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THE NEW DETERMINATION OF THE L-SHELL FLUORESCENCE YIELD OF KRYPTON*

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Applying the proportional counter technique with internal gaseous fluorescer the average L — shell fluorescence yield of krypton was redetermined as

$$\bar{\omega}_L = 0.021 \pm 0.002.$$

The result is compared with the theoretical value obtained for the same primary vacancy distribution.

1. *Introduction*

The L-shell fluorescence yield of Kr has been studied theoretically and experimentally. The theoretical values of Mc Guire[1] and Chen et al.[2] agree as far as relative values of the coefficients are concerned but differ significantly in absolute values. The experimetal data of Auger[3] and Bower[4] are not reliable enough to discriminate between theoretical results. The proportional counter method as

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applied to the study of the fluorescence yields of Xe[5] and Sn, Sb[6] seemed to be suitable for the redetermination of the average L-shell fluorescence of krypton and more reliable results were expected.

2. *Experimental procedure and results*

The special wall-less proportional counter with the central parts and the ring in anticoincidence operation was filled with 30 torr methane to which krypton was added with the pressure of 1 torr. The counter gas was irradiated with K-series X-rays of chlorine from the thin NaCl target irradiated by 900 keV proton beam at the exit of a Van de Graaff generator.

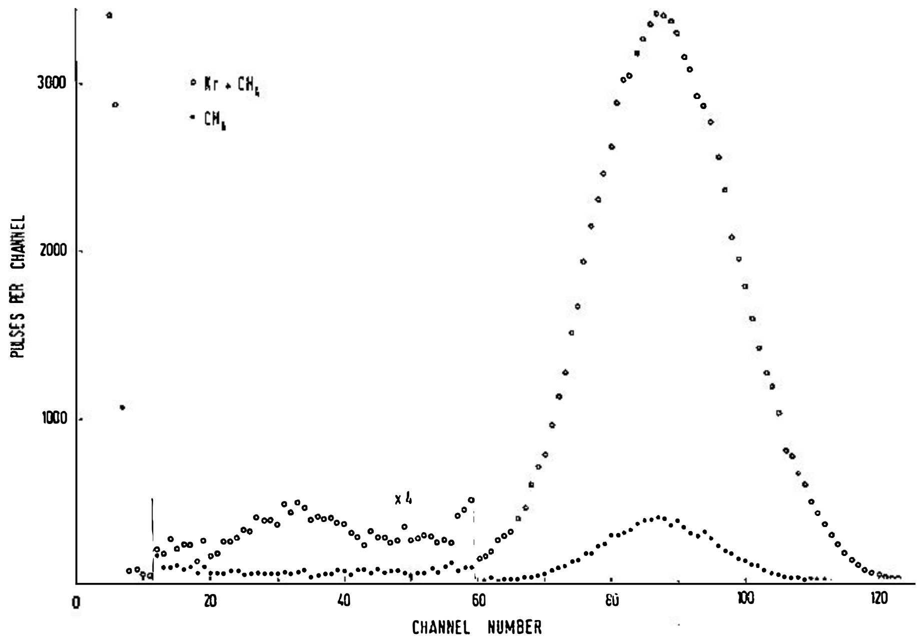

Fig. 1. The spectra of pulses from the proportional counter excited by chlorine K radiation.

The spectrum of pulses from the central counter is shown in Fig. 1. The pulses in the main peak at full energy can be partly attributed to photoelectric events in Kr L shell followed by Auger transitions and partly to photoelectric events in higher krypton shells as well as in methane, in both cases followed mainly by non-radiative transitions. The pulses in the escape-peak are due to photoelectric events in krypton L-shell followed by radiative deexcitations; fluorescent photons escape from the counter. The contribution of methane was studied separately with the counter filled with pure methane only.

The spectrum was analysed for the ratio $N_e/(N_e + N_m)$, where N_e and N_m are the numbers of counts in the escape and the main peaks, respectively. In order to exhibit the relative number of radiative transitions, the ratio has to be corrected for the absorption of the fluorescence photons in the main counter as well as in the ring. The counter filling assures the range of electron to be short in comparison with the dimensions of the counter, so the correction due to electron escape can be neglected. The photon-absorption correction ammounts to +8%, resulting in the value 0.018 ± 0.001 for the corrected ratio. The ratio is connected to the fluorescence yield $\bar{\omega}_L$ by the equation

$$(N_v/(N_e + N_m))_{\text{corr.}} = \bar{\omega}_L P_L$$

in which P_L represents the photoelectric absorption probability for the L shell as compared to atomic photoelectric absorption. It can be expressed by the subshell absorption jump ratios S_1,S_2 and S_3:

$$P_L = 1 - 1/S_1 S_2 S_3.$$

Taking S_1,S_2 and S_3 respectively as 1.14 ± 0.02, 1.39 ± 0.02 and 4.30 ± 0.03 (Ref. 7), we get $P_L = 0.85 \pm 0.02$ and finally average L-shell fluorescence yield

$$\bar{\omega}_L = 0.021 \pm 0.002.$$

In the separate experiment K radiation of potassium was used to excite the counter gas. The same value for $\bar{\omega}_L$ was extracted following the same procedure.

The theoretical values of $\bar{\omega}_L$ were calculated from the data in Refs.1 and 2 following the definitions in the review of Bambynek et al.[8]. Primary vacancy distribution was calculated for the case of photoelectric excitation:

$$n_1 = P_L^{-1} (S_1 - 1)/S_1 = 0.14$$
$$n_2 = P_L^{-1} (S_2 - 1)/S_1 S_2 = 0.29$$
$$n_3 = P_L^{-1} (S_3 - 1)/S_1 S_2 S_3 = 0.57.$$

The values $\bar{\omega}_L = 0.024$ and $\bar{\omega}_L = 0.012$ were obtained from the data of Mc Guire and Chen et al., respectively.

The experiment evidently supports Mc Guire's data. However, experimental data on separate subshell fluorescence yields are needed for the final judgement.

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NOVA DOLOČITEV FLUORESCENČNEGA PRIDELKA LUPINE L PRI KRIPTONU

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Originalno znanstveno delo

Z uporabo proporcionalnega števca z internim fluorescenčnim sevalcem je bil določen povprečni fluorescenčni pridelek lupine L pri kriptonu. Podana je primerjava med eksperimentalno vrednostjo $\bar{\omega}_L = 0.021 \pm 0,002$ in teoretičnimi vrednostmi za enako porazdelitev primarnih vrzeli.