1 Introduction

1.1 General remarks

Volume I/19B (consisting of 3 subvolumes covering different ranges of Z) contains the compilation of parameters of nuclear bound states excited in reactions with charged particles. The data were collected in a file called CRF - Combined charged particle Reaction File. Recently, the properties of low-lying levels of many nuclei were published in three LB Volumes I/18A [01Sc0A], I/18B [02Sc0A], I/18C [03Sc0A] and the properties of nuclear unbound states derived from neutron and charged particle resonances were published in LB Volumes I/16 [98Sc0A, 04Sc0A] and I/19A [04Sc0B, 05Sc0A].

Existing high-quality information on excited bound states situated above the low-lying levels but below the states seen as resonances is essential for an understanding of general properties of nuclei and is important for many applications. The compilation Vol. I/19B contains information on parameters of bound excited states which were obtained in high-resolution measurements with charged particle spectrometers. Frequently these data are combined with data obtained in measurements of γ-ray spectra after neutron capture, in β-decay study etc. We have collected existing information on parameters of nucleon transfer reactions: total and differential cross sections, spectroscopic factors, parameters of inelastic scattering etc. These parameters were not considered (with very few exceptions) in the recent compilation LB I/18ABC. We also include data for many neighbour nuclei not presented in LB I/18ABC. As a result, information on all nuclei, with exception of proton-rich and neutron-rich nuclei situated very far from the valley of stability, is presented in both compilations I/18ABC and I/19B.

The material of CRF is contained in three Volumes, respectively: for nuclei with $Z \leq 36$, $37 \leq Z \leq 62$ and $Z \geq 63$. These regions of Z are the same as in the compilations LB I/18ABC, where an extensive theoretical parameterization for properties of low-lying levels of stable nuclei is presented. We give data for a broader range of nuclei and pay attention to the parameters of nucleon transfer reactions. To avoid duplication with the material in LB I/16 and LB I/19A (resonance parameters), the book only contains those parts of the nuclear excitation spectrum where there are data from reactions with charged particles. Other information is given in the Supplement (on CD). In CRF, we also present existing information on branching ratios of radiative transitions for all bound excited states, but most of these data are contained in the Supplement. Numbers of excited states in Volume 19B (in the book and in the Supplement) are given in Tables 1.1, 1.2 and 1.3 (for the three Volumes 19B1,2 and 3, respectively) as a "ratio" in the first column. These Tables also contain the numbers of excited states presented in the three above mentioned LB-compilations I/18ABC, I/19A, I/16BC.

We have collected the original data on different reactions with charged particles from papers published during the last 25-35 years. Data on energies of excited states and $T_{1/2}$ were taken from publications in the Nuclear Data Sheets (NDS) [04Nu0A]. We give references on NDS in the headings of isotope-tables, usually before other references. Data from NDS evaluations (ENSDF – Evaluated Nuclear Structure Data File) were used to facilitate the presentation of the experimental material on cross sections and spectroscopic factors of charged particle reactions. All data were grouped according to the common Z and A of the compound nuclei formed in different reactions.

The international Nuclear Science Reference system (NSR) was widely used during the collection of data into the CRF. Modern PC-capacities and NSR-files permitted to collect and represent all data scattered in the literature in a common format. We have selected data from the original works mentioned in NSR and used the corresponding identification number of each paper in NSR. In some cases we have tried to find so-called "best values" from the most recent original works, in other cases we give several sets of data from different original works for comparison.

Table 1.1. Numbers of bound states in compound nuclei ^{A}Z with $Z \leq 36$ contained in the first part of this compilation (I/19B1). The ratio shows the number of states in this Volume and in the Supplement.

The number of bound states in the compilation LB I/18A, the number of resonances in reactions with charged particles in compilation LB I/19A and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line and not included in this Volume.

^{A}Z	19B1	18A	19A	16C
^{4}He	15*			8
^{5}He	11*			11
^{6}He	7*			
^{7}He	2*			
^{8}He	4*			
^{9}He	2*			
^{10}He	2*			
^{4}Li	3*			
^{5}Li	11*		1	
^{6}Li	12/13	4	4	
^{7}Li	7/9	3	4	8
^{8}Li	6/10			13
^{9}Li	5/7			
^{10}Li	11*			
^{6}Be	4*		1	
^{7}Be	8*		7	
^{8}Be	25*		23	3
^{9}Be	13/32	8	8	18
^{10}Be	37/40		5	8
^{11}Be	14/15			
^{12}Be	12*			
^{8}B	4/4		1	
^{9}B	11/20		4	
^{10}B	14/39	12	51	
^{11}B	4/40	11	33	13
^{12}B	15/49		5	34
^{13}B	14/22			
^{14}B	8/15			
^{15}B	7*			
^{16}B	1*			
^{17}B	1*			
^{9}C	1*		1	
^{10}C	7*		4	
^{11}C	13/36		28	
^{12}C	27/55	9	46	
^{13}C	13/72	7	34	58
^{14}C	24/45	7		37
^{15}C	16/30			4
^{16}C	17/20			
^{17}C	3/3			
^{18}C	1*			
^{11}N	5*		7	
^{12}N	21*			

^{A}Z	19B1	18A	19A	16C
^{13}N	18/53		41	
^{14}N	61/121	10	154	
^{15}N	21/115	16	133	61
^{16}N	14/65		7	47
^{17}N	21/35			
^{18}N	7*			
^{19}N	5*			
^{13}O	3*			
^{14}O	17*		5	
^{15}O	8/84		95	
^{16}O	38/133	12	215	
^{17}O	36/119	11	70	92
^{18}O	31/123	23	33	15
^{19}O	21/55			21
^{20}O	15/22			
^{21}O	5*			
^{22}O	5*			
^{15}F	1*		2	
^{16}F	27*			
^{17}F	36/76		91	
^{18}F	25/100		432	
^{19}F	51/190	48	254	
^{20}F	49/152			66
^{21}F	14/36			
^{22}F	7/22			
^{23}F	4/6			
^{24}F	2*			
^{25}F	2*			
^{16}Ne	1*			
^{17}Ne	12*		13	
^{18}Ne	21*		13	
^{19}Ne	68*		48	
^{20}Ne	28/232	20	282	
^{21}Ne	33/116	27	74	102
^{22}Ne	65/101	42	65	45
^{23}Ne	13/34			20
^{24}Ne	1/12			
^{25}Ne	2/7			
^{26}Ne	4*			
^{28}Ne	2*			
^{30}Ne	1*			
^{20}Na	6/24		11	
^{21}Na	14/64		52	

^{A}Z	19B1	18A	19A	16C
^{22}Na	36/214		60	
^{23}Na	73/172	94	264	1
^{24}Na	78/119			114
^{25}Na	13/42			
^{26}Na	20/24			
^{27}Na	18/18			
^{28}Na	2*			
^{30}Na	1*			
^{21}Mg	12/21			
^{22}Mg	18/60		11	
^{23}Mg	66/78		21	
^{24}Mg	77/245	59	385	
^{25}Mg	56/131	51	67	64
^{26}Mg	48/204	79	155	35
^{27}Mg	23/55			12
^{28}Mg	3/24			
^{29}Mg	13*			
^{30}Mg	11*			
^{31}Mg	10*			
^{32}Mg	7*			
^{33}Mg	4*			
^{22}Al	2*			
^{23}Al	7*			
^{24}Al	46*		4	
^{25}Al	8/64		47	
^{26}Al	64/201		146	
^{27}Al	46/243	76	258	7
^{28}Al	33/166			260
^{29}Al	8/49			
^{30}Al	21*			
^{31}Al	13*			
^{32}Al	5*			
^{35}Al	1*			
^{25}Si	12*		1	
^{26}Si	30*		7	
^{27}Si	37/85		24	
^{28}Si	74/294	64	314	
^{29}Si	25/129	52	37	81
^{30}Si	31/135	108	69	31
^{31}Si	42/74			30
^{32}Si	37/58			
^{33}Si	4*			
^{34}Si	5*			

Table 1.1. (continued) Numbers of bound states in compound nuclei ^{A}Z with $Z \leq 36$ contained in the first part of this compilation (I/19B1). The ratio shows the number of states in this Volume and in the Supplement.

The number of bound states in the compilation LB I/18A, the number of resonances in reactions with charged particles in compilation LB I/19A and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line not included in this Volume.

^{A}Z	19B1	18A	19A	16C
^{35}Si	2*			
^{36}Si	1*			
^{37}Si	1*			
^{38}Si	1*			
^{28}P	15/33			
^{29}P	15/68		77	
^{30}P	33/149		97	
^{31}P	127/171	46	504	
^{32}P	147/147			33
^{33}P	21/35			
^{34}P	3/12			
^{35}P	19*			
^{36}P	5*			
^{37}P	5*			
^{39}P	1*			
^{30}S	1/5		9	
^{31}S	40/60			
^{32}S	146/256	42	315	
^{33}S	27/151	64	156	105
^{34}S	39/133	100	104	60
^{35}S	36/59			82
^{36}S	7/23	17		
^{37}S	33/39			1
^{38}S	16*			
^{39}S	1*			
^{40}S	10*			
^{41}S	2*			
^{42}S	4*			
^{43}S	2*			
^{44}S	3*			
^{31}Cl	19/24			
^{32}Cl	8/47		4	
^{33}Cl	1/84		65	
^{34}Cl	33/120		194	
^{35}Cl	134/248	41	224	
^{36}Cl	92/127			84
^{37}Cl	28/84	77	422	16
^{38}Cl	24/39			37
^{39}Cl	16/26			
^{40}Cl	18*			
^{41}Cl	4*			
^{42}Cl	11*			
^{45}Cl	1*			

^{A}Z	19B1	18A	19A	16C
^{33}Ar	3*			
^{34}Ar	20*			
^{35}Ar	37*			
^{36}Ar	10/186	41	179	
^{37}Ar	39/105			1
^{38}Ar	79/219	133	578	4
^{39}Ar	39/75			
^{40}Ar	108/198	73	59	
^{41}Ar	57/126			207
^{42}Ar	29/64			
^{43}Ar	3/14			
^{44}Ar	6/12			
^{45}Ar	3/3			
^{46}Ar	4*			
^{35}K	13*			
^{36}K	15*			
^{37}K	90*		78	
^{38}K	23/86			
^{39}K	34/93	70	99	
^{40}K	45/100			70
^{41}K	123/205	87	256	39
^{42}K	56/171			110
^{43}K	27/65			
^{44}K	10/18			
^{45}K	15/26			
^{46}K	11/15			
^{47}K	27/27			
^{48}K	4/4			
^{37}Ca	1*			
^{38}Ca	24*			
^{39}Ca	58/85			
^{40}Ca	109/580	53	382	
^{41}Ca	204/271			253
^{42}Ca	105/544	127	415	9
^{43}Ca	111/150	64		95
^{44}Ca	73/91	45		55
^{45}Ca	82/103			65
^{46}Ca	38/90	6		
^{47}Ca	102/135			1
^{48}Ca	119/247	44		
^{49}Ca	26/58			39
^{50}Ca	10/35			
^{51}Ca	12/13			

^{A}Z	19B1	18A	19A	16C
^{39}Sc	2*			
^{52}Ca	6/6			
^{38}Sc	1*			
^{40}Sc	9/41			
^{41}Sc	25/200		182	
^{42}Sc	85/118		112	
^{43}Sc	105/142	31	315	
^{44}Sc	101/116	21	4	
^{45}Sc	53/210	22	1110	
^{46}Sc	177/255	36		
^{47}Sc	49/144	14	294	197
^{48}Sc	57/101	25		
^{49}Sc	149/213	18	107	
^{50}Sc	42/50			
^{51}Sc	9/19			
^{52}Sc	5*			
^{54}Sc	1*			
^{42}Ti	16/31			
^{43}Ti	12/15			
^{44}Ti	43/114	21	66	
^{45}Ti	39/43	12		
^{46}Ti	120/248	44	106	
^{47}Ti	95/212	36		114
^{48}Ti	118/289	78		118
^{49}Ti	98/108	34		87
^{50}Ti	117/259	15		79
^{51}Ti	22/33	10		34
^{52}Ti	4/24	10		
^{54}Ti	2*			
^{43}V	1*			
^{44}V	1*			
^{45}V	6*			
^{46}V	17/76			
^{47}V	48/144	33	282	
^{48}V	56/81	21	105	
^{49}V	94/254	26	1213	
^{50}V	150/180	13	98	
^{51}V	117/213	38	322	18
^{52}V	79/131	19		153
^{53}V	9/55			
^{54}V	10/27			
^{60}V	3*			
^{46}Cr	1*			

Table 1.1. (continued) Numbers of bound states in compound nuclei ^{A}Z with $Z \leq 36$ contained in the first part of this compilation (I/19B1). The ratio shows the number of states in this Volume and in the Supplement.

The number of bound states in the compilation LB I/18A, the number of resonances in reactions with charged particles in compilation LB I/19A and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line not included in this Volume.

^{A}Z	19B1	18A	19A	16C
^{47}Cr	20/34			
^{48}Cr	32/37			
^{49}Cr	99/158	18		
^{50}Cr	47/146	37		
^{51}Cr	152/269	70		382
^{52}Cr	227/299	42	32	
^{53}Cr	51/166	16		341
^{54}Cr	35/138	29		124
^{55}Cr	64/106	18		111
^{56}Cr	35/36			
^{57}Cr	4/4			
^{58}Cr	1/1			
^{59}Cr	3*			
^{60}Cr	1*			
^{48}Mn	3/5			
^{49}Mn	6/12			
^{50}Mn	25/25			
^{51}Mn	40/140	13	406	
^{52}Mn	83/101	14		
^{53}Mn	153/416	36	973	
^{54}Mn	79/146	38	281	
^{55}Mn	125/213	18	374	
^{56}Mn	122/262	21		175
^{57}Mn	47/75			
^{58}Mn	12/34			
^{59}Mn	3*			
^{50}Fe	3/7			
^{51}Fe	11/11			
^{52}Fe	91/100	23		
^{53}Fe	51/76	17		
^{54}Fe	108/235	38		
^{55}Fe	83/183	36		425
^{56}Fe	114/271	78	92	
^{57}Fe	136/180	38		316
^{58}Fe	54/184	64		127
^{59}Fe	24/77	18		82
^{60}Fe	32/49	24		
^{61}Fe	4/6			
^{62}Fe	5/14			
^{52}Co	1*			
^{53}Co	2/2			
^{54}Co	26/95			
^{55}Co	100/467	17	321	
^{56}Co	102/111	32		
^{57}Co	105/219	31	587	
^{58}Co	152/181	41	135	
^{59}Co	20/165	11	194	
^{60}Co	138/286	22		221
^{61}Co	94/120			5
^{62}Co	12/41			
^{63}Co	49/56			
^{64}Co	16/16			
^{65}Co	1*			
^{54}Ni	1*			
^{55}Ni	19/24			
^{56}Ni	59/87			
^{57}Ni	157/163	18		
^{58}Ni	215/263	36	4	
^{59}Ni	192/325	33		576
^{60}Ni	72/201	35	22	15
^{61}Ni	230/263	28		465
^{62}Ni	68/145	44		67
^{63}Ni	86/100	19		81
^{64}Ni	45/110	20		
^{65}Ni	59/113	19		58
^{66}Ni	22/63			
^{67}Ni	3/9			
^{68}Ni	8/21			
^{69}Ni	6/6			
^{70}Ni	2/7			
^{57}Cu	3/8			
^{58}Cu	21/55			
^{59}Cu	107/260		359	
^{60}Cu	6/89			
^{61}Cu	50/126	27	592	
^{62}Cu	80/133	18		
^{63}Cu	114/250	33	369	
^{64}Cu	147/172	9		291
^{65}Cu	42/193	8	88	
^{66}Cu	97/123	16		197
^{67}Cu	16/18			
^{68}Cu	19/19			
^{69}Cu	10/22			
^{70}Cu	5/5			
^{71}Cu	6/6			
^{73}Cu	8*			
^{59}Zn	8*			
^{60}Zn	18/62			
^{61}Zn	4/55			
^{62}Zn	32/109	19	2	
^{63}Zn	49/72	31		
^{64}Zn	79/230	26	2	
^{65}Zn	63/171	29		402
^{66}Zn	65/171	26	22	
^{67}Zn	80/129	32		400
^{68}Zn	73/128	21		504
^{69}Zn	38/69	16		292
^{70}Zn	35/41	22		
^{71}Zn	38/38			167
^{72}Zn	10/14			
^{73}Zn	7*			
^{74}Zn	12*			
^{76}Zn	8*			
^{77}Zn	1*			
^{78}Zn	4*			
^{62}Ga	17*			
^{63}Ga	12*			
^{64}Ga	38/56			
^{65}Ga	20/130		220	
^{66}Ga	7/61	12		
^{67}Ga	51/127	32	156	
^{68}Ga	63/86	15		
^{69}Ga	87/107	23	23	
^{70}Ga	91/97	12		109
^{71}Ga	54/79	22	15	
^{72}Ga	53/110			26
^{73}Ga	30/30			
^{74}Ga	11			
^{75}Ga	45*			
^{76}Ga	22*			
^{77}Ga	34*			
^{78}Ga	19*			
^{79}Ga	19*			
^{80}Ga	13*			
^{61}Ge	5*			
^{64}Ge	18*			
^{65}Ge	9*			
^{66}Ge	43*			
^{67}Ge	34*			
^{68}Ge	36/171	33		
^{69}Ge	36/173	31		
^{70}Ge	136/176	65		

Table 1.1. (continued) Numbers of bound states in compound nuclei ^{A}Z with $Z \leq 36$ contained in the first part of this compilation (I/19B1). The ratio shows the number of states in this Volume and in the Supplement.

The number of bound states in the compilation LB I/18A, the number of resonances in reactions with charged particles in compilation LB I/19A and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line not included in this Volume.

^{A}Z	19B1	18A	19A	16C	^{A}Z	19B1	18A	19A	16C	^{A}Z	19B1	18A	19A	16C
^{71}Ge	104/180	40		22	^{70}Se	34*				^{82}Br	23/67			330
^{72}Ge	142/180	58			^{71}Se	5/26				^{83}Br	38/73		15	
^{73}Ge	81/119	22		17	^{72}Se	4/52	21			^{84}Br	2/2			
^{74}Ge	150/251	66		85	^{73}Se	6/81	28			^{85}Br	9/25			
^{75}Ge	76/103	34		11	^{74}Se	24/101	27			^{86}Br	8/9			
^{76}Ge	61/137	24			^{75}Se	60/144	22		9	^{87}Br	8*			
^{77}Ge	43/51	10		10	^{76}Se	65/166	18	17		^{88}Br	8*			
^{78}Ge	11/48				^{77}Se	51/159	28		22	^{72}Kr	4*			
^{79}Ge	39*				^{78}Se	85/185	76		58	^{73}Kr	53*			
^{80}Ge	31*				^{79}Se	68/113	35		14	^{74}Kr	26*			
^{81}Ge	36*				^{80}Se	43/84	11			^{75}Kr	86*			
^{82}Ge	6*				^{81}Se	48/74	16		15	^{76}Kr	12/58	12		
^{67}As	12*				^{82}Se	31/38	14			^{77}Kr	6/66			
^{68}As	42*				^{83}Se	27/51	15		16	^{78}Kr	6/97	14		
^{69}As	108*				^{84}Se	42/64				^{79}Kr	13/98	24		5
^{70}As	40*				^{85}Se	13/28				^{80}Kr	12/49	17		
^{71}As	41/63		52		^{86}Se	1*				^{81}Kr	27/101	13		9
^{72}As	8/66				^{69}Br	1*				^{82}Kr	13/71	8		
^{73}As	46/144	9	36		^{70}Br	13*				^{83}Kr	25/77	12		176
^{74}As	38/77				^{71}Br	11*				^{84}Kr	5/69	26		6
^{75}As	56/118	18	23		^{72}Br	36*				^{85}Kr	26/76	13		207
^{76}As	122/156			247	^{73}Br	121*	16			^{86}Kr	40/63	9		
^{77}As	55/98	12	10		^{74}Br	93*				^{87}Kr	17/169			225
^{78}As	21/32				^{75}Br	4/102		11		^{88}Kr	23/73			
^{79}As	36/37				^{76}Br	2/68	8			^{89}Kr	44*			
^{80}As	11/22				^{77}Br	41/110	8	8		^{90}Kr	34*			
^{81}As	22/43				^{78}Br	51/69				^{91}Kr	20*			
^{82}As	12*				^{79}Br	36/140	13	8		^{92}Kr	36*			
^{83}As	27*				^{80}Br	60/119			340	^{93}Kr	8*			
^{69}Se	22*				^{81}Br	27/112	9	7		^{94}Kr	3*			

While considering the numbers of excited states in these four compilations (I/18 and I/19B for bound states, I/16 and I/19A for resonances) one should remember that stable nuclei, which are described in I/18, serve as targets in different reactions with nucleons (transfer reactions, neutron scattering and capture etc.) and most data in I/16BC and I/19A correspond to the excited states of the neighbour compound nuclei which are unstable. The limited number of existing stable nuclei makes the task of nuclear structure investigation very complicated and difficult in some cases. Really, only in the case of (γ, γ) and nucleon inelastic scattering reactions one can see the spectrum of the target nucleus. After the appearance of tandem accelerators with energy greater than 10 MeV and an energy resolution of several keV in the 1960s, nuclear spectroscopy was in the position to study different nuclei using different projectiles in different transfer reactions.

Table 1.2. Numbers of bound states in compound nuclei ^{A}Z with $37 \le Z \le 63$ contained in the second part of this compilation (I/19B2). The ratio shows the number of states in the book and its Supplement.

The number of bound states in Volume LB I/18B, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B2	18B	19A	16C
^{73}Rb	1*			
^{74}Rb	12*			
^{75}Rb	31*			
^{76}Rb	23*			
^{77}Rb	99*			
^{78}Rb	14*			
^{79}Rb	19/97			
^{80}Rb	3/13			
^{81}Rb	37/102			
^{82}Rb	3/57			
^{83}Rb	28/113	5		
^{84}Rb	14/30	2		
^{85}Rb	82/99	12	2	
^{86}Rb	30/94	11		348
^{87}Rb	85/113	18	14	
^{88}Rb	28/61			99
^{89}Rb	21/58			
^{90}Rb	3/31			
^{91}Rb	1/60			
^{92}Rb	26*			
^{93}Rb	55*			
^{94}Rb	8*			
^{98}Rb	1*			
^{76}Sr	1*			
^{77}Sr	32*			
^{78}Sr	9*			
^{79}Sr	29*			
^{80}Sr	3/129			
^{81}Sr	2/149			
^{82}Sr	8/95	44		
^{83}Sr	14/114			
^{84}Sr	5/59	28		
^{85}Sr	39/106	20		11
^{86}Sr	64/75	17		
^{87}Sr	177/202	22		75
^{88}Sr	146/242	35		115
^{89}Sr	97/131	25		443
^{90}Sr	3/83	10		
^{91}Sr	2/46			
^{92}Sr	3/34			
^{93}Sr	4/73			
^{94}Sr	3/63			
^{95}Sr	57*			
^{96}Sr	55*			
^{97}Sr	35*			
^{98}Sr	31*			
^{99}Sr	15*			
^{100}Sr	9*			
^{101}Sr	6*			
^{102}Sr	1*			
^{78}Y	1*			
^{79}Y	11*			
^{80}Y	83*			
^{81}Y	114*			
^{82}Y	71*			
^{83}Y	138*			
^{84}Y	76*			
^{85}Y	48/92		15	
^{86}Y	22/29			
^{87}Y	39/147	15	11	
^{88}Y	37/85		8	
^{89}Y	63/223	20	30	
^{90}Y	161/166	38		697
^{91}Y	17/48	8		
^{92}Y	8/15			
^{93}Y	11/39	4		
^{94}Y	10/24			
^{95}Y	5/36			
^{96}Y	5/7			
^{97}Y	24*			
^{98}Y	33*			
^{99}Y	33*			
^{100}Y	26*			
^{101}Y	34*			
^{102}Y	10*			
^{80}Zr	5*			
^{81}Zr	14*			
^{82}Zr	55*			
^{83}Zr	123*			
^{84}Zr	5/68			
^{85}Zr	2/2			
^{86}Zr	5/113	25		
^{87}Zr	3/62			
^{88}Zr	8/81	7		
^{89}Zr	123/132	28		
^{90}Zr	85/273	37	23	
^{91}Zr	99/157	11		141
^{92}Zr	84/135	43		145
^{93}Zr	69/69	9		101
^{94}Zr	53/53	23		139
^{95}Zr	59/63	2		73
^{96}Zr	93/129	50		
^{97}Zr	17/22	3		30
^{98}Zr	1/58			
^{99}Zr	43*			
^{100}Zr	40*			
^{101}Zr	31*			
^{102}Zr	29*			
^{103}Zr	7*			
^{104}Zr	4*			
^{83}Nb	8*			
^{84}Nb	21*			
^{86}Nb	79*			
^{87}Nb	5/99			
^{88}Nb	7/46			
^{89}Nb	5/46			
^{90}Nb	5/69	11		
^{91}Nb	58/137	10	30	
^{92}Nb	155/165		5	
^{93}Nb	48/100	11	19	
^{94}Nb	73/377			238
^{95}Nb	53/74	18		3
^{96}Nb	8/36			
^{97}Nb	47/62		4	
^{98}Nb	6/16			
^{99}Nb	21/21			
^{100}Nb	7/30			
^{101}Nb	38*			
^{102}Nb	14*			
^{103}Nb	44*			
^{104}Nb	9*			
^{105}Nb	5*			
^{86}Mo	30*			
^{87}Mo	27*			
^{88}Mo	48*			
^{89}Mo	7/34			

Table 1.2. (continued) Numbers of bound states in compound nuclei ^{A}Z with $37 \leq Z \leq 63$ contained in the second part of this compilation (I/19B2). The ratio shows the number of states in the book and its Supplement.

The number of bound states in Volume LB I/18B, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B2	18B	19A	16C
^{90}Mo	8/85			
^{91}Mo	73/132			
^{92}Mo	119/229	33		
^{93}Mo	123/132	14		77
^{94}Mo	94/127	25	23	23
^{95}Mo	107/113	15		57
^{96}Mo	81/83	40		107
^{97}Mo	156/164	29		75
^{98}Mo	76/136	12		107
^{99}Mo	20/127	30		159
^{100}Mo	61/116	18		
^{101}Mo	40/57			125
^{102}Mo	3/33			
^{103}Mo	27*			
^{104}Mo	41*			
^{105}Mo	17*			
^{106}Mo	11*			
^{107}Mo	21*			
^{108}Mo	16*			
^{109}Mo	6*			
^{86}Tc	3*			
^{87}Tc	2*			
^{88}Tc	11*			
^{89}Tc	51*			
^{90}Tc	49*			
^{91}Tc	68*			
^{92}Tc	50*			
^{93}Tc	65/129		240	
^{94}Tc	4/86			
^{95}Tc	107/107	33	9	
^{96}Tc	9/111	58		
^{97}Tc	149/149	24		
^{98}Tc	69/93			
^{99}Tc	101/123	25	6	
^{100}Tc	51/65			691
^{101}Tc	58/88			
^{102}Tc	7/24			
^{103}Tc	21/32			
^{104}Tc	19*			
^{105}Tc	30*			
^{106}Tc	16*			
^{107}Tc	26*			
^{108}Tc	27*			

^{A}Z	19B2	18B	19A	16C
^{109}Tc	12*			
^{110}Tc	6*			
^{88}Ru	4*			
^{90}Ru	9*			
^{91}Ru	32*			
^{92}Ru	36*			
^{93}Ru	41*			
^{94}Ru	15/37			
^{95}Ru	23/51			
^{96}Ru	5/71	20		
^{97}Ru	58/70	24		
^{98}Ru	32/70	9		
^{99}Ru	4/71	23		
^{100}Ru	87/128	18		40
^{101}Ru	127/127	38		89
^{102}Ru	1/98	20		173
^{103}Ru	109/133	14		140
^{104}Ru	5/52	10		8
^{105}Ru	48/55			105
^{106}Ru	20/30	4		
^{107}Ru	37*			
^{108}Ru	34*			
^{109}Ru	33*			
^{110}Ru	24*			
^{111}Ru	50*			
^{112}Ru	20*			
^{113}Ru	11*			
^{92}Rh	19*			
^{93}Rh	21*			
^{94}Rh	2*			
^{95}Rh	21*			
^{96}Rh	40*			
^{97}Rh	68*		2	
^{98}Rh	8/43			
^{99}Rh	8/77	15	4	
^{100}Rh	4/42			
^{101}Rh	60/73	10	5	
^{102}Rh	7/61		1	
^{103}Rh	180/188	19	3	
^{104}Rh	173/183			293
^{105}Rh	68/68	21	4	
^{106}Rh	1/1			
^{107}Rh	46/57			

^{A}Z	19B2	18B	19A	16C
^{108}Rh	4/4			
^{109}Rh	46/58			
^{110}Rh	7*			
^{111}Rh	54*			
^{112}Rh	5*			
^{113}Rh	58*			
^{114}Rh	5*			
^{94}Pd	6*			
^{95}Pd	1*			
^{96}Pd	9*			
^{97}Pd	170*			
^{98}Pd	199*			
^{99}Pd	9/49			
^{100}Pd	8/50	6		
^{101}Pd	44/66			
^{102}Pd	48/90	39		
^{103}Pd	49/115	21		4
^{104}Pd	78/121	53		
^{105}Pd	23/109	11		327
^{106}Pd	86/132	71		319
^{107}Pd	82/103	38		320
^{108}Pd	42/55	22		133
^{109}Pd	130/134	44		243
^{110}Pd	64/182	39		
^{111}Pd	41/46			232
^{112}Pd	7/18	2		
^{113}Pd	42*			
^{114}Pd	39*			
^{115}Pd	25*			
^{116}Pd	45*			
^{117}Pd	7*			
^{94}Ag	2*			
^{97}Ag	4*			
^{98}Ag	19*			
^{99}Ag	14*			
^{100}Ag	56*			
^{101}Ag	77*			
^{102}Ag	48*			
^{103}Ag	96*		2	
^{104}Ag	65*			
^{105}Ag	51/129	31	19	
^{106}Ag	84/117			
^{107}Ag	80/141	21	11	

Table 1.2. (continued) Numbers of bound states in compound nuclei ^{A}Z with $37 \leq Z \leq 63$ contained in the second part of this compilation (I/19B2). The ratio shows the number of states in the book and its Supplement.

The number of bound states in Volume LB I/18B, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B2	18B	19A	16C
^{108}Ag	155/168	35		434
^{109}Ag	60/85	14	4	
^{110}Ag	76/76	4		438
^{111}Ag	105/123	36		11
^{112}Ag	1*			
^{113}Ag	15*			
^{114}Ag	4*			
^{115}Ag	37*			
^{116}Ag	6*			
^{117}Ag	3*			
^{118}Ag	14*			
^{119}Ag	4*			
^{120}Ag	5*			
^{98}Cd	4*			
^{100}Cd	9*			
^{101}Cd	40*			
^{102}Cd	15*			
^{103}Cd	69*			
^{104}Cd	90*			
^{105}Cd	38/53			
^{106}Cd	34/94	28		
^{107}Cd	86/146			58
^{108}Cd	194/298	68	11	
^{109}Cd	25/134	44		65
^{110}Cd	171/288	62	8	
^{111}Cd	71/114	40		103
^{112}Cd	207/258	156		157
^{113}Cd	133/170	45		121
^{114}Cd	120/127	40		443
^{115}Cd	42/70	9		86
^{116}Cd	48/76	26		
^{117}Cd	11/55			48
^{118}Cd	11/34			
^{119}Cd	2/26			
^{120}Cd	6/26			
^{121}Cd	55*			
^{122}Cd	6*			
^{123}Cd	21*			
^{124}Cd	12*			
^{125}Cd	1*			
^{126}Cd	7*			
^{128}Cd	2*			
^{130}Cd	1*			

^{A}Z	19B2	18B	19A	16C
^{100}In	1*			
^{101}In	1*			
^{102}In	8*			
^{103}In	19*			
^{104}In	45*			
^{105}In	1*			
^{106}In	22*			
^{107}In	9/62		3	
^{108}In	4/104			
^{109}In	3/95		3	
^{110}In	6/84			
^{111}In	123/210	37	33	
^{112}In	29/65		2	
^{113}In	83/167	15	30	
^{114}In	12/54	2		76
^{115}In	7/90	14	25	
^{116}In	24/81			258
^{117}In	35/61		4	
^{118}In	3/18			
^{119}In	52/58			
^{120}In	2/2			
^{121}In	3/52			
^{122}In	16/16			
^{123}In	3/34			
^{124}In	5/7			
^{125}In	44*			
^{126}In	7*			
^{127}In	15*			
^{128}In	5*			
^{129}In	1*			
^{130}In	3*			
^{131}In	2*			
^{102}Sn	4*			
^{104}Sn	19*			
^{105}Sn	30*			
^{106}Sn	22*			
^{107}Sn	25*			
^{108}Sn	111*			
^{109}Sn	86*			
^{110}Sn	37/55			
^{111}Sn	80/133			
^{112}Sn	33/110	41		
^{113}Sn	126/148	35		15

^{A}Z	19B2	18B	19A	16C
^{114}Sn	81/271	51		4
^{115}Sn	60/177	18		15
^{116}Sn	206/288	64		5
^{117}Sn	121/142	9		218
^{118}Sn	123/149	44		103
^{119}Sn	147/148	10		86
^{120}Sn	65/114	17		30
^{121}Sn	87/140	12		282
^{122}Sn	80/92	23		
^{123}Sn	81/85	11		361
^{124}Sn	216/218	47		
^{125}Sn	56/65	5		192
^{126}Sn	72/84	41		
^{127}Sn	3/15			
^{128}Sn	2/41			
^{129}Sn	13*			
^{130}Sn	20*			
^{131}Sn	15*			
^{132}Sn	9*			
^{133}Sn	5*			
^{106}Sb	4*			
^{107}Sb	20*			
^{108}Sb	59*			
^{109}Sb	102*			
^{110}Sb	69*			
^{111}Sb	101*			
^{112}Sb	34*			
^{113}Sb	5/59		3	
^{114}Sb	5/127			
^{115}Sb	15/77		4	
^{116}Sb	39/87			
^{117}Sb	37/104		5	
^{118}Sb	5/131		10	
^{119}Sb	15/129		7	
^{120}Sb	36/79		10	
^{121}Sb	163/177	7	13	
^{122}Sb	80/118	5		301
^{123}Sb	78/91	6	8	
^{124}Sb	88/104	4		261
^{125}Sb	26/50	10		9
^{126}Sb	2/5			
^{127}Sb	8/60	2		
^{128}Sb	2/8			

Table 1.2. (continued) Numbers of bound states in compound nuclei ^{A}Z with $37 \le Z \le 63$ contained in the second part of this compilation (I/19B2). The ratio shows the number of states in the book and its Supplement.

The number of bound states in Volume LB I/18B, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B2	18B	19A	16C
^{129}Sb	7/47			
^{130}Sb	60*			
^{131}Sb	48*			
^{132}Sb	11*			
^{133}Sb	30*			
^{134}Sb	4*			
^{135}Sb	13*			
^{136}Sb	1*			
^{108}Te	22*			
^{109}Te	26*			
^{110}Te	2/50			
^{111}Te	2/48			
^{112}Te	2/46			
^{113}Te	2/19			
^{114}Te	3/105			
^{115}Te	4/81			
^{116}Te	8/84			
^{117}Te	4/75			
^{118}Te	2/87	14		
^{119}Te	115/173	13		
^{120}Te	7/67	28		
^{121}Te	145/212	5		
^{122}Te	36/71	15		
^{123}Te	145/210	7		395
^{124}Te	60/152	29		361
^{125}Te	212/307	17		444
^{126}Te	76/137	21		297
^{127}Te	47/247	13		321
^{128}Te	10/96	15		
^{129}Te	124/323	9		40
^{130}Te	15/84	13		
^{131}Te	307/317			23
^{132}Te	11/21	3		
^{133}Te	18/18			
^{134}Te	14/18			
^{135}Te	16/32			
^{136}Te	9/22			
^{138}Te	6*			
^{139}Te	5*			
^{109}I	11*			
^{111}I	38*			
^{113}I	124*			
^{114}I	37*			
^{115}I	100*			
^{116}I	40*			
^{117}I	157*			
^{118}I	26*			
^{119}I	172*			
^{120}I	80*			
^{121}I	40/171			
^{122}I	3/22			
^{123}I	79/115		14	
^{124}I	4/45			
^{125}I	119/137	33	18	
^{126}I	3/58	2		
^{127}I	58/115	8	23	
^{128}I	232/232			377
^{129}I	38/57	19	11	
^{130}I	47/57			127
^{131}I	24/83	14	27	
^{132}I	5/5			
^{133}I	3/87			
^{134}I	3/9			
^{135}I	23/27			
^{136}I	6/20			
^{113}Xe	7*			
^{114}Xe	76*			
^{115}Xe	7*			
^{116}Xe	103*			
^{117}Xe	138*			
^{118}Xe	61*			
^{119}Xe	104*			
^{120}Xe	121*			
^{121}Xe	124*			
^{122}Xe	82*			
^{123}Xe	2/44			
^{124}Xe	2/72	20		
^{125}Xe	2/233			4
^{126}Xe	2/195	29		
^{127}Xe	2/107	16		3
^{128}Xe	3/182	24		
^{129}Xe	2/57	9		10
^{130}Xe	13/102	12		71
^{131}Xe	4/42	15		17
^{132}Xe	2/74	17		43
^{133}Xe	2/28	11		6
^{134}Xe	2/23	10		
^{135}Xe	6/28			6
^{136}Xe	14/76	13		1
^{137}Xe	3/163			35
^{138}Xe	4/62			
^{139}Xe	41*			
^{140}Xe	28*			
^{141}Xe	18*			
^{142}Xe	17*			
^{143}Xe	8*			
^{144}Xe	5*			
^{116}Cs	1*			
^{117}Cs	51*			
^{118}Cs	1*			
^{119}Cs	18*			
^{120}Cs	69*			
^{121}Cs	56*			
^{122}Cs	59*			
^{123}Cs	38*			
^{124}Cs	108*			
^{125}Cs	54*			
^{126}Cs	83*			
^{127}Cs	84*			
^{128}Cs	53*			
^{129}Cs	70*			
^{130}Cs	46*			
^{131}Cs	26/37	14		
^{132}Cs	5/18			
^{133}Cs	28/56	11		
^{134}Cs	54/111	12		324
^{135}Cs	1/10	4		8
^{136}Cs	1/1			6
^{137}Cs	1/60	4	14	
^{138}Cs	28*			
^{139}Cs	70*			
^{140}Cs	32*			
^{141}Cs	32*			
^{142}Cs	44*			
^{143}Cs	29*			
^{144}Cs	1*			
^{120}Ba	38*			
^{121}Ba	60*			
^{122}Ba	22*			

Table 1.2. (continued) Numbers of bound states in compound nuclei ^{A}Z with $37 \leq Z \leq 63$ contained in the second part of this compilation (I/19B2). The ratio shows the number of states in the book and its Supplement.

The number of bound states in Volume LB I/18B, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B2	18B	19A	16C	^{A}Z	19B2	18B	19A	16C	^{A}Z	19B2	18B	19A	16C
^{123}Ba	52*				^{139}La	67/94	11		11	^{132}Pr	144*			
^{124}Ba	80*				^{140}La	34/230			173	^{133}Pr	170*			
^{125}Ba	64*				^{141}La	32*				^{134}Pr	48*			
^{126}Ba	141*				^{142}La	23*				^{135}Pr	104*			
^{127}Ba	98*				^{143}La	46*				^{136}Pr	105*			
^{128}Ba	38/129	21			^{144}La	25*				^{137}Pr	93*			
^{129}Ba	78/143				^{145}La	33*				^{138}Pr	47*			
^{130}Ba	3/74	13			^{146}La	48*				^{139}Pr	8/69			
^{131}Ba	77/129	24		41	^{147}La	50*				^{140}Pr	37/37			
^{132}Ba	81/159	30			^{148}La	25*				^{141}Pr	16/111	31	18	
^{133}Ba	44/46	9		17	^{124}Ce	7*				^{142}Pr	170/170			258
^{134}Ba	82/100	20		6	^{125}Ce	19*				^{143}Pr	20/29	6	8	
^{135}Ba	82/99	8		90	^{126}Ce	62*				^{144}Pr	4/4			5
^{136}Ba	19/96	21		156	^{127}Ce	44*				^{145}Pr	2/24			
^{137}Ba	74/85	14		189	^{128}Ce	119*				^{146}Pr	8*			
^{138}Ba	59/117	30		81	^{129}Ce	93*				^{147}Pr	20*			
^{139}Ba	81/99			148	^{130}Ce	151*				^{148}Pr	16*			
^{140}Ba	4/58	17			^{131}Ce	121*				^{149}Pr	13*			
^{141}Ba	83*				^{132}Ce	71*				^{150}Pr	1*			
^{142}Ba	37*				^{133}Ce	129*				^{128}Nd	6*			
^{143}Ba	49*				^{134}Ce	2/57	15			^{129}Nd	17*			
^{144}Ba	31*				^{135}Ce	3/70				^{130}Nd	52*			
^{145}Ba	44*				^{136}Ce	3/74	12			^{131}Nd	34*			
^{146}Ba	42*				^{137}Ce	4/68			10	^{132}Nd	89*			
^{147}Ba	30*				^{138}Ce	8/78	19			^{133}Nd	173*			
^{148}Ba	15*				^{139}Ce	47/52	10			^{134}Nd	86*			
^{121}La	21*				^{140}Ce	69/125	52	14		^{135}Nd	85*			
^{123}La	38*				^{141}Ce	88/88	23		198	^{136}Nd	174*			
^{124}La	42*				^{142}Ce	91/104	14		6	^{137}Nd	144*			
^{125}La	59*				^{143}Ce	35/76			76	^{138}Nd	104*			
^{126}La	37*				^{144}Ce	3/61	11			^{139}Nd	49*			
^{127}La	82*				^{145}Ce	4/30				^{140}Nd	58/74	18		
^{128}La	90*				^{146}Ce	118*				^{141}Nd	82/88			
^{129}La	65*				^{147}Ce	26*				^{142}Nd	132/218	41		
^{130}La	107*				^{148}Ce	49*				^{143}Nd	146/252	71		85
^{131}La	120*		5		^{149}Ce	19*				^{144}Nd	186/201	18		150
^{132}La	28*				^{150}Ce	4*				^{145}Nd	122/137	41		90
^{133}La	3/141		5		^{152}Ce	8*				^{146}Nd	280/291	146		210
^{134}La	6/63				^{126}Pr	46*				^{147}Nd	125/125	23		93
^{135}La	4/77		8		^{128}Pr	47*				^{148}Nd	15/113	22		12
^{136}La	13/87				^{129}Pr	23*				^{149}Nd	82/82			123
^{137}La	4/61	13	8		^{130}Pr	152*				^{150}Nd	12/133	72		
^{138}La	52/62				^{131}Pr	29*				^{151}Nd	83/95			79

Table 1.2. (continued) Numbers of bound states in compound nuclei ^{A}Z with $37 \leq Z \leq 63$ contained in the second part of this compilation (I/19B2). The ratio shows the number of states in the book and its Supplement.

The number of bound states in Volume LB I/18B, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison.

^{A}Z	19B2	18B	19A	16C
^{152}Nd	13/43			
^{153}Nd	17*			
^{154}Nd	24*			
^{156}Nd	9*			
^{133}Pm	67*			
^{134}Pm	50*			
^{135}Pm	32*			
^{136}Pm	103*			
^{137}Pm	38*			
^{138}Pm	60*			
^{139}Pm	70*			
^{140}Pm	63*			
^{141}Pm	66*			
^{142}Pm	2/44			
^{143}Pm	53/90	18	8	
^{144}Pm	18/84			
^{145}Pm	52/53	21	4	
^{146}Pm	5/78			

^{A}Z	19B2	18B	19A	16C
^{147}Pm	8/41	7	4	
^{148}Pm	4/43	2		42
^{149}Pm	73/73	24		1
^{151}Pm	77/131		2	
^{152}Pm	4/14			
^{153}Pm	35/70			
^{154}Pm	28*			
^{155}Pm	36*			
^{130}Sm	1*			
^{132}Sm	8*			
^{133}Sm	65*			
^{134}Sm	6*			
^{135}Sm	50*			
^{136}Sm	79*			
^{137}Sm	41*			
^{138}Sm	82*			
^{139}Sm	106*			
^{140}Sm	70*			

^{A}Z	19B2	18B	19A	16C
^{141}Sm	83*			
^{142}Sm	35/98			
^{143}Sm	83/89			
^{144}Sm	81/162	34		
^{145}Sm	62/168	35		206
^{146}Sm	173/189	64		
^{147}Sm	38/95	22		
^{148}Sm	201/289	49		213
^{149}Sm	122/193	31		25
^{150}Sm	161/180	47		160
^{151}Sm	120/231	19		25
^{152}Sm	121/152	46		121
^{153}Sm	198/270			92
^{154}Sm	110/110	47		
^{155}Sm	141/141			36
^{156}Sm	25/38			
^{157}Sm	17*			
^{158}Sm	11*			

Spectroscopic factors together with occupation probabilities and magnetic moments are basic elements needed for an understanding of the nuclear structure. The spectroscopic factor S is defined as the probability to reach a final single-particle (hole) state when a nucleon is added to (or removed from) the target nucleus (correspondingly $S_{\rm p}^{+}, S_{\rm n}^{+}$ or $S_{\rm p}^{-}, S_{\rm n}^{-}$). The mean field approximation is a basic idea of nuclear shell-models used for the description of nuclear states. The occupation number is the number of nucleons in the certain quantum state in the target nucleus, relative to the $2j+1$ limit [93Ud01]. The commonly used method of data analysis consists in the comparison with results of calculations by the Distorted Wave Born Approximation (DWBA). Reviews of data on spectroscopic factors can be found in [60Ma32, 77En02, 90En08, 94Ve04].

The measured cross section $\sigma_{\rm exp}$ and the spectroscopic factor $S_{\rm N}$ of a nucleon transfer reaction are connected with the theoretically estimated cross section $\sigma_{\rm DWBA}$ by relation:

$$\sigma_{\rm exp}=(2J+1)(2I+1)^{-1}(2j+1)^{-1} \times S_{\rm N} \times N \times \sigma_{\rm DWBA}$$

with N a normalization parameter, J, I, j total moments of the final state, the target nuclei and the transferred nucleon.

The measured cross section $\sigma_{\rm exp}$ of few-nucleon transfer reaction is connected with the estimated cross section $\sigma_{\rm DWBA}$ by the relation which includes spectroscopic "enhancement factor" ε:

$$\sigma_{\rm exp}=(2J+1)(2I+1)^{-1}(2j+1)^{-1} \times \varepsilon \times N \times \sigma_{\rm DWBA}.$$

The final goal of the comparison consists in a judgement on the validity of a single-particle approximation of the shell-model. It was found in many experimental works that this model gives good results in near-magic nuclei. It permits to determine the single-particle properties of the real excited states. The closeness of their spectroscopic factors to shell-model values is in accordance with the observed closeness of magnetic moments of near-magic nuclei to the single-particle limit.

Table 1.3. Numbers of bound states in compound nuclei ^{A}Z with $64 \leq Z \leq 99$ contained in the third part of this compilation (I/19B3). The ratio shows the number of states in Volume I/19B3 and its Supplement.

The number of bound states in the compilation LB I/18C, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B3	18C	19A	16C
^{137}Eu	7*			
^{138}Eu	49*			
^{139}Eu	62*			
^{140}Eu	22*			
^{141}Eu	61*			
^{144}Eu	127*			
^{143}Eu	204*			
^{144}Eu	144*			
^{145}Eu	34/204		19	
^{146}Eu	4/35			
^{147}Eu	45/150			
^{148}Eu	4/92			
^{149}Eu	46/128		2	
^{150}Eu	3/84			
^{151}Eu	100/176	16	2	
^{152}Eu	91/195	38		106
^{153}Eu	46/126	12		22
^{154}Eu	12/159	42		77
^{155}Eu	59/66	19		19
^{156}Eu	6/32			7
^{157}Eu	16/40			
^{159}Eu	11/31			
^{138}Gd	34*			
^{139}Gd	57*			
^{140}Gd	23*			
^{141}Gd	65*			
^{142}Gd	111*			
^{143}Gd	105*			
^{144}Gd	158*			
^{145}Gd	151*			
^{146}Gd	84/196	43		
^{147}Gd	5/199			
^{148}Gd	23/304	43		
^{149}Gd	3/393			
^{150}Gd	4/393			
^{151}Gd	39/107	18		
^{152}Gd	23/100	45		
^{153}Gd	132/162	40		131
^{154}Gd	29/226	24		9
^{155}Gd	146/179	27		162
^{156}Gd	169/263	26		95
^{157}Gd	114/286	22		87
^{158}Gd	147/213	25		88

^{A}Z	19B3	18C	19A	16C
^{159}Gd	254/298	12		96
^{160}Gd	19/103	24		
^{161}Gd	35/51			58
^{162}Gd	2/20			
^{141}Tb	5*			
^{142}Tb	7*			
^{143}Tb	103*			
^{144}Tb	31*			
^{145}Tb	19*			
^{146}Tb	26*			
^{147}Tb	94*			
^{148}Tb	82*			
^{149}Tb	18/178			
^{150}Tb	2/115			
^{151}Tb	2/266			
^{152}Tb	5/100			
^{153}Tb	68/99	26		
^{154}Tb	4/37			
^{155}Tb	61/86	36		
^{156}Tb	27/68			
^{157}Tb	44/152	13		
^{158}Tb	96/96	18		
^{159}Tb	100/116	15	2	
^{160}Tb	78/100	14		443
^{161}Tb	64/69	8		3
^{162}Tb	8/8			
^{163}Tb	36/36			
^{140}Dy	5*			
^{142}Dy	6*			
^{143}Dy	79*			
^{144}Dy	14*			
^{145}Dy	12*			
^{146}Dy	21*			
^{147}Dy	20*			
^{148}Dy	56*			
^{149}Dy	58*			
^{150}Dy	85*			
^{151}Dy	130*			
^{152}Dy	249*			
^{153}Dy	206*			
^{154}Dy	35/145	39		
^{155}Dy	56/174			
^{156}Dy	57/314	62		

^{A}Z	19B3	18C	19A	16C
^{157}Dy	81/111			20
^{158}Dy	37/96	40		
^{159}Dy	61/118	32		7
^{160}Dy	79/120	44		
^{161}Dy	110/141	39		114
^{162}Dy	213/238	31		256
^{163}Dy	271/292	44		142
^{164}Dy	115/167	25		131
^{165}Dy	67/134	8		117
^{166}Dy	29/31			
^{167}Dy	3*			
^{168}Dy	4*			
^{141}Ho	15*			
^{145}Ho	4*			
^{147}Ho	5*			
^{148}Ho	16*			
^{149}Ho	81*			
^{150}Ho	16*			
^{151}Ho	65*			
^{152}Ho	31*			
^{153}Ho	105*			
^{154}Ho	37*			
^{155}Ho	67*			
^{156}Ho	150*			
^{157}Ho	86/247			
^{158}Ho	4/117			
^{159}Ho	65/125			
^{160}Ho	4/43			
^{161}Ho	67/109	18		
^{162}Ho	5/16			
^{163}Ho	70/78	12		
^{164}Ho	32/34			
^{165}Ho	190/214	19		
^{166}Ho	213/330	9		374
^{167}Ho	29/31			3
^{168}Ho	2/5			
^{169}Ho	32/32			
^{170}Ho	1/1			
^{145}Er	3*			
^{148}Er	8*			
^{149}Er	14*			
^{150}Er	28*			
^{151}Er	57*			

Table 1.3. (continued) Numbers of bound states in compound nuclei ^{A}Z with $64 \le Z \le 99$ contained in the third part of this compilation (I/19B3). The ratio shows the number of states in Volume I/19B3 and its Supplement.

The number of bound states in the compilation LB I/18C, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B3	18C	19A	16C
^{152}Er	53*			
^{153}Er	38*			
^{154}Er	83*			
^{155}Er	62*			
^{156}Er	113*			
^{157}Er	114*			
^{158}Er	129*			
^{159}Er	186*			
^{160}Er	183*			
^{161}Er	28/122	23		
^{162}Er	22/110	32		
^{163}Er	94/383	41		18
^{164}Er	23/204	28		
^{165}Er	99/105	26		19
^{166}Er	122/159	27		
^{167}Er	75/200	17		1
^{168}Er	194/303	55		276
^{169}Er	118/143	5		130
^{170}Er	5/151	12		
^{171}Er	57/73			125
^{172}Er	26/41			
^{147}Tm	5*			
^{150}Tm	5*			
^{151}Tm	19*			
^{152}Tm	19*			
^{153}Tm	63*			
^{154}Tm	2*			
^{155}Tm	6*			
^{156}Tm	14*			
^{157}Tm	72*			
^{158}Tm	44*			
^{159}Tm	73*			
^{160}Tm	68*			
^{161}Tm	95*			
^{162}Tm	212*			
^{163}Tm	97*			
^{164}Tm	175*			
^{165}Tm	17/85	22		
^{166}Tm	1/1			
^{167}Tm	18/137	12		
^{168}Tm	76/140			
^{169}Tm	26/151	12		
^{170}Tm	116/258			432
^{171}Tm	19/49	11		13
^{172}Tm	4/13			4
^{173}Tm	5/33			
^{174}Tm	3/7			
^{175}Tm	21/31			
^{151}Yb	10*			
^{152}Yb	6*			
^{153}Yb	14*			
^{154}Yb	28*			
^{156}Yb	20*			
^{157}Yb	2*			
^{158}Yb	55*			
^{159}Yb	45*			
^{160}Yb	88*			
^{161}Yb	74*			
^{162}Yb	72*			
^{163}Yb	62*			
^{164}Yb	134*			
^{165}Yb	97*			
^{166}Yb	16/114	22		
^{167}Yb	21/176	25		
^{168}Yb	50/164	14		
^{169}Yb	74/173	31		7
^{170}Yb	70/198	51		22
^{171}Yb	79/176	17		24
^{172}Yb	229/307	41		170
^{173}Yb	93/112	18		101
^{174}Yb	116/203	23		167
^{175}Yb	42/153	8		79
^{176}Yb	35/52	6		
^{177}Yb	47/156			69
^{178}Yb	31/31			
^{153}Lu	9*			
^{154}Lu	15*			
^{155}Lu	2*			
^{156}Lu	16*			
^{157}Lu	1*			
^{159}Lu	32*			
^{160}Lu	14*			
^{161}Lu	73*			
^{162}Lu	104*			
^{163}Lu	219*			
^{164}Lu	193*			
^{165}Lu	152*			
^{166}Lu	9*			
^{167}Lu	169*			
^{168}Lu	1*			
^{169}Lu	56*			
^{170}Lu	203*			
^{171}Lu	35/202	11	7	
^{172}Lu	39/39			
^{173}Lu	51/81	12	6	
^{174}Lu	34/168			
^{175}Lu	84/122	13	13	
^{176}Lu	39/142	24		449
^{177}Lu	135/203	19	10	
^{178}Lu	23/41			
^{179}Lu	14/34			
^{180}Lu	2/12			
^{154}Hf	6*			
^{156}Hf	7*			
^{157}Hf	24*			
^{158}Hf	32*			
^{159}Hf	15*			
^{160}Hf	19*			
^{161}Hf	16*			
^{162}Hf	52*			
^{163}Hf	21*			
^{164}Hf	57*			
^{165}Hf	52*			
^{166}Hf	64*			
^{167}Hf	83*			
^{168}Hf	119*			
^{169}Hf	39*			
^{170}Hf	100*			
^{171}Hf	154*			
^{172}Hf	109*			
^{173}Hf	3/129	11		
^{174}Hf	4/189	10		
^{175}Hf	4/115	6		11
^{176}Hf	131/194	21		
^{177}Hf	3/145	25		128
^{178}Hf	110/160	38		197

Table 1.3. (continued) Numbers of bound states in compound nuclei ^{A}Z with $64 \leq Z \leq 99$ contained in the third part of this compilation (I/19B3). The ratio shows the number of states in Volume I/19B3 and its Supplement.

The number of bound states in the compilation LB I/18C, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B3	18C	19A	16C
^{179}Hf	109/182	32		215
^{180}Hf	204/247	23		154
^{181}Hf	153/179			150
^{182}Hf	7/19			
^{183}Hf	2/7			
^{184}Hf	4			
^{157}Ta	2*			
^{158}Ta	1*			
^{159}Ta	4*			
^{164}Ta	1*			
^{166}Ta	4*			
^{167}Ta	70*			
^{168}Ta	29*			
^{169}Ta	10*			
^{170}Ta	52*			
^{171}Ta	77*			
^{172}Ta	57*			
^{173}Ta	64*			
^{174}Ta	127*			
^{175}Ta	58*			
^{176}Ta	28*			
^{177}Ta	184*			
^{178}Ta	20*			
^{179}Ta	39/135	9	2	
^{180}Ta	53/246	22		
^{181}Ta	36/64	12		61
^{182}Ta	1/154			772
^{183}Ta	3/19			24
^{184}Ta	2/6			
^{185}Ta	16/21			
^{158}W	1*			
^{162}W	1*			
^{164}W	15*			
^{165}W	33*			
^{166}W	41*			
^{167}W	51*			
^{168}W	67*			
^{169}W	37*			
^{170}W	66*			
^{171}W	82*			
^{172}W	49*			
^{173}W	41*			

^{A}Z	19B3	18C	19A	16C
^{174}W	29*			
^{175}W	43*			
^{176}W	108*			
^{177}W	157*			
^{178}W	37/76			
^{179}W	18/184			
^{180}W	45/119	17		
^{181}W	51/72	23		6
^{182}W	98/122	27		1
^{183}W	123/145	21		250
^{184}W	107/184	32		313
^{185}W	90/104			197
^{186}W	51/76	9		7
^{187}W	96/144			175
^{188}W	23/23			
^{190}W	6*			
^{165}Re	1*			
^{167}Re	2*			
^{168}Re	2*			
^{169}Re	1*			
^{170}Re	8*			
^{171}Re	95*			
^{172}Re	10*			
^{173}Re	74*			
^{174}Re	35*			
^{175}Re	105*			
^{176}Re	32*			
^{177}Re	251*			
^{178}Re	68*			
^{179}Re	103*			
^{180}Re	101*			
^{181}Re	7/60			
^{182}Re	4/48			
^{183}Re	37/64	18		
^{184}Re	47/47			
^{185}Re	31/38	6		
^{186}Re	51/167			503
^{187}Re	33/64	8		3
^{188}Re	48/81			399
^{189}Re	11/22	4		
^{190}Re	1/4			
^{191}Re	15/39			

^{A}Z	19B3	18C	19A	16C
^{164}Os	5*			
^{170}Os	28*			
^{171}Os	71*			
^{172}Os	78*			
^{173}Os	66*			
^{174}Os	70*			
^{175}Os	71*			
^{176}Os	53*			
^{177}Os	57*			
^{178}Os	59*			
^{179}Os	134*			
^{180}Os	143*			
^{181}Os	132*			
^{182}Os	148*			
^{183}Os	70*			
^{184}Os	18/49	17		
^{185}Os	41/67			
^{186}Os	36/164	23		
^{187}Os	45/65	17		129
^{188}Os	58/125	15		177
^{189}Os	53/90	12		101
^{190}Os	121/145	13		22
^{191}Os	64/77			24
^{192}Os	82/106	14		
^{193}Os	16/57			20
^{194}Os	14/15			
^{196}Os	2*			
^{165}Ir	1*			
^{166}Ir	1*			
^{167}Ir	1*			
^{172}Ir	3*			
^{173}Ir	47*			
^{174}Ir	1*			
^{175}Ir	53*			
^{176}Ir	4*			
^{177}Ir	122*			
^{178}Ir	2*			
^{179}Ir	89*			
^{180}Ir	84*			
^{181}Ir	77*			
^{182}Ir	41*			
^{183}Ir	3/38	31		

Table 1.3. (continued) Numbers of bound states in compound nuclei ^{A}Z with $64 \leq Z \leq 99$ contained in the third part of this compilation (I/19B3). The ratio shows the number of states in Volume I/19B3 and its Supplement.

The number of bound states in the compilation LB I/18C, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B3	18C	19A	16C	^{A}Z	19B3	18C	19A	16C	^{A}Z	19B3	18C	19A	16C
^{184}Ir	5/71				^{199}Pt	37/61			5	^{191}Hg	3/212			
^{185}Ir	5/90	4			^{200}Pt	38/38				^{192}Hg	3/156			
^{186}Ir	8/95	6			^{170}Au	1*				^{193}Hg	6/252			
^{187}Ir	4/68	21			^{171}Au	1*				^{194}Hg	8/151	10		
^{188}Ir	3/19				^{173}Au	5*				^{195}Hg	5/207			
^{189}Ir	17/85	28			^{177}Au	34*				^{196}Hg	10/68	9		
^{190}Ir	108/157				^{179}Au	3*				^{197}Hg	34/60			2
^{191}Ir	33/71	11			^{181}Au	69*				^{198}Hg	81/97	27		
^{192}Ir	87/190			62	^{183}Au	65*				^{199}Hg	52/84	6		73
^{193}Ir	71/77	17		11	^{184}Au	59*				^{200}Hg	23/98	49		88
^{194}Ir	45/138			54	^{185}Au	92*				^{201}Hg	78/79	9		44
^{195}Ir	38/44	16			^{186}Au	4/84	12			^{202}Hg	37/83	18		86
^{196}Ir	5*				^{187}Au	5/91				^{203}Hg	76/78			38
^{197}Ir	23*				^{188}Au	5/49				^{204}Hg	7/63	15		
^{199}Ir	2*				^{189}Au	4/275	31			^{205}Hg	52/53			23
^{170}Pt	4*				^{190}Au	5/46				^{206}Hg	2/3			
^{171}Pt	6*				^{191}Au	4/97				^{179}Tl	1*			
^{174}Pt	11*				^{192}Au	2/33				^{181}Tl	1*			
^{175}Pt	17*				^{193}Au	4/89	8			^{183}Tl	12*			
^{176}Pt	28*				^{194}Au	3/24				^{184}Tl	2*			
^{177}Pt	51*				^{195}Au	37/45	21			^{185}Tl	2*			
^{178}Pt	10*				^{196}Au	199/215				^{186}Tl	8*			
^{179}Pt	59*				^{197}Au	37/47	10			^{187}Tl	52*			
^{180}Pt	4/92				^{198}Au	155/158	52		270	^{188}Tl	8*			
^{181}Pt	3/138				^{199}Au	52/69	10			^{189}Tl	78*			
^{182}Pt	5/85				^{200}Au	11*				^{190}Tl	24*			
^{183}Pt	4/103	4			^{201}Au	20*				^{191}Tl	84*			
^{184}Pt	4/43				^{203}Au	11*				^{192}Tl	73*			
^{185}Pt	4/161	17			^{176}Hg	3*				^{193}Tl	141*			
^{186}Pt	5/95	17			^{177}Hg	3*				^{194}Tl	125*			
^{187}Pt	5/73				^{179}Hg	4*				^{195}Tl	6/88	21		
^{188}Pt	4/72				^{180}Hg	37*				^{196}Tl	5/35	5		
^{189}Pt	18/47				^{181}Hg	36*				^{197}Tl	3/58	20		
^{190}Pt	25/55	21			^{182}Hg	43*				^{198}Tl	3/31			
^{191}Pt	55/63			2	^{183}Hg	55*				^{199}Tl	3/34	5		
^{192}Pt	104/133	15			^{184}Hg	4/18	12			^{200}Tl	6/16	10		
^{193}Pt	82/89	12		12	^{185}Hg	4/50				^{201}Tl	15/63	7		
^{194}Pt	85/118	27			^{186}Hg	5/89	18			^{202}Tl	12/15	3		
^{195}Pt	101/114	19		8	^{187}Hg	4/34				^{203}Tl	71/103	11		
^{196}Pt	129/130	53		44	^{188}Hg	4/81				^{204}Tl	86/86			138
^{197}Pt	86/104			6	^{189}Hg	3/74				^{205}Tl	73/88	32	10	
^{198}Pt	64/64	10			^{190}Hg	3/196				^{206}Tl	81/94	7		139

Table 1.3. (continued) Numbers of bound states in compound nuclei ^{A}Z with $64 \leq Z \leq 99$ contained in the third part of this compilation (I/19B3). The ratio shows the number of states in Volume I/19B3 and its Supplement.

The number of bound states in the compilation LB I/18C, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B3	18C	19A	16C
^{207}Tl	23/42	7		
^{208}Tl	1/7			
^{209}Tl	1/7			
^{210}Tl	5*			
^{183}Pb	1*			
^{184}Pb	5*			
^{186}Pb	9*			
^{187}Pb	6*			
^{188}Pb	22*			
^{189}Pb	7*			
^{190}Pb	32*			
^{191}Pb	1*			
^{192}Pb	109*			
^{193}Pb	245*			
^{194}Pb	141*			
^{195}Pb	136*			
^{196}Pb	5/149	14		
^{197}Pb	2/184			
^{198}Pb	2/199			
^{199}Pb	4/152			
^{200}Pb	5/69	7		
^{201}Pb	4/69	20		
^{202}Pb	40/61			
^{203}Pb	22/63	23		
^{204}Pb	151/156	54	1	
^{205}Pb	183/183	25		242
^{206}Pb	225/335	84	1	
^{207}Pb	156/199	23		410
^{208}Pb	264/583	100		382
^{209}Pb	167/217	15		94
^{210}Pb	53/65	6		
^{211}Pb	15/20			
^{212}Pb	5/18			
^{214}Pb	1/1			
^{184}Bi	1*			
^{186}Bi	1*			
^{187}Bi	2*			
^{188}Bi	1*			
^{189}Bi	3*			
^{190}Bi	2*			
^{191}Bi	3*			
^{192}Bi	1*			
^{193}Bi	1*			
^{194}Bi	4*			
^{195}Bi	16*			
^{196}Bi	17*			
^{197}Bi	27*			
^{198}Bi	49*			
^{199}Bi	33*			
^{200}Bi	37*			
^{201}Bi	8/58	12		
^{202}Bi	6/37			
^{203}Bi	7/46	25		
^{204}Bi	5/41	14		
^{205}Bi	47/74	31	1	
^{206}Bi	36/45			
^{207}Bi	62/62	15	4	
^{208}Bi	135/191			44
^{209}Bi	200/203	20	8	
^{210}Bi	106/107	11		278
^{211}Bi	50/50			
^{212}Bi	7/9			
^{213}Bi	3/3	1		
^{214}Bi	9/11	3		
^{215}Bi	1/3			
^{216}Bi	1*			
^{190}Po	6*			
^{191}Po	1*			
^{192}Po	4*			
^{193}Po	4*			
^{194}Po	8*			
^{195}Po	5*			
^{196}Po	4/22	13		
^{197}Po	2*			
^{198}Po	5/55			
^{199}Po	3/7			
^{200}Po	4/28			
^{201}Po	5/23			
^{202}Po	5/21			
^{203}Po	6/53			
^{204}Po	5/70	35		
^{205}Po	5/54	30		
^{206}Po	4/98			
^{207}Po	5/63	15		
^{208}Po	20/52	10		
^{209}Po	25/39	14		
^{210}Po	45/76	28		
^{211}Po	47/73	5		
^{212}Po	5/30	10		
^{213}Po	5/5	2		
^{214}Po	4/81	16		
^{215}Po	6/14			
^{216}Po	2/2			
^{217}Po	2*			
^{218}Po	2*			
^{198}At	1*			
^{200}At	3*			
^{201}At	8*			
^{202}At	2*			
^{203}At	3/20	8		
^{204}At	1/1			
^{205}At	4/31	19		
^{207}At	5/34	8		
^{208}At	4/39	4		
^{209}At	3/62	2		
^{210}At	122*			
^{211}At	26*			
^{212}At	37*			
^{213}At	6*			
^{214}At	20*			
^{215}At	6*			
^{216}At	18*			
^{217}At	15*			
^{197}Rn	1*			
^{198}Rn	5*			
^{199}Rn	1*			
^{201}Rn	2*			
^{203}Rn	4*			
^{204}Rn	20*			
^{205}Rn	29*			
^{206}Rn	18*			
^{207}Rn	4*			
^{208}Rn	3/41	22		
^{209}Rn	4/33	4		
^{210}Rn	4/31			
^{211}Rn	3/57	2		

Table 1.3. (continued) Numbers of bound states in compound nuclei ^{A}Z with $64 \leq Z \leq 99$ contained in the third part of this compilation (I/19B3). The ratio shows the number of states in Volume I/19B3 and its Supplement.

The number of bound states in the compilation LB I/18C, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B3	18C	19A	16C
^{212}Rn	3/33	2		
^{213}Rn	2/53			
^{214}Rn	2/48	12		
^{215}Rn	4/4			
^{216}Rn	2/5			
^{217}Rn	3/11			
^{218}Rn	3/4			
^{219}Rn	2/30			
^{220}Rn	3/4	3		
^{222}Rn	2/4	4		
^{200}Fr	1*			
^{202}Fr	1*			
^{204}Fr	2*			
^{206}Fr	2*			
^{210}Fr	2*			
^{211}Fr	26*			
^{212}Fr	43*			
^{213}Fr	3/41	17		
^{214}Fr	3/58			
^{215}Fr	3/21			
^{216}Fr	3/27			
^{217}Fr	3/18	8		
^{218}Fr	4/10			
^{219}Fr	3/30			
^{220}Fr	5/34	5		
^{221}Fr	3/44			
^{222}Fr	1/1			
^{223}Fr	11/58			
^{225}Fr	43/51			
^{227}Fr	38*			
^{206}Ra	4*			
^{207}Ra	3*			
^{211}Ra	2*			
^{212}Ra	3/13	3		
^{213}Ra	3/4			
^{214}Ra	3/50	32		
^{215}Ra	3/32			
^{216}Ra	3/21	12		
^{217}Ra	3/35			
^{218}Ra	3/50	17		
^{219}Ra	3/52			
^{220}Ra	3/31			

^{A}Z	19B3	18C	19A	16C
^{221}Ra	3/10			
^{222}Ra	3/24	7		
^{223}Ra	3/65	18		
^{224}Ra	42/52	11		
^{225}Ra	70/70	12		
^{226}Ra	31/60	25		
^{227}Ra	84/84	11		41
^{228}Ra	26/39	11		
^{229}Ra	32*	11		
^{230}Ra	23*			
^{231}Ra	30*			
^{208}Ac	1*			
^{212}Ac	2*			
^{214}Ac	2*			
^{215}Ac	5*			
^{216}Ac	1*			
^{217}Ac	10*			
^{218}Ac	36*			
^{219}Ac	3/44	22		
^{220}Ac	3/61			
^{221}Ac	1/1			
^{222}Ac	3/3			
^{223}Ac	3/10	11		
^{224}Ac	3/37			
^{225}Ac	3/16	12		
^{226}Ac	3/17			
^{227}Ac	22/45	30		
^{228}Ac	4/4	4		
^{229}Ac	15/26	13		
^{230}Ac	3/18			
^{231}Ac	17/25	12		
^{232}Ac	3*	12		
^{216}Th	8*			
^{217}Th	1/1			
^{218}Th	5/5			
^{220}Th	3/17	11		
^{221}Th	3/13			
^{222}Th	3/25	10		
^{223}Th	3/27	16		
^{224}Th	3/18	10		
^{225}Th	5/5			
^{226}Th	3/24	11		

^{A}Z	19B3	18C	19A	16C
^{227}Th	3/57	7		
^{228}Th	82/91	50		
^{229}Th	5/63	23		3
^{230}Th	68/87	28		31
^{231}Th	92/97	54		30
^{232}Th	71/94	32		
^{233}Th	78/191	46		134
^{234}Th	12/12	11		
^{222}Pa	2*			
^{223}Pa	1*			
^{229}Pa	78/78			
^{230}Pa	1/1			
^{231}Pa	71/86	34		
^{232}Pa	1*			138
^{233}Pa	45/74	28		33
^{234}Pa	3/7			22
^{235}Pa	21/24	7		
^{236}Pa	3/6			
^{237}Pa	20/20	9		
^{226}U	1*			
^{228}U	1*			
^{229}U	1*			
^{230}U	3/15	10		
^{231}U	7/7			
^{232}U	14/40	27		
^{233}U	76/87	34		44
^{234}U	145/150	54		770
^{235}U	183/213	37		144
^{236}U	99/120	27		3184
^{237}U	94/181	38		297
^{238}U	63/152	43		36
^{239}U	70/108	45		1692
^{240}U	13/13			
^{232}Np	1/1			
^{233}Np	3/14			
^{234}Np	1/1			
^{235}Np	47/47	21		
^{236}Np	4/4			
^{237}Np	61/79	30		41
^{238}Np	38/129	48		752
^{239}Np	63/63	31		17
^{240}Np	4/10			

Table 1.3. (continued) Numbers of bound states in compound nuclei ^{A}Z with $64 \leq Z \leq 99$ contained in the third part of this compilation (I/19B3). The ratio shows the number of states in Volume I/19B3 and its Supplement.

The number of bound states in the compilation LB I/18C, the number of resonances in reactions with charged particles in the compilation LB I/19A2 and the number of neutron resonances in the compilation LB I/16C are given in the same line for comparison. Asterisk marks the number of states in nuclei far from the stability-line.

^{A}Z	19B3	18C	19A	16C
^{242}Np	2/7			
^{243}Np	22*			
^{234}Pu	1*			
^{235}Pu	1/1			
^{236}Pu	6/10			
^{237}Pu	56/58	28		2
^{238}Pu	27/46	26		
^{239}Pu	63/96	42		64
^{240}Pu	67/127	38		1040
^{241}Pu	93/96	41		430
^{242}Pu	38/54	21		243
^{243}Pu	68/69	33		255
^{244}Pu	28/46			
^{245}Pu	21/21	14		35
^{246}Pu	12/12			
^{237}Am	1*			
^{239}Am	11/11	11		
^{240}Am	57/60	21		
^{241}Am	37/37	17		
^{242}Am	115/141	51		195
^{243}Am	28/29	15		106
^{244}Am	112/114	55		240
^{245}Am	17/21	14		
^{246}Am	8*			
^{240}Cm	3*			
^{241}Cm	6*			
^{242}Cm	2/5			
^{243}Cm	27/30	10		13
^{244}Cm	8/14			105
^{245}Cm	43/62	29		68
^{246}Cm	51/64	38		91
^{247}Cm	56/56	15		17
^{248}Cm	29/44	12		44
^{249}Cm	50/50	24		50
^{250}Cm	1/1			
^{241}Bk	3*			
^{242}Bk	3*			
^{243}Bk	4*			
^{244}Bk	4*			
^{245}Bk	3*			
^{247}Bk	24/24	22		
^{248}Bk	4/21			
^{249}Bk	51/51	32		
^{250}Bk	40/40	37		40
^{251}Bk	11/11	11		
^{243}Cf	3*			
^{244}Cf	2*			
^{246}Cf	1/2			
^{247}Cf	8/12	12		
^{248}Cf	18/18	16		
^{249}Cf	55/55	38		
^{250}Cf	47/47	36		63
^{251}Cf	49/49	32		4
^{252}Cf	9/9	9		4
^{253}Cf	5/5	5		37
^{244}Es	2*			
^{246}Es	2*			
^{251}Es	23/23	19		
^{252}Es	7/7			
^{253}Es	7/7	7		
^{254}Es	9/9	9		
^{247}Fm	2*			
^{249}Fm	4*			
^{250}Fm	2*			
^{251}Fm	9*	8		
^{253}Fm	2*			
^{254}Fm	4*	4		
^{255}Fm	6*			
^{256}Fm	23*	22		

The agreement between measured spectroscopic factors and the expected theoretical values ($S_{\mathrm{dp}} \approx 1.0$) can be illustrated by the properties of states in low-lying multiplet (with $T = 1$) for three near-magic $A = 40$ nuclei (Table 2), as discussed in [02Fo09].

Table 2. Energies and S_{dp} of the members of the lowest multiplet for $A = 40$, $T = 1$ [02Fo09].

	^{40}K		^{40}Ca($T = 1$)**		^{40}Sc	
J^{π}	E^{*}_{exp} [keV]	S_{dp}	E^{*}_{exp} [keV]	E^{*}_{theor} [keV]	E^{*}_{exp} [keV]	E^{*}_{theor} [keV]
4^{-}	0	0.9	0	1	0	39
3^{-}	30	0.9	36	24	34	34
2^{-}	800	0.9	767	773	772	772
5^{-}	891	0.8	893	864	894	859

** After subtracting 7658 keV.

From large values of the observed spectroscopic factors and constancy of excitations (boxed values) it was concluded that single-particle approximation is valid for these near-magic nuclei. This observation means that nucleons are the real constituents of nuclei and the study of stable excitations of levels with large spectroscopic factors can give important information needed for the development of nuclear models. An analysis of E^{*}-distributions in near-magic nuclei and a stable character of the excitation $E^{*} = 894$ and 894×4=3577 keV were reported in [99So0A, 03So0A].

1.2 Data presentation

The data in CRF are presented in tables whose format is analogous to that of the compilation of energy levels of light nuclei by P. Endt and C. Van der Leun [78En02, 90En08, 98En04]. In these tables, each horizontal line belongs to one excited state. The line starts with standard parameters such as energy of excitation E^*, spin J^π and isospin T. Each date-line in the Volumes I/19B also contains the half-life $T_{1/2}$ of the state or its total width Γ_{cm}. Spectroscopic information on different nuclear transfer reactions together with one (main) reference in NSR-code forms the central part of each data-line. The notations of the parameters given in CRF are listed in Table 3. They are the same as those used in most of the original works, review papers and compilations including the Volumes of LB I/18.

The general properties of nuclei are presented in two sections (Part 1-2) of Table 3. Data on the charged particle reactions, i.e. yields, cross sections ($d\sigma/d\Omega$, σ etc., see Part 3-4 of Table 3) and spectroscopic factors (S_{N}, see Part 5) derived from the experimental data on cross sections of transfer reactions are given after E^* and are followed by the main reference.

Direct referencing to the original papers in each data-line could be used by the interested reader for his own judgement. At the bottom of each column with the experimental data we give again the corresponding reference (only in Supplement). Additional references given at the end of the tables and references in comments could serve for a better orientation in the material. Data taken from papers not included in the Nuclear Science Reference system are provided by a reference which is shown as NSR reference with zero and a letter in the last two (out of 6) characters, for example [04Sc0A].

At its end, each data-line contains branching ratios (in percents) of γ-transitions to the levels situated below this excited state. In cases when there are many transitions from a certain initial state, the corresponding horizontal line has a continuation in Supplement (on CD) where branching ratios of all known transitions are given.

For each isotope, data-lines for states are ordered by increasing E^* and form one isotope-table which ends by reference codes and by short comments where additional information can be found. Each isotope table is labelled by the atomic number (Z) and the atomic weight (A) of the nucleus. The whole set of isotope tables for a given element (Z) is ordered by the increasing atomic weights (A) of the compound nucleus. References are presented at the end of the book.

Data from the great number of transfer reactions used for obtaining information on properties of excited states are grouped in the following way. Transfer reactions with the stripping of the ongoing particle are given first. The sequence of data for these reactions starts with many-nucleon transfer and ends with one-nucleon transfer like the well-known deuteron stripping reaction.

Data from pickup reactions are given in the inverse order – one-nucleon transfer first, many-nucleon pickup reactions at the end. This method of data presentation (also used in NDS) permits a more effective comparison of the results for one-nucleon transfer reactions (stripping and pickup) obtained by the use of different projectiles. For example, the one-neutron transfer reactions (α,^{3}He), (t,d) and (d,p) can be compared with the one-neutron pickup transfer reactions (p,d), (d,t) and (τ, α).

Data from inelastic scattering of different particles and data obtained by NRF – the Nuclear Resonance Fluorescence method – can be found at the end of the data-line or between these two groups of transfer reaction data. In Table 3, different reactions are given approximately in the same order as they appear in data-lines of CRF.

Table 3. List of principal notations in CRF.

No.	Symbol	REFERENCE Its meaning	Explanation
1		PROPERTIES OF COMPOUND NUCLEUS	
	Z	Atomic number	Integer number Z
	A	Atomic weight	Integer number A
	Abundance	Abundance	Percentage of isotope abundance
	J^π, $2J^\pi$, J	Spin of the state	π indicates parity
	T	Isotopic spin	$T_{\rm g.s}=\|N-Z\|/2$
	$T_{1/2}$	Half-life	[04Nu0A]
2		PARAMETERS OF EXCITED STATES	
	E^*	Excitation energy	Total excitation energy
	X, Y, Z, U...	Additional energy	Additional unknown energy
	$E^*_{\rm anal}$	Excitation energy	E^* of the analog state
	$E^*_{\rm f}$	Final energy	Energy of the final state
	$\Gamma_{\rm cm}$, Γ	$\Gamma_{\rm cm} = M/(M+m)\ \Gamma$	Width in center-of-mass frame
	$\Gamma_{\rm n}$, $\Gamma_{\rm p}$, $\Gamma_{\rm d}$, Γ_α	Nucleon width	Width of capture/emission
3		TRANSFER REACTIONS	
	(α,p); $\sigma(\alpha$,p); $I_{\rm p}$	Three-nucleon transfer	Cross section, proton yield
	(α,n); $\sigma(\alpha$,n); $I_{\rm n}$	Three-nucleon transfer	Cross section, neutron yield
	(α,d); $\sigma(\alpha$,d); $I_{\rm d}$	Two-neutron transfer	Cross section, deuteron yield
	(α,t); $\sigma(\alpha$,t); $I_{\rm t}$	Proton transfer	Cross section, tritium yield
	(α,^{3}He); $\sigma(\alpha,\tau)$; I_τ	One-neutron transfer	Cross section, yield of ^{3}He
	(α,^{2}He); $\sigma(\alpha$,^{2}He)	Two-neutron transfer	Cross section of (α,^{2}He) reaction
	(^{3}He,d); $\sigma(\tau$,d); $I_{\rm d}$	Proton transfer	Cross section, deuteron yield
	(^{3}He,n); $\sigma(\tau$,n); $I_{\rm n}$	Two-nucleon transfer	Cross section, neutron yield
	(^{3}He,p); $\sigma(\tau$,p); $I_{\rm p}$	Two-nucleon transfer	Cross section, proton yield
	(t,p); σ(t,p); $I_{\rm p}$	Two-neutron transfer	Cross section, proton yield
	(t,d); σ(t,d); $I_{\rm d}$	One-neutron transfer	Cross section, deuteron yield
	(d,n); σ(d,n); $I_{\rm n}$	One-proton transfer	Deuteron stripping, yield
	(d,p); σ(d,p); $N_{\rm dp}$	One-neutron transfer	Deuteron stripping, yield
	(^{14}C,^{12}N); σ(^{14}C,^{12}N)		
	(^{16}O,^{14}N); σ(^{16}O,^{14}N)	Two-nucleon transfer	All differential cross sections
	(^{16}O,^{15}N); σ(^{16}O,^{15}N)	One-proton transfer	$d\sigma/d\Omega$ are given in [μbarn/sr]
	(^{12}C,^{10}Be); σ(^{12}C,^{10}Be)	Two-proton transfer	All integral cross sections σ
	(^{12}C,α); σ(^{12}C,α)		are given in [μbarn] or [mbarn]
	(^{6}Li,d); σ(^{6}Li,d)	α transfer	S_α – spectroscopic factor
	(^{6}Li,p); σ(^{6}Li,p)		
	(^{7}Li,p); σ(^{7}Li,p)	^{6}He transfer	Cross section of ^{6}He transfer
	(^{7}Li,t); σ(^{7}Li,t)	α transfer	
	(^{7}Li,^{6}He); σ(^{7}Li,^{6}He); $I^{^6{\rm He}}$	One-proton transfer	Cross section, yield of ^{6}He

Table 3. (continued) List of principal notations in CRF.

No.	Symbol	REFERENCE Its meaning	Explanation
4		TRANSFER PICKUP REACTIONS ETC.	
	(d,τ); σ(d,τ); I_τ; $I_{\mathrm{d}\tau}$	One-proton pickup	Cross section, ^{3}He yield
	(e,e′p); σ(e,e′p)	One-proton pickup	Cross section
	(p,t); σ(p,t); I_t	Two-neutron pickup	Cross section, tritium yield
	(p,d); σ(p,d); I_d	One-neutron pickup	Cross section, deuteron yield
	(d,t); σ(d,t)	One-neutron pickup	Cross section
	(p,α); σ(p,α)	Three-nucleon pickup	Cross section
	(d,α); σ(d,α)	Two-nucleon pickup	Cross section
	(t,α); σ(t,α)	One-proton pickup	Cross section
	(τ,α); $\sigma(\tau,\alpha)$; $I_{\tau\alpha}$	One-neutron pickup	Cross section, α yield
	(p,τ); σ(p,τ)	Two-nucleon pickup	Cross section
	(d,^{6}Li); σ(d,^{6}Li) (t,^{6}Li); σ(t,^{6}Li)	α pickup	S_α – spectroscopic factor
	(τ,^{6}He); σ(τ,^{6}He)	Three-neutron pickup	(^{3}He,^{6}He) reaction
	I_p, I_n, I_α	Particle yield	Proton–, neutron–, α–yield
	(τ,t); σ(τ,t); (t,τ)	Charge-exchange	Charge-exchange reactions (t,τ), (τ,t)
	(p,p′); σ(p,p′)	Inelastic scattering	Inelastic scattering of protons
	(d,d′); σ(d,d′)	Inelastic scattering	Inelastic scattering of deuterons
	(α,α'); $\sigma(\alpha,\alpha')$	Inelastic scattering	Inelastic scattering of α-particles
	γ^2_p; γ^2_α; $\gamma^2_\alpha/\gamma^2_\mathrm{W}$	Reduced widths	Widths of resonances, see LB I/19A
	β, β_L, $\beta_L R$	β-parameters	Deformation parameters, $\beta_L R$ in [fm] calculated with the parameter $r_\circ$
5		SPECTROSCOPIC FACTORS	
	S, S_N, C^2S	Spectr. factor	Factors of stripping or pick-up reaction
	C^2	Clebsch-Gordon factor	Isospin factor, see LB Vol. I/18A, p. 2-5
	S^+_p, S^+	Spectr. factor	Single proton transfer reaction (d,n),...
	S^-_p, S^-	Spectr. factor	Single proton pick-up reaction (d,τ),...
	S^+_n, S^+	Spectr. factor	Single neutron transfer reaction (d,p),...
	S^-_n, S^-	Spectr. factor	Single neutron pick-up reaction (p,d),...
	S'; C^2S'	Spectr. factor	$(2J+1)S$; $(2J+1)C^2S$
	S''; C^2S''	Spectr. factor	$(2J+1)/(2I+1)S$, I is the initial spin
	SG_lj	Spectr. factor	$(2J+1)/(2I+1)C^2S$; other factors
	l, l_p, l_n, l_1+l_2,...	Orbital moments	See definitions of S in the works
	S_dp, N_dp, S_dn	S factor, yield	S of deuteron stripping reaction (yield)
	S_pd, S_dt, $S_{\tau\alpha}$	Spectr. factor	S^-_n of neutron pick-up reaction
	S_pt, $S_{\mathrm{d}\tau}$, $S_{\mathrm{p}\tau}$, $S_{\alpha\mathrm{t}\gamma}$	Spectr. factors	S of the different transfer reactions
	$d\sigma/d\Omega$	Experimental yield	Yield of transfer reaction [μbarn/sr]
	ε	Enhancement factor	Parameter which shows the goodness of the fit of a few-nucleon transfer
	N	Norm. parameter	Theoretically calculated overlap of the wave-functions of interacting particles in a transfer, see original work

Table 3. (continued) List of principal notations in CRF.

No.	Symbol	REFERENCE Its meaning	Explanation
6		PROPERTIES OF GAMMA TRANSITIONS	
	E_γ	Energy of γ-quanta	
	I_γ	Relative intensity of γ	Normalized at 100 for the strongest
	$Br; BR$	Branching ratio	Percentage of the relative intensity [%]
	Mult.	Multipolarity	
	E1, E2, E3	Multipolarity	In units [e^2fm^4], [e^2fm^2], [$10^{-3}e^2fm^2$]
	M1, M2, M3	Multipolarity	In units of μ_N^2 etc.
	E_f^*, J_f, J_f^π	Excitation, spin	Excitation energy and spin of final state
	$I_{s,0}$, I_s	Cross section in [eVbarn]	In NRF
	$\Gamma_{\gamma\circ}$,$\Gamma_{\gamma f}$, Γ_γ	Total radiative width	In NRF
	Γ_γ/Γ_W	Γ_γ In Wigner units	See LB Vol. I/18
	${\Gamma_\circ}^2/\Gamma$, g${\Gamma_\circ}^2/\Gamma$	Observed quantity	In NRF (in units [eV] or [MeV])
	$\Gamma_\circ^{red}$, g$\Gamma_\circ^{red}$	Reduced radiative width	In units [meV/MeV^3]=[Mev′]
	B(M1), B(GT), ...	Transition intensity	See LB Vol. I/18
	EWSR	γ-transition strength	Energy Weighted Sum Rule (in [%])
	ω_γ, $S_{p\gamma}$, σ, σ_γ	Radiative strength	See LB Vol. I/19A
	$\Gamma_\alpha\Gamma_\gamma/\Gamma$, $\Gamma_p\Gamma_\alpha/\Gamma$		Strength of (α,γ) or (p,α) reactions
	E_γ^1+E_γ^2		Sum energy of γ cascade
7		OTHER PARAMETERS	
	A_y	VAP parameter	Vector Analyzing Power of the nucleon transfer $(\sigma_+$-$\sigma_-)/(\sigma_+$+$\sigma_-)$ [04Gr26]
	T_{20}	Tensor parameter	Parameter of nucleon transfer
	$E_\circ$, $E_\circ^{cm}$	E_α^{cm}, E_p^{cm}	Resonance energy in lab. or cm. frame
	$\sigma_{p\gamma}$, $\sigma_{n\gamma}$	Cross sections	Radiative cross sections
	nlj	Quantum numbers	Quantum numbers of a certain state
	L, l_n, l_p, l	Quantum number	Orbital momentum
	j, $2j$, $2j_p$, $2j_n$	Quantum number	Momentum of the transferred nucleon
	rel., *arb.u.*		Relative, arbitrary units
	eval., theor.		Evaluated, theoretical values

The abbreviation *Br* is used for the branching ratios of transitions from the neutron capturing state. This column is located, together with the spectroscopic factors, before the branching ratios of all other states. Due to the limited space many parameters are only given in the Supplement.

The abundance of stable isotopes [05TuZX] is given as Comments. Doublets and triplets are marked "doublt" and "triplt". For parameters in the tables, a quantity enclosed in angular brackets ⟨...⟩ indicates that it is preferred by the authors of the original work, a quantity enclosed in square brackets [...] is guessed by the compilers. In all tables the mark "include" means that the value given in the line above the marked one belongs to two states. As in many other compilations we give values $2J^\pi$ and $2T$ for all A-odd nuclei ($2J = 1^+$ instead of $J = 1/2^+$, etc.). Double spin notation 1^-,3^- or 3^+,5^+ is widely used. Alternative values (A,B ...) of the parameter are given as A,B ... while a mixture of parameters for one state are given as A+B ...

Notations presented in Table 3 are common for the data in all three Volumes I/19B.

1.3 Interpretation of data of nuclear excitations

The general description of spectroscopic information for nuclear bound states is given in the Introduction to Vol. I/18, written by V. Soloviev and coauthors [01Sc0A]. V. Soloviev also studied the transition from the order in low-lying levels to quantum chaos [93So0A]. References for these theoretical works can be found in Vol. I/18ABC [01Sc0A, 02Sc0A, 03Sc0A]. The theory of nuclear structure was developed in [66Ku05, 67Co32, 67Br0A, 70Co0A, 75Ku01, 78Ch0A] and shell-model calculations were presented in [77Cl01, 79Ch01, 81Co01, 81Co09, 87He09].

An application of nuclear physics to many practical tasks including astrophysics consists in the description of density and strength functions of nuclear states in the whole energy region of nuclear excitations. The statistical model is widely used for a description of properties of highly excited nuclear states. The estimation of the level density ρ is made frequently within modifications of the Fermi gas model law: $\rho = Ce^{2\sqrt{aU}}$, where U is the effective excitation energy and a and C are parameters [36Be0A, 65Gi11, 88Gr20, 97Pa11]. Information from resonance reactions with neutrons contained in Vol. I/16BC (files NRF) [98Sc0A, 04Sc0A]) and from reactions with charged particles contained in Vol. I/19A1 (PRF file) [04Sc0B] is used for the determination of the statistical model parameters.

The statistical approach is based on N. Bohr's hypothesis [36Bo0A] about the chaotic motion of the nucleons based on the role of the strong interaction between nucleons in contrast to the regular motion of the electrons in an atom. Different statistical formulas and the role of few-nucleon configurations deviating from the statistical approach were discussed in papers referenced in the Introductions to Volumes I/16BC and I/19A (see also [88Vo04, 88Gr20] and more recent work [03Ag02]). The study of the systematics in γ-transition probabilities B(E2) was reviewed by S. Raman [91Ra02]. Observations of deviations from predictions of the statistical model [86Mi27, 85Mi0A, 91Ro0A] and the study of the role of symmetries in the description of properties of nuclear levels become possible after one has obtained the parameters for states and after one has established the almost complete level schemes of many nuclei studied extensively via different reactions.

We include very accurate data obtained by the Nuclear Resonance Fluorescence method [02Ka25, 95Ju01, 94Go36, 90Zi05, 92Vo02, 96Zi02, 01An13, 04Sc36] in CRF. The study of the dynamics of reactions induced by ions with $5 \le Z \le 10$ [73De35, 75Se03, 75Se04], the study of α-transfer reactions [76Ma12, 98Oh0A] and the use of polarized beams to determine the total angular momentum transfer [04Gr26, 87Ci06, 83Ci01, 68Yu01, 71Ko21, 71Gr20, 78Ba13, 84Fr14] are partly reflected in CRF by inclusion of parameters A_{y} (Vector Analyzing Power parameter) and T_{20} (Tensor Analyzing Power parameter). We also include data obtained in a consistent analysis of proton pickup in the (d,τ) and (e,e′p) reactions [01Kr01].

The single particle motion in the nuclear mean field is another equally general approach. Shell-model calculations provide the general guideline for all nuclear effects. Among selected topics which deal with the theoretical description of spectroscopic information in a broad energy region up to tens of MeV, we should mention giant resonances – a clear picture of the collective motion of nucleons in the mean nuclear field. The role of giant resonances in nuclear astrophysics was discussed by K. Langanke [01La12]. The breathing mode (0^+) connected with isoscalar giant resonances and the compressibility of nuclear matter were considered in [99Bl10, 99Yo04, 00Ka22, 01Ga03, 96Bu45, 01Ga02]. Negative parity modes of nuclear excitations (with $J^\pi = 2^-, 0^-, 1^-$) were studied by N. Auerbach and others in [72Au03, 99Vo11, 99De23, 99Ga23, 00Is05].

The optical model for the description of particle strength functions is part of the single-particle shell model. Deriving spectroscopic factors from different nuclear reactions is discussed in [99Li45, 93Na10, 92Cl04, 75Se03, 75Se04, 89Bo18, 89Bo52, 78He15, 77He07]. A dependence of the form of the angular distribution of transfer reactions on the angular momentum transfer was found in [67Gl01]. Stretched two-nucleon configurations with (α,2^2He) reactions have been studied in [94Fi01, 94Vo01, 77De33]. Spectroscopic factors of Isobar Analog States (IAS) were derived in [61Fr12].

A second direction for refinement of the shell-model is the calculation of effects from residual nucleon interactions. Estimations of these effects were considered in many papers by R. Casten and others [88Ca0A, 94Ca18, 99Po23, 99Pi02, 87He09].

Recently much attention was paid to the vanishing of usual magic numbers, for example, the neutron number $N = 20$ [02Ut0A, 02Ot03, 01De55, 99Ta25]. The shell model is a natural way to explain magic numbers as a result of nucleon orbitals. One reason for the study of excitation spectra of nuclei situated far from the stability line is to get information about further development of the shell model calculations [84Ia0A, 88He0A].

The nucleon pairing effect is part of the residual interaction and was recently reviewed by V. Zelevinsky [03Ze05]. Representation of residual interaction in nuclear matter by bosons turned out to be very effective for the description of complexity in schemes of low-lying levels as a reflection of different symmetries. Recent reviews on local symmetries were given by F. Iachello [02Ia0A]. Phase transitions were used in [04He12] for an interpretation of nuclear spectroscopic information.

Recent advances in the study of nuclear clusters were reported in [95Wu0A] and in papers presented to the International Conferences on Clustering Aspects of Nuclear Structure [04Ik0A].

The high energy resolution achieved in measurements with charged particle accelerators (spread of several parts of keV and an absolute calibration within 1-2 keV) resulted in a great number of measured excited states. Information from high-resolution experiments permitted a direct estimation of level densities for certain spins and parities to check the statistical model and to study the applicability of different schemes of interactions represented by "effective bosons" which are used to represent the real interaction between nucleons.

Recently performed investigations about excited states of isotopes situated around the closed shells $Z, N = 20, 40, 50$ at the MP tandem accelerator of the University and Technical University of Munich are a good example for a complex high-resolution study of charged particle reaction data and data from thermal neutron capture for the same isotope (for example, for ^{168}Er in [96Ma50, 00Gr33]). Up to several hundreds of new levels were found in each of the isotopes investigated.

We include parameters found in recent investigations of near-magic isotopes, for example, tellurium isotopes which have two valence protons above the closed $Z = 50$ proton shell. The interested reader can get additional information for these nuclei in the Supplement. The great advantage of high-resolution data consists in the obtaining of spectroscopic factors for individual nuclear levels (given as relative values or in absolute representation).

Data on low-lying levels of the deformed nuclei with $Z = 66 - 76$ and $Z > 90$ were described in a systematic way in Vol. I/18 [01Sc0A, 02Sc0A, 03Sc0A] and in [03AlZX]. Spectra of highly excited states of deformed nuclei are too complicated and only some low-lying states of the deformed nuclei (not included in I/18) are presented in this Volume. Data on high-energy superdeformed excited states are compiled in specialized files [02Si26] and in the Nuclear Data Sheets. In Table 4 we give the number of rotational bands in odd-mass nuclei evaluated in the PNPI Nuclear Data Center [03AlZX]. Together with the detailed description of collective bands in the deformed nuclei given in the Introductions to Vol. I/18A,C, as well as in [02Si26], this information represents the theoretical description of all data contained in Vol. I/19A1,2 (PRF). The respective tables for heavy nuclei are given in the Subvolumes I/19B2,3.

Table 4 Number of rotational bands evaluated in the PNPI Nuclear Data Center for nuclei with $Z \leq 36$ [03AlZX].

^{A}Z	N	^{A}Z	N	^{A}Z	N	^{A}Z	N	^{A}Z	N	^{A}Z	N	^{A}Z	N
^{45}Sc	3	^{47}Sc	1	^{45}Ti	2	^{47}Ti	2	^{45}V	1	^{47}V	2	^{49}V	3
^{51}V	2	^{49}Cr	2	^{51}Cr	3	^{49}Mn	1	^{51}Mn	1	^{57}Fe	1	^{57}Ni	1
^{59}Ni	1	^{59}Cu	1	^{61}Zn	1	^{67}Ga	4	^{73}Ge	1	^{67}As	1	^{69}As	1
^{71}As	1	^{77}As	2	^{71}Se	2	^{73}Se	5	^{75}Se	3	^{77}Se	9	^{79}Se	3
^{71}Br	2	^{73}Br	2	^{75}Br	9	^{77}Br	5	^{79}Br	3	^{81}Br	3	^{75}Kr	4
^{77}Kr	2	^{79}Kr	8	^{81}Kr	6								

Data on excited states obtained in high-resolution measurements of transfer reactions are frequently combined with data from thermal neutron capture $\gamma\gamma$-measurements. Such data, as a result of collaboration between different laboratories, are usually only partly included in the Nuclear Data Sheets, but we give them in CRF. A very effective method to investigate nuclear excited states consists in the measurement of γ-spectra associated with $\gamma\gamma$-coincidences. This method was developed in Dubna by V. Khitrov, A. Sukhovoj and E. Vasilieva [84Po21, 91Bo43, 97Kh0B, 99VaZT, 99VaZU, 99Bo14]; see also works by groups from Prague and Riga [92Be33, 96Ho31, 02Bo41, 97Bo14].

The JINR-group studied the level density in many spherical and deformed nuclei [91Bo0A, 99Su03, 01Va11, 01Va36]. A comparison with data from the BNL-325 compilations by S. Mughabghab [81MuZQ, 84MuZY] and other estimates [73Di0A, 03Gu0A, 03Vo0A, 96Vo0A] permitted the conclusion about the existence of strong vibrational excitations in heavy nuclei frequently seen as equidistant maxima in γ-ray spectra and not predicted by the statistical model [93Va14]. For certain nuclei the information from the $\gamma\gamma$-cascade method is included in the Nuclear Data Sheets, but the largest part of the data is still waiting to be included in the compiled spectra of nuclear excitations.

An attempt to perform a joint analysis of all existing spectroscopic information including $\gamma\gamma$-data is described in [99Gr0A]. For the broad scope of nuclei investigated by the JINR-group (from cobalt [03Su36] to uranium), the obtained results [05Su0A, 98Kh14, 99BoZR, 99BoZT, 89Bo16] were used for a check of the existing level schemes. In the isotope tables, sum energies of γ-cascades are marked as $E_\gamma^1 + E_\gamma^2$ (see Table 3).

1.4 Conclusions

The information in this Volume I/19B1, in combination with the information in Volumes I/18ABC, and Volumes I/19B2 and I/19B3, provide all the available spectroscopic information on bound states. Adding the data on neutron and charged particle resonances contained in Volumes I/16B,C and I/19A1,2 (files NRF and PRF), and the data for unstable nuclei situated far from the line of stability, one can obtain a combined data-file on all available spectroscopic information except the structure of giant resonances. Such a Combined Nuclear Data File consists of all data included in Table 1.

1.5 Acknowledgments

We appreciate communications of data by Ivo Tomandl.

We thank Till von Egidy, L. Malov, and R. Jolos for friendly discussions, and A. Sukhovoj for remarks.

We are grateful to the PNPI scientific library staff headed by I. Spiridonova.

Programs for data handling and text preparation were developed by D. Sukhoruchkin.

We thank Makio Ohkubo for turning our attention to some inconsistencies in total excitation and resonance energies given for several nuclei in NRF (Vol. I/16C), which were corrected by the recent production of the Combined Nuclear Data File.

The work was facilitated by the existence of the international computer Nuclear Science References file and ENSDF-file (Nuclear Data Sheets), maintained in the National Nuclear Data Center (Brookhaven National Laboratory, USA).