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EVALUATION OF NUCLEAR REACTION CROSS-SECTIONS FOR ^{239}Pu IN THE RESONANCE ENERGY REGION WITH A VIEW TO COMPILING A COMPLETE FILE OF CONSTANTS

V.A. Kon'shin, G.B. Morogovskij, E.Sh. Sykhovitskij

Translation of a Reprint from

Vestsi Akad. Navuk BSSR, Ser. Fiz.-Ehnerg. Navuk 2(1974)

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Until recently the evaluation of resonance parameters was usually understood to mean a procedure of averaging the various resonance parameters supplied by experimentalists describing specific series of data. The drawback of this approach is that, despite the inherent self-consistency of a specific series of resonance parameters, the series as a whole are often contradictory.

Therefore, in evaluating resonance parameters, it is clearly safer to take the experimental data themselves and analyse them, making a selection and performing self-consistent processing simultaneously for all types of cross-sections with the aid of some appropriate formalism. This approach is more laborious of course, owing to the large amount of experimental data available.

We have employed this approach here and analysed the existing experimental data for ^{239}Pu in the neutron energy region from 0.3 to 500 eV. In selecting the experimental data, the following criteria were adopted:

(a) From the mass of experimental data available we made a point of selecting those for which it was possible to obtain detailed information on experimental resolution and sample temperature, since processing is impossible without such information;

(b) We did not use results where the energy resolution did not enable the levels to be identified with certainty;

(c) Of the remaining series of experimental data we used those for which the energy dependence of the cross-section was approximately the same;

(d) Caution was exercised in using data obtained in small energy intervals.

Our analysis resulted in the following series of experimental data being included in the processing:

(1) For σ_t - Bollinger et al.[1] (these data were used in the interval 1.4-70 eV), Ignat'ev et al. [2] (30-70 eV), Derrien et al. [3] (70-500 eV);

(2) For σ_f - Deruytter et al.[4] (1-20 eV), Derrien et al. [3] (3.7-40.0 eV), Blons et al. [5] (40-500 eV), Gwin et al. [6] (6-100 eV);

(3) For σ_c - Gwin et al. [6] (6-100 eV).

In our opinion the energy scale has been established most reliably from the experiments performed in Saclay [7]. The energy scale given by Gwin et al. [6] is practically in agreement with this. The energy scales for the data of Derrien et al. [3] and Blons et al. [5] were shifted according to the law: $E' = E + \alpha E + \beta$, where $\alpha = 4.4 \times 10^{-4}$, $\beta = 5.6 \times 10^{-3}$ for Ref. [3] and $\alpha = -4.4 \times 10^{-4}$, $\beta = 4.2 \times 10^{-2}$ for Ref. [5].

The energy scales for the other experimental data used were shifted until they coincided with the chosen absolute energy scale.

The data for σ_f were renormalized to the fission intervals measured by Deruytter et al. [4].

Since the values of the total widths Γ_t are known accurately enough and agree well in different evaluations, we have used the values of Γ_t from a recent evaluation by Ribon and Le Coq [7].

The self-consistent evaluation of the different types of cross-sections was performed in Breit-Wigner formalism by the least-squares method. In order to get a good description of the experimental data, it was necessary to introduce a certain number of additional "fictive" levels, to compensate for the absence of interference terms. The mathematical self-consistency procedure for certain levels (usually wide levels) led to non-physical values of Γ_γ owing to the absence of good experimental data for the capture cross-section in the region above 100 eV. In such cases Γ_γ was assumed close to the mean value.

The resonance parameters obtained are given in Table 1. Figures 1-3 compare by way of illustration the cross-sections calculated from the resonance parameters obtained in this work with the experimental data. Comparison over the whole energy region shows good agreement between the calculated and measured data.

The increasing sum of the levels in relation to energy is shown in Fig. 4. A deviation from the linear law is to be seen in the energy region above 300 eV. An evaluation based on a statistical approach shows that about five levels should be omitted in the interval 300–500 eV with the resolution used in the experiments.

The mean resonance parameters obtained in this work as as follows:

$$\langle D \rangle = 2{,}38 \pm 0{,}06 \text{ eV};$$

$$\langle \Gamma_\gamma \rangle = 43{,}3 \text{ MeV};$$

$$\langle \Gamma_f \rangle^{J=0^+} = 2049 \pm 200 \text{ MeV};$$

$$\langle \Gamma_f \rangle^{J=1^+} = 35{,}6 \pm 2{,}0 \text{ MeV}.$$

Comparison of these values with the mean parameters supplied by Ribon et al. [7] and Simpson et al. [8] shows satisfactory agreement (within the error limits) with the data of Ribon et al. The difference between our values and the parameters given by Simpson et al. is due to the fact that the latter authors did not identify the levels in terms of spin (J).

The mean values of the cross-sections σ_t, σ_f and σ_γ for intervals of the order of 100 eV, calculated from the resonance parameters given in this paper, agree with the experimental values to within 5%.

The authors wish to thank Prof. A.K. Krasin, Academician of the Academy of Sciences of the Byelorussian SSR, for his support.

Evaluated resonance parameters for ^{239}Pu, eV

№	E	Γ_t	Γ_n	Γ_f	Γ_γ	J
1	2,9700E—01	9,8800E—02	6,1550E—05	6,1200E—02	3,7400E—02	0
2	3,0000E—00	2,0000E—00	1,0000E—05	1,9580E—00	4,3300E—02	
3	5,9000E—00	3,3000E—00	4,7000E—05	3,2590E—00	4,3300E—02	
4	7,8200E—00	3,7800E—02	5,7351E—04	4,8200E—02	3,8800E—02	1
5	1,0930E 01	1,9980E—01	1,3239E—03	1,5660E—01	4,2200E—02	1
6	1,1500E 01	5,1800E—02	4,2527E—05	1,0400E—02	4,1200E—02	
7	1,1890E 01	6,7600E—02	6,6947E—04	2,9000E—02	4,7000E—02	1
8	1,4310E 01	1,0160E—01	4,3221E—04	6,7000E—02	3,4000E—02	1
9	1,4680E 01	6,9900E—02	1,4198E—03	2,9200E—02	3,8800E—02	1
10	1,5460E 01	6,9990E—01	4,6707E—04	6,4890E—01	5,0000E—02	0
11	1,7660E 01	7,4800E—02	1,2249E—03	3,2400E—02	4,0600E—02	1
12	2,2290E 01	1,0860E—01	1,8573E—03	6,1800E—02	4,4200E—02	1
13	2,3940E 01	7,0100E—02	6,3869E—05	4,0000E—02	3,0000E—02	1
14	2,6240E 01	8,3400E—02	8,9929E—04	4,5600E—02	3,6400E—02	1
15	2,7240E 01	4,2200E—02	1,0735E—04	6,0000E—03	3,6000E—02	
16	3,2310E 01	1,5189E—01	1,8747E—04	1,1169E—01	3,9406E—02	0
17	3,4600E 01	9,1500E—02	9,1600E—06	4,9900E—02	4,2000E—02	1
18	3,5500E 01	4,7300E—02	2,0441E—04	4,0090E—03	4,3090E—02	1
19	4,1420E 01	5,2100E—02	3,1786E—03	5,0000E—03	4,3000E—02	1
20	4,1660E 01	1,0600E—01	1,1150E—03	4,7000E—02	5,7000E—02	
21	4,4480E 01	5,8600E—02	4,7088E—03	5,4000E—03	4,6690E—02	1
22	4,7600E 01	3,1160E—01	1,4101E—03	2,4500E—01	6,1000E—02	0
23	4,9710E 01	8,0030E—01	1,0143E—03	7,4900E—01	4,9060E—02	0
24	5,0080E 01	5,7000E—02	2,4217E—03	1,3000E—02	4,1000E—02	1
25	5,2600E 01	6,8400E—02	7,2030E—03	8,4000E—03	4,9600E—02	1
26	5,5630E 01	5,8400E—02	1,3473E—03	2,1500E—02	3,5500E—02	1
27	5,7440E 01	4,9980E—01	4,0418E—03	4,4380E—01	4,9000E—02	0
28	5,8840E 01	1,0990E—00	3,0097E—03	1,0470E—00	4,2000E—02	
29	5,9220E 01	1,8040E—01	4,0149E—03	1,2100E—01	5,4000E—02	1
30	6,0940E 01	6,7970E—00	5,0379E—03	6,7350E—00	4,3090E—02	0
31	6,3080E 01	1,5510E—01	6,0472E—04	1,1000E—01	4,2000E—02	1
32	6,5360E 01	9,2000E—02	2,5760E—04	4,9500E—02	4,2000E—02	
33	6,5719E 01	1,3700E—01	8,3370E—03	7,3000E—02	5,2000E—02	1
34	7,4050E 01	7,1100E—02	2,4529E—03	3,1500E—02	3,6500E—02	1
35	7,4950E 01	1,4690E—01	1,5715E—02	8,5000E—02	4,0000E—02	1
36	7,8950E 01	9,1700E—02	1,0229E—04	4,8500E—02	4,3000E—02	
37	8,1760E 01	2,0470E—00	2,1619E—03	1,9950E—00	4,3000E—02	0
38	8,2680E 01	7,0700E—02	3,7550E—04	2,9500E—02	4,0500E—02	
39	8,3520E 01	1,7500E—00	6,1250E—04	1,7050E—00	4,3000E—02	
40	8,5320E 01	2,0980E—00	1,2850E—02	2,0030E—00	4,3000E—02	0
41	8,5480E 01	7,4800E—02	5,7015E—03	1,7000E—02	5,0000E—02	1
42	9,0750E 01	5,9800E—02	8,4946E—03	9,0000E—03	3,9500E—02	1
43	9,2970E 01	5,7000E—02	6,6285E—04	8,6000E—03	4,7500E—02	
44	9,5361E 01	9,8100E—02	1,5912E—03	2,9000E—02	6,7000E—02	1
45	9,6491E 01	1,7000E—00	3,4191E—03	1,6440E—00	4,3000E—02	0
46	1,0025E 02	6,0000E—00	3,0303E—03	5,9460E—00	4,3000E—02	0
47	1,0299E 02	4,7600E—02	1,2957E—03	9,0000E—03	3,6100E—02	1
48	1,0530E 02	4,8000E—02	3,1967E—03	6,0000E—03	3,7700E—02	1
49	1,0667E 02	7,5600E—02	7,2033E—03	2,6000E—02	4,0100E—02	1
50	1,1038E 02	4,3600E—02	3,5760E—04	1,3000E—02	3,0000E—02	
51	1,1444E 02	1,4990E—00	4,1975E—01	1,4535E—00	4,3000E—02	0
52	1,1510E 02	2,0530E—01	1,7220E—04	1,6490E—01	4,1000E—02	
53	1,1603E 02	2,6770E—01	2,9377E—03	2,1799E—01	3,9000E—02	0
54	1,1883E 02	1,0210E—01	1,4050E—02	4,1000E—02	4,2500E—02	1
55	1,2099E 02	7,8300E—02	2,0364E—03	3,8000E—02	3,1300E—02	0
56	1,2344E 02	6,3770E—02	3,5099E—04	3,8000E—02	2,5600E—02	
57	1,2620E 02	9,5960E—02	1,5419E—03	1,9000E—02	7,0000E—02	
58	1,2751E 02	6,4800E—02	3,7570E—04	2,5000E—02	3,9000E—02	
59	1,3175E 02	3,7900E—00	9,5113E—03	3,7190E—00	4,3000E—02	0
60	1,3378E 02	5,5500E—02	3,7528E—03	6,5000E—03	4,4000E—02	1
61	1,3675E 02	1,2610E—01	2,4623E—03	8,3000E—02	3,3000E—02	0

Continued

№	E	Γ_f	Γ_n	Γ_f	Γ_γ	J
62	1,3928E 02	6,2160E—01	8,0400E—05	2,7950E—01	4,2000E—02	
63	1,4292E 02	1,3720E—01	2,5350E—03	8,0000E—02	5,4000E—02	1
64	1,4347E 02	8,3000E—02	3,1120E—03	3,0000E—02	4,9000E—02	1
65	1,4625E 02	7,0000E—02	5,3948E—03	1,2000E—02	5,1000E—02	1
66	1,4744E 02	1,0000E—00	6,6756E—04	9,5600E—01	4,3000E—02	0
67	1,4821E 02	1,4960E—01	3,1316E—04	1,0400E—01	4,5000E—02	
68	1,4942E 02	1,1950E—01	1,1952E—03	5,3000E—02	6,4000E—02	
69	1,5708E 02	6,2160E—01	8,6691E—03	5,4100E—01	4,7000E—02	0
70	1,6080E 02	1,4170E—01	1,5350E—04	1,0100E—01	4,0000E—02	
71	1,6196E 02	1,5020E—01	1,5550E—04	1,0800E—01	4,2000E—02	
72	1,6454E 02	7,8700E—02	1,8686E—02	9,0000E—03	4,4000E—02	1
73	1,6710E 02	1,1170E—01	4,2093E—03	6,9500E—02	3,7000E—02	1
74	1,7049E 02	1,5880E—01	5,1560E—04	1,1500E—01	4,3000E—02	
75	1,7198E 02	9,9970E—01	4,5550E—04	9,5500E—01	4,3000E—02	0
76	1,7456E 02	2,4150E—01	3,3185E—05	1,9930E—01	4,2000E—02	
77	1,7598E 02	7,3100E—02	1,6631E—03	2,9000E—02	4,1000E—02	
78	1,7722E 02	5,1500E—02	2,8609E—03	6,0000E—03	4,2000E—02	1
79	1,7890E 02	5,8200E—02	9,5710E—04	1,4000E—02	4,3000E—02	
80	1,8364E 02	7,2300E—02	1,1672E—03	2,8000E—02	4,2000E—02	
81	1,8487E 02	2,0980E—00	4,6201E—03	2,0380E—00	4,3000E—02	0
82	1,8827E 02	5,2900E—02	4,9060E—04	8,8000E—03	4,3000E—02	
83	1,9064E 02	6,7000E—02	1,3246E—03	1,2500E—02	5,0000E—02	
84	1,9536E 02	4,4640E—01	1,6169E—02	3,3400E—01	4,0000E—02	0
85	1,9669E 02	1,1160E—01	3,6960E—03	5,4000E—02	5,3000E—02	1
86	1,9939E 02	1,3250E—01	6,6273E—03	8,1500E—02	4,2000E—02	1
87	2,0316E 02	7,2400E—02	1,0110E—03	2,7500E—02	4,2000E—02	
88	2,0393E 02	4,4060E—01	1,6023E—02	3,3500E—01	4,2000E—02	0
89	2,0737E 02	5,6900E—02	4,8258E—03	6,5000E—03	4,4000E—02	1
90	2,1109E 02	7,8970E—01	3,3550E—04	7,4650E—01	4,3000E—02	0
91	2,1202E 02	1,5000E—00	4,8000E—04	1,4560E—00	4,3000E—02	0
92	2,1328E 02	1,9960E—01	3,3960E—04	1,5650E—01	4,3000E—02	
93	2,1653E 02	6,7200E—02	4,8832E—03	1,1500E—02	5,0000E—02	1
94	2,1949E 02	7,0500E—02	2,6783E—03	2,6000E—02	4,1000E—02	1
95	2,2022E 02	5,2400E—02	5,2522E—03	1,1500E—02	3,4000E—02	1
96	2,2316E 02	5,9400E—02	2,4203E—03	9,3000E—03	4,7000E—02	1
97	2,2489E 02	8,5500E—02	1,2492E—03	2,6000E—02	5,7000E—02	
98	2,2777E 02	8,0950E—00	7,6199E—03	8,0240E—00	4,2000E—02	0
99	2,2789E 02	6,6700E—02	1,2606E—03	3,1000E—02	3,4000E—02	
100	2,3140E 02	5,3800E—02	8,4190E—03	5,5000E—03	3,7000E—02	0
101	2,3263E 02	1,2060E—01	2,7910E—04	7,8000E—02	4,2000E—02	
102	2,3432E 02	7,4100E—02	8,0510E—03	1,4000E—02	5,0000E—02	1
103	2,3904E 02	7,2400E—02	3,9890E—03	1,7000E—02	5,0000E—02	1
104	2,4060E 02	2,4150E—01	2,6560E—05	1,9940E—01	4,2000E—02	
105	2,4288E 02	9,6500E—02	4,5064E—03	5,8000E—02	3,2000E—02	1
106	2,4750E 02	2,8030E—01	5,8130E—04	2,3600E—01	4,3000E—02	
107	2,4886E 02	6,1600E—02	9,9730E—03	5,5000E—03	4,2500E—02	1
108	2,5123E 02	8,2200E—02	1,8405E—02	1,3500E—02	4,4000E—02	1
109	2,5450E 02	5,4800E—02	1,9573E—03	2,5000E—02	2,7000E—02	
110	2,5611E 02	9,1300E—02	4,8091E—03	3,3000E—02	5,2000E—02	1
111	2,5900E 02	2,4180E—01	2,5131E—04	1,9900E—01	4,2000E—02	
112	2,6237E 02	6,2990E—00	2,5388E—02	6,1560E—00	4,2000E—02	0
113	2,6274E 02	6,9600E—02	1,8101E—03	1,0000E—02	4,6000E—02	
114	2,6423E 02	6,4170E—01	1,9105E—04	2,9900E—01	4,2000E—02	
115	2,6911E 02	1,3000E—01	9,5378E—04	8,6500E—02	4,2000E—02	
116	2,6954E 02	7,1800E—02	3,0186E—03	2,7500E—02	4,0000E—02	1
117	2,7262E 02	9,1600E—02	1,9956E—02	3,2500E—02	3,3000E—02	1
118	2,7480E 02	7,9180E—01	7,4730E—03	7,3500E—01	4,2000E—02	0
119	2,7557E 02	1,4910E—01	1,6738E—02	7,4000E—02	5,4000E—02	1
120	2,7723E 02	5,2990E—00	5,2373E—03	5,2370E—00	4,2000E—02	0
121	2,7959E 02	1,1100E—01	5,6347E—03	5,6000E—02	3,4000E—02	0
122	2,8292E 02	8,5000E—02	1,8045E—02	1,2000E—02	4,9000E—02	1
123	2,8573E 02	3,4150E—01	8,6000E—05	2,9900E—01	4,2000E—02	
124	2,8800E 02	6,4980E—00	6,7520E—03	6,4300E—00	4,2000E—02	0

Continued

№	E	Γ_t	Γ_n	Γ_f	Γ_γ	J
125	2,8830E 02	3,4150E—01	5,1300E—05	2,9900E—01	4,2000E—02	
126	2,9233E 02	1,1450E—01	2,9849E—03	7,1500E—02	3,1000E—02	0
127	2,9646E 02	8,1200E—02	2,6312E—03	3,0000E—02	4,7500E—02	
128	2,9859E 02	7,3400E—02	8,1932E—03	2,0000E—02	4,2500E—02	1
129	3,0181E 02	1,0800E—01	1,3300E—02	4,7000E—02	4,2900E—02	1
130	3,0820E 02	1,5030E—01	2,1730E—03	9,8000E—02	4,8000E—02	
131	3,0901E 02	8,4900E—02	1,0223E—02	2,4000E—02	4,7000E—02	1
132	3,1112E 02	8,2200E—02	3,7350E—04	4,0000E—02	4,1500E—02	
133	3,1362E 02	6,1500E—02	1,0357E—02	9,5000E—03	3,8000E—02	1
134	3,1666E 02	7,3100E—02	3,4250E—03	2,5500E—02	4,3000E—02	1
135	3,2000E 02	5,0610E—00	1,0000E—02	4,9990E—00	4,3000E—02	
136	3,2175E 02	5,4160E—01	1,0157E—04	3,0000E—01	4,1500E—02	
137	3,2336E 02	1,5980E—01	1,5070E—02	4,6500E—02	5,3000E—02	0
138	3,2530E 02	1,0440E—01	6,1325E—03	4,6500E—02	5,0000E—02	1
139	3,2965E 02	1,9990E—00	3,2102E—03	1,9430E—00	4,2000E—02	0
140	3,3391E 02	6,7400E—02	4,2613E—03	9,5000E—03	5,2000E—02	1
141	3,3593E 02	8,2600E—02	1,2931E—02	1,8000E—02	4,6500E—02	1
142	3,3795E 02	7,4000E—02	6,1300E—03	1,0500E—02	5,5000E—02	1
143	3,3924E 02	8,0700E—02	2,4578E—03	3,4000E—02	3,7000E—02	0
144	3,4318E 02	7,4600E—02	1,1232E—02	1,8500E—02	4,1000E—02	1
145	3,4656E 02	1,2000E—00	2,9313E—03	1,1460E—00	4,2000E—02	0
146	3,5030E 02	9,7300E—02	1,6326E—02	3,5000E—02	4,0500E—02	1
147	3,5282E 02	6,8800E—02	2,8873E—03	1,7000E—02	4,8000E—02	
148	3,5489E 02	7,9100E—02	3,2015E—04	3,7000E—02	4,0000E—02	
149	3,5787E 02	5,9990E—00	2,2351E—03	5,9490E—00	4,2000E—02	0
150	3,5999E 02	1,1360E—01	8,0000E—04	8,1000E—02	3,1000E—02	0
151	3,6123E 02	3,4180E—01	1,9360E—04	2,9550E—01	4,2000E—02	
152	3,6400E 02	3,0510E—00	5,2137E—03	2,9990E—00	4,1500E—02	
153	3,6600E 02	4,9990E—00	3,2767E—03	4,9450E—00	4,2000E—02	
154	3,6833E 02	1,6200E—01	2,7750E—04	1,2000E—01	4,1500E—02	
155	3,7031E 02	8,9900E—02	1,8753E—03	3,0000E—02	5,6000E—02	
156	3,7172E 02	3,3990E—00	5,7050E—03	3,3350E—00	4,2000E—02	0
157	3,7502E 02	4,2900E—02	1,9228E—03	6,0000E—03	2,9000E—02	0
158	3,7710E 02	9,9900E—02	1,4631E—03	4,0000E—02	5,7000E—02	
159	3,7804E 02	2,2430E—01	4,5213E—04	1,8200E—01	4,1500E—02	
160	3,8243E 02	1,2960E—01	4,1125E—01	8,6000E—02	4,3000E—02	
161	3,8426E 02	1,0360E—01	1,1371E—03	7,4000E—02	2,9000E—02	1
162	3,8590E 02	9,9970E—01	7,0315E—04	9,5500E—01	4,1500E—02	0
163	3,8951E 02	7,4100E—02	1,1001E—03	2,1000E—02	5,0000E—02	
164	3,9152E 02	1,2480E—01	8,3002E—04	6,9000E—02	5,4000E—02	
165	3,9443E 02	1,0640E—01	4,9513E—03	5,1000E—02	4,8000E—02	1
166	3,9691E 02	1,0810E—01	1,5801E—03	6,2000E—02	4,3000E—02	
167	4,0156E 02	2,1920E—01	1,3821E—02	1,5500E—01	4,6000E—02	1
168	4,0424E 02	1,5500E—01	1,7513E—02	7,6000E—02	5,6500E—02	1
169	4,0603E 02	3,2120E—01	1,2922E—03	2,7700E—01	4,1500E—02	
170	4,0695E 02	3,3140E—01	6,1013E—04	2,9900E—01	3,1000E—02	
171	4,0871E 02	1,1490E—01	9,5703E—04	5,9000E—02	5,4000E—02	
172	4,1231E 02	1,4480E—01	6,4473E—03	7,0000E—02	6,6000E—02	1
173	4,1566E 02	6,1800E—02	2,5138E—03	7,0000E—03	4,9000E—02	
174	4,1760E 02	2,3030E—01	1,0892E—03	1,7800E—01	4,9000E—02	
175	4,1985E 02	1,3900E—01	4,6312E—03	7,4000E—02	5,9000E—02	1
176	4,2567E 02	3,4180E—01	1,9000E—04	3,0000E—01	4,1500E—02	
177	4,2637E 02	6,9960E—00	6,9391E—03	6,9280E—00	4,1500E—02	0
178	4,2964E 02	7,7960E—01	2,8530E—03	7,3200E—01	4,2000E—02	0
179	4,3129E 02	3,4900E—00	3,5107E—03	3,4430E—00	4,1500E—02	0
180	4,3273E 02	3,4100E—01	7,9132E—04	2,9800E—01	4,1500E—02	
181	4,3776E 02	6,1700E—02	2,0513E—03	1,1000E—02	4,8000E—02	
182	4,3872E 02	6,0900E—02	2,1232E—03	4,0000E—03	5,4000E—02	1
183	4,4007E 02	3,4190E—01	2,7310E—04	2,9800E—01	4,3300E—02	
184	4,4241E 02	4,1180E—01	5,1407E—03	3,4500E—01	4,3300E—02	0
185	4,4975E 02	1,3340E—01	1,0015E—03	8,9000E—02	4,2300E—02	
186	4,5135E 02	5,9100E—02	1,0375E—02	4,0000E—03	4,1500E—02	1
187	4,5445E 02	4,0210E—01	4,1200E—04	3,5800E—01	4,3300E—02	

Continued

№	E	Γ_t	Γ_n	Γ_f	Γ_γ	J
188	4,5573E 02	6,1520E—01	1,9643E—02	4,9300E—01	4,3300E—02	0
189	4,5733E 02	1,7050E—01	6,0001E—03	1,1600E—01	4,3300E—02	
190	4,5880E 02	7,9100E—02	3,6210E—03	3,1000E—02	4,3300E—02	1
191	4,6126E 02	9,7400E—02	1,6019E—03	5,2600E—02	4,2000E— 02	
192	4,6264E 02	1,2820E—01	3,9660E—04	8,4000E—02	4,3300E—02	
193	4,6820E 02	2,0920E— 00	3,4102E—03	2,0420E—00	4,3300E—02	0
194	4,7000E 02	5,0850E—00	7,0312E—03	5,0298E—00	4,5000E—02	0
195	4,7310E 02	5,5600E—02	3,0831E—03	9,0000E—03	4,2300E—02	1
196	4,7531E 02	5,8200E—01	2,7741E—03	5,3300E—01	4,3300E—02	0
197	4,7690E 02	1,9930E—00	1,5131E— 03	1,9470E—00	4,3300E—02	0
198	4,7921E 02	2,0150E—01	8,9000E—05	1,5800E—01	4,3300E—02	
199	4,8115E 02	5,9900E—02	1,9513E—03	1,4000E—02	4,2000E—02	
200	4,8729E 02	2,2470E—01	1,7321E—03	1,7800E—01	4,3300E—02	
201	4,8781E 02	2,2660E—01	2,4754E—03	1,8000E—01	4,2500E—02	
202	4,9065E 02	2,2800E—00	9,9313E—03	2,2160E—00	4,5500E—02	0
203	4,9110E 02	1,1600E—01	3,2217E—03	7,0000E—02	4,2000E—02	1
204	4,9563E 02	2,0250E—01	6,2125E—04	1,5800E—01	4,3300E—02	
205	5,0050E 02	7,0900E—02	2,6180E—03	3,0000E—02	4,3300E—02	
206	5,0286E 02	8,5300E—02	8,8234E—03	3,0000E—02	4,3360E—02	1
207	5,0578E 02	4,4230E—01	4,4610E—04	3,9800E—01	4,3300E—02	
208	5,0822E 02	6,9210E—01	3,4700E—04	6,4800E—01	4,3300E—02	
209	5,0974E 02	2,6010E—01	3,8763E—02	1,6500E—01	4,3300E—02	1
210	5,1152E 02	3,3530E—00	6,3945E—03	3,2980E—00	4,3300E—02	0

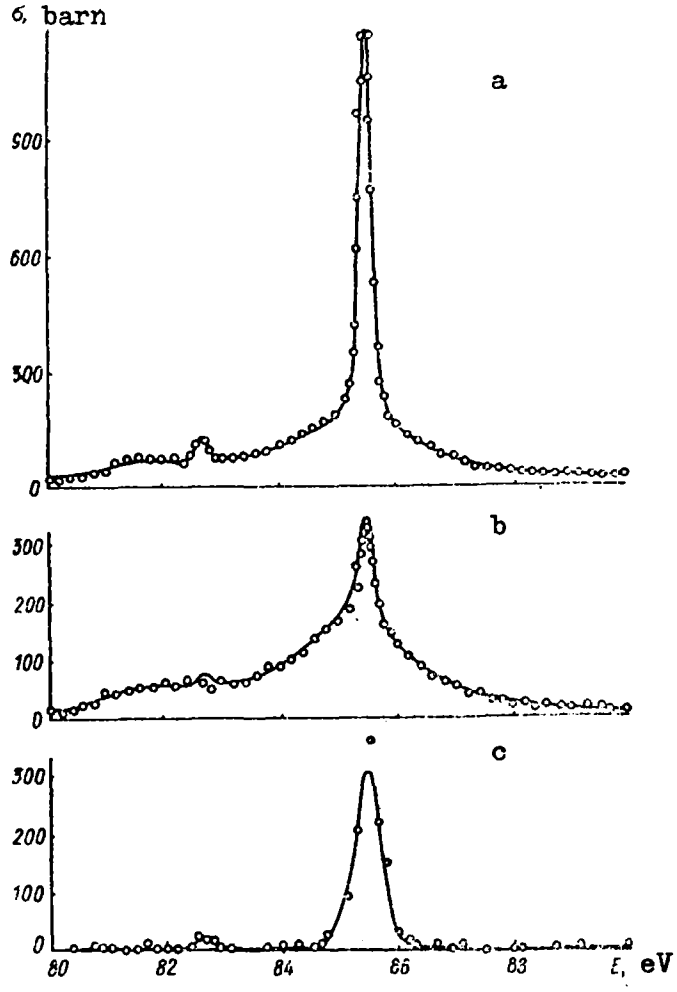

Fig. 1. Comparison of experimental and calculated cross-sections in the region 80–90 eV; a – Derrien, b – Blons, c – Gwin

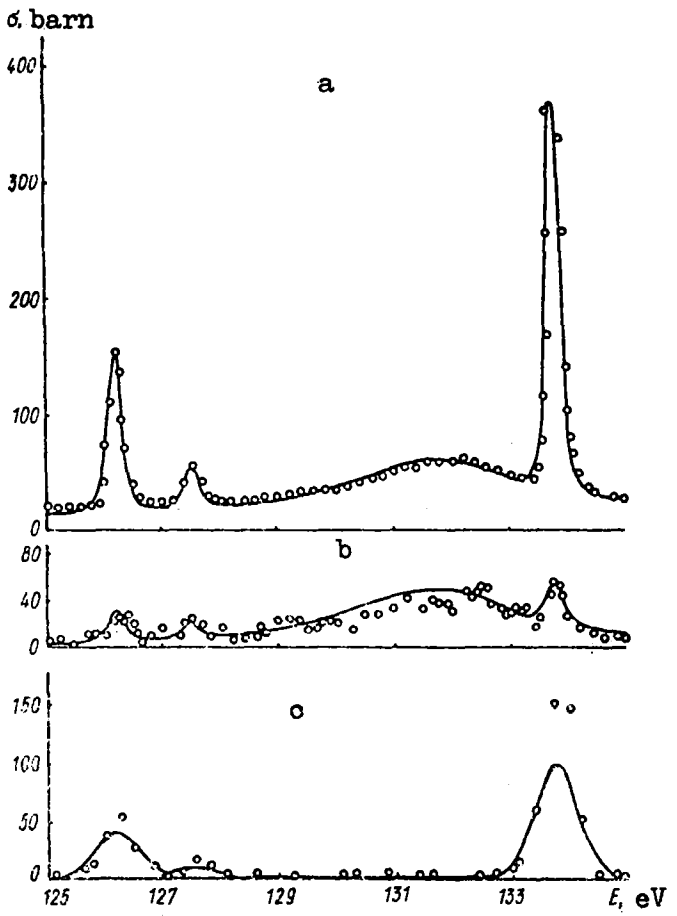

Fig. 2. Comparison of experimental and calculated cross-sections in the region 125-135 eV; a, b and c as Fig. 1.

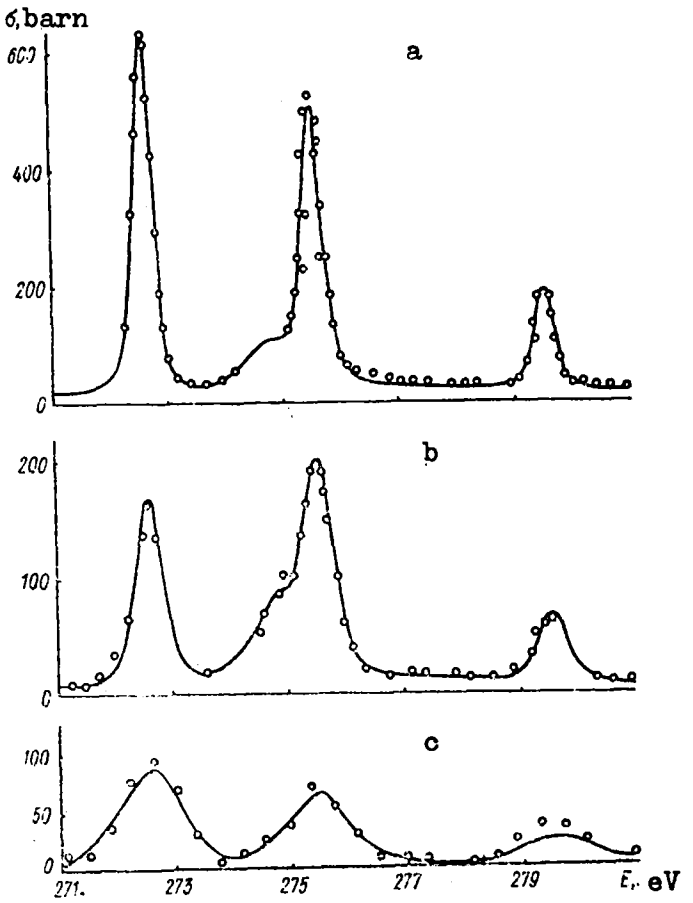

Fig. 3. Comparison of experimental and calculated cross-sections in the region 271-281 eV; a, b and c as Fig. 1

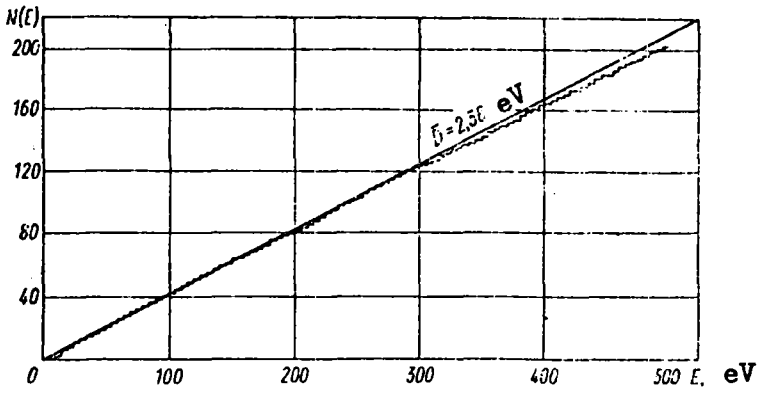

Fig. 4. Increasing sum of the levels in relation to energy

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