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LETTER TO THE EDITOR

Excitation functions of the triplet lines 4713 and 5876 Å of helium measured with low energy electrons

Lately excitation functions have drawn renewed attention, both from the theoretical side (1), (2), and from the experimental side (3), (4), (5). This incited us to start new measurements of the "optical" excitation functions of helium levels.

Sensitive photoelectrical equipment now available makes it possible to measure these excitation functions with greater precision and at lower pressure and smaller electron-beam currents than formerly (8), (9).

We have made preliminary measurements on the optical excitation functions of the 4^3S and 3^3D levels, specifically the 4713 Å (4^3S-2^3P) and the 5876 Å (3^3D-2^3P) lines. Only the low voltage part has been measured. The functions found exhibit a detailed structure (fig. 2 and 3) similar to that observed by Smit and Jongerius (4), (5) for Hg.

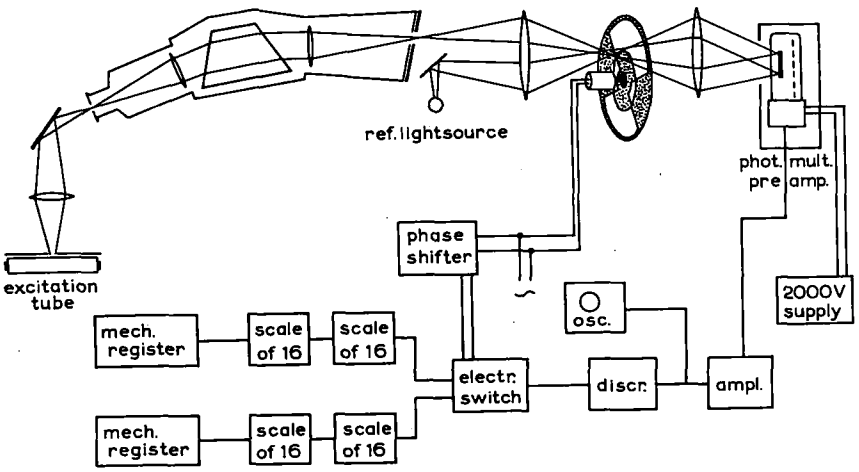

Fig. 1. Schematic diagram of the photon-counter. During the measuring time (one to three minutes) the helium light and the reference light are interrupted by a rotating light chopper, so that they enter the photomultiplier alternately during 1/100 sec.

A description of the construction of the excitation tube used may be found in ref. (4). For our measurements the tube was filled with helium at a pressure of approximately 10^{-2} mm Hg. The electron-beam current was 5–10 μA. A medium size glass spectrograph with an aperture of 1/6 and a dispersion of about 0.05 mm/Å was used as a monochromator. The entry-slit width was about 1 mm, and an exit-slit of about 2 mm was added.

The light intensity was measured by means of a photon counting device as described

in (7). As an example of the sensitivity achieved, it has been possible to measure a radiation flux of aproximately 400 photons/sec at 4000 Å and of 4000 photons/sec at 5800 Å on the photocathode of a RCA 1 P 28 photomultiplier tube with an accuracy of 5% rms in a measuring time of 5 minutes. Usually light intensity and measuring time were chosen such that the accuracy was better than 3%.

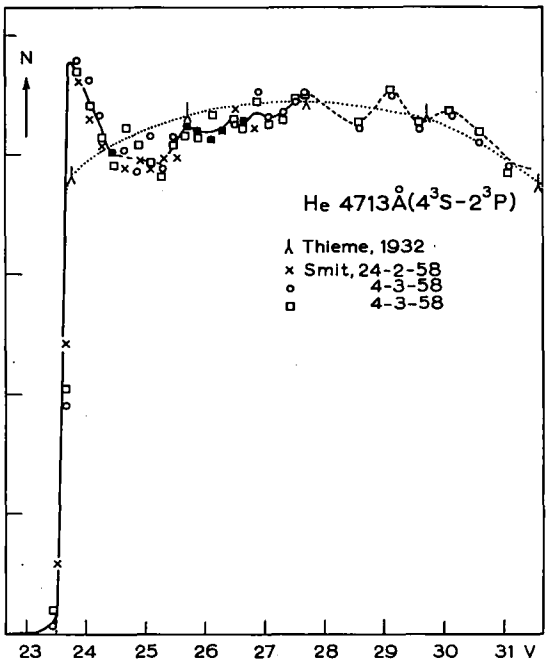

Fig. 2. Excitation function of the 4713 Å (4^3S-2^3P) line of He near threshold. N = number of photon counts per minute in arbitrary units. The curves of Thieme and Smit have been reduced to equal mean height (vertically) and shifted to excitation energy of 23.5 eV (horizontally).

Concerning the interpretation of the various maxima, two possible explanations may be mentioned:

1. A level is not only filled by direct excitation from the ground state, but also from higher excited states falling back in a cascade. If the excitation function of each of these levels has only one maximum, and these maxima lie at different energies, then the excitation function of the line will represent all these maxima. This hypothesis is strengthened by the fact that the spacings between three of the maxima in Fig. 3 correspond roughly to the known spacings between higher triplet levels in He.

2. Resonance with levels of the He^-ion are possible as well (2). In that case the form of the excitation function near a maximum is determined by the wellknown Breit-Wigner formula.

Observed spacing		Level spacing	
b—*c*	0.6 V	3^3D-4^3P	0.52 eV
		3^3D-4^3F	0.67 eV
b—*d*	1.0 V	3^3D-5^3P	0.95 eV
		3^3D-5^3F	0.97 eV

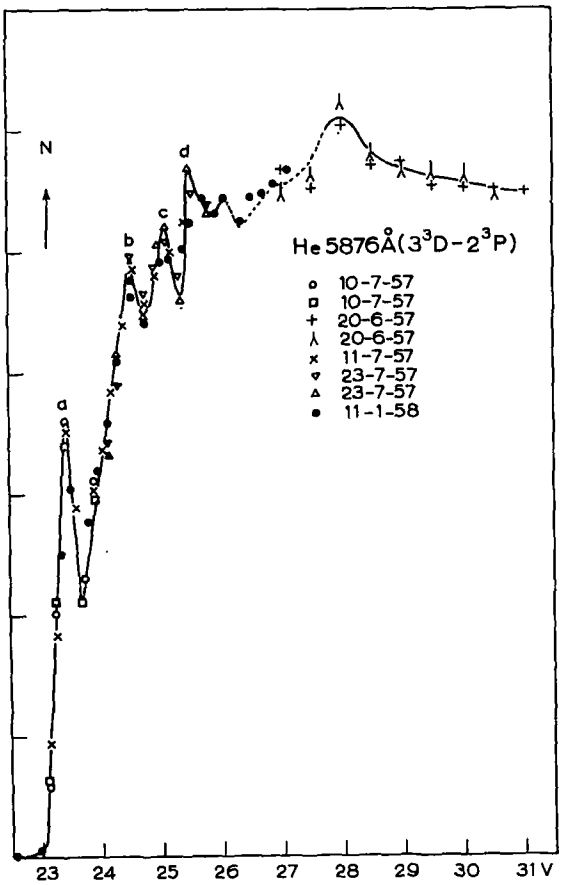

Fig. 3. Excitation function of the 5876 Å (3^3D-2^3P) line of He near threshold. N = number of photon counts per minute in arbitrary units. The results of different series of measurements have been reduced to equal mean height (vertically) and shifted to excitation energy of 23.0 eV (horizontally).

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