

negative zero energy, and therefore no thermal equilibrium of the apeiron is possible. This does not seem to us to be a real difficulty, because a set of electrons left to themselves is not in equilibrium. Electric clouds like those in metals exist only on account of the fact that in this case the interaction energy with other particles (which is omitted in our considerations) is large compared with the thermal energy.

Investigations on the application of this theory to the elementary particles, their masses and their mutual collision cross-sections are in progress.

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¹ *Proc. Roy. Soc. Edinburgh* (in the press).

Rate of *n*-fold Accidental Coincidences

THE rate of accidental coincidences between two Geiger counters is given by $R_2 = 2.N_1.N_2.t$, where N_1, N_2 are the rates of the two single counters and t is the resolving time of the recorder. This formula is sometimes generalized for *n*-fold coincidences as $R_n = N_1.N_2 \dots N_n.(2t)^{n-1}$. This formula is, however, incorrect and it should be replaced by

$$R_n = n.N_1.N_2 \dots N_n.t^{n-1} + \text{terms in } t^n. \quad (1)$$

As the formula for the rate of accidental coincidences is of practical interest, and I have not come across its derivation, a short explanation follows.

Consider a pulse of the counter 1 at the time 0. A necessary condition for this pulse to be recorded as an *n*-fold coincidence is that in the interval $\pm t$ each of the remaining *n* - 1 counters gives rise to at least one pulse. Neglecting all but the lowest power of *t*, the probability for this is

$$P = N_2.N_3 \dots N_n.(2t)^{n-1} \dots \quad (2)$$

The pulse of the first counter, together with the *n* - 1 pulses of the other counters, only gives rise to a coincidence if the interval between any two of the pulses is less than *t*. The probability *Q* that *n* - 1 pulses of the counters 2, 3 . . . *n* all inside the interval $\pm t$ are suitably arranged to give a coincidence is estimated as follows.

The *n* - 1 pulses may all be in the interval 0 - *t*. The probability for this is

$$Q_1 = 2^{-(n-1)}.$$

In this case the pulses give rise to a coincidence.

Alternatively, the first pulse *x* of the group may be in the interval $-t', -t' + dt'$ and the remaining *n* - 2 pulses inside the interval $-t', -t' + t$. The probability for this is $(n-1) (dt'/2t) 2^{-(n-2)}$; the pulses again give rise to a coincidence. The probability for a coincidence while some pulses are in the interval $-t$ to 0 is thus

$$Q_2 = \int_{-t}^0 (n-1) 2^{-(n-2)} \frac{dt'}{2t} = (n-1) 2^{-(n-1)}.$$

The total probability is

$$Q = Q_1 + Q_2 = 2^{-(n-1)}.n \dots \quad (3)$$

Thus the probability that *n* - 1 pulses fall into the interval $\pm t$, and that these pulses are suitably arranged to give a coincidence, is found from (2) and (3) as

$$P.Q = n.N_2.N_3 \dots N_n.t^{n-1}.$$

The above expression multiplied by N_1 gives equation 1.

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Comparison of the Behaviour of Rubber-like Materials under Constant Stress and Constant Strain Conditions

MANY experimental data have been published substantiating the use of the Nutting equation,

$$\psi = S^\beta \sigma^{-1} t^k,$$

where *S* is shear stress, σ is strain, β, k and ψ are constants, when a series of constant stress experiments is performed. Our own as yet unpublished results confirm the equation over an even wider range of materials.

For relaxation experiments, test pieces are given a definite strain as rapidly as possible, the resulting internal stress being then allowed to dissipate with no more change of strain than is required to operate a strong spring whose deflexions, which record the stress, can be read by optical magnification.

According to Maxwell's equation¹, the rate of stress dissipation should be proportional to stress itself, but many authors have shown that this is not so for most complex materials. Simha^{2,3}, notably, has discussed whole spectra of relaxing systems each of which is Maxwellian and has its characteristic relaxation time (t_r).

The appropriate fractional differentiation of Nutting's equation gives

$$\left(\frac{\partial S}{\partial t}\right)_\sigma = -\frac{k S}{\beta t}.$$

Maxwell himself suggested that in complex materials t_r might well be a function of *S*, and the above equation is perhaps the simplest expression of this suggestion, since t_r is proportional to a power of the stress.

We have investigated a number of rubbers and rubber-like materials in tension and a few in compression, and with the exception of some very soft materials, find little if any deviation from linearity when log *S* is plotted against log *t* for a series of

