

JAERI-M

5 9 7 9

NEANDC(J)39AL
INDC(JAP)26G

COMPIRATION OF ^{239}Pu RESONANCE PARAMETER

February 1975

Tadashi YOSHIDA*

日本原子力研究所
Japan Atomic Energy Research Institute

この報告書は、日本原子力研究所が JAERI-M レポートとして、不定期に刊行している研究報告書です。入手、複製などのお問合せは、日本原子力研究所技術情報部（茨城県那珂郡東海村）あて、お申しこしください。

JAERI-M reports, issued irregularly, describe the results of research works carried out in JAERI. Inquiries about the availability of reports and their reproduction should be addressed to Division of Technical Information, Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken, Japan.

JAERI-M 5979

NEANDC(J)39AL
INDC(JAP)26G

COMPILATION OF ^{239}Pu RESONANCE PARAMETERS

Tadashi YOSHIDA*

Japanese Nuclear Data Comm., Tokai, JAERI

(Received January 21, 1975)

As a part of the evaluation work by a working group of the Japanese Nuclear Data Committee, ^{239}Pu neutron cross sections are being evaluated at present. This is an interim report of the work, and collected data of the Breit-Wigner single-level parameters for ^{239}Pu resonances are compiled in tables with a summary of the relevant experimental informations. The multilevel parameters are also given in the Appendix. Subsequent evaluation for the ^{239}Pu resonance parameters will be made on the basis of this compilation.

* NAIG Nuclear Research Laboratory, Nippon Atomic Industry Group Co.

JAERI - M 5979

NEANDC (J) 39AL
INDC (JAP) 26G

^{239}Pu 共鳴パラメータの収集

日本原子力研究所東海研究所シグマ研究委員会

吉 田 正 *

(1975年1月21日受理)

シグマ委員会によって行なわれている核データ評価作業の一環として、 ^{239}Pu データの評価がなされている。本報告は ^{239}Pu 共鳴パラメータ評価作業の中間報告として、今までに測定された共鳴パラメータを収集し、表にまとめたものである。本文中の表はBreit-Wigner の一準位公式に基づく共鳴パラメータに限った。多準位公式によるパラメータはAppendixにまとめてある。各データ、およびその基礎となった測定の概要については本文で簡単に触れる。

今後、この収集結果をもとに、 ^{239}Pu 共鳴パラメータの評価作業が進められるだろう。

* 日本原子力事業株式会社NAIG総合研究所

目 次 な し

I. Introduction

As one of the activities of Japanese Nuclear Data Committee, the evaluation work of nuclear data for ^{235}U , ^{238}U , ^{239}Pu , ^{240}Pu and ^{241}Pu are now in progress. Along with the other evaluation work for light, medium-heavy and FP nuclides, the purpose of this work is to support supplying good data for JENDL, namely, the Japanese Evaluated Nuclear Data Library.

This report presents the review of the experiments on ^{239}Pu neutron cross sections in resonance region and the table of the collected resonance parameters reduced from the measured cross sections using the single-level formula. The data compiled in this work are those appeared after 1966, when J. J. Schmidt published his extensive evaluation work^{Sch66)}. However, the resonance parameters contained in Schmidt's compilation are re-tabulated here without comments. Several authors apply the multilevel resonance formula for the analysis of the experimental results. These sets of multilevel parameters are not included in the present table but are given in Appendix separately.

In chapter II, the present status of the available data is described and in chapter III, the main features of each experiment are given. Some remarks on the parameter tabulation and the guides to the users are summarized in chapter IV.

II. The Present Status of the Available Data

Recent measurements for ^{239}Pu neutron resonance cross sections were carried out extensively by Saclay Group^{D67), B70), T70)} and by Dubna Group^{R70)}.

The parameter set obtained by Saclay Group seems to be of high reliability because they measured σ_T , σ_f and σ_{nn} with good resolutions and analyzed the data simultaneously. It is noteworthy that the resonance parameters have been determined up to the very high energy region ($0 \sim 660\text{eV}$). Though we have Uttley's parameter set (included in Schmidt's compilation^{Sch66)}) up to the rather high energy, the Saclay parameter set is only one available above 300eV at present. In the low energy region, Dubna Group measured σ_T , σ_f and σ_r , and determined the level parameters for 32 levels up to 86eV by analysing these cross

sections.

There exist several studies in which the multilevel formula was applied for the reduction of resonance data. Farrell^{F68)} analysed the fission cross sections obtained from the Petrel experiment^{S66)} using the Reich-Moore's multilevel formula. Derrien et al.^{D70)} and James^{J68)} also adopted the Reich-Moore's formula for their analyses. While, Gwin et al. utilized the Adler-Adler's scheme for the analytical description of their experimental data^{G71)}. These multilevel parameters are summarized in Appendix of this report. Other papers collected in the present review work deal with the spin assignment using various methods. The spins of ^{239}Pu resonances are determined through the studies of the fission fragment kinetic energy^{M65)}, fission symmetry^{C66)} or resonance scattering measurement^{S65), A67), K69), S71)}. Weinstein et al.^{W69)} carried out the spin assignment assuming the correlation between the average fission neutron number $\bar{\nu}$ and the level spin J. However, Trochon et al. came to the conclusion that any correlation was not found between $\bar{\nu}$ and J^{T70)}.

III. Main Features of Measurements

1) A Series of Experiments at Saclay

Derrien 67)

The measurements of the total and fission cross sections were made by TOF method using the Saclay Linear Accelerator. The transmission experiments were carried out to obtain σ_T with five Pu-Al samples (containing 0.1, 0.3, 1, 4 and 14 g of ^{239}Pu per cm^2 , respectively) at the liquid nitrogen temperature. The energy range was from 4 to 700eV and the best resolution was 1.5 ns/m. The comparison of the results with those of supplementary experiments at ambient temperature made it possible to determine precisely the Doppler broadening factor ($A = \eta\sqrt{E}$, $\eta = 0.0122$). Background determination was made with Au, Co, Mn and Bi samples.

The fission cross section measurement was performed on a 16 meter flight path using the Ar (300 g/cm^2) - $\text{N}(25 \text{ g/cm}^2)$ gas scintillators as a fission fragment detector. The measurement covered the energy range from 4eV to 6KeV. Pulse width,

frequency and the best resolution were 60ns, 500c/s and 6ns/m, respectively.

Resonance parameters were obtained up to 500eV by shape analysis using the least square method based on the Doppler broadened single level formula. The details of the method are described in ref.^{R67)}. Statistical study of fission width showed the existence of two families of resonances, one having a large Γ_f (750meV) and the other having a small Γ_f (45meV). Considering the level population, each family was assigned to be of spin 0 and 1, respectively.

Parameters $2g\Gamma_n$ and Γ up to 442eV were obtained as well as Γ_f , Γ_r and J up to 251eV.

Blons 70)

The high resolution measurement of the fission cross section of ^{239}Pu was made using a gas scintillator containing 960 mg of ^{239}Pu as a detector. The incident neutron spectrum was measured with a BF_3 proportional counter placed behind the fission detector. The neutron source, the pulse frequency and the sample temperature are the same as the previous measurement^{D67)} at Saclay. The improvement of the resolution (from 6ns/m to 1ns/m) is noteworthy.

For the calculation of σ_f , $^{10}\text{B}(n,\alpha)$ cross section was assumed to be $\sigma(n, \alpha)(\text{barn}) = \frac{610.3}{\sqrt{E(\text{eV})}} - 0.28$. The value of σ_f was normalized at 44.48, 47.6, 52.6 and 74.95eV to the previous value^{D67)}.

The fission cross section curve thus obtained was used to calculate Γ_f 's with the subsidiary parameters ($2g\Gamma_n$, Γ , $\Gamma_r = 42$ meV) obtained in the previous measurement^{D67)}. The reduction was made in the following manner.

1). From 0 to 450eV, where the resolution function was well known, the values of Γ_f were calculated from E_0 , $2g\Gamma_n$ and $\sigma_0\Gamma_f$.

2). From 450 to 660eV, where the values of Γ were known with the poor accuracy or when the values of Γ were less than 500 meV.

$$\Gamma_f = [\Gamma_r + \frac{2g\Gamma_n}{2g}] \frac{\sigma_0\Gamma_f}{\sigma_0\Gamma - \sigma_0\Gamma_f}$$

3). In the whole energy region, when the values of Γ were greater than 500meV,

$$\Gamma_f = \Gamma - \left(\Gamma_r + \frac{\frac{2g\Gamma_n}{1} *}{2} \right)$$

* g assumed to be 1/4

Trochon 70)

Elastic scattering cross section of ^{239}Pu was measured with high resolution based on the TOF technique using the Saclay Linear Accelerator. Eight liquid scintillators were used. Six of them contained ^{10}B and were sensitive to the fission and scattered neutrons. The other two without ^{10}B counted the fission neutrons only. The signals from the latter were used to eliminate the fission events.

The level spin was determined in such a manner as the theoretical scattering area (A_0)_{th} agreed with the experimental one (A_0)_{exp} obtained from the measurement mentioned above. For the calculation of theoretical scattering area (A_0)_{th} = $\frac{1.02 \cdot 10^3 (2g\Gamma_n)^2}{E_g \Gamma}$, the values for $2g\Gamma_n$ and Γ were quoted from the references D67) and B70). Level spins were assigned for the levels up to 660eV. The previous D67) and the present analyses gave the same results for all the spins although the methods of these two experiments were quite different.

2) Experiment at Dubna

Ryabov 70)

These extensive measurements consist of the total cross section measurement with transmission technique and the fission and capture measurement with self-indication method. Time of flight technique was employed on the 1010 meter flight path using the JINR pulsed fast reactor as a neutron source. The liquid boron scintillation detector was used to detect the resonance neutrons in the transmission measurement. The measurements of the total cross sections and those of fission and capture were carried out using a large cadmium-loaded liquid scintillation detector. Time resolution was $40 \sim 55$ ns/m.

With the aid of the area method, the resonance parameters $g\Gamma_n$, Γ , Γ_f and $\Gamma\gamma$ were obtained for 32 levels up to 86eV.

3) Spin Assignment I. Resonance Scattering
 Sauter 65), Asghar 67), King 69) and Simpson 71)

The experimental conditions are summarized in Table I. Sauter and Bowman assigned the level spin through the relation $g = (g\Gamma_n)^2/\Gamma(g\Gamma_n^2/\Gamma)$, where $g\Gamma_n^2/\Gamma$ was determined from the experimental scattering area, and $g\Gamma_n$ and Γ were taken from the references Sch 65) and B 65). Asghar used the same method. King et al.^{K69)} and Simpson et al.^{S71)} determined the level spin from the measured values for Γ_n/Γ , $g\Gamma_n$ and Γ . The values for $\sigma_0 \Gamma_n$ and $g\Gamma_n^2$ are given in S65) and A67), respectively.

4) Spin assignment II. Various Methods
 Melkonian 65), Cowan 66) and Weinstein 69)

Cowan et al. studied radiochemically the symmetry of fission at individual levels from 15 to 82eV. Assuming that the ratio of asymmetric to symmetric fission depends on the level spin, spin assignment was done for 22 levels. Melkonian and Mehta's way of spin assignment was based on the same assumption as Cowan's in principle. However, they did not measure the symmetry of fission directly but measured the average kinetic energy of the fission fragments, and used the correlation between the fission symmetry and the kinetic energy.

RPI Group^{W69)} measured the average number of fission neutrons $\bar{\nu}$ and assigned the level spin through grouping of the levels by $\bar{\nu}$ values based on the assumption of correlation between $\bar{\nu}$ and J . However, a recent experiment of the same kind^{T73)}, in which the Saclay 60MeV electron linac and the proton recoil scintillator were used, showed no correlation between $\bar{\nu}$ and the level spin J .

IV. Remarks on the Tabulation

The data listed in the table are divided into two groups by dotted lines. The first group consists of the old data which were already referred by Schmidt in his evaluation work. The second group consists of the new data published after 1966.

There are several cases in which single level assigned in the old experiment splits into two levels in the recent high resolution measurements. In this tabulation, these two levels are classified as one level. The splitting of these levels will be considered in the subsequent evaluation work. In the new data section of the table, round parentheses mean the subsidiary parameters cited from the measurement previously carried out or one made by the other authors.

In this compilation, the papers are referred by the name of the first author and the year they were published; for example Blons (70), or, in the more abbreviated form, B70).

The old data are retabulated here only for references and the detailed informations about them should be found in the Schmidt's original report Sch 66). In the old data section, the quantities in round parentheses were calculated from the measured unbracketed quantities for comparison purpose.

Table 1 Experimental Conditions of the Four Scattering Measurements

Reference	Neutron Source	Flight Path Pulse etc.	Detection	Comments
Sauter 65)	Livermore Electron Linear Accelerator	TOF Method Flight Path; 17.8m Pulse; 0.6 μ sec 360Hz	Boron Loaded Liquid Scintillator	The "bright line" technique was used so as to eliminate the fission neutrons and the capture gamma's
Asghar 67)	Harwell 45 MeV Lineac	TOF Method Flight Path; 50m Pulse; 200ns, 200Hz	^{6}Li Glass Scintillator(n,r) Nat Li Scintillator (r only, r discrimination) Stilbene Crystal (fission r, fission discrimination)	
King 69)	Rensselaer 100 MeV Linear Accelerator $\text{Ta}(r,n)$ Reaction	TOF Method Flight Path; 25m Pulse; 10~100ns	^{6}Li Glass Scintillator(n), Pb sample was 1100 liter liquid Scintillators as capture and fission background detector	
Simpson 71)	Rensselaer 100 MeV Linear Accelerator $\text{Ta}(r,n)$ Reaction	TOF Method Flight Path; 11m Pulse; 250ns, 480Hz	Four detectors used; two for scattered n one for transmission one for flux monitoring	All data were normalized to flux monitor

Table 2 SINGLE-LEVEL RESONANCE PARAMETERS FOR PLUTONIUM-239

JAERI-M 5979

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_r (meV)	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (b.eV)	$\sigma_0\Gamma_n$ (b.eV)	$\sigma_0\Gamma$ (b.eV)	$\eta\Gamma_n^0/\Gamma$ (meV)	σ_o (b)	η/ν or (η)	Γ_f/Γ_a or (Γ_f/Γ)	Reference
0.297±0.003	100±5															Reffel(55)
0.3	100															Egelstaff(55)
0.3	100	0.122	0.081	3/4	1	39	61	(305) (329)								Nikitin(55)
0.296±0.001	101±2	0.122	0.081	0.005±0.003		39±2	62±2									Bollinger(58)
0.296±0.002	98±3	0.122	0.081	0.005±0.003		40±5	58±6									Engelstaff(56)
0.3	101±5	0.124														Pattenden(56)
0.3	100±2	(94.2)	0.1136	0.2272	1/4	0	44±4.5	56±5								Kirpichnikov(57)
0.296	0.30	0.108					38.6	55.4							Vogt(60)	
0.296	0.30	0.108					0	0							Ignat'ev(64)	
0.296	0.30	0.108													Ryabov(67)	
0.298	99±4	0.121	0.004	1/4	0	39±3	60±4								Derrien(67)	
0.298	99±4	(99±4)				1									Weinstein(69)	
0.30	102±11	0.108	±0.004			1	40±10	62±2							Blons(70)	
0.30	102±11	0.108	±0.004												Chrien(70)	
0.296	0.30	0.108	±0.004												Ryabov(71)	
7.1±0.2	111±22	0.005	±0.002			40±8	71±20								Egelstaff(55)	
7.85	67±10														Raffle(55)	
7.85	44±7														Raffle(55)	
7.85	60±20														Egelstaff(55)	
8.07	100														Nikitin(55)	
7.82±0.03	83±5	1.305	0.87	3/4	1	33	67	(83.7)							Bollinger(58)	
7.85±0.03	77±13	1.9	0.03	±0.02		40.6	41.5	108.2							Engelstaff(56)	
7.85	37±12	1.9	0.2	±0.2		43±15	32±6	±3							Sokolovski(57)	
7.80	42±6	1.16	0.32	±0.32											Kirpichnikov(57)	
						23±5	19±3									

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	ξ	J	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (b.eV)	$\sigma_0\Gamma_n$ (b.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (b)	η/ν or $[\eta]$	Γ_t/Γ_a or $[\Gamma_t/\Gamma]$	Reference
7.80±0.03	37±6	1.07				(19)	17±4			180±20	4900 ±1200		(0.47)	Vladimirski(58)
7.9	(80.9)	1.316	0.876	3/4	1	38	42						(0.525)	Vogt(60) Fraser(62)
7.8	(76.3)	1.33	0.887	0.82 ±0.31	1	3/4	1	40	35	2.1 ±0.8			0.465	Ignatev(64) de Saussure(65)
7.84	84±3	1.33	0.887	±0.03	±0.02					108.2 ±0.5				Bions(65)
7.83	87	1.21	0.807	3/4	1	39	47			108.2±3	201		(0.546)	
7.82														Sauter(65)
7.9														Melkonian(66)
7.84±0.01														Ryabov(67)
7.8														Derrien(67)
7.84±0.01														Weinstein(69)
7.82														Bions(70)
7.85	87±5	1.21	1.28 ±0.12	3/4	1	39.7±4	47±3			108.2±2			0.54	
7.82	(87±5)	(1.21 ±0.04)								(201 ±6.6)				
7.83±0.01	87.6	87.6	1.23 ±0.03	3/4	1	39.8 ±4.0	46±4							Ryabov(71)
7.82														Simpson(71)
10.95	130±40													Rarfle(55)
11.0	130±40													"
10.95														Egelstaaff(55)
11.33	190	180±12	2.73	1.82 ±0.11	3/4	1	32	158 31.5±9	146.7 ±7	264.4±6	168.4 (324)		0.48 ±0.08	Nikitin(55) Bollinger(58)
10.93±0.05														Engelstaaff(56)
10.95±0.05	146±15	146±15	3.4	1.07	3/4	1	40±8	40±8	103±20		380	0.73 ±65		Sokolovski(57)
10.95±0.03	150±20	150±20	2.34	±0.3							1800 280±20	±0.01		
10.95	130±15													Kirpichnikov (57)
														(0.592)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_t (meV)	$2gr_n^0$ (meV)	$\sigma_o\Gamma_t$ (h.eV)	$\sigma_o\Gamma_n$ (h.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_o (b)	η/v or(y)	R_t/R_a or(Γ_t/Γ)	Reference	
10.96±0.02	130±15	2.42		(50.5)	77±12					290±30				(0.6)	Vladimirski(58)
11.0	2.75	1.83	$3/4$ 0.72 ± 0.23	1	32	147				2240 ±250				(0.82)	Voigt(60) Fraser(62)
10.95	(122.4)	2.15	1.43	$3/4$	1	40	81							0.67 ±0.03	Ignat'ev(64)
10.95		±0.20	±0.13											0.67 ±0.06	Ignat'ev(65)
10.93	185±5	2.84	1.89	$3/4$ 0.86 0.84	1	46	152			256±3 256±3				(0.76)	de Sanssue(65) Blons(65) Saufer(65)
10.94	200														
11.0	10.97±0.02		2.7	± 0.15											Melkonian(66)
11.5	200±20	2.84	~ 0.41	± 0.15											Ryabov(67)
10.93															
11.5	10.95			± 0.15											Weinstein(69)
10.93	(200	(2.84	(2.84)	± 0.15											Blons(70)
	$\pm 20)$	(0.15)	(0.15)												
11.5	10.97±0.02	189±19	2.69	± 0.12											Derrien(67)
11.5	10.93			0.41											"
11.95		90±30													Weinstein(69)
11.9	11.95	90±30													Ryabov(71)
11.90±0.04	64±7	1.605	1.07	$3/4$	1	40.9±5	22.0±2			(0.776 ±0.042)					Simpson(71)
11.95±0.05	52±8	1.9	± 0.05												Raffie(55)
11.86±0.04	85±15	1.18	± 0.2												"
11.90	52±5	± 0.12													Egelstaff(55)
															Bollinger(58)
															Engelstaff(56)
															Sokolovski(57)
															Kirpichnikov (57)

E_0 (eV)	I' (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (h)	η/ν or(η)	I_f/I_a or(I_f/I_r)	Reference
11.83±0.03	52±8	1.46		(24.5)	26±6					170±20			(0.51)	Vladimirski(58)
11.9				0.67 ±0.22	1	23		3.3 ±1.1						Fraser(62)
11.95	(64.4)	1.35	0.9 ±0.35	1	40									Ignat'ev(64)
12.0														Ignat'ev(65)
11.90	68±5													deSaussure(65)
11.89	65	1.52	1.01	3/4	1	39.5	24.5		62.8 ±1.5	166.2	(2560)			Blons(65)
11.9				0.63 0.56	1				62.8 ±1.5					Sauter(65)
11.9	11.91±0.02			1.34 ±0.22	1	42.0 ±4.6	24±3	0.64 ±10	60.3±2					Melkonian(66)
11.89		67±7		1.54 ±0.10	1				168.6 ±11.0					Ryabov(67)
11.9	11.89	(67±7)	(1.54 ±0.10)			24±3								Derrien(67)
11.91±0.02		68±7	(1.43 ±0.08)			28±5	38.6 ±7.0	60.9 ±2.4		(168.6 ±11.0)				Weinstein(69)
11.89				0.97 ±0.16	1									Blons(69)
14.30		70												Ryabov(71)
14.3		70±20												Simpson(71)
14.28±0.1		100.8	0.83 ±0.2	1/2	-	40	60±7		(45)	(75.6)				Raffle(55)
14.3±0.2		131±22	0.61 ±0.10			40±8	90±20			750 ±150	0.5 ±0.01			Egelstaff(55)
14.3±0.05		135±40	0.64 ±0.1							60±10	0.60 ±0.01			Bollinger(58)
14.3		60±10				43±11	17±5			450 ±200	0.69			Engelstaff(56)
14.30±0.05		100±30	1.2				(70.8)	28±14		1100 ±500				Sokolovski(57)
														Kirpichnikov (57)
														Vladimirski(58)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	ϵ	Γ_r (meV)	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_i$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$g\Gamma_n^0/\Gamma$ (meV)	σ_0 (h)	η/ν $\alpha(\eta)$	Γ_f/Γ_a $\alpha(\Gamma_f/\Gamma)$	Reference
14.25	(~74)		3/4	1	40	34							0.46 ± 0.10 (0.77)	Ignat'ev(64) deSaussure(65) Blons(65)
14.28	145±6				24	81		64.5±1	64.5±1					
14.31	106	0.93			1	1		60±16	0.23 ± 0.03	54.7±3				
14.3								67±7		82.8 ± 4.5				
14.3	102±8	0.88 ± 0.12		3/4	1	36±6								
14.31		0.91 ± 0.05			1	1		67±7	54.7 ± 3.3					
14.3								60±10		(82.8 ± 4.5)				
14.31	(102 ± 8)	(0.91 ± 0.05)						40.1 ± 7.0						
14.36±0.02	101±8	0.88 ± 0.05						0.63 ± 0.20	1					
14.31														
14.75	40										280		7000	Raffle(55)
14.75	40±12													Egelstaff(55)
14.68±0.1	79.6±8	3.3 ± 0.02	6.6 ± 0.04	1/4	0	40	33±4		(120.5)					Bollinger(58)
14.68±0.2	80±13	2.7 ± 0.7					40±8	37±10						Egelstaff(56)
14.68±0.05	110±30	2.88 ± 0.42												Sokolovski(57)
14.7	80±15						40±7	40±9						Kirpichnikov (57)
14.7±0.05	75±15	2.1					(35.9)	37±10						Vladimirski(58)
14.7														Fraser(62)
14.7	(~63)						0.37 ± 0.06	0		16.3 ± 2.6				
14.68	82±3						1/4	0	23					Ignat'ev(64)
14.69	71	2.86	5.72											deSaussure(65)
14.7														Blons(65)
								0.86 0.70	1					Sauter(65)

E_0 (eV)	Γ (meV)	$2g\Gamma_a$ (meV)	Γ_n (meV)	g	J	Γ_f (meV)	P_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_o\Gamma$ (b.eV)	$\sigma_o\Gamma_n$ (b.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_o (b)	η/ν or η	R_f/R_a or (P_f/P)	Reference
14.75		2.72 ± 0.54				32±9	0.71 ± 0.14							$[0.43 \pm 0.03]$	Ryabov(67)
14.68	70±7	2.86 ± 0.05		1/2	1	37.6±4	30±3		107.5±2	5.72 ± 0.40	253.6 ± 4.3		0.44		Asghar(67)
14.68	(70±7)	(2.86 ± 0.05)			1				107.5 ± 2.1		(253.6 ± 4.3)				Weinstein(69)
14.7	81±8	2.44 ± 0.10				43.6	35±6								Blons(70)
14.75±0.03	(70)	± 0.10 (29)				1±7.0									Derrien(67)
14.7	14.7					0.82	1								Ryabov(71)
14.69						± 0.14	1								Troction(70) Simpson(71)
14.7															Melkonian(66)
15.5±0.2	800	1.195 ± 0.20	2.39 ± 0.40	1/4	0	40	758 ± 100	(94.8)	(100)		125±10	0.81 ± 0.01	0.95 ± 0.01		Bollinger(58)
15.6±0.3	200±70	1.0 ± 0.3	1.0 ± 0.4			40±8	160±70								Egelstaff(56)
15.4±0.08	200±70					(~45)	155±80								Sokolovski(57)
15.50	200±40	0.8 \sim (802.5)	1.26 \sim (1040)	0.84		3/4	155±62 760 1000								Kirpichnikov (57)
15.5±0.08						3/4	1	(~44.2)							Vladimirski(58)
15.5	15.5					1/4	40 1 40								Vogt(60)
15.5	15.5					1/4	1								Ignat'ev(64)
15.5	895	± 100	700	1.01											deSaussure(65)
15.42															Blons(65)
15.5						0	1								Sauter(65)
15.42						1	1								Cowan(65)
15.5															Melkonian(66)
15.47															Ryabov(67)
15.46	700±50	0.98 ± 0.08	0.98 ± 0.08			1/4	0	360 650	0.25 ± 0.04	80±8					Derrien(67)
15.46	(700)	(0.98 ± 0.08)				0	656								Weinstein(67)
15.46															Blons(70)

E_0 (eV)	F (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_r (meV)	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (b, eV)	$\sigma_0\Gamma_n$ (b, eV)	$g\Gamma_n^0/R$ (meV)	σ_o (b)	η/ν $\sigma(\eta)$	Γ_t/Γ_a $\sigma(\Gamma_t/R)$	Reference
15.47±0.06	76.1±52	0.87±0.06				37.1±6	72.5±11.0							[0.95±0.08]	Ryabov(71)
17.75	150														Raffle(55)
17.7	90±35	90													"
17.7															Egelstaff(55)
17.6±0.1	87±6	2.4±0.11	1.60±0.07	3/4	1	39.1±5	46.3±5	94.1±3							Bollinger(58)
17.75±0.10	85±11	2.2±0.11	2.08±0.2			40±8	43±8								Engelstaff(56)
17.68±0.06	80±10	2.08±0.20				(-51.9)	26±6								Sokolovski(57) (58)
17.65	82±8					55±8	27±5								Kirpichnikov (57)
17.6						0.72±0.4	1								Fraser(62)
17.7	(70.5)	2.2±0.3	1.47±0.2		1	40	29								Ignat'ev(64)
17.8															Ignat'ev(65)
17.6	84±4	2.70	1.80	3/4	1	37.2	35	93.8±2							deSaussure(65)
17.6	74			0.55	1			93.8±2							Blons(65)
17.6				0.82	1										Sauter(65)
17.66															Cowan(65)
17.6															Melkonian(66)
17.69±0.03						2.07±0.34									Ryabov(67)
17.65															Asghar(67)
17.66	75±7	2.74±0.05		3/4	1	38.7±4	34±4	42±13	0.5±0.08						Derrien(67)
17.7															Weinstein(69)
17.66				(75±7)	(2.74±0.05)			1							Blons(70)
17.7				(75)	(2.74±0.05)			1	34±4						Trochon(70)
17.69±0.03						2.58±0.04									Ryabov(71)
17.66									43.4±6						Simpson(71)
									0.75±6	1					

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	ϵ	J	Γ_r (meV)	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_o\Gamma_t$ (b.eV)	$\sigma_o\Gamma_n$ (b.eV)	η/ν or η	F_f/F_a or (F_f/F_r)	Reference
19.2±0.3	64±9	0.25 ±0.08	0.04			40	24±4					(0.375)	Egelstaff(56)
18.6±0.1													Sokolovski(57)
22.35	60												Raffle(55) "
22.2±0.1	113±4	3.37 ±0.15	4.0	1/2		34.6±4	75.0±4	131.3±4					Bollinger(58)
22.35±0.1	105±20	4.0 ±0.8				40±8	61±20						Egelstaff(56)
22.31±0.07	55±6	4.44 ±0.32				(~19.6)	31±6						Sokolovski(57), (58)
22.30	55±5					24±6	31±8						Kirpichnikov (57)
22.2						0.20 ±0.06	0						Fraser(62)
22.4	(75.6)	3.3 ±0.3	6.6 ±0.6			1/4	0	49					Ignat'ev(64) (65)
22.4													"
22.2	101±7	8.60	1/4	0	33.4	48		133.7±3 133.7±3	250.1				deSaussure(65)
22.28	90	4.30											Blons(65)
22.2													Sauter(65)
22.28													Cowan(65)
22.2													Melkonian(66)
22.32±0.04													Ryabov(67)
22.28													Asghar(67)
22.29	109±9	4.00 ±0.10		1		0.49 1.00		52±18 0.61 ±0.10					Derrrien(67)
22.3													Weinstein(69)
22.29	(109 ±9)	2.88 ±0.46											Blons(70)
22.28													Ryabov(70)
22.29	109±9	4.00 ±0.10		1	44.3 ±5.3	62±6		132.3 53	6.1 ±0.35	233.6 ±5.8			Trochen(70)
22.3													Simpson(71)
22.33±0.04													
22.3													
22.28													

E_0 (eV)	Γ (meV)	$2g\Gamma_a$ (meV)	Γ_n (meV)	ϵ	J	Γ_r (meV)	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (b)	η/ν or(η)	Γ_t/Γ_a or(Γ_t/Γ)	Reference
23.9±0.2	82±10	0.128	0.128	1/2		40	42±5		(3.57)	(6.97)		85±10	0.51 ±0.03	(0.512)	Bollinger(58)
23.6±0.3	61±9	0.128	0.128	0.01		40±8	21±4								Egelstaff(56)
27.7±0.2	692±72	0.12	0.12												Sokolovski(57) deSaussure(65) Blons(65)
23.9	65														Ryabov(67)
23.9±0.1															Derrien(67)
23.94	70±12	0.13	0.13	0.01											Weinstein(69)
23.9	(70)	(0.13)	(0.13)	±0.01											Blons(70)
23.876	67±12	0.12	0.12	±0.02											Derrien(70) Ryabov(71)
23.9±0.1															
26.2±0.2	80±6	2.66	2.66	1/2		40	37.3±3		61.9±3	(132)		1650 ±200	0.48 ±0.04 (0.55)		Bollinger(58)
26.1±0.2	91±13	2.8	2.8	0.2		40±8	49±10								Egelstaff(56)
26.4±0.1	140±30	1.68	1.68	0.5											Sokolovski(57), (58)
26.1	115±17	1.68	1.68	±0.12											Kirpichnikov (57)
26.5		2.2	2.2	±0.4											Ignat'ev(64)
26.3															" (65)
26.2	89±6	2.22	2.22												deSaussure(65)
26.29	83														Blons(65)
26.2															Cowan(65)
26.37±0.06		2.26	2.26	±0.22											Melkonian(66)
															Ryabov(67)
															[0.45 ±0.03]

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	ϵ	J	Γ_I (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_I$ (keV)	$g\Gamma_n^0/\Gamma$ (meV)	σ_0 (b)	η/ν or(η)	Γ_I/Γ_a or(Γ_I/Γ)	Reference
26.26	83 ± 10	2.20 ± 0.15		1	$1/2$	37 ± 6	44 ± 7		58 ± 3	2.26 ± 0.30		0.55	
26.24	(83 ± 10)	(2.20 ± 0.15)			1					103 ± 7.4			Derrien(67)
26.2													Weinstein(69)
26.24													Blons(70)
26.31 ± 0.06	81 ± 9	2.25 ± 0.11				31.8 ± 6	47 ± 8			(109.1 ± 7.4)			Ryabov(71)
26.29						0.60 ± 0.13	1						Simpson(71)
27.34 ± 0.3	43 ± 5	0.199 ± 0.04	0.199 ± 0.04	$1/2$	-	40	3 ± 1		(0.66)	(9.46)			
28.11 ± 0.3	45 ± 8	0.4 ± 0.1	0.1			40 ± 8	5 ± 3			5			Bollinger(58)
27.5 ± 0.2	330 ± 30												Egelstaff(56)
27.3	42	0.21											Sokolovski(57)
27.31													deSaussure(65)
													Blons(65)
27.3													Ryabov(67)
27.24	42 ± 8	0.12 ± 0.01	(0.21 ± 0.01)				~ 68	~ 0.048	34 ± 8	5.7 ± 0.3			Derrien(67)
27.24	(42 ± 8)	(0.21 ± 0.01)							5	(10.0 ± 0.3)			Blons(70)
27.3	41 ± 10	0.14 ± 0.10					27.9 ± 12						Ryabov(71)
29.9 ± 0.3	51 ± 9	0.4 ± 0.1	0.2				40 ± 8	11 ± 4		(17.6)			
30.0 ± 0.2										9			Egelstaff(56)
32.3 ± 0.4	230 ± 50	0.43 ± 0.04	0.43 ± 0.04	$1/2$		40	190 ± 50		19 ± 3	(17.25)			Sokolovski(57)
31.8 ± 0.3	63 ± 12	0.4 ± 0.1	0.6 ± 0.2				40 ± 8	23 ± 9					Bollinger(58)
32.8 ± 0.3													Egelstaff(56)
32.5 ± 0.2													"
32.5													Sokolovski(57)
													Ignat'ev(65)
													0.43 ± 0.20

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	f_r (meV)	J (meV)	f_f (meV)	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0 f_f$ (h.eV)	$\sigma_0 \Gamma_n$ (h.eV)	gf_n^2/Γ (meV)	σ_0 (h)	η/ν or(η)	I_f/I_a or(Γ_f/Γ)	Reference	
32.3																
32.38	165	0.42				38.6	126	176±15	12.9±0.5	12.9±0.5	16.9	(102)	(0.767)		deSaussure(65) Blons(65)	
32.3						0	0									Sauter(65) Cowan(65) Mekkonian(66) Ryabov(67)
32.38						0	0	85±21	0.084±0.001	12.2±0.5	16.9±0.7	0.73	0.68±0.07		Derrien(67) Weinstein(69) Blons(70)	
32.1						1/4	0	4.1±8	110±15	12.2±0.5	(16.9±0.7)				Ryabov(71) Simpson(71)	
32.4±0.4							0		110±15	12.2±0.5						
32.31																
32.3																
32.31																
32.31																
32.31																
32.31																
32.4±0.1																
32.38																
34.6																
34.6																
35.3±0.5																
35.0±0.3																
35.3±0.2																
35.3																
35.43																
35.3																
35.6																
35.50																
35.50																
35.6																

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_τ (meV)	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$g\Gamma_n^0/\Gamma$ (meV)	σ_0 (b)	η/ν or(η)	Γ_t/Γ_a or(Γ_t/Γ)	Reference
37.8±0.3	50±10	5.5 ±1.8				40±8	5			(191) (8.3)				(0.111) (0.518)	Egelstaff(56)
39.5±0.5	83±22	0.25 ±0.12	0.6			40±8	43±20			10				"	Sokolovski(57)
38.5±0.2															
41.4±0.7	76±10	9.25 ±0.25	18.5 ±0.5	1/4	0	46.8 ±9	10.7±2	40.8±5		(289)				0.186 ±0.02 (0.259)	Bollinger(58)
41.4±0.4		9.65 ±3.22	7.64 ±0.92			40±8	14±3								Egelstaff(56)
41.7±0.1	140±30														Sokolovski(59)
41.4															Fraser(62)
41.5		5.6 ±2.0													Ignat'ev(64)
41.7		4.6 ±0.5	9.2 ±1.0	1/4	0	40	6.5								" (65)
41.4	182±8														deSaussure(65)
41.4	52	6.20	4.13	3/4	1										Uttley(64)
41.52															Blons(65)
41.76	105	2.02													"
41.4															Sauter(65)
41.52															Cowan(65)
41.2															Melkonian(66)
41.5															Asghar(67)
41.64±0.12		5.5 ±1.1				0.77 0.52	1								Ryabov(67)
41.42	52±8	6.20 ±0.20		1/2											Derrrien(67)
41.66	105±16	2.02 ±0.25		1/2											"
41.7	J=0 170° a)	J=0 17.5° a)				22±4	0.86 3	9							King(69)
	J=1 72°	J=1 5.8													Weinstein(69)
41.5															

E_0 (eV)	F (meV)	$2gF_n$ (meV)	F_n (meV)	g	J	F_J (meV)	$2gF_n^0$ (meV)	$\sigma_d F_J$ (b.eV)	$\sigma_a F_a$ (b.eV)	gF_a^0/F (meV)	σ_a (b)	η/ν or(γ)	F_t/F_a or(F_t/F)	Reference
41.42	(52±8)	(6.20 ±0.20)				4±1		15.7 ±3.5 28.1 ±4.2		(194.9 ±6.2) (63.1 ±7.9)				Blons(70)
41.66	(105 ±16)	(2.02 ±0.25)			1	46±12							"	Trochon(70)
41.4	(52)	(6.2)											"	Chrien(70)
41.7	(105)	(2.0)											"	Ryabov(71)
41.7	78±13	5.93 ±0.33			1	56.1 ±10.5	16±4							Simpson(71)
41.68														
41.42														
44.5±0.7	51±10	9.6 ±0.15	6.4 ±0.1	3/4	1	40.4 ±10 40±8	4.2±1 7±3			(280.5)	5500 ±1172	0.094 ±0.01 (0.149)		Bollinger(58)
44.1±0.4	170±70	5.31 ±2.66	5.31 ±0.74			0.42 ±0.1	0							Egelstaff(56)
44.8±0.2														Sokolovski(57)
44.5														Fraser(62)
44.5	(-52)	7.5 ±1.5	4.0			0.42	0							Ignat'ev(64)
44.6	(51)	8.25 ±1.5	5.5 ±1.0	3/4	1	4.0	4.5							" (65)
44.6	101±8													deSaussure(65)
44.5	58	9.97	19.94	1/4	0	32.8	5.2							Uttley(64)
44.5														Blons(65)
44.5														Sauter(65)
44.59														Cowan(65)
44.2														Melkonian(66)
44.74±0.12														Ryabov(67)
44.5														Asghar(67)
44.48	58±7	9.97 ±0.20												Derrien(67)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	Γ_r (meV)	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (h.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (b)	η/ν or η	Γ_f/Γ_a or (Γ_f/Γ)	Reference
44.6	J=0 180 J=1 40	J=0 18.4 J=1 6.1	1									King(69)
44.5	(58±7)	(9.97 ±0.20)	1	5±1								Weinstein(69) Blons(69)
44.48	58 52±8	10.0 7.63 ±0.29	1	36.4 ±12	8±2							Trochon(70)
44.5	44.60±0.12		0.89 ±0.27	1								Ryabov(71)
44.48												Simpson(71)
47.6±0.8	350±50	2.7 ±0.3	1/2	40	310±50	63.3±5	(73.5)	210±50	0.886 ±0.2 (0.765)	Bollinger(58)		
48.0±0.5	(~173.5)	3.464 ±1.078		40±8	130±60					Egelstaff(56)		
48.1±0.1		2.16 ±0.3								Sokolowski(57)		
47.7	(~117)	3.0 ±1.0		40	74					Ignat'ev(64)		
47.8	310±9									" (65)		
47.6	47.7	300	2.90		73	58.9±1	79.0	(263)	0.65 ±0.20 0.59 ±0.12	deSaussure(65) Uttley(64) Blons(65)		
47.6	47.74					58.9±1				Sauter(65)		
47.6	47.7									Cowan(65) Melkonian(66) Asghar(67)		
47.92±0.15						0.043 ±0.014				Ryabov(67)		
47.60	322±25	3.04 ±0.38 2.90 ±0.15	1/4	0	74±16	1.52 ±0.33				Derrien(67)		
47.6	47.60	(322 ±25) (398)	(2.90 ±0.15) (2.6)	0	248±30	59.2±2	79.3 ±4.0			Weinstein(69) Blons(70)		
47.6				0		61.0 ±2.5	(79.3 ±4.0)			Trochon(70)		

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	κ	J	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (h.eV)	$g\Gamma_n^2/R$ (meV)	σ_0 (b)	η/ν or(η)	R/R_a or(Γ_t/Γ)	Reference
47.494	273 ± 39	3.01	5.25			26.7 ± 6	243 ± 15				(0.89 ± 0.06)		Derrien(70) Ryabov(71) Simpson(71)
47.92 ± 0.15	273 ± 39	3.01 ± 0.17											
47.60			1.6 ± 1.3										
50.0 ± 0.8	80 ± 6	6.8	6.8	1/2		40	33.2 ± 4		(176)	2200	0.453 ± 0.05	Bollinger(58)	
49.2 ± 0.5	(~ 88.5)	3.5	± 0.4			40 ± 8	45 ± 25			± 263	(0.529)	Egelstaff(56)	
50.3 ± 0.2	70 ± 20	6.48	± 2.1							± 1000		Sokolovski(57)	
50.0	(~ 72.1)	± 0.84	± 1.5			40	27					0.40 ± 0.10	Ignat'ev(64)
49.9		5.1										0.65 ± 0.09	" (65)
50.0	50 ± 20												deSaussure(65)
50.1													Uttley(64)
49.85	810	2.2											Blons(65)
50.22	57	4.55											Blons(65)
50.0													
49.85													
50.22													
50.0													
49.85													
50.22													
49.4													
49.6													
50.18													
50.2													
49.71	810	2.2											
50.08	57 ± 10	4.55 ± 0.2											
50.1	$J=0$	$J=1$	$J=0$	$J=1$	$J=0$	$J=1$	$J=0$	$J=1$	$J=0$	$J=1$	$J=0$	$J=1$	King(69)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	E	J	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (b.eV)	$\sigma_0\Gamma_n$ (b.eV)	η/ν or [η]	Γ_f/Γ_a or [Γ_f/Γ]	Reference
49.71	(810 ±200) (57±10) (57)	(2.2 ±0.2) (4.55 ±0.20) (4.5)				810 57±10	53.2 ±2.7 26.2 ±2.1	(58±6) (118.2 ±5.2)				Blons(70)
50.08												"
50.1												Derrien(70)
49.446												Ryabov(71)
50.033												"
49.6												Simpson(71)
50.18±0.16												
50.08												
52.6±0.9	57±7	22.8 ±1.5 90±25	15.2 ±1.0 10±1.6	3/4	1	34.1 ±5	7.7±2		(376)	6600 240±35	0.184 ±0.02	Bollinger(58)
53.0±0.2												Sokolovski(57)
52.3	(~58)	10.0 ±5.0 8.7 ±1.0	17.4 ±2.0	1/4	0	40 40	8 23					Ignat'ev(64)
52.6												" (65)
52.5												deSaussure(65)
52.6	92±5											Utley(64)
52.74	68	15.70					28.4 (J=0) 49 (J=-1)	9	51.5±1	387.1 (5690)		Blons(65)
52.6												
52.9±0.2												
52.6												
52.60	68±10	15.70 ±0.30		3/4	1	48.6 ±9	9±2		5±1		0.16	
52.7	J=0 110 J=1 45											King(69)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (h)	η/ν	η/ν	η/Γ_a	$\eta/\Gamma_a/\Gamma_f$	Reference
52.6	(68 ± 10)	(15.70 ± 0.30)	10a)			9±2			51±1	(388.5 ± 7.4)						Weinstein(69) Blons(70)
52.6	(68 ± 10)	(15.7)			1	40.6±7	10±3									Trochon(70) Ryabov(71)
52.8±0.2	63±9	12.4 ± 0.4				0.88 ± 0.29	1									Simpson(71)
52.60																Cowan(65)
52.74																
55.6	83±26															deSaussure(65)
55.8																James(65a)
55.8																James(65b)
55.8																Uttley(64)
55.79	~50	2.14														Blons(65)
55.79																
56.9																Cowan(65)
55.9±0.4																Melkonian(66)
55.7																Ryabov(67)
55.63																Asghar(67)
55.13	59	2.20 ± 0.12 (["])	1/2	-	35	22		36±10 ± 0.07	0.35 ± 0.07	1.62 ± 0.42	51.5 ± 2.9 (["])	0.40				Derrien(67)
55.6	(["])	(["])				21				19±2						Blons(70)
55.9±0.4	67±10	(2.2) 2.43 ± 0.21		1	35.6±8	29±6				18.7 ± 1.9						Trochon(70) Ryabov(71)
55.63								0.58 ± 0.20	1							Simpson(71)
57.5	(~200)							40	160							
57.8																Ignat'ev(64)
57.4																Ignat'ev(65)
57.8																deSaussure(65)
57.8																James(65a)
57.8																James(65b)
57.7(^{+57.2})																Uttley(64)
57.6																Blons(65)
57.6																

८

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_I (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_I^0$ (b.eV $^{-1}$)	$\sigma_0\Gamma_n$ (b.eV $^{-1}$)	$g\Gamma_n^0/\Gamma$ (meV $^{-1}$)	σ_0 (b)	η/ν or(γ)	Γ_I/Γ_n or(Γ_I/Γ)	Reference
62.7														
63.08	(155 ± 17)	(1.20 ± 0.25)	0			1111 ± 57								Weinstein(69) Blons(70)
63.4 ± 0.2	156 ± 21	8.4 ± 0.6				39.6 ± 8	103 ± 21							Ryabov(71)
64.8						0								Melkonian(66)
66.0	250 ± 25	14 ± 7				40	45							Uttley(64)
65.5	(~97)					19.5 ± 4	1/4	0	40	(69.5)				deSaussure(65)
65.7	(122)													Ignat'ev(64)
65.9														(65)
66.4 ± 0.2	400 ± 60	29.2 ± 3.4												Sokolovskii(57)
65.9														James(65a)
65.9														James(65b)
65.96	137	18.8												Blons(65)
65.96														Cowan(65)
66.2 ± 0.2														Ryabov(67)
65.8														Asghar(67)
65.71	137 ± 14	18.22 ± 0.50												Derrien(67)
65.5														King(69)
65.71	J=0 240 J=1	18.22 ± 0.50				1	86 ± 28	2.7 ± 0.6						Blons(70)
65.7														Trochon(70)
66.2 ± 0.2														Ryabov(71)
65.71														Simpson(71)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_f (meV)	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (b.eV)	$\sigma_0\Gamma_n$ (b.eV)	gf_n^2/R (meV)	σ_o (b)	η/ν or(η)	Γ_f/Γ_a or(Γ_f/Γ_r)	Reference
75.21	162	33.2				$J=0$ $J=1$	95				573.8				Blons(65)
75.2	36 ± 10					0.52 0.68	1								Sauter(65)
75.01															Ryabov(67)
74.95	147	14	53.20 ± 1.50			$J=0$ $J=1$	71.0								Asghar(67)
74.9	$J=0$	$J=1$				$J=0$ $J=1$	24.2								Derrrien(67)
75.0															King(69)
74.95															Weinstein(69)
74.9															Blons(70)
75.6 \pm 0.3															Trochon(70)
74.95															Ryabov(71)
75.21															Simpson(71)
78.95															Cowan(65)
82.2															Derrrien(67)
81.7															
82.5															
81.5															
82.2															
82.0															
82.7 \pm 0.3															
81.76															
82.68															

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	ϵ	Γ_γ (meV)	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (keV)	$\sigma_0\Gamma_n$ (keV)	$g\Gamma_n^0/\Gamma$ (meV)	σ_0 (b)	η/ν	Γ_f/Γ_a	Reference
81.0	(2050) (6) 124±36	0	0		1996 72±30	61								Weinstein(69)
81.76	124±36 ±0.9	45.2 ±19	0											Blons(70)
82.7±0.3														Ryabov(71)
81.7														Cowan(65)
83.0														
83.3														
84.9														
83.52	1750 (1750)	1.2 (1.2)				1706								
83.52														
85.8	260±50													
85.6														
86.0	(~128)	23±10												
85.0														
85.6														
85.6	36													
85.6	≥2000													
85.6														
85.6														
85.7	30±10	0	0		540 ±240	3.3 ±1.1		32.0 ±1.56						
85.7														
85.32	2300 85±10	28±4 ±0.36	11.8			17±9		392 35	427±60 179.7 ±5.5	0.94 0.24				
85.48														
85.32	(2300)	(28±4)				2002		360	(427 ±60)					Blons(70)
85.48	(75 ±20)	(111.8 ±0.36)				16		39	(179.7 ±5.5)					"

d)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_r (meV)	Γ_f (meV)	$2g\Gamma_n^2$ (meV)	$\sigma_0\Gamma_f$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (b)	η/ν $\alpha(\eta)$	Γ_f/Γ_a $\alpha(\Gamma_f/\Gamma)$	Reference
85.5	(85) 881 ±249	(11.8) 38.7 ±5.4	1	40.3 ±15	802 ±288										Trochon(70) Ryabov(71) Simpson(71)
85.7			0.88 ±0.39	1											Uttley(64) deSaussure(65)
(87.0) - (89.0)															
87.9															
90.9	157±25														
90.9	(<71)	21±10													
90.5															
90.3															
90.8															
90.75	60±10	18.45 ±0.42													
90.1	J=0 J=1	95 30	J=0 28.5 J=1 8.5	1	0	9±2									
90.0															
90.75	(60) ±10 (60)	(18.4) ±0.42 (18.4)		0	0	9±2									
90.8															
90.8															
92.5															
92.6															
92.97	57±5 (57±5)	1.05 ±0.04 (1.05) ±0.04	1/2	47±6	9								14.7 ±0.6 (14.7) ±0.6	0.16	Derrien(67) Blons(70)
92.97															

E_0 (eV)	F (meV)	$2gF_n$ (meV)	F_n (meV)	g	J	F_T (meV)	F_f (meV)	$2gF_n^0$ (meV)	$\sigma_0 F_f$ (b. eV)	$\sigma_0 F_n$ (b. eV)	gF_n^2/F (meV)	$\sigma_0 F$ (b. eV)	η/ν or $[\eta]$	F_f/F_a or $[F_f/F]$	Reference
102.99	48±5 (48±5) (48)	2.42 ±0.08 (2.42) ±0.08 (2.4)	1/2		32±5	13±4		8±1		30.6 ±0.3			0.28		Derrien(67)
102.99					10±3			6.6±1.7 ±0.3	(30.6 ±0.3)						Blons(70)
103.0					1										Trochon(70)
105.5	250														deSaussure(65)
105.3	150	8.8 ±0.8													Uttley(65)
105.6															Asghar(67)
105.30	48±7 (48±7) (48)	6.96 ±0.40 (6.96) ±0.40 (7.0)		3/4	1	38±7	6±1								Derrien(67)
105.30								5±2							Blons(70)
105.3								1							Trochon(70)
106.8	150±40														deSaussure(65)
106.7	80	12.0 ±0.4													Uttley(65)
106.8															Asghar(67)
106.67	75±4 (75±4) (75)	13.96 ±0.60 (13.96) ±0.60 (14.0)		3/4	1	40±4	26±2								Derrien(67)
106.67								26±2							Blons(70)
106.7															Trochon(70)
106.8															Simpson(71)
110.4	170	1.4 ±0.2													deSaussure(65)
110.3															Uttley(65)
110.38	43±16 (43 ±16)	0.66 ±0.07 (0.66 ±0.07)		1/2		30	13								Derrien(67)
110.38															Blons(70)
114.5															deSaussure(65)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_f (meV)	Γ_r (meV)	$2gf_n^0$ (meV)	$\sigma_0\Gamma_f$ (keV)	$\sigma_0\Gamma_n$ (keV)	gf_n^0/Γ (meV)	σ_0 (b)	η/ν or(η)	Γ_f/Γ_a or(Γ_f/Γ)	Reference
114.44	0.20 (0.8)					1456		1.5	7	2.3			0.66		Derrien(67) Blons(70)
114.44	(1500)														deSaussure(65)
115.2								3.4±1.1							Derrien(67) Blons(70)
115.10	200 (200)	0.32 (0.32) ±0.10 ±0.10)						3		3.6±0.1			0.83		deSaussure(65)
115.10									3		(3.6 ±0.1)				Derrien(67) Blons(70)
116.2	300														deSaussure(65)
116.0	220±20	5.0 ±0.4													Uttley(65)
116.3						0									Asghar(67)
116.03	257±15	5.41 ±0.13		1/2	36	215±20		51±3		2.60 ±0.9			0.86		Derrien(67)
116.03	(257 ±15)	(5.41 ±0.13)				215±20		51±3		60.7 ±1.5 (60.7 ±1.5)					Blons(70)
116.0	(257)	(5.4)			0										Trochon(70)
117.9															deSaussure(65)
117.9	J=0 240 J=1 150		J=0 70.0 J=1 26												King(69)
118.9	180±40														deSaussure(65)
118.8	140±20	22.0 ±2.0													Uttley(65)
119.0															Asghar(67)
118.83	102±6	25.92 ±0.60				1									Derrien(67)
118.83	(102 ±6)	(25.92 ±0.60)													Blons(70)
118.8	(102)	(25.9)													Trochon(70)

E_0 (eV)	F (meV)	$2gF_n$ (meV)	F_n (meV)	g	J	F_f (meV)	$2gF_n^0$ (meV)	$\sigma_0 F_f$ (keV)	$\sigma_0 F_n$ (keV)	gf_n^2/F (meV)	$\sigma_0 F$ (keV)	η/ν or η	F_f/F_n or $[F_f/F]$	Reference
119.0				0.84 ± 0.46	1									Simpson(71)
121.1	220							20.6 ± 0.8						desSaussure(65) Uttley(65)
120.99	78 \pm 2	3.70 ± 0.15	1/2	35 \pm 7	39 \pm 7	20 \pm 2	39.8 ± 1.6			0.53				Derrrien(67) Blons(70) Trochon(70)
120.99	(")	(")		0	39 \pm 7	20 \pm 2	(")							desSaussure(65) Uttley(65)
121.0	(78)	(3.7)												Derrrien(67) Blons(70) Trochon(70)
123.5	100							5.1 \pm 0.5		7.5				desSaussure(65) Uttley(65)
123.3	75	0.8 ± 0.08						5		7.4 \pm 0.9				Derrrien(67) Blons(70)
125.44	58 \pm 3	0.70 ± 0.08												desSaussure(65) Uttley(65)
123.44	(63 \pm 4)	(")						39	4.6	(")				Derrrien(67) Blons(70)
125.0										4.2 \pm 0.7				desSaussure(65) Uttley(65)
126.3										10.6 \pm 1				Derrrien(67) Blons(70) Trochon(70)
126.2	85	2.8 ± 0.4								28				desSaussure(65) Uttley(65)
126.20	96 \pm 10	2.96 ± 0.12												Derrrien(67) Blons(70) Trochon(70)
126.20	(")	(")						8	30.5 ± 1.2					desSaussure(65) Uttley(65)
126.2	(96)	(3.0)		0		20	6.2							Derrrien(67) Blons(70) Trochon(70)
127.6										7.6 \pm 1				desSaussure(65) Uttley(65)
127.5		0.8 ± 0.08								9				Derrrien(67) Blons(70)
127.51	160 \pm 30	1.09 ± 0.12									5	11.1 ± 1.2	0.45	DesSaussure(65) Uttley(65)
127.51	(64 ± 10)	(0.77 ± 0.12)						25	3.1					Derrrien(67) Blons(70)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	Γ_J (meV)	Γ_T (meV)	Γ_t^0 (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (b. str.)	$g\Gamma_n^0/R$ (meV)	σ_o (b)	η/ν or η	R_t/R_a or $[R_t/R]$	Reference
132.1	>4000						80±2.9						deSaussure(65)
132	3800	17.4 ±1.6											Blons(65)
131.7				0									Uttley(65)
131.9													
131.75	3830 ±240 (3800 ±250)	18.26 ±1.2 (18.26 ±1.20)											Asghar(67)
131.75													Derrien(67)
133.8													Blons(70)
133.7	47	8.0 ±0.6											
134.2													deSaussure(65)
133.78	56±6 (") (81)	8.38 ±0.30 (") (8.4)		3/4	43.5±7	7							Uttley(65)
133.78													
133.8													
135.5													Asghar(67)
135.2		0.6 ±0.06											Derrien(67)
136.8	200												Blons(70)
136.7	70	4.8 ±0.4											Trochon(70)
137.1													
136.75	126±10 (")	5.12 ±0.16 (")		1/2	33±8	88±10							
136.75													
136.7	126	5.1											

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J (meV)	Γ_r (meV)	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_o\Gamma_t$ (h.eV)	$\sigma_o\Gamma_n$ (h.eV)	$\sigma_o\Gamma$ (h.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_o (h)	η/ν	Γ_t/Γ_a or(Γ_t/Γ)	Reference
140.0									2.4±0.4	1.2 1.5	1.7 (")				0.71	deSaussure(65)
139.28		0.18 (")														Derrien(67) Blons(70)
142.9									24.9±5	27.3 ±3.1						deSaussure(65)
143.4																"
142.9-143.4		11±0.8														Uttley(65)
142.92	137±20	4.86 (") (")		1/2		56	76±15		24.7±3							Derrien(67)
142.92		±0.21 (")					82±15		26.6 ±3.2							Blons(70)
142.9	(137)	(4.9)			1											Trochon(70)
143.47	83±12	6.12 (") (83)		1/2		36	41±7		27.5±2							Derrien(67)
143.47		±0.15 (")					31±5		21±3							Blons(70)
143.5		{6.1}			1											Trochon(70)
144.5																Uttley(64)
146.3	200															deSaussure(65)
146.2	80	11.6 ±0.6														Uttley(65)
146.7						1										Asghar(67)
146.25	70±7	10.58 (")		1/4		36	13±2		17.1±1							Derrien(67)
146.25		±0.30 (")					12±2		16.8 ±1.0							Blons(70)
146.2	(70)	(10.6)					1									Trochon(70)
147.3																deSaussure(65)
147.44	1000	1.20 (1000)														Derrien(67)
147.44		±0.60 (1.20) ±0.60														Blons(70)

E_0 (eV)	I' (meV)	$2gF_n$ (meV)	F_n (meV)	g	J	Γ_γ (meV)	Γ_t (meV)	$2gF_n^0$ (meV)	$\sigma_0 F_t$ (h.eV)	$\sigma_0 F_n$ (h.eV)	gF_n^2/F (meV)	σ_o (b)	η/ν or(η)	I'_t/I_a or(I_t/I')	Reference	
148.1																
147.9																
148.21	150	0.70 (")	2.0 ± 0.2													
148.21	(")															
149.4																
149.3	90	2.2 ± 0.4														
149.42																
149.42	120 \pm 20	2.62 (")	± 0.12 (")	1/2	62	55 \pm 14	10.5 \pm 2									
149.42	(")					50 \pm 13	9.5 \pm 1.8									
151.8																
152.4																
155.8																
157.0	720															
156.9	760 \pm 50	17.4 ± 1.6														
157.5						0										
157.08	670 \pm 50	17.2 (")	± 0.4 (")													
157.08	(")															
157.1	(673)	(17.2)														
160.9	550															
160.8																

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J (meV)	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (b.eV)	$\sigma_0\Gamma_n$ (b.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (b)	γ/ν or η	F_t/F_a or $[F_t/\Gamma]$	Reference
161.6														Uttley(64)
162.3														"
161.96	150	0.21 ± 0.07								1.7 ± 0.6				Derrien(67)
164.4	250													deSaussure(65)
164.4	90	38.0 ± 3.6												Uttley(65)
164.7														Asghar(67)
164.54	79 ± 10	42 ± 3												Derrien(67)
164.54	(")	(")												Blons(70)
164.5	(79)	(42.0)												Trochon(70)
166.9	320													deSaussure(65)
166.8	95	8.6 ± 0.4												Uttley(65)
167.10	112 ± 8	8.75 ± 0.40 (")												Derrien(67)
167.10	(112)	(8.7)												Blons(70)
167.1														Trochon(70)
167.7														Asghar(67)
170.5	880 1300													deSaussure(65)
170.5		4.4 ± 0.2												Uttley(65)
170.49	158 1000	0.86 ± 0.02 0.89 ± 0.30												Derrien(67)
171.08														"

E_0 (eV)	I (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_r (meV)	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$\sigma_0\Gamma$ (h.eV)	η/ν or η	Γ_t/Γ_n or (Γ_t/Γ)	Reference	
170.49	(158 ±60) (1000)	(0.86 ±0.02) (0.89 ±0.30)				120		5							Blons(70)
171.08						956		6							Blons(70)
171.0															Trochon(70)
171.7															Uttley(64)
174.56		0.05													Derrien(67)
175.9															deSaussure(65)
175.7	80	3.2 ±0.2													Uttley(65)
175.98	73±5	3.14 ±0.10 (")			1/2	41±8	29								Derrien(67)
175.98	(")	(")					31±6		9.1						Blons(70)
177.1															deSaussure(65)
177.0	75	5.8 ±0.4													Uttley(65)
177.8						1									Asghar(67)
177.22	51±6	5.36 ±0.18 (") (51)			1/2	41±6	5								Derrien(67)
177.2		(") (5.4)					6±2								Blons(70)
178.8															Trochon(70)
178.7		2.0 ±0.2													deSaussure(65)
178.90	58±9	1.83 ±0.06 (")				1/2	42±7	14						Uttley(67)	
178.90		(")					14±4								Blons(70)
178.9		(5.8)						1							Trochon(70)
		(1.8)													

E_0 (eV)	F (meV)	$2gF_n$ (meV)	F_n (meV)	g	J	F_r (meV)	F_t (meV)	$2gF_n^0$ (meV)	$\sigma_o F_t$ (h.eV)	$\sigma_o F_n$ (h.eV)	η/ν or η	F_t/F_a or (F_t/F)	Reference
181.7 (181.5)								0.3±0.8					deSaussure(65) Uttley(65)
184.0								38.9 ±1.6					deSaussure(65) Uttley(65)
183.4	3.6 ±0.4												deSaussure(65) Uttley(65)
183.64	2.29 ±0.12 (")							5	16.2 ±0.08 (")		0.33		Derrien(69) Blons(70)
183.64	(72)					28	6.4						deSaussure(65) Blons(65) Uttley(65)
185.2								19±1.2		49			deSaussure(65) Blons(65) Uttley(65)
185	>1500												deSaussure(65) Blons(70)
185.1	1800	7.0 ±0.8											deSaussure(65) Blons(70)
184.87	2200 ±200 (")	10±2 (")						50±10 1570 ±500 1800 ±500	58±12		0.71		Derrien(67) Blons(70)
184.87													deSaussure(65) Blons(70)
188.6									8.1±0.9	5			deSaussure(65) Uttley(65)
188.1	0.66 ±0.06												deSaussure(65) Blons(70)
188.27	53±10 (")	0.92 ±0.07 (")		1/2	41	11	9	1.3	6.4 ±0.5 (")		0.21		Derrien(67) Blons(70)
188.27													deSaussure(65) Uttley(65)
190.2									2.5±0.8	16			deSaussure(65) Blons(70) Trochon(70)
190.4	160	2.4 ±0.2											Derrien(67) Blons(70)
190.64	67±9	2.51 ±0.09 (")						56	9	2.2 ±0.6 (")	0.13		Uttley(64) Uttley(64)
190.64	(67)	(2.5)							13	3.4			
191.6													
192.4													

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J (meV)	Γ_f (meV)	Γ_r (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (b.eV)	$\sigma_0\Gamma_n$ (b.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (b)	η/ν	Γ_f/Γ_a	Reference
195.1	760 ±200							160.9 ±12.9							deSaussure(65)
195.1	400 ±2.4	24.8 ±2.4						165							Uttley(65)
196.0			0												Asghar(67)
195.36	447±40 (") (447)	30±1.2 (") (30.0)	1/4	36±1.2	350±42 335±40			14.4 ±1.4							Derrien(67) Blons(70) Trocbon(70)
195.36			0	0				157±10 150±9	200±8 (")			0.91			
195.4								25.5±5							deSaussure(65)
196.3								50							Uttley(65)
196.4	135	7.6±0.6		1											Asghar(67)
197.6															Derrien(67)
196.69	112±8 (")	7.04 ±0.42 (")	1/2	46±11	59±12 54±12			24.4±5 22.5 ±2.3	46.6 ±2.8 (")			0.56			Blons(70)
196.69															Trocbon(70)
196.7															deSaussure(65)
199.1															Uttley(65)
199.2	160±30	13.4 ±0.6													Asghar(67)
200.0															Derrien(67)
199.39	133±13 (")	14.49 ±0.75 (")		1	33±8	90±10 80±10		64±3 57±3	94.6 ±4.8 (")			0.73			Blons(70)
199.39															Trocbon(70)
199.4															deSaussure(65)
203.4															Uttley(65)
203.7	365	28.0 ±1.0													Asghar(67)
204.7								0							
												19.4 ±1.73			

E_0 (eV)	R (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	ϵ	J	Γ_T (meV)	Γ_I (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_I$ (h.eV)	$g\Gamma_n^0/R$ (meV)	σ_0 (b)	η/ν or(η)	Γ_I/Γ_a or(Γ_I/R)	Reference
203.46	200	6						176.5±6	38.4					Derrien(67)
203.93	430	26.6±1						176.5±6	169.7					"
203.46	(430)	{ 6 (26.6 ±1) (26.6)						14	±6.4 (38.4 169.7 ±6.4)					Blons(70)
203.93	(430)				0			145±22						"
203.9														Trochon(70)
207.1	60	10.0								60				Uttley(65)
208.0														Asghar(67)
207.37	57±5	10.5												Derrien(70)
207.37	{ "	+0.4 (57)												Blons(70)
207.4		{ 10.5 (10.5)												Trochon(70)
210.9														Uttley(65)
211.09	800	1.4												Derrien(67)
211.09	{ "	(")												Blons(70)
212.02	1500	1.2												Derrien(67)
212.02	{ "	(")												Blons(70)
213.28	200±60	0.7												Derrien(67)
213.28	{ "	(")												Blons(70)
216.3	70	9.6												Uttley(65)
217.0														Asghar(67)
216.53	67±7	9.40												Derrien(67)
216.53	{ "	+0.40 (67)												Blons(70)
216.5		{ 9.4 (9.4)												"
219.2-220.0														Uttley(65)

E_0 (eV)	Γ^* (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	σ	J	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (h.eV)	$g\Gamma_n^0/\Gamma$ (meV)	σ_0 (h.eV)	η/ν or(η)	Γ_f/Γ_a or(Γ_f/Γ)	Reference	
219.49	70±10 (")	5.36 ±0.27 (")				26±6		17.7		0.60				Derrrien(67)
219.49	(70)	(5.4)		1				11.9 ±3.6						Blons(70)
219.5														Trochon(70)
220.22	45±8	11.14 ±0.50 (52±8)	3/4	33	4	6.2		65.8 ±1.5 (")		0.11				Derrrien(67)
220.22	(52)	(11.1)				11±3		13.9 ±4.2						Blons(70)
220.2														Trochon(70)
222.8	95	4.6 ±0.2							26					Uttley(65)
223.16	59±6	5.12 ±0.15 (")						1						0.37
223.16	(")	(5.1)						4.3						Derrrien(67)
223.2	(59)							9						Blons(70)
224.6		2.2 ±0.2												Trochon(70)
224.89	85±17 (")	2.56 ±0.15 (")						2		14.8 ±0.9 (")		0.14		Uttley(65)
224.89								25		4.4				
227.5		3.2 ±0.4								18				Uttley(65)
227.77	6000	17												
227.89	67±10	2.54 ±0.15								76		0.78		Derrrien(67)
227.77	9000 (67)	17±3 ±0.15								8		0.57		"
227.89		(2.54) ±0.15												Blons(70)
227.9	(67)	(2.5)												"
231.1	66	15.2 ±0.8												Uttley(65)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	κ	Γ_t (meV)	J	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (b.eV)	$g\Gamma_n^2/\Gamma$ (b.eV)	σ_0 (b)	η/ν or(η)	Γ_t/Γ_a or(Γ_t/Γ)	Reference	
232.0				1										
231.40	43±8	17.8 ±1.0 (54±8) (54)	3/4	27	4		9		8.5 ±1.27	100.1 ±5.6 100±6		0.12		Asghar(67)
231.40						5±2								Derrien(67)
231.4				1										Blons(70) Trochon(70)
232.63	130	0.66 ±0.15 (")					2.5		3.7±0.2 (")		0.68			Derrien(67)
232.63							2							Blons(70)
234.0	72	13.6 ±0.8							74					Uttley(65)
235.4				0										
234.32	74±9	15.35 ±0.60 (")	1/2	45	14				35.5 ±1.83	85.2 ±3.3 (")		0.24		Asghar(67)
234.32						15±3								Derrien(67)
234.3				(74)	(15.3)	1								Blons(70)
234.3														Trochon(70)
238.7	115	7.8 ±0.6							43					Uttley(65)
240.0				1										
239.04	73±8	8.15 ±0.40 (") (73)	1/2	47	17				4.45 ±1.18	44.4 ±2.2 (")		0.27		Asghar(67)
239.04						16±4								Derrien(67)
239.0						1								Blons(70) Trochon(70)
240.60														Derrien(67)
240.60														Blons(70)
242.6	100	8.6 ±0.6							0.27					Uttley(65)
243.8														
242.88	97±6	9.92 ±0.45 (")					0		48					Asghar(67)
242.88							3/4							Derrien(67)
242.88									7.28 ±1.94	53.2 ±2.6 (")		0.65		Blons(70)

E_0 (eV)	Γ (meV)	Γ_n (meV)	g	J	Γ_γ (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$g\Gamma_n^2/R$ (meV)	σ_0 (b)	η/ν or(η)	R/R_a or(R_t/R)	Reference
242.9	(97)	(9.9)		1									Trochon(70)
247.1		1.2								6			
247.50	312±60 (")	1.39 ±0.20 (")			227		6		7.3±1.2 (")		0.82		Uttley(65) Derrien(67)
247.50					227		5.3±1.3						
248.5	95	22.0 ±1.0								115			Uttley(65)
250.0													
248.86	62±6 (") (62)	22.13 ±0.72 (") (22.1)		3/4	41	6		10	18.1 ±1.4	115.7 ±3.7 (")	0.12		Asghar(67) Derrien(67) Blons(70) Trochon(70)
248.86						5±1			9.7±1.2				
248.9						1							
250.9	90	36.0 ±1.8								188			Uttley(65)
251.5													
251.23	83±5 (") (83)	41.2 ±1.2 (") (41.2)		3/4	41±7	14±2			28.4 ±3.0				Asghar(67) Derrien(67) Blons(70) Trochon(70)
251.23						12±2			36.4±3 31.1 ±2.5	213.4 ±6.3 (")	0.25		
251.2						1							
254.2		3.8 ±0.4								19			Uttley(65)
254.58	55±10 (55±5)	4.2 ±0.3 (")											Derrien(67) Blons(70) Trochon(70)
254.58													
254.6	(55)	(4.2)											
255.8		8.4 ±0.6									43		Uttley(65)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_a (meV)	E	J (meV)	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (h.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (b)	η/ν or(y)	Γ_f/Γ_a or(Γ_f/Γ)	Reference
257.2				1				4.05 ± 1.52					Asghar(67)
256.11	91 \pm 16	9.5 (")	± 0.5 (")										Derrien(67)
256.11	(")	(9.5)	(9.5)		1		32 \pm 7	16.8 ± 2.2					Blons(70)
256.1													Trochon(70)
259.00													Derrien(67)
259.00		0.4 ± 0.1 (")											Blons(70)
261.8	6400	42.4 ± 4.0								211			Uttley(65)
262.5				0									Asghar(67)
262.37	6100	50 (6300)	± 4										Derrien(67)
262.37													Blons(70)
262.2													Uttley(65)
262.74	60 \pm 10	3.64 (60) ± 10	± 0.4 (3.64) ± 0.45										Derrien(67)
262.74													Blons(70)
264.23		0.25 (0.25)											Derrien(67)
264.23													Blons(70)
269.2	380	8.6 ± 0.8											Uttley(65)
269.11													Derrien(67)
269.11	160	2.5 ± 0.1 (2.1) ± 0.5											Blons(70)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	κ	J	Γ_r (meV)	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (b.eV)	$\sigma_0\Gamma_n$ (b.eV)	$\epsilon\Gamma_n^2/\Gamma$ (meV)	σ_0 (b)	η/ν $\alpha(\eta)$	Γ_t/R_a $\alpha(R_t/R)$	Reference
269.54	72±20	5.8 (γ_2 ±20) (72)				28±10		11±2			(28.0 ±2.7)				Derrrien(67)
269.54					1										Blons(70)
269.5															Trochon(70)
272.3	90	36.0 ±3.0													Uttley(65)
273.6					1										
272.62	92±10	41.8 (") (92)													Asghar(67)
272.62															Derrrien(67)
272.6					1			31±12							Blons(70)
274.80	800	14.0 ±2.0 (800)						730							Trochon(70)
274.80															Derrrien(67)
275.2	380	42.0 ±3.0													Blons(70)
276.9					1										Uttley(65)
275.57	150±30	35.1 (") (150)													Asghar(67)
275.57															Derrrien(67)
275.6								72±20							Blons(70)
277.23	5300	8 (9)							5260						Trochon(70)
277.23															Derrrien(67)
279.1	70	11.8 0.2													Blons(70)
281.0									0						Uttley(65)
															Asghar(67)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J (meV)	Γ_r (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (b)	η/ν or η	Γ_t/Γ_a or (Γ_t/Γ)	Reference	
279.59	111±8	10.64 ±0.35 (")				56±8									Derrien(67)
279.59	(")	(")			0										Blons(70)
279.6	(111)	(10.6)													Trochon(70)
282.5	80	36.0 ±3.0													Uttley(65)
284.1				1											Asghar(67)
282.92	85±6	37.8 ±2.7 (")													Derrien(67)
282.92	(85)	(37.8)			1										Blons(70)
282.9															Trochon(70)
286.7		3.2 ±0.4													Uttley(65)
285.73		0.10 (0.10)													Derrien(67)
285.73															Blons(70)
287	6000	50 (7000)	(15)			6028		60		(68)					Derrien(67)
288.00															Blons(70)
288.30		0.08 (")													Derrien(67)
288.30															Blons(70)
291.8	350	7.0 ±0.4													Uttley(65)
292.33	115±13	5.82 ±0.24 (")													Derrien(67)
292.33	(115)	(5.8)													Blons(70)
292.3															Trochon(70)
296.0	130	4.6 ±0.4													Uttley(65)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J (meV)	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (b.eV)	$g\Gamma_n^2/\Gamma$ (meV)	$\sigma_0\Gamma$ (b)	η/u or [η]	Γ_f/Γ_a or [Γ_f/Γ]	Reference	
296.46	81±12 (")	4.89 (")				30								Derrien(67)
296.46	(81)	(4.9)			1									Blons(70)
296.5														Trochon(70)
298.1	100	15.0 ±1.0												Uttley(65)
299.7						1								Asghar(67)
298.59	74±7 (")	15.80 ±0.60 (")												Derrien(67)
298.59	(74)	(15.8)			1		20±5							Blons(70)
298.6														Trochon(70)
303.2						1								Asghar(67)
301.81	108±6 (108±6)	27.3 ±1.0 (27.3 ±1.0)												Derrien(67)
301.81	(108)	(27.3)				1		48±10						Blons(70)
301.8														Trochon(70)
308.20	150±30 (150 ±30)	4.40 ±0.27 (4.40 ±2.7)												Derrien(67)
308.20														Blons(70)
309.01	85±12 (85±12)	21.10 ±0.72 (21.10 ±0.72)						98±45						Derrien(67)
309.01	(85)	(21.1)												Blons(70)
309.0														Trochon(70)
311.12		0.73 ±0.18 (0.73 ±0.18)												Derrien(67)
311.12														Blons(70)

E_0 (eV)	I^r (meV)	$2gI_n$ (meV)	I_n (meV)	g	J	Γ_r (meV)	Γ_f (meV)	$2gI_n^0$ (meV)	$\sigma_0 I_f$ (h.eV)	$\sigma_0 I_n$ (h.eV)	gI_n^2/R (meV)	σ_0 (b)	η/ν or(η)	I_f/I_a or(I_f/R)	Reference
313.62	62±6 (62±6) (62)	20.40 ±0.72 (20.40) ±0.72 (20.4)				10±3		13.0 ±1.3			(85±3)				Derrien(67) Blons(70) Trochon(70)
313.62	62±6 (62±6) (62)	20.40 ±0.72 (20.40) ±0.72 (20.4)			1										Derrien(67) Blons(70) Trochon(70)
313.6															
316.66	73±0 (73) (73)	7.75 ±0.30 (7.75) ±0.30 (7.7)				25±5		10.8 ±1.6			(31.8 ±0.9)				Derrien(67) Blons(70) Trochon(70)
316.66	73±0 (73) (73)	7.75 ±0.30 (7.75) ±0.30 (7.7)			1										Derrien(67) Blons(70) Trochon(70)
316.7															
321.75		0.20 ±0.08 (0.20)									(0.9)				Derrien(67) Blons(70)
321.75		0.20 ±0.08 (0.20)													Derrien(67) Blons(70) Trochon(70)
323.36	160±16 (160) ±20 (160)	30.2 ±0.9 (30.2) ±0.9 (30.2)				47±9	35.5 ±5.3				(121.4 ±3.6)				Derrien(67) Blons(70) Trochon(70)
323.36	160±16 (160) ±20 (160)	30.2 ±0.9 (30.2) ±0.9 (30.2)			0										Derrien(67) Blons(70) Trochon(70)
323.4															
325.30	105±9 (105) ±9 (105)	12.8 ±0.5 (12.8) ±0.5 (12.8)				46±12		22.6 ±3.2			(51.2 ±2.1)				Derrien(67) Blons(70) Trochon(70)
325.30	105±9 (105) ±9 (105)	12.8 ±0.5 (12.8) ±0.5 (12.8)			1										Derrien(67) Blons(70) Trochon(70)
329.65	1500 (2000)	1.5 (5.6)				1947		20			(22)				Derrien(67) Blons(70)
329.65	1500 (2000)	1.5 (5.6)													Derrien(67) Blons(70) Trochon(70)
333.91	67±7 (67±7) (67)	8.24 ±0.30 (8.24) ±0.30 (8.2)				10		4.7			(32.1 ±1.2)				Derrien(67) Blons(70) Trochon(70)
333.91	67±7 (67±7) (67)	8.24 ±0.30 (8.24) ±0.30 (8.2)			1										Derrien(67) Blons(70) Trochon(70)
333.9															
335.93	83±6 (83±6) (83)	26.60 ±0.72 (26.60) ±0.72 (26.6)				18±4		22.1 ±3.3			(102.9 ±2.7)				Derrien(67) Blons(70) Trochon(70)
335.93	83±6 (83±6) (83)	26.60 ±0.72 (26.60) ±0.72 (26.6)			1										Derrien(67) Blons(70) Trochon(70)
335.9															

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	θ	J	Γ_γ (meV)	Γ_ℓ (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_\ell$ (keV)	$\sigma_0\Gamma_n$ (keV)	η/ν $\text{or } \eta$	Γ_ℓ/Γ_n $\text{or } (\Gamma_\ell/\Gamma)$	Reference	
359.99	114±20 (114 ±20)	1.66 ±0.18 (1.66 ±0.18)				80		4.2						Derrien(67) Blons(70)
361.28		0.33 ±0.10 (0.33 ±0.10)									(1.2 ±0.4)			Derrien(67) Blons(70)
366.00	5000 (5000)	4.9 (5.4)				4947	20				(20)			Derrien(67) Blons(70)
368.33		0.60 ±0.20 (0.60 ±0.20)												Derrien(67) Blons(70)
370.31	105±20 (105 ±20)	3.90 ±0.24 (3.90 ±0.24)							1.6		(2.1 ±0.7)			Derrien(67) Blons(70)
371.72	3400 (3400)	11 ±1.4 (11.5 ±1.4)								3	(1.37 ±0.8)			Derrien(67) Blons(70)
375.02	43±12 (43 ±12)	4±0.3 ±0.3 (4.0 ±0.3)							3335	41±5	(41±5)			Derrien(67) Blons(70)
377.10	101±20 (100 ±20)	2.98 ±0.30 (2.98 ±0.30)			0				6	2	(1.39 ±1.1)			Derrien(67) Blons(70)
378.04	223±60 (223 ±60)	1.88 ±0.30 (1.88 ±0.30)							39±16	4±1	10.3 ±1.1			Derrien(67) Blons(70)

E_0 (eV)	F (meV)	$2gF_n$ (meV)	F_n (meV)	\mathbf{g}	J (meV)	F_r (meV)	F_t (meV)	$2gF_n^0$ (meV)	$\sigma_o F_n$ (b.eV)	$\sigma_o F_t$ (b.eV)	gF_n^2/F (meV)	σ_o (b)	η/ν or(η)	F_t/F_a or(F_t/F)	Reference
382.43	130 (130)	0.63 ± 0.15 (0.63) ± 0.15				85									Derrien(67) Blons(70)
382.43															
384.26	109 \pm 30 (109) ± 30 (109)	8.55 ± 0.50 (8.55) ± 0.50 (8.5)					75 \pm 25	20 \pm 3							Derrien(67) Blons(70)
384.3						1									
385.90	>1000 (1000)	2 (1.4)													
385.90															
389.51	74 \pm 14 (74) ± 14	2.09 ± 0.18 (2.09) ± 0.18					955	4.3							Derrien(67) Blons(70)
389.51															
391.52	142 \pm 28 (142) ± 28	1.89 ± 0.18 (1.89) ± 0.18					21	2							Derrien(67) Blons(70)
391.52															
394.43	106 \pm 13 (106) ± 13 (106)	9.78 ± 0.33 (9.78) ± 0.33 (9.8)						52 \pm 10		16.0 ± 2.4					Derrien(67) Blons(70)
394.43															
394.4								1							Trochon(70)
396.91	108 \pm 20 (108) ± 20	3.17 ± 0.21 (3.17) ± 0.21						61 \pm 20		5.9 \pm 1.2					Derrien(67) Blons(70)
396.91															
401.56	220 \pm 20 (220) ± 20 (220)	29.1 ± 1.2 (29.1) ± 1.2 (29.1)							154 \pm 25		66 \pm 7				Derrien(67) Blons(70)
401.56															
401.6										1					Trochon(70)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	ϵ	J	Γ_t (meV)	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$g\Gamma_n^2/R$ (meV)	σ_0 (b)	γ/ν or γ	f_t/f_a or (f_t/R)	Reference
404.24	178 ± 6	34.8 (155 ± 25)				76 ± 5									Derrien(67)
404.24		34.8 ± 1.3 (34.8 ± 1.3)													Blons(70)
404.2		(155 ± 25)	(34.8 ± 1.3)	1											Trochon(70)
406.03	320	2.75 ± 0.60 (320)													Derrien(67)
406.03		(2.73 ± 0.60)													Blons(70)
406.95	330	1.46 ± 0.60 (330)													Derrien(67)
406.95		(1.46 ± 0.60)													Blons(70)
408.71	150	1.94 ± 0.30 (150)													Derrien(67)
408.71		(1.94 ± 0.30)													Blons(70)
412.31	145 ± 15	13.41 ± 0.63 (145 ± 15)													Derrien(67)
412.31		(13.41 ± 0.63)													Blons(70)
412		(145 ± 15)	(13.4 ± 0.63)												Trochon(70)
415.66	152 ± 30	4.89 ± 0.36 (152 ± 30)													Derrien(67)
415.66		(4.89 ± 0.36)													Blons(70)
417.60	267 ± 64	2.57 ± 0.36 (267 ± 64)													Derrien(67)
417.60		(2.40 ± 0.36)													Blons(70)
419.85	139 ± 25	9.11 ± 0.45 (139 ± 25)													Derrien(67)
419.85		(9.11 ± 0.45)													Blons(70)
419.8		(139 ± 25)	(9.1 ± 0.45)	1											Trochon(70)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	\mathbf{g}	J	Γ_r (meV)	Γ_t (meV)	$2g\Gamma_n^2$ (meV)	$\sigma_0\Gamma_t$ (meV)	$\sigma_0\Gamma_n$ (meV)	$g\Gamma_n^2/\Gamma$ (h.eV)	σ_0 (h.eV)	η/ν or(η)	Γ_t/Γ_n or(Γ_t/Γ)	Reference
425.67		0.40 (0.40)													Derrien(67) Blons(70)
425.67															
428.33	>6000	40													Derrien(67) Blons(70)
426.37	7000	14.8													
429.64	780	5.66 ±0.81 (780)													Derrien(67) Blons(70)
429.64		(5.66 ±0.81)													
431.29	3500	7.3													Blons(70)
432.73		1.54 ±0.30 (1.54 ±0.30)													Derrien(67) Blons(70)
432.73															
437.76	62±15	4.04 ±0.30 (62±15)													Derrien(67) Blons(70)
437.76		(4.04 ±0.30) (4.0)													
437.8	(62)	(62)													Trochon(70)
438.72	61±15	4.36 ±0.30 (61±15)													Derrien(67) Blons(70)
438.72		(4.36 ±0.30) (4.4)													
438.7	(61)	(61)													Trochon(70)
440.07		0.42 ±0.15 0.42 ±0.15													Derrien(67) Blons(70)
440.07															
442.41	422	10.5 ±0.5 (422) ±50													Derrien(67) Blons(70)
442.41		(10.5 ±0.5) (422) ±50													
442.4															Trochon(70)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_o\Gamma_t$ (h.eV)	$\sigma_o\Gamma_n$ (h.eV)	$g\Gamma_n^0/\Gamma$ (meV)	σ_o (b)	η/ν or(η)	Γ_t/Γ_a or(Γ_t/Γ)	Reference	
449.75		(2.0 ±0.3)		1/2		90				(5.8 ±0.9)					Blons(70)
451.35	(81)	(21.1 ±1.4) (21.1)		3/4		3.7				(60.8 ±4.2)					Blons(70) Trochon(70)
454.45		(0.7)								(2.0)					Blons(70)
455.73	(503)	(39.7 ±2.5) (39.7)		1/4		495				(113.3 ±7.5)					Blons(70) Trochon(70)
455.7	(303)	(11.1 ±1.1) (11.1)		1/2		118				(31.6 ±3.2)					Blons(70) Trochon(70)
457.33															Blons(70)
457.3	(303)	(6.9 ±0.6) (6.9)		3/4		33									Blons(70) Trochon(70)
458.80	(83)	(3.5 ±0.4)		1/2											Blons(70)
458.8															Blons(70)
461.26		(0.8 ±0.2)		1/2											Blons(70)
462.64															Blons(70)
468.20	(6.5)			1/4			2045								Blons(70)
470	(15)			1/4			5030								Blons(70)
473.10		(6.2 ±0.4) (6.2)		3/4		10									Blons(70)
473.1	(60)			1											Blons(70)
475.31		(5.7)		1/4			535								Blons(70)
476.90		(2.7)		1/4			1950								Blons(70)
479.24		(0.2)													Blons(70)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	δ	J (meV)	Γ_f (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_f$ (h.eV)	$\sigma_0\Gamma_n$ (h.eV)	$g\Gamma_n^0/\Gamma$ (meV)	σ_0 (b)	η/ν or η	Γ_f/Γ_a or (Γ_f/Γ)	Reference
484.15	(3.9 ±0.4)	(3.9 1/2)				14.5		2.5		(10.4 ±1.1)				Blons(70)
487.29	(3.3)						19.8			(8.8)				Blons(70)
487.81	(5.2)						19.8			(15.4)				Blons(70)
490.65	(20±3)	1/4				2220				(53±8)				Blons(70)
494.10	(6.9 ±0.4)	3/4			1	70		10.5		(18.2 ±1.1)				Blons(70)
494.1	(96)													Trochon(70)
495.63	(1.2)													Blons(70)
500.50	(5.1 ±1.3) (5.1)	3/4			1									Blons(70)
500.5	(84)													Trochon(70)
502.86	(17.8 ±1.4) (17.8)	3/4			1	32		5.6		(13.2 ±3.4)				Blons(70)
502.9	(207)													Trochon(70)
505.78	(0.9)													Blons(70)
508.22	(0.7)													Blons(70)
509.74	(78.2 ±4.0) (78.2)	3/4			1	167		127.4		(199.4 ±10.4)				Blons(70)
511.52	(12.9)	1/4				3300				(32.8)				Trochon(70)
515.16	(1)													Blons(70)
516.57	(0.3)													Blons(70)
517.98	(0.7)													Blons(70)
520.22	(22.4 ±1.8) (22.4)	3/4			1	43		24		(56.0 ±4.5)				Blons(70)
520.2	(172)													Trochon(70)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J (meV)	Γ_t (meV)	$2g\Gamma_a^0$ (meV)	$\sigma_0\Gamma_t$ (b.eV)	$g\Gamma_n^0/\Gamma$ (meV)	σ_0 (b)	η/ν or $\langle \eta \rangle$	Γ_t/Γ_a or $\langle \Gamma_t/\Gamma \rangle$	Reference
524.21	(101)	(45.9 ±4.8) (46.0)		3/4		20			(113.6 ±11.9)				Blons(70)
524.2			(121)		1				(299)				Trochon(70)
525.40				1/4		10500							Blons(70)
526.00			(1.5)		1/2		51	2	(3.7)				Blons(70)
527.38			(1.5)		1/2		~16	~1	(3.7)				Blons(70)
530.52			(63.8 ±5.1) (63.8)		1/4		75		(156.3 ±12.8)				Blons(70)
530.5	(192)				0								Trochon(70)
539.17			(17.1 ±3.0) (17.0)		3/4		2.4		1.8	(41.2 ±7.2)			Blons(70)
539.2	(70)				1								Trochon(70)
540.71			(4)						14	(9.6)			Blons(70)
541.55			(8)						14	(19)			Blons(70)
543.08			(17.6 ±3.0) (17.6)		3/4		5		3.5	(41.0 ±7.2)			Blons(70)
543.1	(67)				1								Trochon(70)
545.85			(17.5 ±2.5)		1/4		1120		34	(41.7 ±6.0)			Blons(70)
547.14			(1.8)							(4.3)			Blons(70)
549.67			(17.7 ±1.5) (17.7)		3/4		7		5	(41.9 ±3.5)			Blons(70)
549.7	(51)				1								Trochon(70)
553.50			(17)				~5		~2	(39.9)			Blons(70)
554.13			(52.2)		1/4		1140			(122.5)			Blons(70)
555.72			(4.9)						10.5	(11.5)			Blons(70)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_f (meV)	$2gr_n^0$ (meV)	$\sigma_0\Gamma_f$ (h.eV)	$g\Gamma_n^0/\Gamma$ (meV)	σ_0 (h)	γ/ν or(γ)	Γ_f/Γ_a or(Γ_f/Γ)	Reference
559.16		(40.8 ± 2.4) (41.0)	3/4		21		22		(94.9 ± 6.7)				Blons(70)
559.2	(127)	(127)		1									Trochon(70)
562.84		(53.6 ± 4.0)						81	(123.8 ± 9.3)				Blons(70)
564.03		(9.8 ± 1.6)						1	(22.6 ± 3.7)				Blons(70)
565.81		(142 ± 1.2)	1/2				5		(32.6 ± 2.7)				Blons(70)
571.11		(12.9 ± 0.9) (12.9)	3/4				33		11.5				Blons(70)
571.1	(71)			1						(29.4 ± 2.1)			Trochon(70)
574.00		79.5 ± 6.0 (79.5)	1/4				220		94	(180.0 ± 13.6)			Blons(70)
574.0	(180)		0										Trochon(70)
575.77		(59.7 ± 5.6) (59.7)	3/4				8		12	(134.8 ± 12.6)			Blons(70)
575.8	(115)		1										Trochon(70)
578.00		(2.5)	1/2				36		2.5	(5.6)			Blons(70)
579.04		(10.3 ± 0.9) (10.3)	3/4				7		2.8	(23.1 ± 2.1)			Blons(70)
579.1	(77)		1										Trochon(70)
584.81		(0.7)								(1.6)			Blons(70)
588.09		(16.9 ± 1.2) (16.9)	3/4				10		6	(37.4 ± 2.6)			Blons(70)
588.1	(78)		1										Trochon(70)
589.94		(0.5)									(1.1)		Blons(70)
593.52		(3.2 ± 0.5)	1/2				4		0.6	(7.0 ± 1.2)			Blons(70)

E_0 (eV)	Γ (meV)	$2g\Gamma_n$ (meV)	Γ_n (meV)	g	J	Γ_r (meV)	Γ_t (meV)	$2g\Gamma_n^0$ (meV)	$\sigma_0\Gamma_t$ (h.eV)	$g\Gamma_n^2/\Gamma$ (meV)	σ_0 (h)	η/v or(η)	Γ_t/Γ_a or(Γ_t/Γ)	Reference
597.35	(65)	(12.9 ±1.5) (13.0)	3/4		5			2.6		(27.0 ±1.7)				Blons(70)
598.04		(21.6 ±4.0)		1/4		5915	44		(47.0 ±8.2)					Trochon(70)
604.01	(75)	(37.6 ±3.3) (37.5)		3/4		3.5		4	(80.9 ±6.8)					Blons(70)
604.0		(14.6 ±1.2) (14.6)		3/4		7.7	4.2		(31.2 ±2.5)					Trochon(70)
607.64	(83)			1				5.2						Blons(70)
607.6				1										Trochon(70)
609.29	(85)	(23.6 ±2.4) (23.6)		3/4		6.6								Blons(70)
609.3		(8.8 ±0.8)		1/2		14		4		(18.7 ±1.8)				Trochon(70)
612.82				1										Blons(70)
620.24	(77)	(17.8 ±1.5) (17.8)		3/4		5.4		3.4		(37.3 ±3.2)				Blons(70)
620.8		(60)	(14.7 ±1.2) (14.7)		1									Trochon(70)
622.39				3/4		9.8		4.9		(30.7 ±2.6)				Blons(70)
622.6				1										Trochon(70)
625.17				3/4		7.5		3.2		(24.5 ±2.6)				Blons(70)
625.2	(65)	(11.8 ±1.2) (11.8)		1										Trochon(70)
628.21		(2.2 ±0.7)		1/2		9		0.8		(4.6 ±1.5)				Blons(70)
632.97		(34 ±4)		1/4			3800	68		(69.8 ±8.2)				Blons(70)
636.47		(8.0 ±1.2)		1/2				16	4	(16.3 ±2.5)				Blons(70)

E_0 (eV)	F (meV)	$2gF_n$ (meV)	F_n (meV)	g	J	F_r (meV)	$2gF_n^0$ (meV)	$\sigma_0 F_t$ (b.eV)	gF_n^2/F (meV)	σ_o (b)	η/ν or(η)	F_t/F_a or(F_t/F)	Reference
639.28		(13.9 ±1.5) (13.9)		3/4		6			2.8		(28.3 ±3.1)		Blons(70) Trocbon(70)
639.3	(63)				1								Blons(70) Trocbon(70)
641.42		0.7								1.4			Blons(70)
644.94		(8.8 ±1.2) (8.8)		3/4		3		1			(17.7 ±2.4)		Blons(70) Trocbon(70)
644.9	(57)				1								Blons(70) Trocbon(70)
646.65		1.5								3			Blons(70)
658.29		(122 ±13)		3/4		19		33.2			(253 ±25)		Blons(70) Trocbon(70)
658.3	(271)	(128.0)			1								

Original Notes for Table 2

Sauter 65)

- a) Quoted uncertainties for $g\Gamma_n^2/\Gamma$ values are estimates of uncertainties in measuring scattering area only.
- b) Upper and lower values in column for g are determined using values of $g\Gamma_n$ and Γ from references Sch 67) and B 65), respectively.

Derrien 67)

- a) BNL 325
- b) Assumed level to explain the large residual cross section between 10.93 and 11.89 eV.
- c) Assumed level to explain the strong asymmetry of the resonance at 57.44 eV.
- d) Complex group of resonances among which two narrow resonances are clearly distinguished. Taking account of these two levels (81.76 and 85.32 eV) only, the cross section curve can not be reproduced.
- e) Assumed level to explain the strong asymmetry of the resonance at 212.02 eV.
- f) Assumed level to explain the large residual cross section between 225 and 228 eV. There are, perhaps, two large resonances.

King 69)

- a) The upper and lower values are obtained assuming J to be 0 or 1, respectively.

Weinstein 69)

- a) Uncertain assignment.

Appendix Multilevel Parameters

Derrien et al. carried out the analysis of the Saclay data on total and fission cross sections of ^{239}Pu using the Reich-Moore's multilevel formula^{D70)}. Experimental informations on the Saclay data are summarized in Chapter III. The agreement is very good between the theoretical curve and the measured points. Their resonance parameters are shown in Table A1.

The same kinds of the analysis were made by James^{J68)} and Farrel^{F68)}. The resonance parameter sets obtained by them (Table A2 and A3) are considerably different from each other and from the set by Derrien et al. mentioned above, even though these three analyses were carried out by using the same formula. On this point, Derrien et al. comment in their paper^{D70)} as follows. "James' conclusions are qualitatively the same as ours. But the parameters he obtained are very different from ours, probably because he did not take into account the resonances outside the range he studied, for example, those at 60.94, 96.49 and 100.25 eV. It is not possible, within the available informations, to make a detailed discussion about the parameters obtained by us and those by Farrel."

Gwin et al. adopted the multilevel formula of Adler and Adler for the analytical description of their experimental results^{G71)}. Their parameter set is summarized in Table A4.

The Reich-Moore and the Adler-Adler multilevel formulae are briefly reviewed in Table A5.

Table A1 Multilevel Parameters of ^{239}Pu , Derrien (70)

Energy (eV)	Γ_n (meV)	Channel 1 ⁺		Channel 0 ⁺		J
		Γ_f (meV)	Γ_{f1} (meV)	Γ_{f2} (meV)		
0.296	0.24			60.0		
7.800	0.77	-47.0				
10.910	1.85	-120.0				
11.878	0.98	21.0				
14.307	0.66	61.0				
14.660	1.92	37.0				
15.405	1.73		-442.0	99.4		
17.633	1.83	-40.5				
22.234	2.59	-64.0				
23.876	0.09	30.0				1
26.223	1.52	44.0				
27.233	0.15	-8.0				
32.265	0.84			-114.0		
35.422	0.25	5.3				
41.373	3.79	-3.6				
41.623	1.38	43.4				1
44.435	5.83	-5.0				
47.494	5.25		281.0	-70.0		
49.446	3.44		-786.0	-61.0		
50.033	2.97	-12.5				
52.533	10.02	9.0				
55.582	1.51	22.0				
57.003	14.47		-1554.0	28.0		
59.153	4.80	102.0				
61.866	26.25		7102.0	20.0		
63.018	0.70	80.0				1
65.497	13.66		238.0	151.0	0	
65.711	9.17	28.5				
74.053	3.37	-26.0				
74.937	22.78	-87.0				
78.968	0.04	2.0				1
80.915	4.95		963.0	582.0		
82.666	0.39	10.0				1
85.490	7.45	9.4				
85.534	53.41		-2010.0	55.0		
90.711	11.86	9.0				
92.953	0.70	9.0				1
95.374	1.90	-25.0				
96.332	20.66		842.0	1816.0		
101.751	9.05		-4823.0	25.0		
103.010	1.61	10.0				
105.301	4.78	-6.0				
106.670	8.93	-26.0				
110.410	0.44	13.0				1
114.692	2.50		-1654.0	-17.0		
115.185	0.21	160.0				1
116.075	11.75		-117.0	-139.0		
118.831	16.85	-34.0				1
121.006	2.38	36.0				1
123.467	0.51	-39.0				1

126.226	1.93	-20.0			1
127.557	0.51	25.0			1
132.321	35.06	-	3991.0	- 35.0	
133.784	5.59	6.0			
136.770	10.24			- 84.0	
139.340	0.10	120.0			
142.963	3.24	82.0			
143.470	4.08	31.0			
146.250	7.05	13.0			
147.496	3.53		1499.0	86.0	
148.242	0.44	102.0			1
149.442	1.69	50.0			1
157.009	32.55		29.0	473.0	

Table A2 Multilevel Parameters of ^{239}Pu , James (68)

Energy (eV)	Γ_n^o (meV)	Γ_{f_1} (meV)	Γ_{f_2} (meV)	Γ_r (meV)	J
60.94	3.843	5930	0	40	0
78.95	0.012	140	-	40	1
81.36	0.598	-456.2	415.8	40	0
82.68	0.055	29.5	-	40	1
85.22	6.24	2686	571	40	0
85.48	0.85	37.0	-	40	1
96.49	1.36	1647	0	40	0
100.25	1.11	0	5949	40	0

Table A3 Multilevel Parameters of ^{239}Pu , Farrel (68)

En	Energy (eV)	Γ_n^o (meV)	Γ_{f_1} (meV)	Γ_{f_2} (meV)	Γ_r (meV)	J
	14.29	0.183	-67.00		40	1
	14.68	0.429	68.00		40	1
	15.38	0.537	608.00		40	0
	17.65	0.390	-68.36		40	1
	19.32 ^a	0.017	-9.93		40	1
	21.45 ^b	0.018	250.00		40	0
	21.70 ^b	0.0087	-110.00		40	1
	22.26	0.585	47.24		40	1
	23.91	0.038	-14.8		40	1
	25.15 ^b	0.000	45.00		40	1
	26.25	0.360	-44.0		40	1
	27.25	0.080	-1.58		40	1
	30.60 ^c	0.000	2000.0		40	0
	32.34	0.147	99.10		40	0
	33.50	0.0001	-50.0		40	1
	34.30	0.0013	50.00		40	0
	35.47	0.010	-25.0		40	1
	37.25 ^b	0.0002	80.00		40	1
	39.25 ^b	0.0004	50.00		40	0
	40.95 ^c	0.015	760.00		40	0
	41.43	0.101	39.35		40	1
	41.72	0.112	-79.2		40	1
	44.51	0.220	23.75		40	1
	46.00 ^c	0.0002	30.00		40	1
	47.64	0.718		230.0	40	0
	49.60	0.536	900.00		40	0
	50.10	0.231	-23.70		40	1
	51.60 ^b	0.0021	-30.0		40	1
	52.59	0.405	32.43		40	1
	55.66	0.143	-43.7		40	1
	57.30	2.607	1040.00		40	0
	59.22	0.563	-141.00		40	1
	60.65 ^c	0.011	185.0		40	1
	62.70	1.689	-4250.0		40	0
	63.16	0.087	-54.4		40	1
	65.40 ^c	0.099	-39.2		40	1
	65.75	0.934	-127.00		40	1
	66.75	0.515		1355.00	40	0
	68.05 ^c	0.0017	-250.00		40	1
	74.19	0.385	91.90		40	1
	74.97	1.893	148.00		40	1
	77.80 ^c	0.040		2000.0	40	0
	78.60	0.0009	50.00		40	1
	81.10	0.948	1950.00		40	0
	83.62	0.024	-74.30		40	1
	85.40	0.160	48.30		40	1
	85.60	4.702	-1916.00		40	0

Original Remarks:

- Γ_{f_1} and Γ_{f_2} are the partial fission width in the two channels assumed open.
- $\Gamma_n^0 = \Gamma_n / [E_0/(1eV)]^{1/2}$, Γ_r assumed constant
 - a) Parameters very uncertain due to close proximity to a resonance in the target backing.
 - b) Resonance included to improve the fit, primarily in the valleys. Their existence is probable but positions and width are uncertain.
 - c) Resonance previously unreported but whose presence seems well established by the present fit.

Table A4 Multilevel Resonance Parameters for ^{239}Pu up to 100 eV, Gwin (71)

μ (eV)	ν (eV)	G^r (b.eV $^{3/2}$)	H^r (b.eV $^{3/2}$)	G^f (b.eV $^{3/2}$)	H^f (b.eV $^{3/2}$)
-1.59980	0.09639	337.16308	17.75120	2196.92669	15.96231
-0.26000	0.10000	-0.56911	0.35413	23.11888	7.89156
0.29835	0.04866	59.67277	0.00506	85.91635	-3.15557
1.06270 ^a	0.01678	23.26925	-0.25338	0.0	0.0
7.65000 ^b	0.03600	6.04517	-1.11225	0.0	0.0
7.85088	0.04638	128.75158	1.22563	151.42278	9.08156
10.97580	0.10560	110.42144	5.42050	421.15396	-28.63627
11.93653	0.03590	182.96548	-3.25150	105.63263	23.04872
14.37746	0.05802	55.81039	3.92790	112.98468	36.01877
14.72565	0.03759	260.98909	2.63596	220.58809	-25.56715
15.48510	0.36115	14.41901	1.25293	165.16944	-9.48970
17.70590	0.03956	222.00144	5.44303	192.16712	8.10439
18.84000 ^b	0.18450	298.90448	-30.36788	0.0	0.0
21.20000 ^b	0.05000	144.94222	29.68602	0.0	0.0
22.31846	0.05748	230.21998	7.72855	318.49420	-0.88909
23.96776	0.12357	15.66631	4.85672	14.40227	5.59772
26.31851	0.05203	147.91834	8.51285	155.57259	6.14954
27.13000 ^b	0.05950	71.77136	30.71388	0.0	0.0
27.28879	0.07169	50.19682	0.0	4.45996	3.13136
32.41014	0.10048	14.73027	1.46599	37.33409	4.08433
35.56785	0.03278	48.28967	6.87629	4.21690	1.71237
38.34451 ^a	0.04505	18.38474	2.32437	0.0	0.0
41.44697	0.03159	551.94794	-9.30022	47.70132	0.0
41.70891	0.05210	68.14301	11.99331	85.18111	8.90254
44.51491	0.03292	803.21122	18.69121	78.85531	4.94228
46.28127 ^b	0.14646	101.66089	9.11142	0.0	0.0
47.64913	0.14511	51.03913	-12.68877	196.64505	4.34830
49.81032	0.57648	-19.08534	69.06896	189.13998	-11.44309
50.12126	0.04688	353.38880	-9.18960	83.68742	19.36298
52.63105	0.04038	1020.15666	21.22875	180.54524	-0.08102
55.69361	0.04680	128.70973	10.57667	71.40199	19.25959
57.52205	0.51794	62.40372	16.04176	902.69006	-314.81178
59.25127	0.08883	172.50816	9.58430	412.66512	6.32604
62.01051	2.45979	75.04860	98.85408	441.52957	347.55798
63.16234	0.18572	44.56036	2.70246	86.84371	11.91151
65.78392	0.08616	717.59642	-26.50485	666.27011	77.13599
65.83534	1.08981	0.0	0.0	246.28587	-206.20557
74.13715	0.08681	266.91436	25.85486	195.44100	63.40090
74.98343	0.07623	659.59511	-49.07940	1378.25859	-52.41285
82.57221	1.06468	77.25720	19.78875	0.0	0.0
81.12790	0.87003	-23.39849	0.0	139.68610	-247.69306
85.47746	1.14217	115.46310	1.67278	1605.56795	276.08260
85.56970	0.02067	539.20575	16.58042	147.85674	18.09259
90.79346	0.03099	846.04172	12.43116	169.27493	2.78836
93.02340	0.01909	65.73827	4.59544	7.57478	3.49719
95.46961	0.02301	133.81049	21.17057	50.98222	7.88974
96.59844	0.83728	47.41997	40.72303	378.24246	58.49551
100.12074	4.48486	191.72241	-196.05215	771.56103	76.79344

^a ^{240}Pu .^b Tungsten.

Table A5 The Reich-Moore and the Adler-Adler Formulae
for the Neutron Cross Sections

Reich-Moore Formula¹⁾

$$\sigma_t^J = 2\pi \lambda^2 g [1 - \cos(2ka)] + 4\pi \lambda^2 g \operatorname{Re} (e^{2ika} \rho_{nn})$$

$$\sigma_a^J = 4\pi \lambda^2 g [\operatorname{Re} (\rho_{nn}) - |\rho_{nn}|^2]$$

$$\sigma_f^J = 4\pi \lambda^2 g \sum_c |\rho_{nc}|^2 \quad (\text{The sum extends only over f channels})$$

$$\rho_{nc} = \delta_{nc} - [(I - K)^{-1}]_{nc}$$

$$(I - K)_{cc'} = \delta_{cc'} - \frac{i}{2} \sum_\lambda \frac{(\Gamma_{\lambda c} \Gamma_{\lambda c'})^{1/2}}{E_\lambda - E - \frac{i}{2} \Gamma_{\lambda r}}$$

Adler-Adler Formula²⁾

$$\sigma_t = 2\pi \lambda^2 g [1 - \cos(2ka)] + \frac{\alpha}{\sqrt{E}} \sum_\lambda \frac{\nu_\lambda G_\lambda^t + (\mu_\lambda - E) H_\lambda^t}{(\mu_\lambda - E)^2 + \nu_\lambda^2}$$

$$\sigma_a = \frac{\alpha}{\sqrt{E}} \sum_\lambda \frac{\nu_\lambda G_\lambda^a + (\mu_\lambda - E) H_\lambda^a}{(\mu_\lambda - E)^2 + \nu_\lambda^2}$$

$$\sigma_f = \frac{\alpha}{\sqrt{E}} \sum_\lambda \frac{\nu_\lambda G_\lambda^f + (\mu_\lambda - E) H_\lambda^f}{(\mu_\lambda - E)^2 + \nu_\lambda^2} \quad (\alpha = 6.52 \times 10^5 \text{ barns.eV})$$

Note: Symbols C (or C') and λ in the above expressions denote the channel and the level. Especially, the letter n stands for the neutron channel. Other symbols are used in their conventional meaning. The smooth background due to the neglected "far away" levels has been omitted for simplicity.

- 1) DeSaussure G., "Resonance Reaction Formalism for Fissile Nuclei" BNL 50387 (1973)
Reich C. W., Moore M. S., Phys. Rev., 111, 929 (1958).
- 2) DeSaussure G., ibid.
Adler D. B., Adler F. T., ANL-6792, 695 (1963) and
BNL-50045 (1973).

References for the New Data

- A67) Asghar M., "Spin Assignment of Low Energy Resonance in ^{239}Pu ", Nucl. Phys., A95, 33 (1967).
- B65) Blons J., Derrien H., Michaudon A., Ribon P., and deSaussure G., Proceedings of International Conference on the Study of Nuclear Structure with Neutrons, Antwerp, Paper No. 163 (July, 1965).
- B70) Blons J., Derrien H., Michaudon A., "Mesure a Haute Resolution et Analyse de la Section Efficace de Fission du ^{239}Pu ", Nuclear Data for Reactors (Helsinki Conference), I, AIEA, Vienne, 513 (1970).
- C66) Cowan G. A., Bayhurst B. P., Prestwood R. J., Gilmore J. S., Knobeloch G. W., "Symmetry of Neutron-induced ^{239}Pu Fission at Individual Resonances", Phys. Rev., 144, 979 (1966).
- C70) Chrien R. E., Wasson O. A., Drista S. D., Bokharee S., Garg J. B., "High Energy Gamma-rays Following Neutron Capture in ^{239}Pu and ^{235}U " Nuclear Data for Reactors (Helsinki Conference), I, AIEA, Vienne, 377 (1970).
- D67) Derrien H., Blons J., Eggemann C., Michaudon A., Paya D., Ribon P., "Section Efficaces Total et de Fission du ^{239}Pu ", Nuclear Data for Reactors (Paris Conference), II, AIEA, Vienne, 195 (1967).
- D70) Derrien H., Blons J., Michaudon A., "Analyse Simultanee de 5.7 a 160 eV de Section Efficaces Total et Fission du ^{239}Pu par un Formalisme Multiniveau", Nuclear Data for Reactors (Helsinki Conference), I, AIEA, Vienne, 481 (1970).
- F68) Farrel J. A., "Multilevel Analysis of the ^{239}Pu Fission Cross Section from 14 to 90 eV", Phys. Rev., 165, 1371 (1968).
- G71) Gwin R., Weston L. W., deSaussure G., Ingle R. W., Todd J. H., Gillespie F. E., Hockenbury R. W., Block R. C., "Measurements of the Neutron Fission and Absorption Cross Sections of ^{239}Pu over the Energy Range 0.02 to 30 KeV" ORNL-4707 (1971).
- J68) James G. D., "Multilevel Analysis of ^{239}Pu Fission Cross

- Section near 83 eV", J. Nucl. Energy, 22, 263 (1968).
- K69) King T. J., Block R. C., "Neutron Scattering Measurements in the Resonance Region", Nucl. Phys., A138, 556 (1969).
- M65) Melkonian E., Metha G. K., "Variation of Fission Fragment Kinetic Energy Distribution, Mass Distribution and Yield of Long Range Alpha Particles in the Resonance Neutron Induced Fission of ^{235}U and ^{239}Pu ", Phys. and Chem. of Fission (Salzburg Conference), II, AIEA, Vienne, 355 (1965).
- R67) Ribon P., Cauvin B., Derrien H., Michaudon A., Sauche M., "Dispositifs et Programmes pour l'Acquisition et le Traitement des Informations de Temps de Vol", Nuclear Data for Reactors (Paris Conference), I, AIEA, Vienne, 107 (1967).
- R70) Рябов Ю.В., Содон Сик, Чиков Н., Янева Н., "Параметры Нейтронных Резонансов ^{233}U , ^{235}U и ^{239}Pu ", ОИЯИ (Дубна), Р-3-4992 (1870), Руахов Yu. V. et al. Sov. J. Nucl. Phys. 13, 255 (1971)
- S65) Sauter G. D., Bowman C. D., "Scattering Measurements on Neutron Resonances in ^{239}Pu ", Phys. Rev. Lett., 15 No.19, 761 (1965).
- S66) Shunk E. R., Brown W. K., LaBauve R., Proceedings of the Conference on Neutron Cross Section Technology, Washington, 1966 (unpublished).
- S71) Simpson F. B., Miller L. G., Moore M. S., Hockenbury R. W., King T. J., "Neutron Scattering Cross Section of ^{233}U , ^{235}U and ^{239}Pu " Nucl. Phys., A164, 34 (1971).
- Sch65) Schmidt J. J., AEC-ENEA Seminar on the Evaluation of Neutron Cross Section Data, BNL, May 1965 (unpublished).
- Sch66) Schmidt J. J., "Neutron Cross Section for Fast Reactor Materials, Part 1: Evaluation", KFK 120, EANDC-E-35"U", (1966).
- T70) Trochon J., Derrien H., Lucas B., Michaudon A., "Determination du Spin des Resonances Induites par des Neutrons Lent dans le Plutonium-239", Nuclear Data for Reactors (Helsinki Conference), I, AIEA, Vienne, 495 (1970).
- T73) Trochon J., Lucas B., Michaudon A., Paya D., Ryabov Yu., "Mesure des Variation Nombre Moyen $\bar{\nu}$ de Neutrons Prompts

émis Lors de la Fission de ^{239}Pu Induite par des Neutrons de Resonances", Le Journal de Physique, 34, 131 (1973).

- W69) Weinstein S., Block R. C., "Neutron Multiplicity Spin State Correlations for ^{239}Pu Resonances", Phys. Rev. Lett., 22 No. 5, 195 (1969), Weinstein S., Read R., Block R. C., "Neutron Multiplicity Measurement for ^{233}U ^{235}U and ^{239}Pu Resonance Fission", Phys. and Chem. of Fission (Vienne Conference), AIEA, Vienne, 477 (1969).

References for the Old Data, Sch66)

- B58) Bollinger L. M., Coté R. E., Thomas G. E., Proceedings of the Geneva Conf., 15, 127 (1958).
- B65) Blons J., Derrien H., Michaudon A., Ribon P., de Saussure G., EANDC Conf. on Study of Nuclear Structure with Neutrons, Antwerp, 1965, P/163
- E55) Egelstaff P. A., Sanders J. E., Proceedings of the Geneva Conf., 4, 307 (1955).
- E56) Egelstaff P. A., Huges D. J., Progr. Nucl. En. I, 1, 55 (1956).
- F62) Fraser J. S., Schwartz R. B., Nucl. Phys., 30, 269 (1962).
- I64) Ignat'ev K. G., Kirpichnikov I. V., Sukhoruchkin S. I., At. Energ., 16, 110 (1964); translated in Sov. At. Energ., 16, 121 (1965); J. Nucl. En., Pts A/B, Reactor Sci. Techn., 18, 719 (1964), Kirpichnikov I. V., Ignat'ev K.G., Sukhoruchkin S. I., At. Energ., 16, 211 (1964); translated in Sov. At. Energ., 16, 251 (1965); J. Nucl. En., Pts. A/B, Reactor Sci. Techn., 18, 523 (1964).
- I65) Ignat'ev K. G., Kirpichnikov I. V., Euro Nuclear, 2, 77 (1965).
- J65a) James G. D., Phys. and Chem. of Fission (Salzburg Conference), I, IAEA, Vienne, 235 (1965).
- J65b) James G. D., AERE-NP-PR-8, 5 (1965).
- K57) Kirpichnikov I. V. et al., Sov. Research on Lanthanide and Actinide Elements III, 502 (1957); At Energ., 3, 247

- (1957); translated in Sov. J. At. En., 3, 299 (1957).
- N55) Nikitin S. Y., Sukhoruchkin S. I., Ignat'ev K. G., Galanina N. D., Proceedings of the USSR Conf. in Peaceful Uses of Atomic Energy, Moscow, July, 1955, AEC-tr-2435, I, p.81.
- P56) Pattenden N. J., J. Nucl. En., 2, 187 (1956).
- R55) Raffel J. F., Price B. T., Proceedings of the Geneva Conf., 4, 187 (1955).
- S57) Sokolovski V. V. et al., J. Nucl. En., 5, 389 (1957).
- S65) de Saussure G., Blons J., Jousseau C., Michaudon A., Pranal Y., Phys. and Chem. of Fission (Saltzburg Conference), I. IAEA, Vinne, 205 (1965).
- U64) Uttley C. A., EANDC(UK)-40 "L", 1964.
- U65) Uttley C. A., EANDC Conf. on Study of Nuclear Structure with Neutrons, Antwerp, 1965, P/98; see also AERE-NP/PR-8, 2 (1965).
- V58) Vladimirski V. V., et al., Proceedings of the Geneva Conf., 15, 309 (1958).
- V60) Vogt E., Phys. Rev., 118, 724 (1960).