REMARKS ON THE ARTICLE BY COOPER AND GROSSART, "TIME DELAYS IN INTERNAL ELECTRIC BREAKDOWN OF SOLID DIELECTRICS"[1]

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In the breakdown of the ionic crystals NaCl, KCl, and KBr under 1/5000 microsecond pulses, Cooper and Grossart[1] obtained anomalously large delay times for the discharge, of the order of 10^{-6} to 10^{-5} seconds. In our opinion, this result followed from deficiencies in the method of investigation. In the first place, a test made by the full-wave method (repeating the voltage pulses with increasing amplitudes) may lead to an incomplete breakdown if the field is not sufficiently uniform.[2] In this case, there would be a distortion of the field within the dielectric. In addition, when a 1/5000 microsecond pulse is used, and especially when several such pulses are repeated, the voltage is applied to the dielectric for a considerable time, which may lead to the introduction of various secondary factors, such as heating effects, etc.,[3] which complicate the interpretation of the results.

In determining the delay time for discharges in ionic crystals it is sounder to make the test by means of individual rectangular voltage pulses with amplitudes exceeding the breakdown voltage by, say, 10, 20, 30%, and so on. Experiments which we have carried out in this way on NaCl samples 0.12 mm thick, in a uniform field at 20% over-voltage, gave time delays of the order of 4 to 5×10^{-8} seconds. Experiments with repeated rectangular voltage pulses (rise time of the order of 3×10^{-8} sec), of uniform amplitude somewhat below the breakdown value, showed that the effect of each successive pulse was to lower the electric strength, and that the breakdown took place, not at the first pulse, but at the n-th, where n has been found to range from 2 to 81.

In the article cited, the authors do not give the values of electric strength for the dielectrics they studied, nor do they show how they measured the time delays from the oscillograms and the pulse repetition rate, which limits the value of their paper.

[1] R. Cooper and D. T. Grossart, Proc. Phys. Soc. 69, 1351 (1956).
[2] A. Walter and L. Inge, J. Tech Phys. (U.S.S.R.) 1, 389 (1931).
[3] F. Lehmhaus, Arch. Elektr. 32, 281 (1938).

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THE n-ELECTRON GREEN'S FUNCTION IN THE BLOCH-NORDSIECK APPROXIMATION

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On the basis of the results of Schwinger[1] one can write for the n-electron Green's function G_n in the Bloch-Nordsieck[2] approximation, i.e., after replacing the matrices γ^μ by c-numbers, the following equation:

$$\left\{iu^\mu \partial/\partial x_1^\mu - m + \sqrt{4\pi} e u^\mu A_\mu(x_1) + i\sqrt{4\pi} e u^\mu \int D_{\mu\nu}(x_1, \xi) \frac{\delta}{\delta A_\nu(\xi)} d\xi \right\} G_n(x_1, \ldots, x_n;\; y_1, \ldots, y_n \mid A)$$
$$= -\sum_{P} (-1)^l \delta(x_1 - y_j)\, G_{n-1}(x_2, \ldots, x_n;\; y_{j+1}, \ldots, y_n, y_1, \ldots, y_{j-1} \mid A), \quad (1)$$