(4) The lifetime of the V_1^0 is $(10\pm7)\times10^{-10}$ second and the lifetime of the V_2^0 is $(4\pm3)\times10^{-10}$ second. The errors given are statistical variances, not probable errors, and the calculated values depend quite strongly on the assumed mass of the unstable particle. If the V_2^0 actually decays into a π-meson and a meson of intermediate mass,[15,16] which would be quite consistent with our data, the lifetime would of course be different.

(5) Three pairs were observed. Only one allowed classification of both its members, one of which turned out to be a V_1^0 and the other a V_2^0. This frequency of observation contradicts the hypothesis that V^0's are created only in pairs, unless one V^0 usually has a value of $\beta\gamma$ from 5 to 10 times as large as the other.

(6) The data do not preclude interpretation by means of a three-particle decay scheme, one of which would be a neutrino.

It was not possible to deduce from the angle between the decay plane and the plane of the V^0 and the primary whether or not the V^0 was consistently emitted with a high angular momentum. Nor was it possible to connect the type of V^0 emitted with the type of primary causing the initial event.

[16] Report from Copenhagen Conference, June, 1952.

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Enhancement of the Green Continuum of Hg by a Rare Gas

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The green continuum of Hg vapor in a low current, positive column discharge has been found to be greatly enhanced by the presence of a considerable pressure of a rare gas (e.g., 50-mm argon). The effect is most striking for lower Hg pressures (e.g., at 50°C). At 215°C the light efficiency of the continuum reaches 41 lu/w. The continuum extends from 4000 to 6400A; its maximum occurs at 5130A at 115° and shifts toward the violet at higher temperatures. Very small amounts of gas impurity, e.g., 40 parts per million of N_2 increase the brightness and also the voltage; larger amounts, e.g., 150 ppm N_2, quench the brightness almost completely.

THE green and ultraviolet continua of Hg as excited in a low current discharge were first studied by Rayleigh.[1] Volkringer[2] excited the bands with an electrodeless discharge. The requisites for strong continua are a low current (~1 ma) and an elevated Hg pressure (e.g., 200°C).

We have found that the addition of a rare gas (e.g., 43-mm argon) brings out the green, so-called 4850, band strongly at as low as 60°C (hot cathode, $\frac{1}{2}$-ma positive column, $1\frac{1}{2}$-inch tube). At 100°C the line spectrum is nearly gone (see Fig. 1, curve *A*). Without the argon, curves *B* and *C* show that the continuum is very weak relative to the lines at 100°C and only moderately strong at 180°. 4916 and 5770–90 tend to persist. Curve *D* shows the continuum excited optically.

Approximately true light intensity distributions for two different temperatures are shown by Fig. 2. They agree sufficiently with Volkringer's[2] distribution, and show the band extending from 4000 to 6400A, much further than is commonly recognized. At 115° the maximum is at 5130A and shifts toward the blue at higher temperatures.

The brightness of the continuum increases rapidly with Hg temperature up to ~210°, where arc constriction sets in and the lines appear. Thus with 55-mm argon the brightness of a 0.25-ma discharge increased 250-fold from 75 to 215°. Meanwhile the voltage rose from 115 to 470 (arc length 10 cm). The light efficiency of the discharge at the higher limit was measured as 41 lu/w.

From 10 to 60 mm argon and, e.g., at 160°C, the brightness and voltage increase roughly in proportion to p; below 10 mm the brightness decreases rapidly.

The other rare gases yielded qualitatively similar results; Xe in particular gave about the same efficiencies as argon.

The brightness is very sensitive to impurities. So far, and unless otherwise stated, all results deal with "spectroscopically pure" argon containing 30–50 parts per million of N_2. Removal of most of this N_2 was found to lower the brightness to less than half and decrease the voltage 25 percent. Maxima in both brightness and voltage occur around 50 ppm N_2; beyond this the brightness drops rapidly to a few percent at 150 ppm N_2. A drop in voltage beyond the maximum may be due to one or more of several causes not discussed here. The initial rise in brightness is closely related to the increase in voltage whatever the impurity (e.g., H_2O, CO_2).[3]

With a well-developed continuum (100°C), strong

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[1] Lord Rayleigh, Proc. Roy. Soc. (London) **A114**, 620 (1927).

[2] H. Volkringer, Ann. phys. **10**, 14, 15 (1930).

[3] C. Kenty, Phys. Rev. **80**, 95, 96 (1950).

irradiation[3] with visible Hg lines had a negligible effect on voltage. Also the discharge showed negligible absorption[3] for 5461. These results indicate negligible concentrations of metastable Hg atoms.[3]

With commutator and sectored disk, the continuum was found to decay with a half-life of ~2 msec (55 mm argon, 100°C) in agreement with results of Rayleigh[1] and Holstein, Alpert, and McCoubrey.[4] Such a decay time and the measured brightness yield a relatively high concentration of emitters, 5×10^{11} cm^{-3}. Mobility considerations indicate ~10^9 electrons cm^{-3}.

According to Mrozowski[5] the emitters are $A^3\Sigma_u^-$ Hg_2 molecules ($6^3P_0+6^1S_0$). The upper metastable state

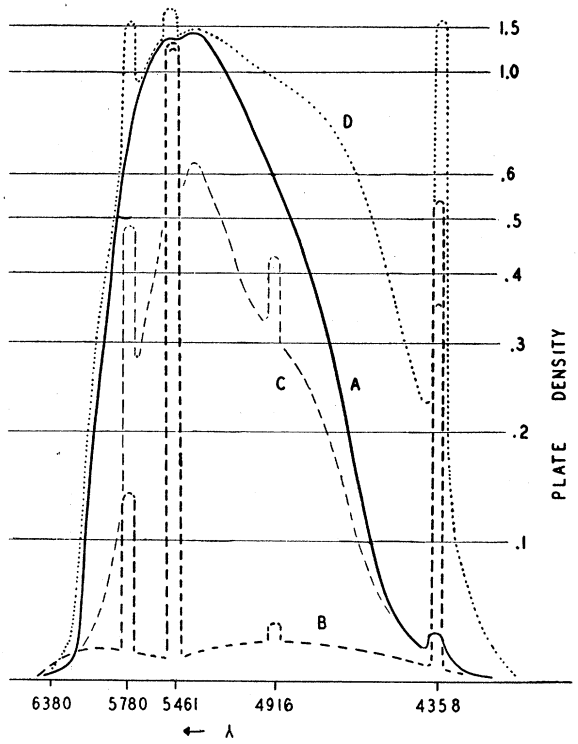

FIG. 1. Densitometer traces of panchromatic film spectrograms of green continuum. *A*, 43 mm argon, 100°C, 0.5 ma; *B*, no argon, 100°C, 0.5 ma; *C*, no argon, 180°C, 0.3 ma; *D*, no argon, 270°C, optically excited through quartz by low pressure Hg lamps. The curves have no absolute significance.

[4] Holstein, Alpert, and McCoubrey, Phys. Rev. **76**, 1259 (1949); Alpert, McCoubrey, and Holstein, Phys. Rev. **76**, 1257 (1949).

[5] See, for example, W. Finkelnburg, *Kontinuerliche Spectren* (Verlag. Julius Springer, Berlin, 1938), Sec. 60.

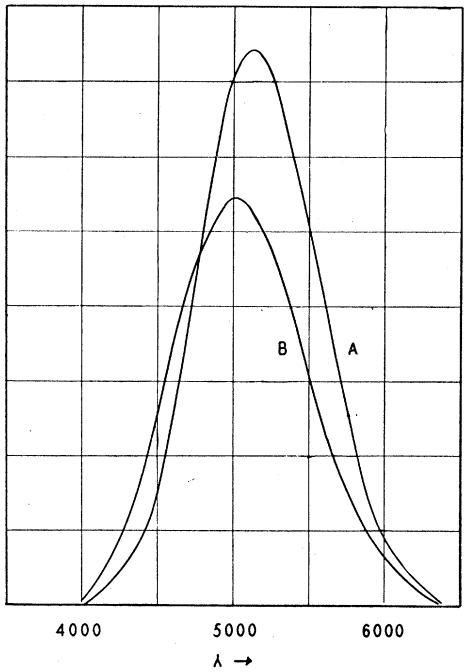

FIG. 2. G.E. recording microphotometer tracings of green continuum with 55 mm argon. *A*, 0.5-ma discharge at 115°C; *B*, 0.25-ma discharge at 200°C.

(6^3P_2) forms $B^3\Pi_u$ and $B^3\Sigma_u^-$ molecules,[5] the latter of which is metastable. The initial increase of voltage due to impurity would indicate, following earlier results,[3] that the ionization is largely two-stage and that these molecules from 6^3P_2, especially $B^3\Sigma_u^-$ (and possibly to some extent 6^3P_2 itself), figure importantly in the two-stage process, being destroyed[3] by N_2. The increase in brightness, as in earlier experiments,[3] could then be due to enrichment by N_2 of $A^3\Sigma_u^-$ from 6^3P_2 and its molecular states and also[6] 6^3P_1. A lot of N_2 evidently destroys[7] $A^3\Sigma_u^-$.

With 50 ppm N_2 the ionization is assumed to be two-stage involving almost entirely $A^3\Sigma_u^-$. Very few electrons evidently reach the 7.74 v energy necessary to excite 7^3S_1 from normal. Evidently also this state is hardly produced from $A^3\Sigma_u^-$ by electron collision.

It is assumed that the argon functions by reducing loss of Hg_2 molecules to the walls, and possibly assisting in their formation.

[6] E.g., G. A. Rosselot, Phys. Rev. **49**, 871 (1936).

[7] See Foote, Ruark, and Chenault, Phys. Rev. **37**, 1685 (1931).