltage between the cathode and the first dynode is kept three times that of the voltage per stage in order to get better collection efficiency. The variable voltages Vd_3-d_2, Vd_1-d_2 and V_g-k act as fine and coarse control respectively. These controls are adjusted for a maximum anode output. Energy signals are taken from the 10th dynode with a 100 Ω load resistor. They are required for the spectral analysis by fast and slow coincidence technique[1]. The anode load was kept at 100 Ω to match the impedance of the transmission cable. The 20 Ω damping registors were included in both the anode and the last dynode potential divider chain. This was to reduce the ringing of the output pulses. The rise time of the anode output pulse was 2 ns and the FWHM of the pulse was estimated to be 8 ns. In order to avoid the electric field disturbances in the electron-optical system, the external conducting coating (shown by dotted line in figure 1) is connected to the cathode potential which is earthed. The last stages of the tube were decoupled by capacitors to prevent serious voltage drops across the dynodes. During the experiment, the EHT on the photomultiplier is kept at 2.2 kV.

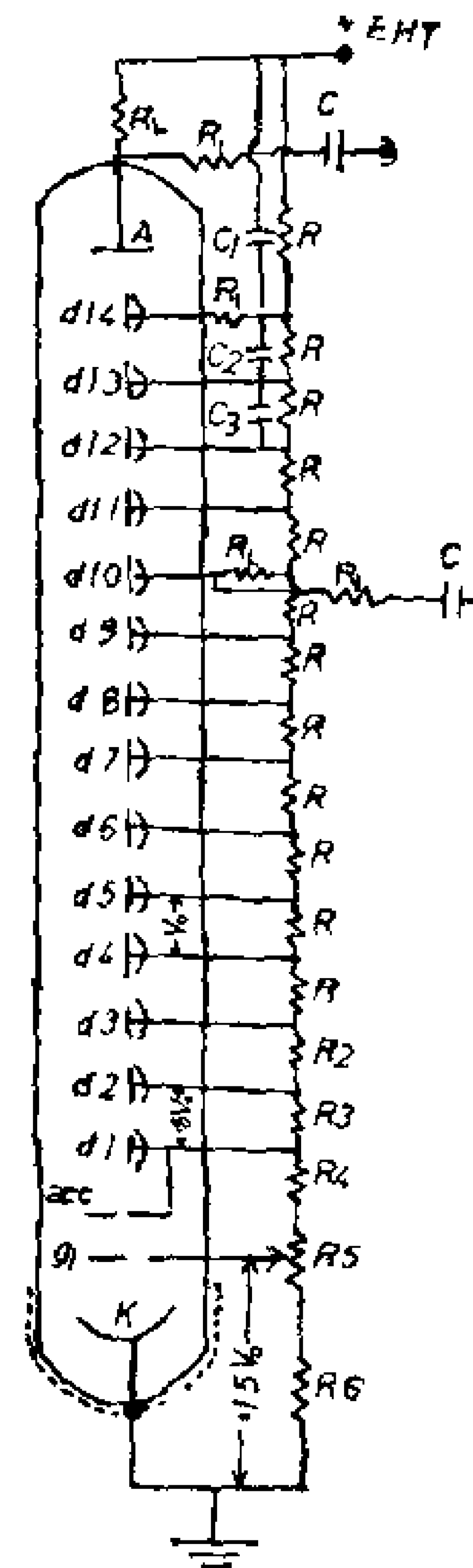

Figure 1. The photomultiplier circuit.
$C_1 = C = 5000$ pF, $C_2 = 100$ pF; $C_3 = 50$ pF.
$R_L = 100\Omega$, $R = 120$ kΩ, $R_1 = 20\Omega$, $R_2 = 50$ kΩ.
$R_3 = 68$ kΩ, $R_4 = 330$ kΩ, R_5 kΩ, $R_6 = 5.6$ kΩ.

The basic aim was to look for the suitability of the tube for the analysis of low energy β-ray lines. The problem was to resolve the closely spaced low energy weak satellite of 33 keV gamma transition of ^{144}Pr[1] for which a high resolving time of the coincidence system was inevitable. With photomultiplier in circuit, the resolving time of the system was estimated to be $2T$ = 14 ns[7]. This was found compatible for the analysis of the low energy conversion electron lines[1].

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RADIATION RESISTANCE OF CORNER-DRIVEN LOOP ANTENNA IMMERSED IN A TWO COMPONENT WARM PLASMA

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Loop aerials of different types are widely used for satellite communications and rocket-probe studies in the ionosphere. They are simple in construction, and more efficient than conventional dipoles of similar dimensions. Theory of radiation from a corner-driven loop and an Alford loop aerials immersed in one component electron plasma was developed[1,2]. Theoretical study of an Alford loop in two component warm plasma is reported recently[3]. The radiation characteristics of corner-driven loop antenna has not yet been studied in two component warm plasma. The purpose of this note is to compare the theoretical values of the radiation resistance of the corner-driven loop with the experimental observations of the loop used on Ariel-3 satellite and the theoretical results from an Alford loop aerial in an electron-ion warm plasma.

The current on a corner driven loop shown in figure 1a, with a travelling wave distribution and negligible attenuation can be written

$$I(s) = I_0 \exp(-j\beta s) \tag{1}$$

where β is the propagation coefficient of the current on the wire, and s is the distance along the aerial. The loop is small compared to the wavelength, equation no. 1 gives a constant current distribution. Using linearised hydrodynamic theory in conjunction with the Maxwell's equations and the force and the continuity equation, following are the expressions for the electromagnetic and plasma wave components of the radiation resistance of the aerial in the two component warm plasma:

$$R_e = \frac{480\, a^2 \sin^2\delta}{\pi A} \int_0^{\pi}\int_0^{2\pi} \frac{\sin^2\frac{\beta l}{2}(1-a\cos\theta_1)\sin^2\frac{\beta l}{2}(1-a\cos\theta_2)}{(1-a\cos\theta_1)(1-a\cos\theta_2)} \times\left[1-\frac{(1-a^2)\sin^2\varphi\sin^2\theta}{(1-a\cos\theta_1)(1-a\cos\theta_2)}\right]\sin\theta\, d\theta\, d\varphi \tag{2}$$

$$R_{pj} = \frac{\omega_{pe}^2(1-\alpha_j)^2}{\omega\pi^2 u_e^2 \epsilon_0 \beta_{pj}(1+\alpha_j^2)} \int_0^{\pi}\int_0^{2\pi} \sin\theta\, d\theta\, d\varphi \; (1-b_j\cos\theta\cos\delta)\sin\beta l(1-b_j\cos\theta\cos\delta) \times\left[\frac{-(b_j\sin\theta\sin\delta\sin\varphi)\sin\beta l(b_j\sin\theta\sin\delta\sin\varphi)}{(1-b_j\cos\theta_1)(1-b_j\cos\theta_2)}\right]^2 \tag{3}$$

where θ and φ are the azimuth and zenith angles of the spherical polar coordinate system, centred on the aerial and $a, \alpha_j, \beta_{pj}, b_j$ have the same values as defined in earlier paper[3].
and

$$\cos\theta_1 = \cos\delta\cos\theta + \sin\theta\sin\delta\sin\varphi$$
$$\cos\theta_2 = \cos\delta\cos\theta - \sin\theta\sin\delta\sin\varphi \tag{4}$$

the total radiation resistance R_T is given by

$$R_T = R_e + R_{pj} \qquad (j = 1, 2) \tag{5}$$