USE OF THE HAUDSMITH – SAUNDERSON THEORY IN THE ENERGY RANGE 1-20 keV

G. E. Gorelik and S. G. Rozin

UDC 537.533.7

It is shown by means of numerical calculation that the series representing the Haudsmith –Saunderson function is asymptotic.

In calculations related with an investigation of the effect of electrons on matter one usually uses the Haudsmith–Saunderson distribution function [1-3]

$$f_{\text{H-S}} = \sum_{l=0}^{\infty} \left(l + \frac{1}{2} \right) \exp \{ -G_l t \} P_l (\cos \theta), \tag{1}$$

where the P_l (cos θ) are Lagrange polynomials; θ is the scattering angle; t is the electron mean free path; the coefficients G_l are functions of energy and are calculated from recursion relations [1].

TABLE 1. Values of Coefficients G_l at Energy 6.3 keV for Al

l	$2{,}87 \cdot 10^{-4} G_l$	l	$2{,}87 \cdot 10^{-4} G_l$	l	$2{,}87 \cdot 10^{-4} G_l$
1	3,66	40	51,60	80	—8,79
4	17,66	44	51,61	81	—7,96
8	32,61	48	51,59	82	—12,53
12	41,61	52	51,52	83	—26,89
16	46,53	56	51,34	84	—44 45
20	49,10	60	50,93	92	—429,86
24	50,40	64	50,00	96	—1024,29
28	51,05	68	47,90	99	—1913,60
32	51,37	72	43,18	100	—2350,84
36	51,52	76	32,58		

It is usually considered [2] that up to an energy of order 1 keV series (1) is weakly convergent and attempts are made to sum as few terms of this series as possible. However, as calculations showed, for energies of 1-20 keV series (1) diverges, since G_l increases with increase of l ($G_0 = 0$), reaches a maximum at $l = l_{\max}$, and then decreases, passing into the region of negative values (Table 1).

A comparison of the calculations with the experimental data, which is given in [2, 3], permits us to consider series (1) to be asymptotic and to

TABLE 2. Dependence of $l_{\max}$ on Energy for Al

n	E, keV	$l_{\max}$	n	E, keV	$l_{\max}$
1	21,3	95	11	10,6	63
2	20,1	—	12	9,5	65
3	19,0	—	13	8,5	55
4	17,9	—	14	6,7	48
5	16,9	—	15	6,3	44
6	15,9	—	16	5,6	46
7	15,0	79	17	5,0	—
8	14,2	75	18	4,7	38
9	13,4	70	19	4,5	—
10	11,9	—	20	4,2	34
			21	4,0	32
			22	3,8	30

Note. The dash indicates that a maximum value was not observed at the given energy in G_l ($0 \leq l \leq 200$).

Institute of Heat and Mass Transfer, Academy of Sciences of the Belorussian SSR. Institute of Nuclear Power Engineering, Academy of Sciences of the Belorussian SSR, Minsk. Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 21, No. 2, pp. 359-360, August, 1971. Original article submitted September 3, 1970.

approximate the distribution function with an accuracy to the first discarded term by a part of this series.

To achieve maximum accuracy series (1) should be cut off at a term containing $(G_l)_{max}$. The values of l_{max} for some energies are given in Table 2.

The program was compiled for the Minsk-22 computer for further use in Monte Carlo calculations. The calculation time of f_{H-S} for a fixed value of the angle and energy is 30 sec. The input data indicated in [2] were used.

LITERATURE CITED

1. L. V. Spencer, Phys. Rev., 98, No. 6 (1955).
2. M. I. Berger, NBS Technical Note, No. 187 (1963).
3. H. E. Bishop, Brit. J. Appl. Phys., 18, 703 (1967).