Journal of Physical and Chemical Reference Data

Energy levels of nickel, Ni I through Ni XXVIII

Cite as: Journal of Physical and Chemical Reference Data **10**, 197 (1981); https://doi.org/10.1063/1.555638
Published Online: 15 October 2009

Charles Corliss, and Jack Sugar

Energy Levels of Nickel, Ni I through Ni XXVIII

Charles Corliss and Jack Sugar

National Measurement Laboratory, National Bureau of Standards, Washington, D.C. 20234

The energy levels of the nickel atom in all of its stages of ionization, as derived from the analyses of atomic spectra, have been critically compiled. In cases where only line classifications are reported in the literature, level values have been derived. Electron configurations, term designations, *J*-values, experimental *g*-values, and ionization energies are included.

Key Words: Atomic energy levels; atomic spectra; nickel energy levels.

Contents

Introduction

At the time of the compilation of atomic energy levels by Bacher and Goudsmit in 1932, only the first 2 of the 28 spectra of nickel had been studied. By 1952, Moore was able to compile levels for nine spectra of nickel. At that time, oxygen was the heaviest atom for which some levels of all stages of ionization were known. Today energy levels and ionization potentials are available for every stage of ionization of nickel. This is the result of the development of more energetic light sources, which was stimulated by the need to interpret new spectroscopic observations of the sun at short wavelengths from rocket and satellite-borne spectrographs. A new impetus for the interpretation of spectra of highly-ionized atoms has arisen from the investigation of hot laboratory plasmas generated to achieve nuclear fusion.

These activities have produced a substantial increase in spectroscopic information and have made the earlier compilations of energy levels inadequate. The NBS Atomic Energy Levels Data Center has undertaken the preparation new compilations of energy levels, the program at prese dealing with the elements through nickel (Z=28). T material on each atom and its ions is being published separately. The compilations for iron by Reader and Sugar (1975); calcium, chromium, scandium, and vanadium by Sugar and Corliss (1979, 1977, 1980, 1978); manganese, titanium, and potassium by Corliss and Sugar (1977, 1979a, 1979b); and aluminum and magnesium by Martin and Zalubas (1979, 1980) have been published. The present work will be followed by similar investigations of the energy levels of cobalt and sodium. Later it is planned to prepare a single volume including the separate papers on the elements potassium through nickel (Z=19–28).

The present compilation comprises the energy levels of the nickel atom and all of its ions, as derived from analyses of atomic spectra. Although generally we used only published papers as sources of data, unpublished data have been included when they constituted a substantial improvement over material in the literature. Where only classifications of observed lines are given, we have derived the level values.

Ionization energies found in the literature are usually given in eV or in cm^{-1}. The conversion factor

8065.479±0.021 cm^{-1}/eV, given by Cohen and Taylor (1973), is used here.

In a few cases where Rydberg series were available but the ionization energy was not derived, we carried out the calculation. For a large number of ions, no suitable series are known. In these cases we have quoted values obtained by Lotz (1967) by a method of successive differences along isoelectronic sequences. The uncertainty in these values is estimated to be 1 to 10 units in the last significant figure given.

Nearly all of the data are the result of observations of various types of laboratory light sources. However, they are sometimes supplemented by data obtained from solar observations. This is particularly true where spin-forbidden lines are needed to establish the absolute energy of a system of excited levels and also where parity-forbidden transitions between levels of a ground configuration are used to obtain accurate relative energies for the low levels. Whenever both solar data and equivalent laboratory data are available, preference is generally given to the laboratory measurements in order to avoid the problem of blended lines of various elements in the solar spectrum.

When no observations are available to connect independent systems of levels, an estimate of the connecting energy is frequently made. Those level values affected by the estimate are denoted by $+x$ following the value. The value of x is the systematic error of the estimate. For Ni XXVII and Ni XXVIII, which are isoelectronic with He I and H I, respectively, we give only calculated level values since they are more accurate than experimental x-ray wavelengths from which level values may be obtained.

For convenient general sources of wavelengths of nickel lines we refer the reader to the compilation by Kelly and Palumbo (1973) for wavelengths below 2000 Å, to the tables of spectral lines in the CRC Handbook of Chemistry and Physics (1979) and to Meggers, Corliss, and Scribner (1975).

We have included under the heading "Leading Percentages" the results of calculations that express the percentage composition of levels in terms of the basis states of a single configuration, or more than one configuration where configuration interaction has been included. Where these results contradict a designation derived from observation, and the calculation appears to be reliable, we have accepted the theoretical term-designation of a level to conform with its calculated leading percentage. In cases where the leading percentage is low, no designation is given.

In the columns of the present tables headed "Leading percentages" we give first the percentage of the basis state corresponding to the term name (when a designation is given); next the second largest percentage together with the related basis state. Sometimes the leading component in an alternative coupling scheme is given.

Of course, the percentage compositions cannot be considered to be as reliable as experimental quantities inasmuch as a new calculation based on a different approximation, such as the introduction of configuration interaction where none had been used before, might yield a different set of percentages. For some levels the percentages may change drastically in a new calculation. In the present tables, the percentages are taken mostly from published level-fitting calculations derived by least squares. When only *ab initio* calculations are found in the literature, we have used them if there appears to be a reasonable correspondence with the experimental data.

For configurations of equivalent d electrons, repeating terms of the same LS type may occur. These are theoretically distinguished by their seniority number. In the present compilation they are designated in the notation of Nielson and Koster (1963). For example, in the $3d^5$ configuration there are three ^{2}D terms with seniorities of 1, 3, and 5. These terms are denoted as ^{2}D1, ^{2}D2, and ^{2}D3, respectively, by Nielson and Koster. Martin, Zalubas, and Hagan (1978) give a complete summary of the coupling notations and conventions used here. The prefixing of terms by lower case letters (for example a ^{5}D, z ^{5}G, etc.) has been dropped except for Ni I, where their use in connection with various wavelength tables makes their retention desirable.

In assembling the data for each spectrum, we referred to the following bibliographies:

i. papers cited by Moore (1952)
ii. C. E. Moore (1969)
iii. L. Hagan and W. C. Martin (1972)
iv. L. Hagan (1977)
v. card file of publications since June 1975 maintained by the NBS Atomic Energy Levels Data Center.

A selection of data was made that, in our judgment, represents the most accurate and reliable available. The text for each ion is not always a complete review of the literature but includes the major contributions. This compilation is derived from all material available to us as of October 1979.

Acknowledgments

Throughout this work we have made extensive use of the bibliographical files and reprint collection maintained in the Atomic Energy Levels Data Center by R. Zalubas and A. Albright. Our thanks are extended to them for generous cooperation. The compilation has also benefited greatly from the preprints that were provided by many of our colleagues.

We thank W. C. Martin for a critical reading of the manuscript.

This work was partially supported by the U.S. Department of Energy, Division of Magnetic Fusion Energy, and the National Aeronautics and Space Administration, Astrophysics Division.

References for Introduction

Bacher, R. F., and Goudsmit, S. (1932), Atomic Energy States, (McGraw-Hill Book Co., N.Y.).

Cohen, E. R., and Taylor, B. N. (1973), J. Phys. Chem. Ref. Data **2**, 663.

Corliss, C., and Sugar, J. (1977), Energy Levels of Manganese, Mn I through Mn XXV, J. Phys. Chem. Ref. Data **6**, 1253.

Corliss, C., and Sugar, J. (1979a), Energy Levels of Titanium, Ti I through Ti XXII, J. Phys. Chem. Ref. Data **8**, 1.

Corliss, C., and Sugar, J. (1979b), Energy Levels of Potassium, K I through K XIX, J. Phys. Chem. Ref. Data **8**, 1109.

CRC Handbook of Chemistry and Physics (1979), p.E-217, Line Spectra of the Elements, Ed. by J. Reader and C. H. Corliss (CRC Press, Inc., Boca Raton, Fla.)

Hagan, L. (1977), Bibliography on Atomic Energy Levels and Spectra, July 1971 through June 1975, Nat. Bur. Stand. (U.S.) Spec. Publ. 363, Suppl. 1 (U.S. Gov't Printing Office, Washington, D.C.).

Hagan, L., and Martin, W. C. (1972), Bibliography on Atomic Energy Levels and Spectra, July 1968 through June 1971, Nat. Bur. Stand. (U.S.) Spec. Publ. 363 (U.S. Gov't Printing Office, Washington, D.C.).

Kelly, R. L., and Palumbo, L. J. (1973), Atomic and Ionic Emission Lines Below 2000 Angstroms—Hydrogen Through Krypton, NRL Report 7599 (U.S. Gov't Printing Office, Washington, D.C.).

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Martin, W. C., and Zalubas, R. (1979), Energy Levels of Aluminum, Al I through Al XIII, J. Phys. Chem. Ref. Data **8**, 817.

Martin, W. C., Zalubas, R., and Hagan, L. (1978), Atomic Energy Levels—The Rare Earth Elements, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 60.

Martin, W. C., and Zalubas, R. (1980), Energy Levels of Magnesium, Mg I through Mg XII, J. Phys. Chem. Ref. Data **9**, 1.

Meggers, W. F., Corliss, C. H., and Scribner, B. F. (1975), Nat. Bur. Stand. Monogr. 145.

Moore, C. E. (1952), Atomic Energy Levels, Nat. Bur. Stand. (U.S.) Circ. 467, Vol. II (reissued as Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 35).

Moore, C. E. (1969), Bibliography on the Analysis of Optical Atomic Spectra, Section 2, Nat. Bur. Stand. (U.S.), Spec. Publ. 306-2 (U.S. Gov't Printing Office, Washington, D.C.).

Nielson, C. W., and Koster, G. F., Spectroscopic Coefficients for the p^n, d^n, and f^n Configurations, 275 pp. (M.I.T. Press, Cambridge, Mass., 1963).

Reader, J., and Sugar, J. (1975), Energy Levels of Iron, Fe I through Fe XXVI, J. Phys. Chem. Ref. Data **4**, 353.

Sugar, J., and Corliss, C. (1977), Energy Levels of Chromium, Cr I through Cr XXIV, J. Phys. Chem. Ref. Data **6**, 317.

Sugar, J., and Corliss, C. (1978), Energy Levels of Vanadium, V I through V XXIII, J. Phys. Chem. Ref. Data **7**, 1191.

Sugar, J., and Corliss, C. (1979), Energy Levels of Calcium, Ca I through Ca XX, J. Phys. Chem. Ref. Data **8**, 865.

Sugar, J., and Corliss, C. (1980), Energy Levels of Scandium, Sc I through Sc XXI, J. Phys. Chem. Ref. Data **9**, 473.

Energy Level Tables

Ni I

$Z=28$

Ground state: $1s^22s^22p^63s^23p^63d^84s^2\ ^3F_4$

Ionization energy = 61 600±10 cm^{-1} (7.6375±0.0012 eV)

The analysis of this spectrum is by Russell (1929), with a few changes of interpretation taken from recent theoretical studies. No energy levels have been found since his work 50 years ago. He outlined the previous work in his paper and increased the number of classified lines from 622 to 1071. His line list extends from 1963 to 18 040 Å.

The spectrum was reobserved by Burns and Sullivan (1947, 1948) from a vacuum arc with a Fabry-Perot interferometer. Three decimal place wavelengths were measured from 2173 to 8968 Å. From these they derived the three decimal place energy levels. Except for 10 level values retained from Russell, their values are given here. In the course of their work they measured about 400 lines not previously observed.

The five place g-values from the three lowest terms are from Childs, Fred, and Goodman (1966), Childs and Goodman (1968), and Childs and Greenebaum (1972). The three place g-values are from measurements of M.I.T. Zeeman patterns reported by Lindsley (1942). The remaining (two place) values are from Marvin and Baragar (1933) or Dijkstra (1937).

The composition of the levels of $3d^84s^2$ and $3d^94s$ was calculated with configuration interaction by Childs, Fred, and Goodman.

All of the known odd levels arise from the configurations $3d^94p$, $3d^84s4p$, and $3d^95p$. Roth (1970) calculated the composition of the levels of these configurations. His identifications and compositions are given here for all the odd terms. Of the 35 odd terms given here, 18 are unchanged from Russell's paper and 17 are from Roth. The original letter prefixes have been retained for older designations.

The ionization energy was determined from the three member $3d^9ns$ series by means of a Ritz formula giving the value 61 579 cm^{-1}. We have added a correction of 21 cm^{-1} obtained from comparison with a corresponding longer ns-series in Cu I.

References

Burns, K., and Sullivan, F. (1947), Science Studies St. Bonaventure College **13**, No. 3; (1948), ibid. **14**, No 3.
Childs, W. J., Fred, M., and Goodman, L. S. (1966), Phys. Rev. **141**, 44.
Childs, W. J., and Goodman, L. S. (1968), Phys. Rev. **170**, 136.
Childs, W. J., and Greenebaum, B. (1972), Phys. Rev. **6A**, 105.
Dijkstra, H. (1937), Physica IV, 81.
Lindsley, C. H. (1942), J. Opt. Soc. Am. **32**, 94.
Marvin, H. H., and Baragar, A. E. (1933), Phys. Rev. **43**, 973.
Roth, C. (1970), J. Res. Nat. Bur. Stand. **74A**, 715.
Russell, H. N. (1929), Phys. Rev. **34**, 821.

Ni I

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^8\,4s^2$	$a\ ^3F$	4	0.000	1.24965			
		3	1 332.153	1.08280			
		2	2 216.519	0.66956	95	1	^1D
$3d^9(^2D)4s$	$a\ ^3D$	3	204.786	1.33354			
		2	879.813	1.15105	91	9	^1D
		1	1 713.080	0.49804			
$3d^9(^2D)4s$	$a\ ^1D$	2	3 409.925	1.01297	89	9	^3D
$3d^8\,4s^2$	$b\ ^1D$	2	13 521.352	1,143	70	26	^3P
$3d^{10}$	$a\ ^1S$	0	14 728.847				
$3d^8\,4s^2$	$a\ ^3P$	2	15 609.861	1.356	71	25	^1D
		1	15 734.018	1.497			
		0	16 017.317				
$3d^8\,4s^2$	$a\ ^1G$	4	22 102.349	0.99			

Ni I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^8(^3F)4s4p(^3P^\circ)$	$z\ ^5D^\circ$	4	25 753.578	1.51	96			
		3	26 665.903	1.495	94			
		2	27 414.893	1.494	94			
		1	27 943.543	1.486	95			
		0	28 212.997		96			
$3d^8(^3F)4s4p(^3P^\circ)$	$z\ ^5G^\circ$	6	27 260.891	1.32	100			
		5	27 580.411	1.276	88		10	$^5F^\circ$
		4	28 068.091	1.171	87		8	$^5F^\circ$
		3	28 578.046	0.945	90		6	$^5F^\circ$
		2	29 013.228	0.364	96			
$3d^8(^3F)4s4p(^3P^\circ)$	$z\ ^5F^\circ$	5	28 542.113	1.377	90		8	$3d^8(^3F)4s4p(^3P^\circ)\ ^5G^\circ$
		4	29 084.478	1.288	76		9	$3d^9(^2D)4p\ ^3F^\circ$
		3	29 832.810	1.208	84		5	$3d^8(^3F)4s4p(^3P^\circ)\ ^5G^\circ$
		2	30 163.140	0.985	72		9	$3d^9(^2D)4p\ ^3D^\circ$
		1	30 392.052	0.006	97			
$3d^9(^2D)4p$	$z\ ^3P^\circ$	2	28 569.210	1.485	91		4	$3d^9(^2D)4p\ ^3D^\circ$
		1	29 500.690	1.426	87		5	
		0	30 192.268		96			
$3d^9(^2D)4p$	$z\ ^3F^\circ$	3	29 320.782	1.086	48		27	$3d^9(^2D)4p\ ^1F^\circ$
		4	29 481.020	1.287	79		12	$3d^8(^3F)4s4p(^3P^\circ)\ ^5F^\circ$
		2	30 619.440	0.740	72		10	$3d^8(^3F)4s4p(^3P^\circ)\ ^3F^\circ$
$3d^9(^2D)4p$	$z\ ^3D^\circ$	3	29 668.918	1.300	59		24	$3d^8(^3F)4s4p(^3P^\circ)\ ^3D^\circ$
		1	30 912.838	0.552	59		30	
$3d^8(^3F)4s4p(^3P^\circ)$		2	29 888.505	1.044	28	$^3D^\circ$	22	$3d^8(^3F)4s4p(^3P^\circ)\ ^5F^\circ$
$3d^8(^3F)4s4p(^3P^\circ)$	$z\ ^3G^\circ$	5	30 922.763	1.214	96			
		4	30 979.789	1.052	91			
		3	31 786.210	0.761	95			
$3d^9(^2D)4p$	$z\ ^1F^\circ$	3	31 031.042	1.048	52		34	$3d^9(^2D)4p\ ^3F^\circ$
$3d^9(^2D)4p$	$z\ ^1D^\circ$	2	31 441.665	1.060	61		17	$3d^9(^2D)4p\ ^3D^\circ$
$3d^8(^3F)4s4p(^3P^\circ)$	$^3F^\circ$	4	32 973.414	1.222	86			
		3	33 112.368	1.193	43		29	$3d^8(^3F)4s4p(^3P^\circ)\ ^3D^\circ$
		2	34 163.294	0.859	49		35	$3d^8(^3F)4s4p(^3P^\circ)\ ^3D^\circ$
$3d^9(^2D)4p$	$z\ ^1P^\circ$	1	32 982.280	1.005	95			
$3d^8(^3F)4s4p(^3P^\circ)$	$^3D^\circ$	3	33 500.854	1.198	45		32	$3d^8(^3F)4s4p(^3P^\circ)\ ^3F^\circ$
		1	34 408.574	0.511	69		27	$3d^9(^2D)4p\ ^3D^\circ$
$3d^8(^3F)4s4p(^3P^\circ)$	$z\ ^1G^\circ$	4	33 590.159	1.035	72		13	$3d^8(^3F)4s4p(^1P^\circ)\ ^3G^\circ$
$3d^8(^3F)4s4p(^3P^\circ)$		2	33 610.916	0.973	39	$^3F^\circ$	31	$3d^8(^3F)4s4p(^3P^\circ)\ ^3D^\circ$
$3d^8(^3F)4s4p(^3P^\circ)$	$y\ ^1F^\circ$	3	35 639.148	1.013	84		10	$3d^8(^3F)4s4p(^3P^\circ)\ ^3F^\circ$
$3d^8(^3F)4s4p(^3P^\circ)$	$y\ ^1D^\circ$	2	36 600.805	1.013	82		8	$3d^9(^2D)4p\ ^1D^\circ$

Ni I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^8(^3P)4s4p(^3P^\circ)$	$^5P^\circ$	3	*40 361.254*		90		8	$3d^8(^1D)4s4p(^3P^\circ)\ ^3D^\circ$
		2	*40 484.282*		92			
$3d^8(^1D)4s4p(^3P^\circ)$	$^3F^\circ$	4	*42 585.296*	1.346	53		39	$3d^8(^3P)4s4p(^3P^\circ)\ ^5D^\circ$
		3	*42 767.900*	1.218	66		20	
		2	*42 954.234*	0.840	80		4	
$3d^9(^2D)5s$	$e\ ^3D$	3	42 605.964	1.34				
		2	42 790.027	1.085				
		1	44 112.192					
$3d^8(^1D)4s4p(^3P^\circ)$	$^3D^\circ$	3	*42 621.048*		41		39	$3d^8(^3F)4s4p(^1P^\circ)\ ^3D^\circ$
		2	*42 653.723*		68		12	
		1	*42 656.317*	1.320	75		10	
$3d^8(^3F)4s4p(^1P^\circ)$	$^3G^\circ$	5	*43 089.636*	1.226	100			
		4	*44 314.980*	1.182	72		24	$3d^8(^3F)4s4p(^1P^\circ)\ ^3F^\circ$
		3	*44 565.10*	1.044	91			
$3d^8(^3F)4s4p(^1P^\circ)$	$^3F^\circ$	4	*43 258.792*	1.247	36		30	$3d^8(^1D)4s4p(^3P^\circ)\ ^3F^\circ$
		3	*45 281.152*	0.779	77			
		2	*45 418.858*	0.677	86			
$3d^8(^1D)4s4p(^3P^\circ)$	$^3P^\circ$	1	*43 464.019*	1.390	59		23	$3d^8(^3P)4s4p(^3P^\circ)\ ^3P^\circ$
		2	*43 933.428*	1.476	44		27	$3d^8(^3P)4s4p(^3P^\circ)\ ^5D^\circ$
$3d^8(^3F)4s4p(^1P^\circ)$	$^3D^\circ$	3	*43 654.974*	1.243	34		29	$3d^8(^1D)4s4p(^3P^\circ)\ ^3D^\circ$
		2	*44 475.158*	1.155	56		15	$3d^8(^1D)4s4p(^3P^\circ)\ ^3D^\circ$
		1	*45 122.460*	0.566	67		11	$3d^8(^3P)4s4p(^3P^\circ)\ ^3D^\circ$
$3d^8(^3P)4s4p(^3P^\circ)$	$^5D^\circ$	3	*44 206.185*		58		17	$3d^8(^1D)4s4p(^3P^\circ)\ ^3D^\circ$
$3d^9(^2D)5s$	$e\ ^1D$	2	44 262.619	1.09				
$3d^8(^3P)4s4p(^3P^\circ)$		4	*44 336.10*		34	$^3F^\circ$	30	$3d^8(^3F)4s4p(^1P^\circ)\ ^3F^\circ$
$3d^8(^3P)4s4p(^3P^\circ)$	$x\ ^3P^\circ$	2	*46 522.965*		59		18	$3d^8(^3P)4s4p(^3P^\circ)\ ^5S^\circ$
		1	*47 208.228*		47		19	$3d^8(^3P)4s4p(^3P^\circ)\ ^3D^\circ$
		0	*47 686.625*		63		30	$3d^8(^1D)4s4p(^3P^\circ)\ ^3P^\circ$
$3d^8(^3P)4s4p(^3P^\circ)$	$v\ ^3D^\circ$	3	*47 030.148*	1.331	90			
		2	*47 139.392*	1.209	81			
		1	*47 424.830*	0.726	66		14	$3d^8(^3P)4s4p(^3P^\circ)\ ^3P^\circ$
$3d^8(^3P)4s4p(^3P^\circ)$	$^5S^\circ$	2	*47 328.85*		76		9	$3d^8(^3P)4s4p(^3P^\circ)\ ^3P^\circ$
$3d^8\,4s(^4F)5s$	$e\ ^5F$	5	48 466.530	1.40				
		4	49 086.030	1.33				
		3	49 777.619	1.23				
		2	50 346.477	0.95				
		1	50 744.593	0.20				
$3d^9(^2D)5p$	$^1F^\circ$	3	*48 671.9*		56		35	$3d^9(^2D)5p\ ^3F^\circ$
$3d^9(^2D)5p$	$^3F^\circ$	4	*48 715.2*		84		13	$3d^8(^1G)4s4p(^3P^\circ)\ ^3F^\circ$
		2	*50 039.18*		57		30	$3d^8(^1G)4s4p(^3P^\circ)\ ^3F^\circ$

Ni I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^9(^2D)5p$	$w\ ^3P^\circ$	2	*48 735.308*		65		19	$3d^9(^2D)5p\ ^1D^\circ$
		1	*49 403.42*		62		22	$3d^9(^2D)5p\ ^1P^\circ$
		0	*50 138.53*		91		8	$3d^8(^3P)4s4p(^3P^\circ)\ ^3P^\circ$
$3d^8(^3P)4s4p(^3P^\circ)$	$^1P^\circ$	1	*48 817.6*		83		6	$3d^9(^2D)5p\ ^1P^\circ$
$3d^9(^2D)4d$	$e\ ^3S$	1	48 953.344	1.92				
$3d^8(^3P)4s4p(^3P^\circ)$	$^1D^\circ$	2	*49 032.589*		75		11	$3d^9(^2D)5p\ ^1D^\circ$
$3d^9(^2D)4d$	$e\ ^3G$	5	49 158.529	1.20				
		4	49 174.811	1.05				
		3	50 677.599	0.77				
$3d^9(^2D)4d$	$e\ ^3P$	2	49 159.060	1.43				
		1	49 171.187	1.00				
		0	50 276.354					
$3d^9(^2D)5p$	$^1D^\circ$	2	*49 185.146*		47		17	$3d^9(^2D)5p\ ^3P^\circ$
$3d^9(^2D)4d$	$f\ ^3D$	3	49 271.578	1.32				
		2	49 327.845					
		1	50 716.927	0.45				
$3d^9(^2D)4d$	$e\ ^3F$	3	49 313.851					
		4	49 332.643					
		2	50 834.435					
$3d^9(^2D)5p$	$^3D^\circ$	3	*49 327.56*		59		14	$3d^9(^2D)5p\ ^1F^\circ$
		2	*50 689.490*		69		11	$3d^9(^2D)5p\ ^1D^\circ$
		1	*50 851.22*		80		10	$3d^8(^3F)4s4p(^1P^\circ)\ ^3D^\circ$
$3d^9(^2D)5p$		3	*50 142.8*		24	$^3D^\circ$	23	$3d^9(^2D)5p\ ^3F^\circ$
$3d^9(^2D)5p$	$x\ ^1P^\circ$	1	*50 458.187*		64		26	$3d^9(^2D)5p\ ^3P^\circ$
$3d^8\,4s(^4F)5s$	$f\ ^3F$	4	50 466.172	1.27				
		3	51 306.085	1.08				
		2	52 040.568	0.67				
$3d^9(^2D)4d$	$e\ ^1P$	1	50 536.742	1.54				
$3d^9(^2D)4d$	$e\ ^1G$	4	50 706.310	1.02				
$3d^9(^2D)4d$	$f\ ^1D$	2	50 754.137					
$3d^8(^1G)4s4p(^3P^\circ)$	$u\ ^3F^\circ$	4	*50 789.5*		81		12	$3d^9(^2D)5p\ ^3F^\circ$
		3	*51 124.8*		61		27	
		2	*51 343.80*		57		32	
$3d^9(^2D)4d$	$e\ ^1F$	3	50 832.039					
$3d^8\,4s^2$	$e\ ^1S$	0	51 457.285					
$3d^9(^2D)6s$	$g\ ^3D$	3	52 197.482					
		2	52 271.716					
		1	53 703.899					

Ni I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^9(^2D)6s$	$g\ ^1D$	2	53 754.036		
$3d^8 4s(^2F)5s$	$g\ ^3F$	4	54 237.136	1.27	
		3	54 251.353	1.00	
		2	55 873.78		
$3d^9(^2D)5d$	$f\ ^3S$	1	54 574.64		
$3d^9(^2D)5d$	$f\ ^3G$	5	54 659.759		
		4	54 667.928	1.03	
		3	56 172.704		
$3d^9(^2D)5d$	$h\ ^3D$	3	54 699.852		
		2	54 732.425		
$3d^9(^2D)5d$	$h\ ^3F$	4	54 761.346		
		3	54 772.940		
		2	56 274.516		
$3d^8 4s(^2F)5s$	$f\ ^1F$	3	55 576.905	1.07	
$3d^9(^2D)5d$	$f\ ^1G$	4	56 183.51		
$3d^9(^2D)5d$	$g\ ^1F$	3	56 262.92		
$3d^8 4s(^4F)4d$	$e\ ^3H$	6	56 624.668		
		5	57 677.649		
		4	58 518.11		
$3d^8 4s(^4F)4d$	$f\ ^3P$	2	56 710.889		
		1	57 767.83		
		0	58 448.79		
$3d^8 4s(^4F)4d$	$i\ ^3F$	4	56 766.523		
		3	57 968.08		
		2	58 629.84		
$3d^8 4s(^4F)4d$	$g\ ^3G$	5	56 801.654		
		4	57 789.611		
		3	58 530.35		
$3d^8 4s(^4F)4d$	$e\ ^5P$	3	56 821.553		
		2	57 586.7		
		1	58 525.507		
$3d^8 4s(^4F)4d$	$e\ ^5D$	4	56 857.933		
		3	57 743.596		
$3d^8 4s(^4F)4d$	$e\ ^5H$	7	56 885.249	1.26	
		6	57 762.106		
		5	58 520.923		
		4	59 039.693		
		3	59 188.78		
$3d^8 4s(^4F)4d$	$e\ ^5G$	6	56 954.167		
		5	57 829.405		
		3	58 629.55		
		4	58 872.31		
		2	59 118.06		

Ni I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^8 4s(^4F)4d$	$f\ ^5F$	5	56 973.707		
		4	57 810.494		
		3	58 588.168		
		2	58 992.52		
		1	59 226.03		
$3d^8 4s(^4F)4d$	$i\ ^3D$	3	57 103.946		
$3d^8 4s(^4F)6s$	$g\ ^5F$	5	59 862.756		
Ni II ($^2D_{5/2}$)	***Limit***		**61 600**		
$3d^8 4s(^2F)4d$	$j\ ^3F$	4	61 832.47		
$3d^8 4s(^2F)4d$	$h\ ^3G$	5	61 843.28		
$3d^8 4s(^2F)4d$	$f\ ^3H$	6	61 957.517		
$3d^8 4s(^4F)5d$	$f\ ^5H$	7	62 782.614		
$3d^8 4s(^4F)5d$	$f\ ^5G$	6	62 808.03		
$3d^8 4s(^4F)5d$	$h\ ^5F$	5	62 815.34		

Ni II

$Z=28$

Co I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9\ ^2D_{5/2}$

Ionization energy = 146 541.56±0.2 cm^{-1} (18.16898±0.00005 eV)

This compilation is based on the very extensive analysis of Shenstone (1970, 1971) with recent unpublished additions to $4d^8 5g$. He has observed 4300 lines between 700 and 10 000 Å with the hollow cathode and has established 320 even and 336 odd levels. The low configurations $3d^8 4s$ and $3d^7 4s^2$ are nearly complete. Long series in $3d^8 ns$, nd, nf, and ng were observed. About half of the levels of the complex configuration $3d^7 4s4p$ are known.

The Zeeman effect data are from observations at M.I.T. reported by Lindsley (1942).

The leading percentages given here for the levels of $3d^8 4p$ were calculated by Roth (1969). Those for $3d^8 5p$ and $3d^7 4s4p$ are from Shadmi and Caspi (1972). These authors give percentages only for cases where the coupling is not pure. Repeating terms of the $3d^7$ parent configuration are distinguished by alphabetic prefixes. In these cases the percentage includes the sum over all contributing seniority states.

We have calculated the compositions of $3d^8 4s$, $5s$, $4d$, $5d$, $4f$, $5f$, $6f$, $5g$, $6g$ and $3d^7 4s^2$ and give the leading percentages.

Shenstone found the limits of the $3d^8 ns$ and nd series at 146 532.0 cm^{-1} and of the ng series at 146 541.56 cm^{-1}. He has adopted the latter limit, which is used here.

References

Lindsley, C. H. (1942), J. Opt. Soc. Am. **32**, 387.
Roth, C. (1969), J. Res. Nat. Bur. Stand. **73A**, 125.
Shadmi, Y., and Caspi, E. (1972), J. Res. Nat. Bur. Stand. **76A**, 125.
Shenstone, A. G. (1970), J. Res. Nat. Bur. Stand. **74A**, 801.
Shenstone, A. G. (1971), J. Res. Nat. Bur. Stand. **75A**, 335.

Ni II

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^9$	^{2}D	5/2	0.00				
		3/2	1 506.94				
$3d^8(^3F)4s$	^{4}F	9/2	8 393.90	1.355	100		
		7/2	9 330.04	1.244	98	2	(^{3}F) ^{2}F
		5/2	10 115.66	1.023	99	1	(^{3}F) ^{2}F
		3/2	10 663.89	0.397	99	1	(^{1}D) ^{2}D
$3d^8(^3F)4s$	^{2}F	7/2	13 550.39	1.141	98	2	(^{3}F) ^{4}F
		5/2	14 995.57	0.866	98	1	(^{1}D) ^{2}D
$3d^8(^3P)4s$	^{4}P	5/2	23 108.28	1.428	54	46	(^{1}D) ^{2}D
		3/2	24 788.20		78	22	
		1/2	24 835.93	2.667	100		
$3d^8(^1D)4s$	^{2}D	3/2	23 796.18	1.045	75	22	(^{3}P) ^{4}P
		5/2	25 036.38	1.368	53	46	
$3d^8(^3P)4s$	^{2}P	3/2	29 070.93	1.322	97	3	(^{1}D) ^{2}D
		1/2	29 593.46	0.670	100		
$3d^8(^1G)4s$	^{2}G	9/2	32 499.53	1.135	100		
		7/2	32 523.54	0.895	100		
$3d^7 4s^2$	^{4}F	9/2	51 045.46		100		
		7/2	52 205.95		100		
		5/2	53 037.93		100		
		3/2	53 601.19		100		

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^8(^3F)4p$	$^4D°$	7/2	*51 557.85*	1.420	94		
		5/2	*52 738.45*	1.365	93		
		3/2	*53 634.62*	1.186	94	4	$(^3P)\ ^4D°$
		1/2	*54 176.26*	-0.005	96		
$3d^8(^3F)4p$	$^4G°$	9/2	*53 365.17*	1.156	67	23	$(^3F)\ ^2G°$
		11/2	*53 496.49*	1.305	100		
		7/2	*54 262.63*	1.025	81	10	$(^3F)\ ^4F°$
		5/2	*55 018.71*	0.616	94	5	$(^3F)\ ^4F°$
$3d^8(^3F)4p$	$^4F°$	9/2	*54 557.05*	1.26	80	19	$(^3F)\ ^2G°$
		7/2	*55 417.83*	1.184	76	10	$(^3F)\ ^2F°$
		5/2	*56 075.26*	0.985	87	6	$(^3F)\ ^4G°$
		3/2	*56 424.49*	0.412	95		
$3d^8(^3F)4p$	$^2G°$	9/2	*55 299.65*	1.152	58	32	$(^3F)\ ^4G°$
		7/2	*56 371.41*	0.940	84	8	$(^3F)\ ^4G°$
$3d^8(^3F)4p$	$^2F°$	7/2	*57 080.55*	1.154	81	11	$(^3F)\ ^4F°$
		5/2	*58 493.21*	0.946	74	20	$(^3F)\ ^2D°$
$3d^8(^3F)4p$	$^2D°$	5/2	*57 420.16*	1.116	74	20	$(^3F)\ ^2F°$
		3/2	*58 705.95*	0.795	89	7	$(^1D)\ ^2D°$
$3d^8(^3P)4p$	$^4P°$	5/2	*66 571.34*	1.48	73	20	$(^1D)\ ^2D°$
		3/2	*66 579.71*	1.550	73	12	$(^1D)\ ^2P°$
		1/2	*67 031.02*	2.331	85	11	$(^1D)\ ^2P°$
$3d^8(^1D)4p$	$^2F°$	5/2	*67 694.64*	0.960	84	8	$(^3P)\ ^4P°$
		7/2	*68 131.21*	1.200	86	9	$(^3P)\ ^4D°$
$3d^7\,4s^2$	^4P	5/2	67 880.16		100		
		3/2	68 156.57		94	6	^2P
		1/2	68 709.76		98	2	
$3d^8(^1D)4p$	$^2D°$	3/2	*68 154.31*	1.02	65	18	$(^3P)\ ^4P°$
		5/2	*68 735.98*	1.264	74	19	$(^3P)\ ^4P°$
$3d^8(^1D)4p$	$^2P°$	1/2	*68 281.62*	1.008	61	23	$(^3P)\ ^2P°$
		3/2	*68 965.65*	1.305	64	15	$(^1D)\ ^2D°$
$3d^7\,4s^2$	^2G	9/2	70 358.94		97	3	^2H
		7/2	71 457.74		100		
$3d^8(^3P)4p$	$^4D°$	5/2	*70 635.46*	1.325	83	9	$(^3P)\ ^2D°$
		3/2	*70 706.77*	1.190	91	4	$(^3F)\ ^4D°$
		1/2	*70 748.70*		95	4	$(^3F)\ ^4D°$
		7/2	*70 778.12*	1.385	87	9	$(^1D)\ ^2F°$
$3d^8(^3P)4p$	$^2D°$	5/2	*71 770.83*	1.240	87	10	$(^3P)\ ^4D°$
		3/2	*72 375.42*	0.844	82	11	$(^3P)\ ^2P°$
$3d^8(^3P)4p$	$^2P°$	3/2	*72 985.65*	1.326	67	16	$(^1D)\ ^2P°$
		1/2	*73 903.25*	1.039	70	24	$(^1D)\ ^2P°$
$3d^7\,4s^2$	^2P	3/2	73 893.73		85	8	$^2D2$

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^8(^3P)4p$	$^2S^\circ$	1/2	*74 283.33*		94	4	$(^1D)\ ^2P^\circ$
$3d^8(^3P)4p$	$^4S^\circ$	3/2	*74 300.93*		97		
$3d^8(^1G)4p$	$^2H^\circ$	9/2	*75 149.48*	0.903	100		
		11/2	*75 721.68*	1.119	100		
$3d^8(^1G)4p$	$^2F^\circ$	7/2	*75 917.63*	1.165	94	4	$(^1D)\ ^2F^\circ$
		5/2	*76 402.03*		95		
$3d^7\ 4s^2$	^2H	11/2	76 727.36		100		
		9/2	77 736.79		97	3	^2G
$3d^7\ 4s^2$	$^2D2$	5/2	77 332.47		77	23	$^2D1$
		3/2	78 955.45		72	18	
$3d^8(^1G)4p$	$^2G^\circ$	7/2	*79 823.03*		99		
		9/2	*79 923.88*		100		
$3d^7(^4F)4s4p(^3P^\circ)$	$^6F^\circ$	11/2	*86 343.21*				
		9/2	*86 870.03*				
		7/2	*87 538.09*				
		5/2	*88 128.56*				
		3/2	*88 582.01*				
		1/2	*88 881.59*				
$3d^7(^4F)4s4p(^3P^\circ)$	$^6D^\circ$	9/2	*88 171.88*				
		7/2	*89 100.49*				
$3d^7(^4F)4s4p(^3P^\circ)$	$^6G^\circ$	11/2	*89 460.35*				
		9/2	*89 918.47*				
		7/2	*90 275.30*				
		5/2	*90 526.18?*				
$3d^8(^3F)5s$	^4F	9/2	91 800.05	1.350	100		
		7/2	92 325.85	1.188	61	39	$(^3F)\ ^2F$
		5/2	93 390.06	1.02	88	12	$(^3F)\ ^2F$
		3/2	94 067.14	0.392	99	1	$(^1D)\ ^2D$
$3d^7\ 4s^2$	^2F	5/2	92 373.45		100		
		7/2	92 792.08		100		
$3d^8(^3F)5s$	^2F	7/2	93 528.44	1.166	61	39	^4F
		5/2	94 729.25	0.865	87	12	
$3d^7(^4F)4s4p(^3P^\circ)$	$^4F^\circ$	9/2	*94 283.94*				
		7/2	*94 705.93*				
		5/2	*95 332.53*				
		3/2	*95 893.76*				
$3d^7(^4F)4s4p(^3P^\circ)$	$^4G^\circ$	11/2	*94 396.74*				
		9/2	*95 017.71*				
		7/2	*95 573.39*				
		5/2	*96 052.48*				
$3d^7(^4F)4s4p(^3P^\circ)$	$^4D^\circ$	7/2	*96 535.87*				
		5/2	*97 273.83*				
		3/2	*97 799.66*				
		1/2	*98 122.63*				

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^7(^4F)4s4p(^3P^\circ)$	$^2G^\circ$	9/2	*98 276.70*					
		7/2	*99 844.13*					
$3d^8(^3F)4d$	^4D	7/2	98 467.25		90		7	$(^3F)\ ^4F$
		5/2	99 559.33		42		39	$(^3F)\ ^4P$
		1/2	100 010.17		69		16	$(^3F)\ ^4P$
		3/2	100 078.78		49		45	$(^3F)\ ^2P$
$3d^8(^3F)4d$	^4P	5/2	98 561.22		57		40	$(^3P)\ ^4D$
		1/2	100 845.41		66		26	$(^3F)\ ^4D$
		3/2	100 490.95		73		12	$(^3F)\ ^4D$
$3d^8(^3F)4d$	^4H	13/2	98 822.55		100			
		11/2	100 309.29		54		32	$(^3F)\ ^2H$
		9/2	100 332.09		52		22	$(^3F)\ ^2H$
		7/2	101 144.63		62		28	$(^3F)\ ^4G$
$3d^8(^3F)4d$	^2H	11/2	98 969.44		47		45	$(^3F)\ ^4H$
		9/2	101 357.20		55		19	
$3d^8(^3F)4d$	^2P	3/2	99 040.75		44		29	$(^3F)\ ^4D$
		1/2	101 246.16		77		18	$(^3F)\ ^4P$
$3d^8(^3F)4d$	^4G	11/2	99 132.78		78		21	$(^3F)\ ^2H$
		5/2	101 366.14		68		28	$(^3F)\ ^4F$
$3d^8(^3F)4d$	^4F	9/2	99 154.81		63		31	$(^3F)\ ^4G$
		7/2	100 592.98		40		27	$(^3F)\ ^4H$
		3/2	101 258.01		89		8	$(^3F)\ ^4D$
$3d^8(^3F)4d$	^2F	7/2	99 340.55		58		23	$(^3F)\ ^4F$
		5/2	101 247.37		47		31	
$3d^7(^4F)4s4p(^3P^\circ)$	$^2F^\circ$	7/2	*99 418.61*					
		5/2	*100 609.01*					
$3d^8(^3F)4d$	^2G	9/2	99 442.86		45		21	$(^3F)\ ^4F$
		7/2	101 740.27		72		13	$(^3F)\ ^4G$
$3d^8(^3F)4d$		5/2	100 389.52		42	^2F	25	$(^3F)\ ^4F$
$3d^8(^3F)4d$		7/2	100 475.82		34	^4G	34	$(^3F)\ ^2F$
$3d^8(^3F)4d$		9/2	100 619.26		32	^2G	30	$(^3F)\ ^4G$
$3d^7(^4F)4s4p(^3P^\circ)$	$^2D^\circ$	5/2	*101 754.80*					
		3/2	*102 742.74*					
$3d^8(^3F)4d$	^2D	5/2	103 025.58		85		9	$(^3F)\ ^2F$
		3/2	103 663.50		90		4	$(^1D)\ ^2D$
$3d^8(^3F)5p$	$^4D^\circ$	7/2	*103 653.03*					
		5/2	*104 503.22*					
		3/2	*105 439.85*					
		1/2	*106 022.79*					
$3d^8(^3F)5p$	$^2G^\circ$	9/2	*104 081.04*		60		32	$^4G^\circ$
		7/2	*106 620.53*		58		24	$^4G^\circ$

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^8(^3F)5p$	$^4G^\circ$	11/2	*104 147.29*				
		7/2	*105 499.05*		55	24	$^2G^\circ$
		9/2	*105 588.89*		41	38	$^2G^\circ$
		5/2	*106 283.16*				
$3d^8(^3F)5p$	$^4F^\circ$	9/2	*104 298.23*				
		7/2	*104 646.52*		39	33	$^2F^\circ$
		5/2	*105 668.78*		53	24	$^4G^\circ$
		3/2	*106 369.30*				
$3d^8(^3F)5p$	$^2F^\circ$	7/2	*105 838.06*		46	32	$^4F^\circ$
		5/2	*107 082.21*				
$3d^8(^3F)5p$	$^2D^\circ$	5/2	*105 861.19*				
		3/2	*107 142.12*				
$3d^7(^4P)4s4p(^3P^\circ)$	$^6D^\circ$	9/2	*105 981.50?*				
$3d^8(^1D)5s$	^2D	5/2	106 007.89		80	20	$(^3P)\ ^4P$
		3/2	106 133.14		87	9	$(^3P)\ ^2P$
$3d^7(^4P)4s4p(^3P^\circ)$	$^4S^\circ$	3/2	*107 737.81*				
$3d^8(^3P)5s$	^4P	5/2	108 368.05		80	20	$(^1D)\ ^2D$
		3/2	108 548.61		94	5	$(^1D)\ ^2D$
		1/2	108 763.32		98	2	$(^3P)\ ^2P$
$3d^7(^4P)4s4p(^3P^\circ)$	$^6P^\circ$	3/2	*109 038.84*				
$3d^7(^2G)4s4p(^3P^\circ)$	$^4F^\circ$	9/2	*109 148.05*				
		7/2	*109 846.00*				
		5/2	*110 573.36*				
		3/2	*111 120.54*				
$3d^8(^3P)5s$	^2P	3/2	109 269.83		90	7	$(^1D)\ ^2D$
		1/2	109 675.72		98	2	$(^3P)\ ^4P$
		9/2	*110 021.92*				
$3d^7(^2G)4s4p(^3P^\circ)$	$^4G^\circ$	7/2	*111 783.79*				
$3d^7(^4F)4s4p(^1P^\circ)$	$^4G^\circ$	11/2	*112 422.19?*				
		9/2	*113 753.04*		67	28	$^4F^\circ$
		5/2	*115 108.09*		50	28	$^2F^\circ$
$3d^8(^1D)4d$	^2F	5/2	112 686.30		66	13	$(^1D)\ ^2D$
		7/2	112 719.75		77	19	$(^3P)\ ^4D$
$3d^8(^1D)4d$	^2D	3/2	112 906.93		62	22	$(^3P)\ ^2D$
		5/2	113 407.31		55	25	$(^1D)\ ^2F$
$3d^8(^1D)4d$	^2G	9/2	113 172.96		84	15	$(^3P)\ ^4F$
		7/2	113 177.61		86	10	$(^3P)\ ^2F$
$3d^8(^1D)4d$	^2P	1/2	113 225.06		78	13	$(^3P)\ ^4D$
		3/2	113 408.71		77	13	

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^7(^4F)4s4p(^1P^\circ)$	$^4F^\circ$	9/2	*113 321.95*		63		34	$^4G^\circ$
		5/2	*115 120.00?*		61		16	$^2F^\circ$
		3/2	*115 592.25?*		42		30	$^4D^\circ$
$3d^8(^1D)4d$	^2S	1/2	113 623.10		85		10	$(^3P)\ ^4P$
$3d^7\ 4s4p$		7/2	*114 052.04*		29	$^4G^\circ$	28	$^4F^\circ$
$3d^8(^3P)4d$	^4D	7/2	114 836.63		79		20	$(^1D)\ ^2F$
		5/2	114 874.88		72		19	$(^1D)\ ^2D$
		3/2	114 942.42		79		11	$(^1D)\ ^2P$
		1/2	114 970.19		87		12	$(^1D)\ ^2P$
$3d^7(^2H)4s4p(^3P^\circ)$	$^4G^\circ$	11/2	*114 858.88*					
		9/2	*115 612.88*					
		7/2	*116 275.81*					
		5/2	*116 754.93*					
$3d^7(^2P)4s4p(^3P^\circ)$	$^2D^\circ$	3/2	*114 869.35*		62			
		5/2	*116 893.98*		50		33	$^4D^\circ$
$3d^7(^2G)4s4p(^3P^\circ)$	$^2F^\circ$	7/2	*115 000.25*		51		22	$^4D^\circ$
$3d^8(^1G)5s$	^2G	9/2	115 081.36		100			
		7/2	115 085.36		100			
$3d^7\ 4s4p$	$^4D^\circ$	7/2	*115 209.85*		55		18	$^2F^\circ$
$3d^7\ 4s4p$		5/2	*115 565.98*		32	$^4D^\circ$	25	$^4F^\circ$
$3d^8(^3P)4d$	^4F	9/2	115 739.15		84		15	$(^1D)\ ^2G$
		7/2	115 827.12		82		8	
		5/2	115 956.71		68		13	$(^3P)\ ^2F$
		3/2	116 167.76		97		1	$(^3P)\ ^4P$
		3/2	*115 785.06*					
$3d^7\ 4s^2$	$^2D1$	5/2	115 870.28		77		23	$^2D2$
$3d^8(^3P)4d$	^2F	7/2	116 145.69		82		11	$(^3P)\ ^4F$
$3d^8(^3P)4d$		5/2	116 191.47		38	^2D	24	$(^3P)\ ^4F$
$3d^8(^3P)4d$	^4P	1/2	116 261.81		86		11	$(^1D)\ ^2S$
		3/2	116 312.34		85		8	$(^1D)\ ^2P$
		5/2	116 732.51		41		28	$(^3P)\ ^2D$
$3d^7\ 4s4p$	$^4D^\circ$	7/2	*116 512.06*					
$3d^8(^3P)4d$	^2P	1/2	116 786.42		89		7	$(^1D)\ ^2P$
		3/2	116 838.33		91		4	$(^3P)\ ^2D$
$3d^8(^3F)6s$	^4F	9/2	116 833.15					
		7/2	117 074.70					
		5/2	118 314.82					
		3/2	119 100.06					

Ni II—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages			
$3d^7(a\,^2D)4s4p(^3P^\circ)$	$^4F^\circ$	9/2	*117 573.68*					
		7/2	*117 972.47*					
$3d^7(^2P)4s4p(^3P^\circ)$		3/2	*117 662.11*		37	$^4S^\circ$	12	$^2D^\circ$
$3d^8(^1D)5p$	$^2D^\circ$	3/2	*117 763.91*		36		12	$^2P^\circ$
		5/2	*117 872.78*		65			
$3d^7(^2H)4s4p(^3P^\circ)$	$^2I^\circ$	11/2	*118 248.98*					
		13/2	*119 010.21*					
$3d^8(^3F)6s$	^2F	7/2	118 294.17					
		5/2	119 315.44					
$3d^8(^1D)5p$	$^2F^\circ$	5/2	*118 379.11*					
		7/2	*118 563.39*					
$3d^8(^1D)5p$		3/2	*118 442.81*		37	$^2P^\circ$	35	$^2D^\circ$
$3d^8(^1D)5p$	$^2P^\circ$	1/2	*118 631.95*		50		29	$3d^74s4p\ ^4D^\circ$
$3d^8(^3F_4)4f$	$^2[1]^\circ$	1/2	*118 774.76*		100			
		3/2	*118 809.34?*		87		13	$^2[2]^\circ$
$3d^8(^3F_4)4f$	$^2[7]^\circ$	13/2	*118 803.82*		100			
		15/2	*118 848.92*		100			
$3d^8(^3F_4)4f$	$^2[2]^\circ$	5/2	*118 828.61*		92		8	$^2[3]^\circ$
		3/2	*118 877.09*		87		13	$^2[1]^\circ$
$3d^8(^3F_4)4f$	$^2[3]^\circ$	7/2	*118 874.11*		97		3	$^2[4]^\circ$
		5/2	*118 897.94*		92		8	$^2[2]^\circ$
$3d^8(^3F_4)4f$	$^2[6]^\circ$	11/2	*118 892.99*		99			
		13/2	*118 893.24*		100			
$3d^8(^3F_4)4f$	$^2[4]^\circ$	9/2	*118 914.34*		99			
		7/2	*118 923.20*		97		3	$^2[3]^\circ$
$3d^8(^3F_4)4f$	$^2[5]^\circ$	9/2	*118 927.02*		99			
		11/2	*118 939.53*		99			
$3d^8(^3F)5d$	^4D	7/2	119 656.25		84		13	^4F
		1/2	121 111.90		48		30	^2P
		3/2	121 115.59		44		34	^2P
$3d^8(^3F)5d$	^4P	5/2	119 665.29		67		30	^4D
		1/2	121 925.16		51		43	^4D
$3d^8(^3F)5d$	^4H	13/2	119 773.60		100			
		11/2	121 180.55		59		30	^2H
		9/2	121 190.34		59		27	^2H
		7/2	122 047.29		77		18	^4G
$3d^8(^3P)5p$	$^4P^\circ$	5/2	*119 796.98*		51		19	$(^1D)\ ^2D^\circ$
		3/2	*120 166.52*		36		17	
		1/2	*120 316.02*					

Ni II—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages			
$3d^3(^3F)5d$	^4G	11/2	119 833.00		53		34	^4H
		7/2	121 240.90		42		30	^2F
		9/2	121 294.67		43		25	^2G
		5/2	122 144.99		59		35	^4F
$3d^8(^3F)5d$	^2H	11/2	119 889.47		56		36	^4G
		9/2	122 140.71		59		25	^4H
$3d^8(^3F)5d$	^2P	3/2	119 909.72		59		18	^4P
		1/2	122 112.94?		65		26	^4P
$3d^8(^3F)5d$	^4F	9/2	119 913.33		59		34	^4G
		7/2	121 317.89		41		30	^2G
		3/2	122 084.79		62		26	^4D
$3d^8(^3F)5d$	^2F	7/2	120 002.86		60		20	^4F
		5/2	122 175.42?		52		20	^2D
$3d^8(^3F)5d$	^2G	9/2	120 044.95		58		23	^4F
		7/2	122 270.05		61		18	^4G
$3d^8(^3F)5d$		5/2	120 144.17		37	^2D	18	^4D
$3d^8(^3F_3)4f$	$^2[1]°$	1/2	*120 189.55*		60		40	$^2[0]°$
		3/2	*120 199.18*		88		12	$^2[2]°$
$3d^8(^3F_3)4f$	$^2[2]°$	5/2	*120 203.49*		99		1	$^2[3]°$
		3/2	*120 222.89*		88		12	$^2[1]°$
$3d^8(^3F_3)4f$	$^2[6]°$	11/2	*120 211.30*		100			
		13/2	*120 218.22*		100			
$3d^8(^3F_3)4f$	$^2[3]°$	7/2	*120 250.17*		98		1	$^2[4]°$
		5/2	*120 271.97*		99		1	$^2[2]°$
$3d^8(^3F_3)4f$	$^2[4]°$	7/2	*120 268.81*		98		1	$^2[3]°$
		9/2	*120 281.11*		97		3	$^2[5]°$
$3d^8(^3F_3)4f$	$^2[5]°$	11/2	*120 270.44*		100			
		9/2	*120 272.53*		97		3	$^2[4]°$
$3d^8(^3P)5p$	$^4D°$	7/2	*120 903.31*		81			
		5/2	*121 325.09*		63		27	$^2D°$
		3/2	*121 385.80*		54			
		1/2	*121 561.06*		83			
$3d^8(^3F_2)4f$	$^2[1]°$	3/2	*121 042.52*		90		9	$^2[2]°$
		1/2	*121 090.71*		99			
$3d^8(^3P)5p$		3/2	*121 042.57*		35	$^2P°$	18	$^2D°$
$3d^8(^3P)5p$	$^2D°$	5/2	*121 050.66*		57		20	$^4D°$
$3d^8(^3F)6p$	$^4G°$	11/2	*121 120.37*					
$3d^8(^3F_2)4f$	$^2[5]°$	11/2	*121 120.88*		99			
		9/2	*121 125.41*		99			

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^8(^3F_2)4f$	$^2[2]^\circ$	5/2	*121 146.98*		94		5	$^2[3]^\circ$
		3/2	*121 161.81*		90		9	$^2[1]^\circ$
$3d^8(^3F_2)4f$	$^2[4]^\circ$	7/2	*121 178.56*		86		13	$^2[3]^\circ$
		9/2	*121 180.54*		99			
$3d^8(^3F_2)4f$	$^2[3]^\circ$	7/2	*121 192.32*		86		13	$^2[4]^\circ$
		5/2	*121 194.14*		94		5	$^2[2]^\circ$
$3d^8(^3F)5d$		5/2	121 227.80		37	^4D	36	^2F
$3d^8(^1G)4d$	^2I	11/2	121 437.68		100			
		13/2	121 476.56		100			
$3d^8(^3P)5p$	$^4S^\circ$	3/2	*121 456.30*		43		23	$^2D^\circ$
$3d^7(^2H)4s4p(^3P^\circ)$	$^2G^\circ$	9/2	*121 692.55*					
		7/2	*121 862.57*					
		3/2	121 699.02					
$3d^8(^3P)5p$		3/2	*121 800.34*		32	$^2P^\circ$	28	$^2D^\circ$
$3d^8(^1G)4d$	^2F	5/2	122 080.25		99			
		7/2	122 086.58		100			
$3d^8(^3F)6p$	$^4F^\circ$	9/2	*122 441.22*					
$3d^8(^1G)4d$	^2H	9/2	122 790.41		100			
		11/2	122 821.63		100			
$3d^8(^3F)6p$	$^4D^\circ$	7/2	*122 812.97*					
$3d^8(^1G)4d$	^2G	9/2	122 837.33		99			
		7/2	122 847.60		100			
$3d^8(^3F)6p$	$^2G^\circ$	9/2	*123 434.60*					
$3d^7(^2H)4s4p(^3P^\circ)$	$^2H^\circ$	9/2	*124 652.00*					
		11/2	*125 003.41*					
$3d^8(^1G)5p$	$^2H^\circ$	9/2	*126 679.98*					
		11/2	*126 857.97*					
$3d^7(^4P)4s4p(^1P^\circ)$	$^4S^\circ$	3/2	*126 738.82*					
$3d^8(^1G)5p$	$^2F^\circ$	7/2	*127 219.57*					
		5/2	*127 331.60*					
$3d^8(^3F)7s$	^4F	9/2	127 867.13					
		7/2	127 991.56					
		5/2	129 294.51					
		3/2	130 135.19					
$3d^8(^1G)5p$	$^2G^\circ$	9/2	*127 885.86*					
		7/2	*127 895.33*					

Ni II—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages		
$3d^8(^3F_4)5f$	$^2[1]°$	3/2	*128 732.03*		87	13	$^2[2]°$
		1/2	*128 799.72*		100		
$3d^8(^3F_4)5f$	$^2[2]°$	5/2	*128 803.23*		92	8	$^2[3]°$
		3/2	*128 822.23*		87	13	$^2[1]°$
$3d^8(^3F_4)5f$	$^2[7]°$	13/2	*128 818.41*		100		
		15/2	*128 827.05*		100		
$3d^8(^3F_4)5f$	$^2[3]°$	7/2	*128 827.15*		97		
		5/2	*128 853.87*		92	8	$^2[2]°$
$3d^8(^3F_4)5f$	$^2[6]°$	11/2	*128 837.11*		99		
		13/2	*128 855.60*		100		
$3d^8(^3F_4)5f$	$^2[4]°$	9/2	*128 853.91*		100		
		7/2	*128 867.00?*		97		
$3d^8(^3F_4)5f$	$^2[5]°$	9/2	*128 862.49*		100		
		11/2	*128 869.89*		100		
$3d^8(^3F_4)5g$	$^2[0]$	1/2	128 937.47		100		
$3d^8(^3F_4)5g$	$^2[1]$	3/2	128 939.76		100		
		1/2	128 939.76		100		
$3d^8(^3F_4)5g$	$^2[2]$	5/2	128 944.36		100		
		3/2	128 944.36		100		
$3d^8(^3F_4)5g$	$^2[8]$	17/2	128 946.17		100		
		15/2	128 946.15		100		
$3d^8(^3F_4)5g$	$^2[3]$	7/2	128 950.84		100		
		5/2	128 950.89		100		
$3d^8(^3F_4)5g$	$^2[4]$	9/2	128 958.34		100		
		7/2	128 958.40		100		
$3d^8(^3F_4)5g$	$^2[7]$	15/2	128 960.74		100		
		13/2	128 960.74		100		
$3d^8(^3F_4)5g$	$^2[5]$	11/2	128 964.63		100		
		9/2	128 964.62		100		
$3d^8(^3F_4)5g$	$^2[6]$	13/2	128 966.51		100		
		11/2	128 966.51		100		
$3d^8(^3F)7s$	^2F	7/2	129 271.72				
		5/2	130 236.26				
$3d^8(^3F)6d$	^4P	5/2	129 284.50				
		3/2	129 479.73				
		1/2	130 710.85				
$3d^8(^3F)6d$	^4D	7/2	129 297.91				
		5/2	129 842.33				
		3/2	130 942.30				

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^8(^3F)6d$	^4H	13/2	129 367.91				
		11/2	129 396.04				
		9/2	130 757.51				
		7/2	131 637.10				
$3d^8(^3F)6d$	^4F	9/2	129 419.58				
		7/2	129 474.27				
		5/2	130 730.53				
		3/2	131 620.45				
$3d^8(^3F)6d$	^4G	11/2	129 424.03				
		9/2	129 503.24				
		7/2	130 815.91				
		5/2	131 670.87				
$3d^7(^4P)4s4p(^1P^\circ)$	$^4D^\circ$	7/2	*129 782.07*				
		5/2	*129 988.05*				
		3/2	*130 331.78*				
		1/2	*130 570.42*				
$3d^8(^3F_3)5f$	$^2[0]^\circ$	1/2	*130 147.87*		51	49	$^2[1]^\circ$
$3d^8(^3F_3)5f$	$^2[1]^\circ$	3/2	*130 174.03*		88	11	$^2[2]^\circ$
$3d^8(^3F_3)5f$	$^2[2]^\circ$	5/2	*130 184.39*		100		
		3/2	*130 197.23*		88	12	$^2[1]^\circ$
$3d^8(^3F_3)5f$	$^2[6]^\circ$	11/2	*130 184.61*		100		
		13/2	*130 187.81*		100		
$3d^8(^3F_3)5f$	$^2[5]^\circ$	11/2	*130 205.62*		100		
		9/2	*130 206.90*		98		
$3d^8(^3F_3)5f$	$^2[3]^\circ$	7/2	*130 208.89*		97		
		5/2	*130 227.52*		100		
$3d^8(^3F_3)5f$	$^2[4]^\circ$	9/2	*130 215.50*		98		
		7/2	*130 225.87*		97		
$3d^8(^3F_3)5g$	$^2[1]$	3/2	130 301.40		100		
		1/2	130 301.40		100		
$3d^8(^3F_3)5g$	$^2[2]$	5/2	130 306.97		99		
		3/2	130 306.97		99		
$3d^8(^3F_3)5g$	$^2[7]$	15/2	130 308.71		100		
		13/2	130 308.71		100		
$3d^8(^3F_3)5g$	$^2[3]$	7/2	130 314.07		99		
		5/2	130 314.07		99		
$3d^8(^3F_3)5g$	$^2[4]$	9/2	130 320.97		100		
		7/2	130 320.94		100		
$3d^8(^3F_3)5g$	$^2[6]$	11/2	130 321.73		99		
		13/2	130 321.73		99		

Ni II—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages		
$3d^8(^3F_3)5g$	$^2[5]$	11/2	130 324.72		100		
		9/2	130 324.72		100		
$3d^8(^3F)7p$	$^4F°$	9/2	*130 470.90*				
$3d^8(^3F)7p$	$^4D°$	7/2	*130 480.55*				
$3d^8(^3F)7p$	$^4G°$	11/2	*130 661.32*				
$3d^8(^3F)6d$	^2P	3/2	130 691.35				
		1/2	131 655.83				
$3d^8(^3F)6d$	^2H	11/2	130 751.03				
		9/2	131 686.56				
$3d^8(^3F)6d$	^2F	7/2	130 765.26				
		5/2	131 796.26				
$3d^8(^3F)6d$	^2G	9/2	130 801.33				
		7/2	131 750.73				
$3d^8(^1D)6s$	^2D	5/2	130 900.65				
		3/2	130 942.36				
$3d^8(^3F)6d$	^2D	5/2	131 032.01				
$3d^8(^3F_2)5f$	$^2[1]°$	1/2	*131 063.85*		99		
		3/2	*131 075.78*		87	12	$^2[2]°$
$3d^8(^3F_2)5f$	$^2[5]°$	9/2	*131 093.30*		99		
		11/2	*131 122.28?*		99		
$3d^8(^3F_2)5f$	$^2[2]°$	5/2	*131 103.18*		91	8	$^2[3]°$
$3d^8(^3F_2)5f$	$^2[4]°$	9/2	*131 115.28*		99		
		7/2	*131 124.96*		66	33	$^2[3]°$
$3d^8(^3F_2)5f$	$^2[3]°$	5/2	*131 133.58*		91	8	$^2[2]°$
$3d^8(^3F_2)5g$	$^2[2]°$	5/2	131 211.85		99	1	$(^1D_2)\,^2[2]$
		3/2	131 211.85		99	1	
$3d^8(^3F_2)5g$	$^2[6]°$	13/2	131 218.56		99		
		11/2	131 218.56		99		
$3d^8(^3F_2)5g$	$^2[3]°$	7/2	131 222.98		99		
		5/2	131 222.98		99		
$3d^8(^3F_2)5g$	$^2[4]°$	9/2	131 232.83		99		
		7/2	131 232.83		99		
$3d^8(^3F_2)5g$	$^2[5]°$	11/2	131 233.31		99		
		9/2	131 233.31		99		
$3d^7(^2G)4s4p(^1P°)$	$^2H°$	11/2	*131 424.32?*				
		9/2	*132 311.98?*				

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^7(^4P)4s4p(^1P^\circ)$	$^4P^\circ$	5/2	*131 834.94*				
		1/2	*132 120.70*				
		3/2	*132 225.15*				
$3d^8(^3F)7p$	$^2G^\circ$	9/2	*131 928.77*				
$3d^8(^1D_2)4f$	$^2[3]^\circ$	5/2	*132 729.48*		82	16	$(^3P_2)\ ^2[3]^\circ$
		7/2	*132 869.16*		75	14	$(^3P_2)\ ^2[3]^\circ$
$3d^8(^1D_2)4f$	$^2[4]^\circ$	9/2	*132 818.16*		83	16	$(^3P_2)\ ^2[4]^\circ$
		7/2	*132 846.53*		75	15	$(^3P_2)\ ^2[4]^\circ$
$3d^8(^1D_2)4f$	$^2[2]^\circ$	5/2	*132 912.15*		83	15	$(^3P_2)\ ^2[2]^\circ$
		3/2	*132 927.97*		83	15	$(^3P_2)\ ^2[2]^\circ$
$3d^8(^1D_2)4f$	$^2[1]^\circ$	3/2	*132 982.51*		84	16	$(^3P_2)\ ^2[1]^\circ$
		1/2	*133 001.47*		84	16	$(^3P_2)\ ^2[1]^\circ$
$3d^8(^1D_2)4f$	$^2[5]^\circ$	11/2	*133 014.08*		83	16	$(^3P_2)\ ^2[5]^\circ$
		9/2	*133 031.00*		83	16	$(^3P_2)\ ^2[5]^\circ$
$3d^7(^2G)4s4p(^1P^\circ)$	$^2F^\circ$	7/2	*133 169.92*				
		5/2	*134 208.30*				
$3d^7(^2F)4s4p(^3P^\circ)$	$^4F^\circ$	3/2	*133 190.19?*				
		5/2	*133 209.30*				
		7/2	*133 528.02*				
		9/2	*133 853.04*				
$3d^8(^3P)6s$	^4P	5/2	133 443.89				
		3/2	133 613.99				
		1/2	133 857.73				
$3d^7(^2G)4s4p(^1P^\circ)$	$^2G^\circ$	9/2	*133 445.75*				
		7/2	*134 380.82*				
$3d^7(^2F)4s4p(^3P^\circ)$	$^4G^\circ$	11/2	*133 625.96*				
$3d^8(^3F)8s$	^4F	9/2	133 715.13				
		7/2	133 809.76				
		5/2	135 116.72				
		3/2	135 983.22				
$3d^8(^1D)5d$	^2F	7/2	133 734.98		81	13	$(^3P)\ ^4D$
		5/2	133 735.26		68	14	$(^1D)\ ^2D$
$3d^7(^2F)4s4p(^3P^\circ)$	$^4D^\circ$	7/2	*133 850.83*				
		5/2	*133 973.33*				
		3/2	*134 156.28*				
		1/2	*134 283.76*				
$3d^8(^3P)6s$	^2P	3/2	133 862.21				
		1/2	134 241.96				
$3d^8(^1D)5d$	^2D	3/2	133 903.00		80	7	$(^3P)\ ^2D$
		5/2	134 053.05		69	16	$(^1D)\ ^2F$

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^8(^1D)5d$	^2G	9/2	133 922.91		83	16	$(^3P)\ ^4F$
		7/2	133 929.88		84	11	$(^3P)\ ^2F$
$3d^8(^1D)5d$	^2P	1/2	133 954.85		82	8	$(^3P)\ ^2P$
		3/2	134 067.76		84	9	$(^3P)\ ^4P$
$3d^8(^3F_4)6f$	$^2[7]^\circ$	13/2	*134 238.44*		100		
		15/2	*134 251.30*		100		
$3d^8(^3F_4)6f$	$^2[1]^\circ$	3/2	*134 249.72*		87	13	$^2[2]^\circ$
$3d^8(^3F_4)6f$	$^2[3]^\circ$	7/2	*134 252.85*		97	3	$^2[4]^\circ$
		5/2	*134 294.99*		91	9	$^2[2]^\circ$
$3d^8(^3F_4)6f$	$^2[2]^\circ$	3/2	*134 254.69*		87	13	$^2[1]^\circ$
		5/2	*134 256.05*		91	9	$^2[3]^\circ$
$3d^8(^3F_4)6f$	$^2[4]^\circ$	7/2	*134 262.07*		97	3	$^2[3]^\circ$
		9/2	*134 271.59*		100		
$3d^8(^3F_4)6f$	$^2[6]^\circ$	13/2	*134 267.20*		100		
		11/2	*134 274.62*		99	1	$^2[5]^\circ$
$3d^8(^3F_4)6f$	$^2[5]^\circ$	11/2	*134 281.66*		99	1	$^2[6]^\circ$
		9/2	*134 286.38*		100		
$3d^8(^3F_4)6g$	$^2[8]$	15/2	134 316.80		100		
		17/2	134 325.15		100		
$3d^8(^3F_4)6g$	$^2[7]$	13/2	134 316.85		100		
		15/2	134 325.15		100		
$3d^8(^3F_4)6g$	$^2[1]$	3/2	134 323.88		100		
$3d^8(^3F_4)6g$	$^2[2]$	5/2	134 323.88		100		
		3/2	134 334.46?		100		
$3d^8(^3F_4)6g$	$^2[3]$	7/2	134 327.54		100		
		5/2	134 327.61		100		
$3d^8(^3F_4)6g$	$^2[4]$	9/2	134 331.84		100		
		7/2	134 331.89		100		
$3d^8(^3F_4)6g$	$^2[5]$	11/2	134 333.41		100		
		9/2	134 336.68		100		
$3d^8(^3F_4)6g$	$^2[6]$	13/2	134 333.41		100		
		11/2	134 336.68		100		
$3d^8(^3F)7d$	^4D	7/2	134 527.24				
		5/2	134 978.47				
		3/2	136 054.50				
$3d^8(^3F)7d$	^4P	5/2	134 539.37				
		3/2	134 670.07				

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^8(^3F)7d$	^4H	13/2	134 583.07				
		11/2	134 597.43				
		9/2	135 960.08				
		7/2	136 895.36?				
$3d^8(^3F)7d$	^4F	9/2	134 607.37				
		7/2	134 642.09				
		5/2	135 901.96				
		3/2	136 852.44				
$3d^8(^3F)7d$	^4G	11/2	134 614.55				
		9/2	134 658.60				
		7/2	135 986.06				
		5/2	136 899.34				
$3d^7(^2F)4s4p(^3P^\circ)$	$^2D^\circ$	5/2	*134 783.14*				
		3/2	*134 964.78*				
$3d^7(^2P)4s4p(^1P^\circ)$	$^2P^\circ$	1/2	*135 053.14*				
		3/2	*135 382.53*				
$3d^8(^3F)8s$	^2F	7/2	135 100.45				
		5/2	136 050.53				
$3d^7(^2P)4s4p(^1P^\circ)$	$^2D^\circ$	5/2	*135 258.92*				
		3/2	*136 461.10*				
$3d^8(^3F)8p$	$^4G^\circ$	9/2	*135 261.99*				
		11/2	*135 338.01*				
$3d^8(^3P_2)4f$	$^2[4]^\circ$	7/2	*135 400.67*		46	37	$(^3P_2)\ ^2[3]^\circ$
		9/2	*135 435.26*		83	16	$(^1D_2)\ ^2[4]^\circ$
$3d^8(^3P_2)4f$	$^2[3]^\circ$	7/2	*135 444.47*		46	38	$(^3P_2)\ ^2[4]^\circ$
		5/2	*135 461.55*		71	14	$(^1D_2)\ ^2[3]^\circ$
		7/2	*135 464.86*				
$3d^8(^3P_2)4f$	$^2[2]^\circ$	3/2	*135 493.26*		82	13	$(^1D_2)\ ^2[2]^\circ$
		5/2	*135 512.92*		71	12	$(^3P_2)\ ^2[3]^\circ$
$3d^8(^3P_2)4f$	$^2[5]^\circ$	11/2	*135 538.61?*		84	16	$(^1D_2)\ ^2[5]^\circ$
		9/2	*135 580.25*		84	16	$(^1D_2)\ ^2[5]^\circ$
		9/2	*135 558.80*				
$3d^8(^3F_3)6f$	$^2[1]^\circ$	1/2	*135 599.00*		59	41	$^2[0]^\circ$
		3/2	*135 619.91*		86	14	$^2[2]^\circ$
$3d^8(^3F_3)6f$	$^2[6]^\circ$	11/2	*135 606.20*		100		
		13/2	*135 606.30*		100		
$3d^\circ 8(^3F_3)6f$	$^2[2]^\circ$	5/2	*135 618.08*		100		
		3/2	*135 623.59*		85	14	$^2[1]^\circ$
$3d^8(^3F_3)6f$	$^2[3]^\circ$	7/2	*135 622.60*		97	3	$^2[4]^\circ$
		5/2	*135 630.63*		100		

Ni II—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages		
$3d^8(^3F_3)6f$	$^2[5]°$	9/2	*135 628.41*		96	4	$^2[4]°$
		11/2	*135 645.10*		100		
$3d^8(^3F_3)6f$	$^2[4]°$	7/2	*135 629.40*		97	3	$^2[3]°$
		9/2	*135 640.53*		96	4	$^2[5]°$
$3d^8(^3P_2)4f$	$^2[1]°$	3/2	*135 652.93*		84	16	$(^1D_2)\ ^2[1]°$
		1/2	*135 670.49*		84	16	$(^1D_2)\ ^2[1]°$
$3d^8(^3F_3)6g$	$^2[7]$	13/2	135 678.18?		100		
		15/2	135 686.64		100		
$3d^8(^3F_3)6g$	$^2[6]$	13/2	135 686.64		100		
		11/2	135 693.57		100		
$3d^8(^3F_3)6g$	$^2[3]$	7/2	135 693.43		99		
		5/2	135 693.43		99		
$3d^8(^3F_3)6g$	$^2[4]$	9/2	135 693.57		100		
$3d^8(^3F_3)6g$	$^2[5]$	9/2	135 695.67		100		
$3d^7(^2F)4s4p(^3P°)$	$^2G°$	7/2	*135 746.06*				
		9/2	*136 076.26*				
$3d^8(^3P_1)4f$	$^2[2]°$	3/2	*135 746.13*		93	4	$(^1D_2)\ ^2[2]°$
$3d^8(^3P_1)4f$	$^2[3]°$	5/2	*135 849.41*		100		
		7/2	*135 879.41*		100		
$3d^8(^3F)7d$	^2F	7/2	135 944.40				
		5/2	136 959.86				
$3d^8(^3P_0)4f$	$^2[3]°$	7/2	*135 954.09*		99		
		5/2	*136 122.61*		99		
$3d^8(^3F)7d$	^2H	11/2	135 956.01				
		9/2	136 880.56				
$3d^8(^3F)7d$	^2G	9/2	135 977.31				
		7/2	136 936.82				
$3d^8(^3F)7d$	^2D	5/2	136 031.43				
$3d^8(^3P)5d$	^4D	7/2	136 201.46		81	16	$(^1D)\ ^2F$
		5/2	136 288.60		77	14	$(^1D)\ ^2D$
		1/2	136 290.83?		91	8	$(^1D)\ ^2P$
		3/2	136 327.55		83	7	$(^1D)\ ^2D$
$3d^8(^1D)6p$	$^2F°$	7/2	*136 392.85*				
$3d^8(^3F_2)6f$	$^2[5]°$	11/2	*136 508.20*		99	1	$(^1D_2)\ ^2[5]°$
		9/2	*136 524.42*		99	1	$(^1D_2)\ ^2[5]°$
$3d^8(^3F_2)6f$	$^2[1]°$	1/2	*136 517.20*		99	1	$(^1D_2)\ ^2[1]°$
		3/2	*136 531.26*		85	14	$(^3F_2)\ ^2[2]°$

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^8(^3P)5d$	^4F	9/2	136 519.28		84		16	$(^1D)\ ^2G$
		7/2	136 589.35		62		24	$(^3P)\ ^2F$
		5/2	136 766.49		74		17	$(^3P)\ ^2D$
$3d^8(^3F_2)6f$	$^2[4]^\circ$	7/2	*136 542.28*		68		31	$(^3F_2)\ ^2[3]^\circ$
		9/2	*136 546.50*		99		1	$(^1D_2)\ ^2[4]^\circ$
$3d^8(^3F_2)6f$	$^2[3]^\circ$	7/2	*136 547.13*		68		31	$^2[4]^\circ$
		5/2	*136 548.55*		89		10	$^2[2]^\circ$
$3d^8(^3F_2)6g$	$^2[6]$	11/2	136 596.04		99			
		13/2	136 596.04		99			
$3d^8(^3F_2)6g$	$^2[5]$	11/2	136 598.73?		99			
$3d^8(^3F_2)6g$	$^2[4]$	7/2	136 604.79?		99			
$3d^8(^3F)8p$	$^2G^\circ$	9/2	*136 673.64*					
		7/2	*137 562.74*					
$3d^8(^3P)5d$	^4P	1/2	136 725.33		82		12	$(^1D)\ ^2S$
		5/2	136 960.75		58		37	$(^3P)\ ^2F$
$3d^8(^3P)5d$		3/2	136 732.74		31	^2D	31	$(^3P)\ ^4P$
$3d^8(^3P)5d$		3/2	136 899.33		38	^4F	37	^4P
$3d^8(^3F)7d$	^2P	1/2	136 955.28					
$3d^8(^3F)9s$	^4F	9/2	137 188.58					
		7/2	137 236.28					
		5/2	138 575.69					
		3/2	139 456.75					
$3d^8(^3P)5d$	^2P	1/2	137 211.93		85		8	$(^1D)\ ^2P$
		3/2	137 278.22?		67		19	$(^3P)\ ^2D$
$3d^8(^3F_4)7f$	$^2[2]^\circ$	5/2	*137 519.23*					
$3d^8(^3F_4)7f$	$^2[7]^\circ$	15/2	*137 519.63*					
$3d^8(^3F_4)7f$	$^2[3]^\circ$	7/2	*137 523.51*					
		5/2	*137 526.73*					
$3d^8(^3F_4)7f$	$^2[6]^\circ$	13/2	*137 529.37*					
		11/2	*137 535.83*					
$3d^8(^3F_4)7f$	$^2[4]^\circ$	9/2	*137 531.18*					
		7/2	*137 535.96*					
$3d^8(^3F_4)7g$	$^2[8]^\circ$	15/2	137 568.00					
		17/2	137 568.02					
$3d^8(^3F_4)7g$	$^2[6]^\circ$	13/2	137 573.19					
		11/2	137 573.19					
$3d^8(^3F_4)7g$	$^2[5]^\circ$	11/2	137 575.14					

Ni II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^8(^3F)8d$	^4P	5/2	137 706.71		
$3d^8(^3F)8d$	^4D	7/2	137 707.26		
		5/2	138 014.53		
$3d^8(^3F)8d$	^4H	13/2	137 735.22		
		11/2	137 742.95		
$3d^8(^3F)8d$	^4F	9/2	137 753.87		
		7/2	137 776.55		
$3d^8(^3F)8d$	^4G	11/2	137 754.78		
		9/2	137 782.50?		
$3d^8(^3F)9p$	$^4F^\circ$	9/2	*138 121.88*		
$3d^7(^2F)4s4p(^1P^\circ)$	$^2G^\circ$	9/2	*138 495.84?*		
$3d^8(^3F)9s$	^2F	7/2	138 563.71		
		5/2	139 492.10		
$3d^8(^3P)6p$	$^4D^\circ$	7/2	*138 841.00*		
$3d^8(^3F_3)7f$	$^2[6]^\circ$	13/2	*138 888.93*		
$3d^8(^3F_3)7g$	$^2[7]^\circ$	15/2	138 928.70		
$3d^8(^3F)8d$	^2H	11/2	139 103.05		
$3d^8(^3F_2)7g$	$^2[6]^\circ$	13/2	139 834.24		
$3d^8(^1G)6s$	^2G	9/2	140 006.17		
		7/2	140 008.76		
Ni III ($^3F_4$)	***Limit***		**146 541.56**		

Ni III

$Z=28$

Fe I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8$ $^3F_4$

Ionization energy = 284 900±200 cm^{-1} (35.32±0.02 eV)

This analysis has been made by Shenstone (1954) and extended by Garcia-Riquelme (1958) who has also provided unpublished results.

Shenstone's line list includes the range 600–3000 Å. The spectrum has been reobserved and extended by Garcia-Riquelme and Velasco (1955) in the range 2300–8600 Å.

Some of Shenstone's identifications in $3d^7 4p$ have been changed by Roth (1968) in his theoretical study. He calculated the percentage compositions of the $3d^7 4p$ terms.

The $3d^8$ and $3d^7 4s$ configurations have been studied theoretically by Shadmi (1962) and by Shadmi, Caspi, and Oreg (1969). The leading percentages of the $3d^8$ levels are taken from Pasternak and Goldschmidt (1972).

Some changes in the $3d^7 4s$ ^3P and ^3D levels suggested by Shadmi (1962) and agreed to by Shenstone are incorporated in this compilation.

Garcia-Riquelme has provided new terms for the known configurations $3d^8$, $3d^7 4s$, and $3d^7$ ^4p and has extended the analysis further with the discovery of terms from the configurations $3d^6 4s^2$, $3d^7 4d$, $3d^7 5p$, $3d^7 4f$, $3d^7 6s$, $3d^7 5d$, and $3d^7 5g$. With her new measurements, she has determined values to two decimal places for all levels above the ground configuration and has calculated percentage compositions for $3d^7 4d$, $4f$, $5p$, $5d$, and $5g$. In a few cases, we have changed her designations to correspond with her percentages.

In all the calculations, the percentages for the two ^2D states of $3d^7$, distinguished by seniority, include the sum of contributions from both states. They are distinguished by the prefixes A and B.

The ionization energy has been determined by us from the $3d^7(^4F)ns$ ($n=4,5,6$) series.

References

Garcia-Riquelme, O., and Velasco, R. (1955), Anales Real Soc. Esp. Fis. Quim **A51**, 41.
Garcia-Riquelme, O. (1958), J. Opt. Soc. Am. **48**, 183.
Pasternak, A., and Goldschmidt, Z. B. (1972), Phys. Rev. **A6**, 55.
Roth, C. (1968), J. Res. Nat. Bur. Stand. **72A**, 505.
Shadmi, Y. (1962), Bull. Res. Council Israel **10F**, 109.
Shadmi, Y., Caspi, E., and Oreg, J. (1969), J. Res. Nat. Bur. Stand. **73A**, 173.
Shenstone, A. G. (1954), J. Opt. Soc. Am. **44**, 749.

Ni III

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^8$	^3F	4	0.0	100		
		3	1 360.7	100		
		2	2 269.6	99		
$3d^8$	^1D	2	14 031.6	83	16	^3P
$3d^8$	^3P	2	16 661.6	84	16	^1D
		1	16 977.8	100		
		0	17 230.7	100		
$3d^8$	^1G	4	23 108.7	100		
$3d^8$	^1S	0	52 532.0	100		
$3d^7(^4F)4s$	^5F	5	53 703.93			
		4	54 657.83			
		3	55 406.29			
		2	55 952.21			
		1	56 308.24			
$3d^7(^4F)4s$	^3F	4	61 338.58			
		3	62 605.58			
		2	63 471.93			

Ni III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^7(^4P)4s$	^5P	3	71 067.35			
		2	71 384.10			
		1	71 842.42			
$3d^7(^2G)4s$	^3G	5	75 123.65			
		4	75 646.61			
		3	76 237.25			
$3d^7(^4P)4s$	^3P	2	78 303.54	47	53	$(^2P)\ ^3P$
		1	78 482.43	52	35	
		0	78 657.55	48	46	
$3d^7(^2P)4s$	^3P	2	79 143.01	47	53	$(^4P)\ ^3P$
		1	79 749.22	56	39	
		0	80 621.10	43	51	
$3d^7(^2G)4s$	^1G	4	79 250.11			
$3d^7(^2H)4s$	^3H	6	81 686.80			
		5	82 193.80			
		4	82 826.40			
$3d^7(a\ ^2D)4s$	^3D	3	82 172.60			
		1	82 277.26	54	41	$(^2P)\ ^1P$
		2	83 033.45			
$3d^7(^2P)4s$	^1P	1	84 604.10	48	40	$(a\ ^2D)\ ^1D$
$3d^7(^2H)4s$	^1H	5	85 834.20			
$3d^7(a\ ^2D)4s$	^1D	2	86 645.88			
$3d^7(^2F)4s$	^3F	2	97 841.60			
		3	97 995.81			
		4	98 237.93			
$3d^7(^2F)4s$	^1F	3	101 954.90			
$3d^7(^4F)4p$	$^5F^\circ$	5	*110 212.80*	94	5	$(^4F)\ ^5G^\circ$
		4	*110 371.35*	65	29	$(^4F)\ ^5D^\circ$
		3	*111 221.20*	78	17	$(^4F)\ ^5D^\circ$
		2	*111 914.53*	88	9	$(^4F)\ ^5D^\circ$
		1	*112 401.65*	96		
$3d^7(^4F)4p$	$^5D^\circ$	4	*111 898.65*	63	26	$(^4F)\ ^5F^\circ$
		3	*112 935.43*	73	13	$(^4F)\ ^5F^\circ$
		2	*113 651.47*	78	8	$(^4F)\ ^5G^\circ$
		1	*114 095.60*	88	8	$(^4P)\ ^5D^\circ$
		0	*114 295.45*	91	8	$(^4P)\ ^5D^\circ$
$3d^7(^4F)4p$	$^5G^\circ$	6	*112 787.85*	100		
		5	*113 140.92*	82	12	$(^4F)\ ^3G^\circ$
		4	*113 705.12*	84	8	$(^4F)\ ^5G^\circ$
		3	*114 110.20*	86	7	$(^4F)\ ^5F^\circ$
		2	*114 371.01*	88	5	$(^4F)\ ^5D^\circ$

Ni III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^7(^4F)4p$	$^3G°$	5	*115 272.26*	87	13	$(^4F)\ ^5G°$
		4	*116 674.39*	83	9	$(^4F)\ ^3F°$
		3	*117 606.35*	88	7	$(^4F)\ ^3F°$
$3d^7(^4F)4p$	$^3F°$	4	*116 191.93*	85	10	$(^4F)\ ^3G°$
		3	*117 250.80*	83	8	$(^4F)\ ^3G°$
		2	*118 114.95*	92		
$3d^7(^4F)4p$	$^3D°$	3	*118 745.25*	90	5	$(^4F)\ ^3F°$
		2	*119 669.54*	92		
		1	*120 272.32*	93		
$3d^7(b\ ^2D)4s$	^3D	1	121 192.93			
		2	121 411.60			
		3	121 802.45			
$3d^7(^4P)4p$	$^5S°$	2	*122 282.40*	99		
$3d^7(b\ ^2D)4s$	^1D	2	125 433.55			
$3d^7(^4P)4p$	$^5D°$	2	*129 913.10*	82	7	$(^4F)\ ^5D°$
		3	*129 954.00*	84	7	
		1	*129 957.95*	75	7	
		0	*130 190.05*	86	8	
		4	*130 312.30*	93	6	
$3d^7(^4P)4p$	$^3S°$	1	*130 863.50*	53	12	$(^2P)\ ^3S°$
$3d^7(^2G)4p$	$^3H°$	5	*131 500.50*	74	15	$(^2G)\ ^1H°$
		4	*132 156.50*	61	28	$(^2G)\ ^3F°$
		6	*132 168.60*	96		
$3d^7(^2G)4p$	$^3F°$	4	*131 792.02*	41	33	$(^2G)\ ^3H°$
		3	*133 158.50*	78	11	$(^2G)\ ^3G°$
		2	*134 231.90*	94		
$3d^7(^4P)4p$	$^5P°$	2	*132 818.26*	45	21	$(^2P)\ ^3P°$
		3	*133 095.89*	71	19	$(^4P)\ ^3D°$
		1	*133 339.70*	73	20	$(^4P)\ ^3S°$
$3d^7(^2P)4p$	$^3P°$	0	*132 864.8*	69	19	$(a\ ^2D)\ ^3P°$
		1	*133 276.70*	45	19	$(^4P)\ ^3D°$
		2	*133 642.58*	49	10	$(^2P)\ ^3D°$
$3d^7(^2G)4p$	$^1G°$	4	*133 324.70*	47	24	$(^2G)\ ^3F°$
$3d^7(^4P)4p$	$^3D°$	3	*133 390.94*	65	20	$(^4P)\ ^5P°$
		2	*133 500.97*	42	37	$(^4P)\ ^5P°$
		1	*133 839.54*	54	15	$(^2P)\ ^3D°$
$3d^7(^2G)4p$	$^3G°$	5	*133 692.00*	78	19	$(^2G)\ ^1H°$
		3	*134 334.79*	70	16	$(^2G)\ ^1F°$
		4	*134 414.77*	73	14	$(^2G)\ ^1G°$
$3d^7(^2G)4p$	$^1H°$	5	*134 217.60*	62	23	$(^2G)\ ^3H°$
$3d^7(^2G)4p$	$^1F°$	3	*135 023.20*	57	15	$(^2G)\ ^3G°$

Ni III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^7(^4P)4p$	$^3P^\circ$	0	*135 334.90*	52		35	$(^2P)\ ^1S^\circ$
		2	*135 350.33*	75		10	$(a\ ^2D)\ ^3P^\circ$
		1	*136 098.70*	78		11	$(^2P)\ ^3D^\circ$
$3d^7(^2P)4p$	$^3D^\circ$	2	*136 813.20*	41		29	$(^2P)\ ^1D^\circ$
		3	*136 967.00*	77		8	$(a\ ^2D)\ ^3F^\circ$
		1	*137 362.36*	54		15	$(a\ ^2D)\ ^3D^\circ$
$3d^7(^2H)4p$	$^3G^\circ$	5	*137 020.20*	94		5	$(^2F)\ ^3G^\circ$
		4	*138 030.90*	90		5	
		3	*138 852.20*	85		6	
$3d^7(^2P)4p$		2	*137 631.60*	24	$^3D^\circ$	20	$^1D^\circ$
$3d^7(^2H)4p$	$^3I^\circ$	6	*137 391.30*	74		25	$(^2H)\ ^1I^\circ$
		7	*137 991.40*	100			
		5	*138 060.40*	95			
$3d^7(^2P)4p$	$^1S^\circ$	0	*138 146.48*	61		39	$(^4P)\ ^3P^\circ$
$3d^7(a\ ^2D)4p$	$^3D^\circ$	3	*138 487.40*	79		11	$(a\ ^2D)\ ^3F^\circ$
		1	*138 979.20*	50		27	$(^2P)\ ^1P^\circ$
		2	*139 253.70*	63		10	$(^2P)\ ^3D^\circ$
$3d^7(^2H)4p$	$^1I^\circ$	6	*139 633.90*	74		24	$(^2H)\ ^3I^\circ$
$3d^7(a\ ^2D)4p$	$^3F^\circ$	4	*140 184.65*	98			
		3	*140 544.52*	71		8	$(^2P)\ ^3D^\circ$
		2	*140 885.40*	73		10	$(a\ ^2D)\ ^3D^\circ$
$3d^7(^2P)4p$	$^3S^\circ$	1	*140 885.15*	67		8	$(^2P)\ ^1P^\circ$
$3d^7(^2P)4p$	$^1P^\circ$	1	*141 414.10*	49		17	$(a\ ^2D)\ ^3D^\circ$
$3d^7(^2H)4p$	$^3H^\circ$	6	*142 187.80*	98			
		5	*142 575.60*	95			
		4	*143 002.70*	95			
$3d^7(a\ ^2D)4p$	$^1D^\circ$	2	*142 433.95*	46		29	$(a\ ^2D)\ ^3P^\circ$
$3d^7(a\ ^2D)4p$	$^3P^\circ$	2	*143 560.16*	48		24	$(a\ ^2D)\ ^1D^\circ$
		1	*144 624.55*	67		11	$(^2P)\ ^3P^\circ$
		0	*145 088.45*	80		15	$(^2P)\ ^3P^\circ$
$3d^7(a\ ^2D)4p$	$^1F^\circ$	3	*143 864.80*	73		16	$(^2G)\ ^1F^\circ$
$3d^7(^2H)4p$	$^1G^\circ$	4	*144 153.00*	70		27	$(^2G)\ ^1G^\circ$
$3d^7(a\ ^2D)4p$	$^1P^\circ$	1	*145 950.15*	88			
$3d^7(^2H)4p$	$^1H^\circ$	5	*146 325.80*	96			
$3d^6\,4s^2$	^5D	4	153 256.35				
		3	154 170.37				
$3d^7(^2F)4p$	$^1D^\circ$	2	*155 071.00*	60		32	$(^2F)\ ^3F^\circ$

Ni III—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages		
$3d^7(^2F)4p$	$^3G°$	3	*155 443.30*	82	10	$(^2F)\ ^3F°$
		4	*155 841.40*	73	15	$(^2F)\ ^3F°$
		5	*156 808.70*	94	5	$(^2H)\ ^3G°$
$3d^7(^2F)4p$	$^3F°$	3	*156 411.20*	68	19	$(^2F)\ ^3D°$
		2	*156 522.87*	64	29	$(^2F)\ ^1D°$
		4	*156 972.08*	50	28	$(^2F)\ ^1G°$
$3d^7(^2F)4p$	$^3D°$	3	*156 853.00*	72	18	$(^2F)\ ^3F°$
		2	*157 154.27*	85	8	$(^2F)\ ^1D°$
		1	*157 235.16*	93	5	$(b\ ^2D)\ ^3D°$
$3d^7(^2F)4p$	$^1G°$	4	*157 375.42*	65	32	$(^2F)\ ^3F°$
$3d^7(^2F)4p$	$^1F°$	3	*161 754.89*	97		
$3d^7(b\ ^2D)4p$	$^3P°$	2	*176 487.10*	99		
		1	*176 583.20*	98		
		0	*176 736.40*	99		
$3d^7(b\ ^2D)4p$	$^3F°$	2	*177 805.60*	96		
		3	*178 451.50*	96		
		4	*179 282.00*	97		
$3d^7(^4F)4d$	^5F	5	181 019.08	90	8	^5G
		4	181 482.95	83	8	^5G
		3	181 996.70	80	8	^5D
		2	182 587.83	87	5	^5D
		1	183 035.25	95	2	^5D
$3d^7(b\ ^2D)4p$	$^1P°$	1	*181 203.4*	95		
$3d^7(b\ ^2D)4p$	$^1F°$	3	*181 658.4*	97		
$3d^7(^4F)4d$	^5G	6	181 840.00	96	4	^5H
		5	182 327.13	63	26	^3G
		4	183 041.45	71	13	^3G
		3	183 637.76	81	4	^3G
		2	184 124.86	74	17	^5P
$3d^7(^4F)5s$	^5F	5	181 998.15	99		
		4	182 798.20	84	14	^3F
		3	183 612.67	93		
		2	184 220.35	97		
		1	184 609.57	99		
$3d^7(^4F)4d$	^5H	7	182 508.30	99		
		6	183 126.19	59	39	^3H
		5	183 904.88	80	14	^3H
		4	184 510.75	88	5	^3G
		3	184 944.95	81	17	^3G
$3d^7(^4F)4d$	^5P	3	182 524.69	83	9	^5D
		2	183 575.58	55	21	^5G
		1	184 375.68	59	38	^5D

Ni III—Continued

Configuration	Term	*J*	Level (cm⁻¹)	Leading percentages	
$3d^7(^4F)4d$	^3G	5	183 052.20	66	24 ^5G
		4	183 859.72	74	16 ^5G
		3	184 346.50	74	15 ^5H
$3d^7(^4F)4d$	^5D	4	183 464.88	85	9 ^5F
		3	184 518.20	64	13 ^3D
		2	185 067.15	55	25 ^3D
		1	185 116.05	46	38 ^5P
		0	185 147.23	98	
$3d^7(b\,^2D)4p$	$^3D°$	1	*183 717.00*	95	
		2	*183 872.00*	73	25 $^1D°$
		3	*184 723.10*	96	
$3d^7(^4F)4d$	^3D	3	183 839.47	71	14 ^5D
		2	184 623.54	66	15
		1	185 543.70	82	12
$3d^7(^4F)5s$	^3F	4	184 037.62	85	14 ^5F
		3	185 248.15	93	
		2	186 073.40	97	
$3d^7(^4F)4d$	^3H	6	184 166.57	60	37 ^5H
		5	184 805.62	80	15
		4	185 639.13	91	5
$3d^7(^4F)4d$	^3F	4	187 351.88	86	5 $(^2G)\,^3F$
		3	188 140.54	84	6
		2	188 622.87	85	6
$3d^7(^4F)4d$	^3P	2	187 493.38	87	5 $(^4P)\,^3P$
		1	188 542.82	90	6
		0	189 056.90	91	6
$3d^7(^4F)5p$	$^5F°$	5	*199 919.08*	91	8 $^5G°$
		4	*200 076.35*	49	42 $^5D°$
		3	*200 962.97*	64	27 $^5D°$
		2	*201 725.23*	80	15 $^5D°$
		1	*202 263.08*	94	6 $^5D°$
$3d^7(^4F)5p$	$^5G°$	6	*200 747.06*	99	
		5	*201 033.68*	48	43 $^3G°$
		4	*201 969.90*	67	14 $^3F°$
		3	*202 608.20*	76	11 $^5F°$
		2	*203 020.07*	78	10 $^5D°$
$3d^7(^4F)5p$	$^5D°$	4	*200 935.60*	54	29 $^5F°$
		3	*201 829.46*	60	19 $^5F°$
		2	*202 487.82*	71	17 $^5G°$
		1	*202 898.94*	92	6 $^5F°$
		0	*203 078.46*	98	
$3d^7(^4F)5p$	$^3F°$	4	*202 074.33*	71	5 $^5F°$
		3	*203 360.52*	57	29 $^3D°$
		2	*203 739.65*	58	38 $^3D°$

Ni III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^7(^4F)5p$	$^3G°$	5	*202 125.84*	54	44	$^5G°$
		4	*203 197.33*	75	19	
		3	*203 976.35*	85	7	
$3d^7(^4F)5p$	$^3D°$	3	*202 624.51*	62	30	$^3F°$
		2	*204 242.07*	57	38	$^3F°$
		1	*204 677.95*	98		
$3d^6(^5D)4s4p$	$^5D°$	4	*204 404.12*			
		3	*204 714.93*			
		2	*205 062.51*			
		1	*205 327.00*			
		0	*205 466.00*			
$3d^6(^5D)4s4p$	$^5F°$	5	*206 925.18*			
		4	*207 382.10*			
		3	*207 744.30*			
		2	*208 005.7*			
$3d^6(^5D)4s4p$	$^3D°$	3	*212 312.5*			
		2	*213 016.8*			
		1	*213 490.0*			
$3d^6(^5D)4s4p$	$^3F°$	4	*212 837.7*			
		3	*213 979.67*			
		2	*214 744.0*			
$3d^7(^4F_{9/2})4f$	$^2[^{11}/_2]°$	6	*221 187.25*	99		
		5	*221 195.35*	88	11	$^2[^9/_2]°$
$3d^7(^4F_{9/2})4f$	$^2[^9/_2]°$	4	*221 256.08*	98		
		5	*221 268.50*	88	11	$^2[^{11}/_2]°$
$3d^7(^4F_{9/2})4f$	$^2[^{13}/_2]°$	7	*221 286.78*	99		
		6	*221 292.92*	99		
$3d^7(^4F_{9/2})4f$	$^2[^7/_2]°$	3	*221 350.90*	99		
		4	*221 388.14*	98		
$3d^7(^4F_{9/2})4f$	$^2[^{15}/_2]°$	8	*221 433.20*	99		
		7	*221 444.15*	99		
$3d^7(^4F_{7/2})4f$	$^2[^9/_2]°$	5	*222 455.66*	94		
		4	*222 466.47*	89	9	$^2[^7/_2]°$
$3d^7(^4F_{9/2})4f$	$^2[^5/_2]°$	3	*221 476.68*	99		
$3d^7(^4F_{7/2})4f$	$^2[^{11}/_2]°$	6	*222 494.65*	99		
		5	*222 529.55*	94		
$3d^7(^4F_{7/2})4f$	$^2[^7/_2]°$	3	*222 516.60*	97		
		4	*222 547.50*	89	10	$^2[^9/_2]°$
$3d^7(^4F_{7/2})4f$	$^2[^5/_2]°$	3	*222 530.00*	97		
		2	*222 571.37*	98		

Ni III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^7(^4F_{7/2})4f$	$^2[13/2]°$	7	222 596.30	99			
		6	222 599.70	99			
$3d^7(^4F_{5/2})4f$	$^2[7/2]°$	4	223 387.00	98			
		3	223 329.77	87		12	$^2[5/2]°$
$3d^7(^4F_{5/2})4f$	$^2[5/2]°$	3	223 406.81	85		12	$^2[7/2]°$
		2	223 375.18	97			
$3d^7(^4F_{5/2})4f$	$^2[9/2]°$	5	223 434.10	99			
		4	223 314.77	98			
$3d^7(^4F_{5/2})4f$	$^2[11/2]°$	5	223 461.15	99			
		6	223 469.90	99			
$3d^7(^4F_{5/2})4f$	$^2[3/2]°$	2	223 481.25	99			
		1	223 491.34	99			
$3d^7(^4F_{3/2})4f$	$^2[5/2]°$	3	223 957.54	97			
		2	224 026.05	97			
$3d^7(^4F_{3/2})4f$	$^2[9/2]°$	4	223 989.02	99			
		5	224 020.91	99			
$3d^7(^4F)6s$	^5F	5	225 784.20	99			
		4	226 290.44	44		55	^3F
		3	227 270.07	73		26	^3F
		2	227 985.66	90		9	^3F
$3d^7(^4F)5d$	^5F	5	225 918.35	79		20	^5G
		4	226 118.80	55		34	^5D
		1	228 042.24	62		24	^5D
$3d^7(^4F)5d$	^5G	6	226 124.64	91		8	^5H
		5	227 433.80	41		34	^3G
		3	227 963.02	43		17	^5D
		2	228 483.54	68		13	^5F
$3d^7(^4F)5d$	^5H	7	226 380.36	99			
		6	227 649.28	60		33	^3H
		5	227 726.91	61		26	^3H
		4	228 434.45	76		10	^3H
		3	228 955.36	55		42	^3G
$3d^7(^4F)5d$	^5P	3	226 532.85	51		30	^5D
		2	227 767.03	53		26	^5F
		1	228 329.40	42		31	^5D
$3d^7(^4F)5d$	^3G	5	226 603.73	51		30	^5G
		4	228 195.11	46		34	^5G
		3	228 858.30	40		34	^5H
$3d^7(^4F)5d$	^3H	6	226 686.28	66		31	^5H
		5	228 609.82	59		29	
		4	229 291.50	79		12	
$3d^7(^4F)5d$		3	226 757.78	37	^3D	27	^5P

Ni III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^7(^4F)5d$	^5D	4	227 091.99	42		37	^5G
		3	228 363.94	46		23	^5F
		0	228 736.36	99			
		2	228 819.73	56		20	^5P
		1	229 057.39	38		31	^5P
$3d^7(^4F)6s$	^3F	4	227 288.70	44		55	^5F
		3	228 290.97	73		26	
		2	229 036.43	90		9	
$3d^7(^4F)5d$		2	227 346.84	35	^5F	15	^5P
$3d^7(^4F)5d$	^3D	3	227 459.43	48		26	^5F
		2	228 273.42	62		18	^5G
		1	228 879.50	59		21	^5P
$3d^7(^4F)5d$		4	227 553.40	30	^5F	27	^3G
$3d^7(^4F)5d$	^3F	4	230 169.90	89		6	^3G
		3	231 033.56	84		3	^3G
		2	231 548.58	83		2	^3D
$3d^7(^4F)5d$	^3P	2	230 219.9	87		7	$(^4F)\ ^3D$
		1	231 309.0	93		3	$(^4F)\ ^3D$
		0	231 761.8	97		2	$(^4P)\ ^3P$
$3d^7(^4F_{9/2})5g$	$^2[15/2]$	8	244 262.75	97			
		7	244 267.15	93			
$3d^7(^4F_{9/2})5g$	$^2[11/2]$	6	244 264.23	86		10	$^2[13/2]$
		5	244 264.28	72		27	$^2[9/2]$
$3d^7(^4F_{9/2})5g$	$^2[13/2]$	7	244 289.88	94			
		6	244 290.37	86		13	$^2[11/2]$
$3d^7(^4F_{9/2})5g$	$^2[9/2]$	4	244 306.13	53		46	$^2[7/2]$
		5	244 306.20	71		27	$^2[11/2]$
$3d^7(^4F_{9/2})5g$	$^2[17/2]$	9	244 343.23	99			
		8	244 343.20	98			
$3d^7(^4F_{7/2})5g$	$^2[13/2]$	6	245 471.20	87		11	$^2[11/2]$
$3d^7(^4F_{7/2})5g$	$^2[11/2]$	5	245 488.31	60		38	$^2[9/2]$
		6	245 495.36	89		10	$^2[13/2]$
$3d^7(^4F_{7/2})5g$	$^2[15/2]$	7	245 528.40	96			
$3d^7(^4F_{7/2})5g$	$^2[9/2]$	5	245 532.59	60		39	$^2[11/2]$
		4	245 572.57	70		28	$^2[7/2]$
$3d^7(^4F_{5/2})5g$	$^2[9/2]$	4	246 364.86	96			
		5	246 376.24	55		42	$^2[11/2]$
$3d^7(^4F_{5/2})5g$	$^2[13/2]$	6	246 385.97	97			

Ni III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^7(^4F_{3/2})5g$	$^2[9/2]$	4	246 938.98	72	26	$^2[7/2]$
		5	246 954.87	58	40	$^2[11/2]$
Ni IV ($^4F_{9/2}$)	***Limit***		**284 900**			

Ni IV

$Z=28$

Mn I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7\ {}^4F_{9/2}$

Ionization energy = 443 000 cm^{-1} (54.9 eV)

The first work on Ni IV was reported by Poppe (1968), who found two quartets in the $3d^7$ configuration and quartets and sextets from $3d^6 4s$ and $3d^6 4p$. The sextets and quartets were connected by intercombinations found by Garcia-Riquelme (1968).

The present compilation is taken from an extension of the analysis by Poppe (1976). The $3d^7$–$3d^6 4p$ array was observed in the region 390–710 Å and the $3d^6 4s$–$3d^6 4p$ array in the region 1210–1830 Å. All levels of $3d^7$ have been found. The uncertainty of measurement in the short wavelength array is 2 or 3 cm^{-1} and in the longer one, about 0.5 cm^{-1}.

The leading percentages were calculated by Poppe (1976). We use the designations of Nielson and Koster (see introduction) to represent the seniorities.

The ionization energy is from Lotz (1967).

References

Garcia-Riquelme, O. (1968), Physica **40**, 27.
Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.
Poppe, R. (1968), Physica **40**, 17.
Poppe, R. (1976), Physica **81C**, 351.

Ni IV

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^7$	^{4}F	9/2	0.0	100		
		7/2	1 189.7	100		
		5/2	2 042.5	100		
		3/2	2 621.1	100		
$3d^7$	^{4}P	5/2	18 118.6	100		
		3/2	18 366.8	93	7	^{2}P
		1/2	18 958.4	97	3	^{2}P
$3d^7$	^{2}G	9/2	19 829.6	97	2	^{2}H
		7/2	20 947.6	100		
$3d^7$	^{2}P	3/2	23 648.9	83	8	^{2}D2
		1/2	24 651.4	97	3	^{4}P
$3d^7$	^{2}H	11/2	26 649.1	100		
		9/2	27 677.6	98	2	^{2}G
$3d^7$	^{2}D2	5/2	27 096.5	77	23	^{2}D1
		3/2	28 777.7	72	18	
$3d^7$	^{2}F	5/2	43 437.5	100		
		7/2	43 858.6	100		
$3d^7$	^{2}D1	3/2	67 360.0	80	20	^{2}D2
		5/2	67 989.8	77	23	
$3d^6(^5D)4s$	^{6}D	9/2	110 410.6	100		
		7/2	111 195.8	100		
		5/2	111 763.3	100		
		3/2	112 151.9	100		
		1/2	112 379.3	100		

Ni IV—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages		
$3d^6(^5D)4s$	^4D	7/2	120 909.5	100		
		5/2	121 807.7	100		
		3/2	122 386.1	100		
		1/2	122 717.4	99		
$3d^6(^3P2)4s$	^4P	5/2	138 446.2	62	37	$(^3P1)\ ^4P$
		3/2	140 343.0	60	35	
		1/2	141 561.2	60	36	
$3d^6(^3H)4s$	^4H	13/2	139 289.4	100		
		11/2	139 619.2	98	2	$(^3G)\ ^4G$
		9/2	139 886.7	94	3	$(^3G)\ ^4G$
		7/2	140 140.9	96	2	$(^3G)\ ^4G$
$3d^6(^3F2)4s$	^4F	9/2	141 220.3	72	21	$(^3F1)\ ^4F$
		7/2	141 577.2	74	20	
		5/2	141 832.0	77	20	
		3/2	142 023.5	80	19	
$3d^6(^3G)4s$	^4G	11/2	144 815.1	71	28	$(^3H)\ ^2H$
		9/2	145 702.2	76	18	$(^3H)\ ^2H$
		7/2	146 061.5	88	4	$(^3F2)\ ^2F$
		5/2	146 153.8	90	6	$(^3F2)\ ^2F$
$3d^6(^3P2)4s$	^2P	3/2	145 192.1	60	36	$(^3P1)\ ^2P$
$3d^6(^3H)4s$	^2H	11/2	145 962.5	71	27	$(^3G)\ ^4G$
		9/2	146 194.3	78	17	
$3d^6(^3F2)4s$	^2F	7/2	147 635.9	69	19	$(^3F1)\ ^2F$
		5/2	148 358.2	74	18	
$3d^6(^3G)4s$	^2G	9/2	151 574.7	97	3	$(^3H)\ ^2H$
		7/2	152 343.7	95	4	$(^3F2)\ ^2F$
$3d^6(^3D)4s$	^4D	3/2	153 313.8	99		
		5/2	153 338.8	98		
		1/2	153 349.4	99		
		7/2	153 533.6	100		
$3d^6(^1I)4s$	^2I	13/2	155 253.7	100		
		11/2	155 308.7	99		
$3d^6(^1G2)4s$	^2G	9/2	156 294.0	65	32	$(^1G1)\ ^2G$
		7/2	156 351.2	65	32	
$3d^6(^3D)4s$	^2D	3/2	159 498.5	94	4	$(^1D2)\ ^2D$
		5/2	159 818.4	96	2	
$3d^6(^1F)4s$	^2F	7/2	171 406.0	98		
		5/2	171 408.0	98		
$3d^6(^5D)4p$	$^6D^\circ$	9/2	*175 569.5*	98		
		7/2	*175 869.1*	96	2	$(^5D)\ ^6F^\circ$
		5/2	*176 247.1*	97		
		3/2	*176 554.4*	98		
		1/2	*176 749.0*	99		

Ni IV—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages			
$3d^6(^3F1)4s$	^4F	3/2	179 583.0	80		20	$(^3F2)\ ^4F$
		9/2	179 655.0	78		22	
		5/2	179 724.0	79		20	
		7/2	179 792.0	78		20	
$3d^6(^5D)4p$	$^6F°$	11/2	*181 931.5*	100			
		9/2	*182 044.9*	94		4	$(^5D)\ ^4F°$
		7/2	*182 125.6*	93		3	$(^5D)\ ^4F°$
		5/2	*182 206.8*	95		2	$(^5D)\ ^4D°$
		3/2	*182 259.9*	96		2	$(^5D)\ ^4D°$
		1/2	*182 288.4*	97			
$3d^6(^5D)4p$	$^6P°$	7/2	*184 099.1*	84		11	$(^5D)\ ^4D°$
		5/2	*185 505.3*	88		9	
		3/2	*186 441.4*	94		4	
$3d^6(^5D)4p$	$^4D°$	7/2	*185 890.0*	83		13	$(^5D)\ ^6P°$
		5/2	*186 516.1*	84		10	$(^5D)\ ^6P°$
		3/2	*186 957.2*	89		4	$(^5D)\ ^6P°$
		1/2	*187 225.7*	93		3	$(^5D)\ ^6F°$
$3d^6(^3F1)4s$	^2F	7/2	185 967.0	77		21	$(^3F2)\ ^2F$
		5/2	185 997.0	80		20	
$3d^6(^5D)4p$	$^4F°$	9/2	*186 470.1*	94		4	$(^5D)\ ^6F°$
		7/2	*187 570.3*	95		3	$(^5D)\ ^6F°$
		5/2	*188 320.1*	96		2	$(^5D)\ ^6F°$
		3/2	*188 824.2*	97			
$3d^6(^5D)4p$	$^4P°$	5/2	*190 830.3*	97			
		3/2	*191 618.2*	98			
		1/2	*192 033.5*	98			
$3d^6(^1G1)4s$	^2G	9/2	190 864.7	66		33	$(^1G2)\ ^2G$
		7/2	190 932.8	66		33	
$3d^6(^3P2)4p$	$^4S°$	3/2	*205 114.1*	44		19	$(^3P2)\ ^4P°$
$3d^6(^3H)4p$	$^4G°$	11/2	*206 005.3*	68		21	$(^3F2)\ ^4G°$
		9/2	*206 340.9*	51		28	
		7/2	*206 645.7*	45		34	
		5/2	*206 847.0*	42		38	
$3d^6(^3P2)4p$		5/2	*206 523.2*	27	$^4P°$	23	$(^3P1)\ ^4P°$
$3d^6(^3H)4p$	$^4I°$	11/2	*206 740.7*	51		35	$(^3H)\ ^4H°$
		13/2	*206 754.5*	48		38	$(^3H)\ ^4H°$
		9/2	*208 046.8*	46		19	$(^3H)\ ^4H°$
		15/2	*208 149.5*	99			
$3d^6(^3H)4p$		9/2	*206 865.5*	43	$^4I°$	37	$^4H°$
$3d^6(^3H)4p$	$^4H°$	7/2	*207 136.0*	47		20	$(^3H)\ ^2G°$
		11/2	*208 595.3*	45		44	$(^3H)\ ^4I°$
		13/2	*208 631.3*	51		40	$(^3H)\ ^4I°$
$3d^6(^3P2)4p$	$^4P°$	1/2	*207 846.2*	48		41	$(^3P1)\ ^4P°$

Ni IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^6(^3P2)4p$		5/2	*208 009.1*	32	$^2D^\circ$	20	$(^3P1)\ ^2D^\circ$
$3d^6(^3P2)4p$		7/2	*208 330.7*	22	$^4D^\circ$	19	$(^3F2)\ ^4F^\circ$
$3d^6(^3P2)4p$		3/2	*208 461.0*	22	$^4S^\circ$	13	$^4P^\circ$
$3d^6(^3F2)4p$	$^4F^\circ$	5/2	*208 605.7*	54		18	$(^3F1)\ ^4F^\circ$
		3/2	*208 766.9*	63		20	
		9/2	*208 933.6*	49		18	
$3d^6(^3P2)4p$	$^4D^\circ$	7/2	*208 912.1*	39		21	$(^3P1)\ ^4D^\circ$
		1/2	*210 313.3*	59		28	$(^3P1)\ ^4D^\circ$
$3d^6(^3H)4p$		9/2	*209 131.9*	37	$^2G^\circ$	23	$(^3H)\ ^4H^\circ$
$3d^6(^3H)4p$		7/2	*209 391.4*	34	$^2G^\circ$	16	$(^3F2)\ ^4F^\circ$
$3d^6(^3P2)4p$		3/2	*209 985.1*	18	$^2D^\circ$	16	$(^3P2)\ ^4P^\circ$
$3d^6(^3F2)4p$	$^4D^\circ$	7/2	*210 121.8*	49		10	$(^3F1)\ ^4D^\circ$
		5/2	*210 943.6*	37		20	$(^3P2)\ ^4D^\circ$
		3/2	*211 246.8*	49		10	$(^3D)\ ^4D^\circ$
		1/2	*211 351.7*	67		12	$(^3F1)\ ^4D^\circ$
$3d^6(^3H)4p$	$^2I^\circ$	13/2	*210 177.0*	86		11	$(^3H)\ ^4I^\circ$
		11/2	*210 987.5*	88		4	
$3d^6(^3F2)4p$		5/2	*210 590.6*	24	$^4D^\circ$	23	$(^3P2)\ ^4D^\circ$
$3d^6(^3P2)4p$		3/2	*211 027.6*	20	$^4D^\circ$	18	$(^3F2)\ ^4D^\circ$
$3d^6(^3F2)4p$	$^4G^\circ$	9/2	*212 150.9*	37		20	$(^3H)\ ^4G^\circ$
		11/2	*212 207.0*	53		17	
$3d^6(^3F2)4p$		5/2	*212 275.9*	24	$^2F^\circ$	19	$(^3F2)\ ^4G^\circ$
$3d^6(^3F2)4p$		7/2	*212 281.8*	26	$^4G^\circ$	17	$(^3H)\ ^4G^\circ$
$3d^6(^3F2)4p$		7/2	*213 131.1*	24	$^2F^\circ$	14	$(^3H)\ ^4G^\circ$
$3d^6(^3G)4p$	$^4F^\circ$	9/2	*213 408.6*	57		25	$(^3G)\ ^4G^\circ$
		7/2	*214 101.0*	37		41	$(^3G)\ ^4G^\circ$
		5/2	*215 516.8*	43		30	$(^3G)\ ^4G^\circ$
		3/2	*215 541.3*	68		15	$(^3D)\ ^4F^\circ$
$3d^6(^3H)4p$		5/2	*213 412.1*	28	$^4G^\circ$	18	$(^3F2)\ ^4G^\circ$
$3d^6(^3G)4p$		11/2	*213 606.9*	31	$^4G^\circ$	30	$^2H^\circ$
$3d^6(^3P2)4p$		1/2	*213 640.2*	31	$^2P^\circ$	23	$(^3P1)\ ^2P^\circ$
$3d^6(^3F2)4p$		9/2	*213 739.7*	33	$^2G^\circ$	20	$(^3G)\ ^2H^\circ$
$3d^6(^3P2)4p$	$^2P^\circ$	3/2	*214 055.8*	50		33	$(^3P1)\ ^2P^\circ$
$3d^6(^3G)4p$	$^4G^\circ$	11/2	*214 316.8*	47		21	$(^3H)\ ^2H^\circ$
		5/2	*214 718.1*	46		27	$(^3G)\ ^4F^\circ$
		9/2	*214 910.5*	40		16	$(^3H)\ ^2H^\circ$
		7/2	*215 292.9*	39		33	$(^3G)\ ^4F^\circ$

Ni IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^6(^3F2)4p$		9/2	*214 587.4*	21	$^2G°$	16	$(^3H)\ ^2H°$
$3d^6(^3F2)4p$	$^2G°$	7/2	*214 622.8*	60		14	$(^3F1)\ ^2G°$
$3d^6(^3G)4p$	$^4H°$	13/2	*215 506.6*	86		11	$(^3H)\ ^4H°$
		11/2	*215 684.5*	73		10	$(^3H)\ ^2H°$
		7/2	*215 724.5*	73		12	$(^3H)\ ^4H°$
		9/2	*215 736.1*	73		9	$(^3H)\ ^4H°$
$3d^6(^3P2)4p$	$^2S°$	1/2	*215 531.0*	47		19	$(^3P1)\ ^2S°$
$3d^6(^3F2)4p$	$^2D°$	5/2	*217 414.3*	67		10	$(^3P2)\ ^2D°$
		3/2	*217 939.7*	64		15	
$3d^6(^3H)4p$	$^2H°$	11/2	*218 860.6*	48		42	$(^3G)\ ^2H°$
$3d^6(^3G)4p$	$^2F°$	5/2	*219 553.4*	47		19	$(^3D)\ ^2F°$
		7/2	*219 896.0*	52		16	
$3d^6(^3G)4p$	$^2H°$	9/2	*219 765.0*	43		39	$(^3H)\ ^2H°$
$3d^6(^1I)4p$	$^2K°$	13/2	*220 762.6*	97		2	$(^1I)\ ^2I°$
		15/2	*222 202.8*	99			
$3d^6(^3G)4p$	$^2G°$	9/2	*221 991.0*	71		18	$(^3H)\ ^2G°$
		7/2	*222 029.3*	71		12	
$3d^6(^3D)4p$	$^4P°$	5/2	*222 333.3*	87		3	$(^3P2)\ ^4P°$
		3/2	*222 662.9*	74		8	$(^3D)\ ^2P°$
		1/2	*223 225.4*	66		13	$(^3D)\ ^4D°$
$3d^6(^1G2)4p$	$^2H°$	9/2	*222 705.5*	44		17	$(^1I)\ ^2H°$
		11/2	*225 758.5*	36		27	$(^1G1)\ ^2H°$
$3d^6(^1I)4p$	$^2H°$	11/2	*222 993.3*	53		25	$(^1G2)\ ^2H°$
		9/2	*225 903.7*	61		15	$(^1G1)\ ^2H°$
$3d^6(^3D)4p$		1/2	*223 785.4*	33	$^4D°$	26	$(^3D)\ ^4P°$
$3d^6(^3D)4p$	$^4F°$	5/2	*224 021.3*	58		17	$(^3G)\ ^4F°$
		7/2	*224 824.9*	47		12	$(^1G2)\ ^2G°$
		9/2	*225 096.4*	73		11	$(^3G)\ ^4F°$
$3d^6(^3D)4p$		7/2	*224 075.3*	24	$^4F°$	10	$(^1G2)\ ^2F°$
$3d^6(^3D)4p$		3/2	*224 174.0*	30	$^4D°$	30	$(^3D)\ ^2P°$
$3d^6(^1G2)4p$	$^2G°$	7/2	*224 463.6*	44		18	$(^1G1)\ ^2G°$
		9/2	*224 761.5*	50		21	
$3d^6(^3D)4p$	$^4D°$	5/2	*224 645.7*	68		14	$(^3D)\ ^4F°$
		7/2	*225 136.9*	54		13	$(^1G2)\ ^2F°$
$3d^6(^3D)4p$	$^2P°$	3/2	*224 936.9*	41		41	$(^3D)\ ^4D°$
		1/2	*224 996.5*	40		36	
$3d^6(^1G2)4p$		5/2	*225 431.6*	34	$^2F°$	15	$(^1G1)\ ^2F°$

Ni IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^6(^1I)4p$	$^2I°$	13/2	*226 685.0*	98		2	$(^1I)\ ^2K°$
		11/2	*226 702.5*	82		10	$(^1I)\ ^2H°$
$3d^6(^3D)4p$	$^2D°$	3/2	*227 181.1*	76		7	$(^1D2)\ ^2P°$
		5/2	*227 549.4*	86		3	$(^1F)\ ^2D°$
$3d^6(^1D2)4p$	$^2P°$	3/2	*228 214.2*	34		23	$(^1S2)\ ^2P°$
		1/2	*232 897.0*	40		27	
$3d^6(^3D)4p$	$^2F°$	7/2	*228 518.5*	62		14	$(^1D2)\ ^2F°$
		5/2	*229 269.5*	54		20	
$3d^6(^1S2)4p$		1/2	*229 297.5*	32	$^2P°$	26	$(^1D2)\ ^2P°$
$3d^6(^1D2)4p$		5/2	*231 091.8*	31	$^2D°$	17	$(^1D2)\ ^2F°$
$3d^6(^1D2)4p$	$^2D°$	3/2	*231 742.0*	62		12	$(^1D1)\ ^2D°$
$3d^6(^1D2)4p$		5/2	*232 272.7*	30	$^2D°$	25	$^2F°$
$3d^6(^1D2)4p$	$^2F°$	7/2	*232 539.5*	51		13	$(^1D1)\ ^2F°$
$3d^6(^1S2)4p$		3/2	*234 019.5*	37	$^2P°$	24	$(^1D2)\ ^2P°$
$3d^6(^1F)4p$	$^2G°$	7/2	*237 480.3*	90		2	$(^3G)\ ^2G°$
		9/2	*238 957.8*	93		2	$(^1G2)\ ^2G°$
$3d^6(^1F)4p$	$^2D°$	5/2	*239 009.7*	63		15	$(^1D2)\ ^2D°$
		3/2	*240 094.2*	70		9	
$3d^6(^3P1)4p$	$^4D°$	1/2	*241 172.4*	37		37	$(^3F1)\ ^4D°$
$3d^6(^3F1)4p$	$^4D°$	3/2	*241 540.0*	35		32	$(^3P1)\ ^4D°$
		5/2	*241 817.9*	43		29	
		7/2	*241 939.0*	50		23	
$3d^6(^1F)4p$	$^2F°$	5/2	*243 520.1*	83		4	$(^1G2)\ ^2F°$
		7/2	*243 542.0*	82		4	
$3d^6(^3F1)4p$	$^4G°$	7/2	*247 731.7*	77		17	$(^3F2)\ ^4G°$
		9/2	*248 218.0*	74		18	
		11/2	*248 855.4*	78		20	
$3d^6(^3P1)4p$	$^4S°$	3/2	*249 130.0*	74		24	$(^3P2)\ ^4S°$
$3d^6(^3F1)4p$	$^2D°$	3/2	*250 951.0*	49		24	$(^3P1)\ ^2D°$
		5/2	*251 694.3*	46		23	
$3d^6(^3F1)4p$	$^2G°$	9/2	*251 773.6*	66		17	$(^3F2)\ ^2G°$
		7/2	*252 523.0*	69		16	
$3d^6(^3P1)4p$	$^4P°$	5/2	*252 354.0*	37		29	$(^3P2)\ ^4P°$
$3d^6(^3F1)4p$		3/2	*252 975.4*	32	$^4D°$	23	$(^3P1)\ ^4D°$
$3d^6(^3F1)4p$		5/2	*253 326.2*	26	$^4F°$	13	$(^3P1)\ ^4D°$

Ni IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^6(^3F1)4p$	$^4F°$	3/2	*253 579.3*	57		18	$(^3F2)\ ^4F°$
		7/2	*253 639.1*	40		16	$(^3P1)\ ^4D°$
		5/2	*254 123.7*	40		17	$(^3F1)\ ^4D°$
		9/2	*254 300.0*	66		24	$(^3F2)\ ^4F°$
$3d^6(^3F1)4p$		7/2	*254 663.4*	26	$^4F°$	22	$(^3P1)\ ^4D°$
$3d^6(^3F1)4p$		3/2	*255 064.0*	27	$^2D°$	23	$(^3P1)\ ^2D°$
$3d^6(^3F1)4p$	$^2F°$	7/2	*257 018.0*	54		23	$(^3F2)\ ^2F°$
		5/2	*257 406.4*	66		25	
$3d^6(^1G1)4p$	$^2H°$	9/2	*258 672.8*	59		33	$(^1G2)\ ^2H°$
		11/2	*260 065.1*	62		35	
$3d^6(^1G1)4p$		7/2	*260 355.5*	31	$^2F°$	23	$(^1G1)\ ^2G°$
$3d^6(^1G1)4p$	$^2F°$	5/2	*261 226.3*	55		26	$(^1G2)\ ^2F°$
$3d^6(^1G1)4p$	$^2G°$	9/2	*262 275.5*	64		27	$(^1G2)\ ^2G°$
		7/2	*262 538.7*	44		19	
$3d^6(^1D1)4p$	$^2D°$	3/2	*282 179.5*	79		17	$(^1D2)\ ^2D°$
		5/2	*282 645.2*	79		17	
Ni V $(^5D_4)$	***Limit***		**443 000**				

Ni V

Z=28

Cr I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$ $^5D_4$

Ionization energy = 613 500±500 cm^{-1} (76.1±0.6 eV)

The $3d^6$–$3d^5 4p$ transition array between 300 and 425 Å has been observed and analysed by Raassen, van Kleef, and Metsch (1976). They have found all but the high ^{1}S level of $3d^6$ and 177 out of 214 levels of $3d^5 4p$. The uncertainty of the level values is about ±0.5 cm^{-1}.

Raassen and van Kleef (1977) found 37 more levels of $3d^5 4p$ and observed and analysed the $3d^5 4s$–$3d^5 4p$ transition array between 990 and 1400 Å. They also found one term in each of the configurations $3d^5 5p$, $3d^5 4f$ and $3d^5 5f$.

Raassen and van Kleef derived the ionization energy from the two-member np and nf series. We have confirmed their value to within 200 cm^{-1} by recalculating the $3d^5(^6S)nf$ ^{5}F series limit and assuming a value for $n^*(5f)$-$n^*(4f)$ of 0.9952 taken from Zn II. Accordingly, we reduced their uncertainty estimate of ±3000 cm^{-1} to ±500 cm^{-1}.

References

Raassen, A. J. J., van Kleef, Th. A. M., and Metsch, B. C. (1976), Physica **84C**, 133.

Raassen, A. J. J., and van Kleef, Th. A. M. (1977), Physica **85C**, 180.

Ni v

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^6$	^{5}D	4	0.0	100		
		3	889.7	100		
		2	1 489.9	100		
		1	1 871.5	100		
		0	2 057.6	100		
$3d^6$	^{3}P2	2	26 153.0	62	38	^{3}P1
		1	28 697.6	63	37	
		0	29 640.0	62	36	
$3d^6$	^{3}H	6	27 111.2	99	1	^{1}I
		5	27 578.2	97	3	^{3}G
		4	27 858.8	88	5	^{3}F2
$3d^6$	^{3}F2	4	29 123.7	68	20	^{3}F1
		3	29 570.8	75	20	
		2	29 899.2	80	20	
$3d^6$	^{3}G	5	33 256.5	97	3	^{3}H
		4	34 061.7	93	4	^{3}F2
		3	34 416.4	96	4	^{3}F2
$3d^6$	^{1}I	6	41 252.2	99	1	^{3}H
$3d^6$	^{3}D	2	41 626.9	97	2	^{1}D2
		1	41 701.1	100		
		3	41 920.2	100		
$3d^6$	^{1}G2	4	42 208.1	65	33	^{1}G1
$3d^6$	^{1}S2	0	47 699.7	76	22	^{1}S1
$3d^6$	^{1}D2	2	48 607.0	76	21	^{1}D1
$3d^6$	^{1}F	3	57 924.1	98	1	^{3}F1

Ni v—Continued

Configuration	Term	*J*	Level (cm⁻¹)	Leading percentages		
$3d^6$	^{3}P1	0	66 737.8	64	36	^{3}P2
		1	67 547.9	63	37	
		2	69 156.1	62	38	
$3d^6$	^{3}F1	2	68 632.1	80	20	^{3}F2
		4	68 718.7	77	22	
		3	68 854.7	78	20	
$3d^6$	^{1}G1	4	77 899.5	66	34	^{1}G2
$3d^6$	^{1}D1	2	104 420.5	78	22	^{1}D2
$3d^5(^6S)4s$	^{7}S	3	164 525.9	100		
$3d^5(^6S)4s$	^{5}S	2	178 019.8	100		
$3d^5(^4G)4s$	^{5}G	6	208 046.4	100		
		5	208 131.0	100		
		2	208 151.5	99	1	(^{2}F1) ^{3}F
		4	208 163.7	100		
		3	208 164.6	100		
$3d^5(^4P)4s$	^{5}P	3	212 095.8	90	9	(^{4}D) ^{5}D
		2	212 253.4	91	8	
		1	212 455.7	96	4	
$3d^5(^4D)4s$	^{5}D	4	216 189.9	99	1	(^{4}G) ^{3}G
		0	216 305.7	98	2	(^{4}P) ^{3}P
		1	216 434.7	94	4	(^{4}P) ^{5}P
		2	216 590.5	91	8	(^{4}P) ^{5}P
		3	216 596.0	90	9	(^{4}P) ^{5}P
$3d^5(^4G)4s$	^{3}G	5	217 048.7	100		
		3	217 101.0	99	1	(^{2}F1) ^{1}F
		4	217 129.1	99	1	(^{4}D) ^{5}D
$3d^5(^4P)4s$	^{3}P	2	221 087.6	88	9	(^{4}D) ^{3}D
		1	221 429.0	92	6	
$3d^5(^4D)4s$	^{3}D	3	225 200.7	99		
		1	225 545.1	94	6	(^{4}P) ^{3}P
		2	225 616.5	90	9	(^{4}P) ^{3}P
$3d^5(^2I)4s$	^{3}I	6	229 408.8	99	1	(^{2}H) ^{3}H
		5	229 413.0	99	1	(^{2}H) ^{3}H
		7	229 440.6	100		
$3d^5(^2D3)4s$	^{3}D	3	232 545.9	55	19	(^{2}F1) ^{3}F
		2	232 655.6	50	17	(^{2}F1) ^{3}F
		1	232 910.8	50	34	(^{4}F) ^{5}F
$3d^5(^2I)4s$	^{1}I	6	233 839.2	98	2	(^{2}H) ^{3}H
$3d^5(^4F)4s$	^{5}F	5	234 082.1	98	2	(^{2}G2) ^{3}G
		4	234 125.4	92	5	(^{2}F1) ^{3}F
		3	234 275.2	89	8	(^{2}F1) ^{3}F
		2	234 412.7	70	23	(^{2}F1) ^{3}F
		1	235 116.5	65	27	(^{2}D3) ^{3}D

Ni v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^5(^2F1)4s$	^3F	4	235 420.6	92	6	$(^4F)\ ^5F$
		2	235 736.5	36	23	$(^2D3)\ ^3D$
		3	236 454.1	69	16	$(^2D3)\ ^3D$
$3d^5(^2D3)4s$	^1D	2	239 107.7	55	23	$(^2F1)\ ^3F$
$3d^5(^2F1)4s$	^1F	3	240 193.8	83	6	$(^2G2)\ ^3G$
$3d^5(^2H)4s$	^3H	4	240 959.6	71	24	$(^2G2)\ ^3G$
		5	241 082.2	69	28	$(^2G2)\ ^3G$
		6	241 773.6	97	2	$(^2I)\ ^1I$
$3d^5(^2G2)4s$	^3G	3	242 290.4	79	12	$(^4F)\ ^3F$
		4	242 504.3	45	28	$(^4F)\ ^3F$
		5	242 862.6	66	30	$(^2H)\ ^3H$
$3d^5(^6S)4p$	$^7P^\circ$	2	*242 837.0*	99	1	$(^6S)\ ^5P^\circ$
		3	*243 608.5*	98	2	$(^6S)\ ^5P^\circ$
		4	*244 900.5*	100		
$3d^5(^4F)4s$	^3F	2	243 266.2	93	3	$(^2F2)\ ^3F$
		4	243 331.5	62	30	$(^2G2)\ ^3G$
		3	243 370.5	83	14	$(^2G2)\ ^3G$
$3d^5(^2H)4s$	^1H	5	246 240.9	96	4	$(^2G2)\ ^3G$
$3d^5(^2G2)4s$	^1G	4	247 049.1	63	33	$(^2F2)\ ^3F$
$3d^5(^2F2)4s$	^3F	3	247 104.9	97	1	$(^4F)\ ^5F$
		2	247 165.0	96	3	$(^4F)\ ^3F$
		4	247 281.8	63	29	$(^2G2)\ ^1G$
$3d^5(^2F2)4s$	^1F	3	251 654.9	96	2	$(^4F)\ ^3F$
$3d^5(^6S)4p$	$^5P^\circ$	3	*253 862.7*	96	2	$(^6S)\ ^7P^\circ$
		2	*254 495.6*	97	1	$(^4D)\ ^5P^\circ$
		1	*254 885.0*	98	1	$(^4D)\ ^5P^\circ$
$3d^5(^2S)4s$	^3S	1	253 905.2	100		
$3d^5(^2D2)4s$	^3D	1	263 700.9	100		
		2	263 735.7	99		
		3	263 805.8	99		
$3d^5(^2D2)4s$	^1D	2	268 273.9	99		
$3d^5(^2G1)4s$	^3G	5	274 695.4	100		
		4	274 738.6	100		
		3	274 773.5	100		
$3d^5(^2G1)4s$	^1G	4	279 199.5	100		
$3d^5(^4G)4p$	$^5G^\circ$	2	*284 215.5*	92	4	$(^4G)\ ^3F^\circ$
		3	*284 249.0*	84	9	$(^4G)\ ^5H^\circ$
		4	*284 308.9*	81	14	$(^4G)\ ^5H^\circ$
		5	*284 402.5*	80	14	$(^4G)\ ^5H^\circ$
		6	*284 579.5*	84	11	$(^4G)\ ^5H^\circ$

Ni v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^5(^4G)4p$	$^5H^\circ$	3	286 293.6	88		8	$(^4G)\ ^5G^\circ$
		4	286 706.6	82		12	$(^4G)\ ^5G^\circ$
		5	287 127.2	75		11	$(^4G)\ ^5F^\circ$
		6	287 645.9	86		13	$(^4G)\ ^5G^\circ$
		7	288 021.6	100			
$3d^5(^4P)4p$	$^5D^\circ$	1	287 755.5	63		20	$(^4D)\ ^5D^\circ$
		2	287 782.1	45		18	$(^4G)\ ^5F^\circ$
		0	290 262.0	64		19	$(^4D)\ ^5D^\circ$
$3d^5(^4G)4p$	$^5F^\circ$	5	287 906.9	75		8	$(^4G)\ ^5H^\circ$
		4	288 161.6	71		10	$(^4D)\ ^5F^\circ$
		1	289 163.0	71		11	$(^4D)\ ^5F^\circ$
		2	289 247.1	52		13	$(^4P)\ ^5D^\circ$
		3	289 298.0	40		32	$(^4P)\ ^5D^\circ$
$3d^5(^4G)4p$		3	287 960.0	39	$^5F^\circ$	25	$(^4P)\ ^5D^\circ$
$3d^5(^4P)4p$	$^5S^\circ$	2	288 877.9	38		9	$(^4G)\ ^5F^\circ$
$3d^5(^4P)4p$	$^5P^\circ$	3	290 757.0	44		32	$(^4D)\ ^5P^\circ$
		2	291 390.0	58		26	
		1	291 541.7	71		15	
$3d^5(^4G)4p$	$^3F^\circ$	2	291 097.7	84		4	$(^4G)\ ^5G^\circ$
		3	291 328.5	81		4	$(^4F)\ ^3F^\circ$
		4	291 554.6	88		4	$(^4F)\ ^3F^\circ$
$3d^5(^4G)4p$	$^3H^\circ$	6	291 891.4	93		3	$(^4G)\ ^5H^\circ$
		5	292 353.4	94		2	$(^4G)\ ^5H^\circ$
		4	292 631.0	95		2	$(^2I)\ ^3H^\circ$
$3d^5(^4P)4p$	$^3P^\circ$	2	292 983.0	52		18	$(^4D)\ ^3P^\circ$
		1	293 420.0	53		18	
		0	293 867.0	65		20	
$3d^5(^4D)4p$	$^5F^\circ$	1	293 833.8	73		17	$(^4G)\ ^5F^\circ$
		2	294 086.0	76		15	
		3	294 443.3	76		11	
		4	294 939.6	79		8	
		5	295 444.3	91		6	
$3d^5(^4D)4p$	$^5D^\circ$	3	296 574.0	51		18	$(^4P)\ ^5D^\circ$
		4	296 919.3	68		22	
		2	297 013.9	54		17	
		1	297 417.9	51		17	
		0	298 060.0	63		22	
$3d^5(^4G)4p$	$^3G^\circ$	3	296 847.1	90		2	$(^4F)\ ^3G^\circ$
		4	296 897.0	91		2	$(^4F)\ ^3G^\circ$
		5	296 932.9	92		2	$(^4G)\ ^5F^\circ$
$3d^5(^4P)4p$	$^3D^\circ$	3	297 418.1	60		14	$(^4D)\ ^5P^\circ$
		2	297 842.5	57		18	
$3d^5(^4D)4p$	$^5P^\circ$	1	297 982.8	40		36	$(^4P)\ ^3D^\circ$
		2	299 045.6	39		19	$(^4P)\ ^5P^\circ$

Ni v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^5(^4P)4p$		1	*298 600.6*	30	$^3D^\circ$	29	$(^4D)\ ^5P^\circ$
$3d^5(^4D)4p$	$^3D^\circ$	3	*298 972.3*	43		15	$(^4P)\ ^5P^\circ$
		2	*300 224.9*	74		8	$(^4F)\ ^3D^\circ$
		1	*300 563.3*	65		17	$(^4P)\ ^3D^\circ$
$3d^5(^4D)4p$		3	*300 201.0*	36	$^3D^\circ$	31	$(^4D)\ ^5P^\circ$
$3d^5(^4D)4p$	$^3F^\circ$	4	*300 918.1*	84		5	$(^2G2)\ ^3F^\circ$
		3	*301 470.2*	76		8	$(^4P)\ ^3D^\circ$
		2	*301 553.0*	80		7	$(^4P)\ ^3D^\circ$
$3d^5(^4P)4p$	$^3S^\circ$	1	*303 249.5*	91		3	$(^4D)\ ^3P^\circ$
$3d^5(^4D)4p$	$^3P^\circ$	0	*305 386.9*	72		22	$(^4P)\ ^3P^\circ$
		1	*305 838.1*	66		21	
		2	*306 377.8*	63		25	
$3d^5(^2I)4p$	$^3K^\circ$	6	*305 590.8*	69		26	$(^2I)\ ^3I^\circ$
		7	*305 996.3*	56		34	$(^2I)\ ^3I^\circ$
		8	*308 138.8*	100			
$3d^5(^2I)4p$	$^3I^\circ$	5	*306 049.0*	64		19	$(^2I)\ ^1H^\circ$
		6	*307 399.7*	53		26	$(^2I)\ ^3K^\circ$
		7	*308 317.3*	62		38	$(^2I)\ ^3K^\circ$
$3d^5(^2D1)4s$	^3D	3	306 962.9	77		23	$(^2D3)\ ^3D$
		2	307 025.2	77		23	
		1	307 105.1	76		23	
$3d^5(^2D3)4p$	$^3F^\circ$	2	*307 731.1*	21		25	$(^2F1)\ ^3F^\circ$
		3	*308 592.0*	37		23	
		4	*310 212.6*	39		25	
$3d^5(^2I)4p$	$^1H^\circ$	5	*308 804.1*	52		29	$(^2I)\ ^3I^\circ$
$3d^5(^2D3)4p$		2	*308 943.0*	29	$^3F^\circ$	21	$^1D^\circ$
$3d^5(^2I)4p$	$^3H^\circ$	6	*309 264.0*	73		17	$(^2I)\ ^3I^\circ$
		5	*309 919.5*	78		11	$(^2I)\ ^1H^\circ$
		4	*309 952.5*	79		5	$(^2G2)\ ^3H^\circ$
$3d^5(^2I)4p$	$^1K^\circ$	7	*309 743.6*	91		5	$(^2I)\ ^3K^\circ$
$3d^5(^2D1)4s$	^1D	2	311 470.3	77		23	$(^2D3)\ ^1D$
$3d^5(^2D3)4p$	$^3P^\circ$	2	*311 966.5*	40		15	$(^2F1)\ ^3D^\circ$
		0	*313 577.3*	66		20	$(^2D1)\ ^3P^\circ$
$3d^5(^2F1)4p$	$^1G^\circ$	4	*312 008.3*	43		12	$(^2H)\ ^1G^\circ$
$3d^5(^2D3)4p$		1	*312 291.0*	31	$^3P^\circ$	28	$(^2D3)\ ^3D^\circ$
$3d^5(^2F1)4p$	$^3G^\circ$	3	*312 463.3*	43		20	$(^2F1)\ ^3F^\circ$
		5	*314 702.2*	70		23	$(^4F)\ ^5G^\circ$

Ni v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^5(^4F)4p$	$^5G^\circ$	2	312 778.2	78		9	$(^2F1)\ ^3F^\circ$
		3	312 889.4	43		19	$(^2D3)\ ^3D^\circ$
		4	313 281.3	72		5	$(^4F)\ ^5F^\circ$
		5	313 464.7	56		15	$(^2F1)\ ^3G^\circ$
		6	314 756.4	53		42	$(^2I)\ ^1I^\circ$
$3d^5(^2F1)4p$		3	312 953.6	33	$^3D^\circ$	31	$(^4F)\ ^5G^\circ$
$3d^5(^2D3)4p$		1	313 679.0	29	$^3D^\circ$	27	$(^2D3)\ ^3P^\circ$
$3d^5(^2D3)4p$	$^3D^\circ$	2	313 686.6	45		15	$(^2D1)\ ^3D^\circ$
$3d^5(^2F1)4p$		3	313 919.8	23	$^3D^\circ$	22	$(^2D3)\ ^3D^\circ$
$3d^5(^2F1)4p$		4	314 208.8	30	$^3F^\circ$	30	$(^2F1)\ ^3G^\circ$
$3d^5(^2I)4p$	$^1I^\circ$	6	314 392.0	44		38	$(^4F)\ ^5G^\circ$
$3d^5(^4F)4p$	$^5F^\circ$	3	314 562.8	61		25	$(^4F)\ ^5D^\circ$
		4	314 599.2	39		21	$(^4F)\ ^5D^\circ$
		2	314 834.7	42		23	$(^4F)\ ^5D^\circ$
		1	315 152.8	74		9	$(^4F)\ ^5D^\circ$
		5	315 168.2	65		9	$(^4F)\ ^5G^\circ$
$3d^5(^2F1)4p$	$^3D^\circ$	1	315 300.7	51		19	$(^2D3)\ ^1P^\circ$
$3d^5(^2F1)4p$		3	315 326.2	25	$^3G^\circ$	14	$(^2D3)\ ^1F^\circ$
$3d^5(^2F1)4p$		2	315 366.1	32	$^3D^\circ$	18	$(^4F)\ ^5F^\circ$
$3d^5(^2G2)4p$	$^3H^\circ$	4	315 370.1	31		29	$(^2H)\ ^3H^\circ$
		5	323 908.6	36		28	
		6	325 148.4	45		37	
$3d^5(^2H)4p$	$^3H^\circ$	5	315 990.5	30		36	$(^2G2)\ ^3H^\circ$
		6	317 327.3	39		35	
		4	323 926.3	44		36	
$3d^5(^2D3)4p$		4	316 068.8	20	$^3F^\circ$	18	$(^2F1)\ ^3G^\circ$
$3d^5(^2F1)4p$		2	316 165.4	31	$^3F^\circ$	17	$(^2F1)\ ^3D^\circ$
$3d^5(^2F1)4p$		3	316 280.3	19	$^3F^\circ$	14	$(^2D3)\ ^1F^\circ$
$3d^5(^2H)4p$	$^3G^\circ$	5	316 726.6	47		14	$(^2G2)\ ^3G^\circ$
$3d^5(^4F)4p$	$^5D^\circ$	4	316 744.0	44		24	$(^4F)\ ^5F^\circ$
		3	317 232.0	39		17	$(^4F)\ ^5F^\circ$
		0	317 462.3	88		7	$(^2D3)\ ^3P^\circ$
		1	317 477.9	76		9	$(^4F)\ ^5F^\circ$
		2	317 517.5	65		15	$(^4F)\ ^5F^\circ$
$3d^5(^2H)4p$		4	316 887.8	36	$^3G^\circ$	12	$(^2F2)\ ^3G^\circ$
$3d^5(^4F)4p$		3	317 376.8	22	$^5D^\circ$	20	$(^2H)\ ^3G^\circ$
$3d^5(^2D3)4p$	$^1P^\circ$	1	319 073.4	45		22	$(^2F1)\ ^3D^\circ$

Ni v—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages			
$3d^5(^2H)4p$	$^3I°$	5	*319 076.2*	85		6	$(^2H)\ ^3H°$
		6	*319 860.4*	78		8	$(^2H)\ ^1I°$
		7	*320 783.1*	95		2	$(^2I)\ ^3I°$
$3d^5(^2G2)4p$		4	*319 138.7*	25	$^1G°$	18	$(^2F1)\ ^1G°$
$3d^5(^4F)4p$	$^3G°$	3	*319 620.2*	38		32	$(^2G2)\ ^3G°$
		5	*319 652.7*	65		15	
		4	*319 899.1*	57		15	
$3d^5(^2F1)4p$	$^1D°$	2	*319 926.5*	51		29	$(^2D3)\ ^1D°$
$3d^5(^2G2)4p$	$^3F°$	3	*320 513.8*	41		18	$(^4F)\ ^3G°$
		2	*321 018.3*	57		11	$(^4F)\ ^3F°$
		4	*321 056.4*	54		13	$(^2G2)\ ^1G°$
$3d^5(^2F1)4p$	$^1F°$	3	*321 081.9*	52		17	$(^2G2)\ ^3F°$
$3d^5(^2H)4p$	$^1I°$	6	*322 324.2*	76		9	$(^2H)\ ^3H°$
$3d^5(^4F)4p$	$^3D°$	2	*322 436.4*	54		11	$(^2F2)\ ^3F°$
		3	*322 617.6*	50		10	$(^2F2)\ ^3F°$
		1	*322 984.5*	79		7	$(^4D)\ ^3D°$
$3d^5(^4F)4p$	$^3F°$	4	*322 820.8*	60		28	$(^2F2)\ ^3F°$
		3	*323 532.2*	60		17	
		2	*323 853.1*	53		20	
$3d^5(^2G2)4p$	$^3G°$	5	*324 980.2*	25		21	$(^2F2)\ ^3G°$
		3	*325 211.9*	30		29	
		4	*325 222.9*	27		28	
$3d^5(^2F2)4p$		4	*325 558.6*	32	$^1G°$	13	$(^2G2)\ ^1G°$
$3d^5(^2F2)4p$	$^3F°$	2	*325 982.2*	26		23	$(^4F)\ ^3F°$
		3	*326 029.9*	48		13	
		4	*326 876.3*	44		14	
$3d^5(^2G2)4p$	$^1H°$	5	*326 337.1*	53		26	$(^2H)\ ^1H°$
$3d^5(^2G2)4p$	$^1F°$	3	*326 739.0*	58		6	$(^2G2)\ ^3G°$
$3d^5(^2F2)4p$	$^1D°$	2	*327 122.7*	60		24	$(^2F2)\ ^3F°$
$3d^5(^2H)4p$	$^1H°$	5	*327 356.6*	63		29	$(^2G2)\ ^1H°$
$3d^5(^2F2)4p$	$^3D°$	1	*329 462.3*	55		21	$(^2S)\ ^3P°$
		2	*329 776.3*	70		12	$(^2F1)\ ^3D°$
		3	*329 872.9*	47		12	$(^2F2)\ ^3G°$
$3d^5(^2F2)4p$	$^3G°$	3	*329 614.3*	27		33	$(^2H)\ ^3G°$
		4	*330 297.6*	47		37	
		5	*330 718.1*	58		31	
$3d^5(^2S)4p$	$^3P°$	0	*329 618.5*	83		13	$(^2D2)\ ^3P°$
		1	*330 370.7*	58		23	$(^2F2)\ ^3D°$
		2	*331 678.2*	74		16	$(^2D2)\ ^3P°$

Ni v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^5(^2H)4p$	$^1G^\circ$	4	332 995.6	39	37	$(^2F2)\ ^1G^\circ$
$3d^5(^2S)4p$	$^1P^\circ$	1	334 477.2	70	19	$(^2D2)\ ^1P^\circ$
$3d^5(^2F2)4p$	$^1F^\circ$	3	334 727.6	88	4	$(^2F1)\ ^1F^\circ$
$3d^5(^2D2)4p$	$^3F^\circ$	2	342 894.6	67	21	$(^2D2)\ ^3D^\circ$
		3	343 281.0	50	27	$(^2D2)\ ^3D^\circ$
		4	344 911.2	92	5	$(^2G2)\ ^3F^\circ$
$3d^5(^2D2)4p$	$^3D^\circ$	1	343 478.2	89	2	$(^2D2)\ ^3P^\circ$
		2	343 905.7	65	21	$(^2D2)\ ^3F^\circ$
		3	344 805.3	60	33	$(^2D2)\ ^3F^\circ$
$3d^5(^2D2)4p$	$^1F^\circ$	3	345 936.1	72	12	$(^2G1)\ ^1F^\circ$
$3d^5(^2D2)4p$	$^3P^\circ$	2	346 912.4	72	16	$(^2S)\ ^3P^\circ$
		0	346 920.2	85	14	
		1	346 959.5	76	15	
$3d^5(^2D2)4p$	$^1P^\circ$	1	348 477.9	72	17	$(^2S)\ ^1P^\circ$
$3d^5(^2D2)4p$	$^1D^\circ$	2	349 546.0	87	5	$(^2F2)\ ^1D^\circ$
$3d^5(^2G1)4p$	$^3H^\circ$	4	353 071.6	47	31	$(^2G1)\ ^3F^\circ$
		5	353 548.7	76	15	$(^2G1)\ ^3G^\circ$
		6	354 989.6	98	2	$(^2I)\ ^3H^\circ$
$3d^5(^2G1)4p$	$^3F^\circ$	4	353 347.1	50	40	$(^2G1)\ ^3H^\circ$
		3	353 944.1	55	36	$(^2G1)\ ^3G^\circ$
		2	355 150.0	90	6	$(^2D1)\ ^3F^\circ$
$3d^5(^2G1)4p$	$^3G^\circ$	3	355 398.0	59	36	$(^2G1)\ ^3F^\circ$
		4	355 765.2	80	9	$(^2G1)\ ^3F^\circ$
		5	356 036.3	78	18	$(^2G1)\ ^3H^\circ$
$3d^5(^2G1)4p$	$^1H^\circ$	5	358 475.6	90	4	$(^2G1)\ ^3G^\circ$
$3d^5(^2G1)4p$	$^1G^\circ$	4	358 760.0	93	2	$(^2G1)\ ^3F^\circ$
$3d^5(^2G1)4p$	$^1F^\circ$	3	360 059.7	78	10	$(^2D2)\ ^1F^\circ$
$3d^5(^2P)4p$	$^3P^\circ$	0	368 440.5	75	20	$(^2D1)\ ^3P^\circ$
		1	368 749.7	73	21	
		2	369 649.1	72	23	
$3d^5(^2P)4p$	$^3D^\circ$	2	374 803.7	57	27	$(^2P)\ ^1D^\circ$
		1	374 828.1	90	5	$(^2D1)\ ^3D^\circ$
		3	376 471.6	89	7	$(^2D1)\ ^3D^\circ$
$3d^5(^2P)4p$	$^1D^\circ$	2	377 059.1	49	33	$(^2P)\ ^3D^\circ$
$3d^5(^2P)4p$	$^3S^\circ$	1	378 555.0	90	7	$(^2P)\ ^1P^\circ$
$3d^5(^2P)4p$	$^1P^\circ$	1	380 165.6	68	16	$(^2D1)\ ^1P^\circ$

Ni v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^5(^2D1)4p$	$^3F°$	2	*386 968.8*	63	20	$(^2D3)$ $^3F°$
		3	*387 333.4*	60	19	
		4	*388 698.9*	72	22	
$3d^5(^2D1)4p$	$^3D°$	1	*388 746.1*	71	21	$(^2D3)$ $^3D°$
		2	*389 571.8*	60	18	
		3	*390 478.2*	60	18	
$3d^5(^2D1)4p$	$^1D°$	2	*390 675.1*	44	16	(^2P) $^1D°$
$3d^5(^2D1)4p$	$^3P°$	2	*392 413.5*	43	21	(^2P) $^3P°$
$3d^5(^2D1)4p$	$^1F°$	3	*392 957.1*	69	21	$(^2D3)$ $^1F°$
$3d^5(^6S)5p$	$^5P°$	3	*423 533*			
		2	*423 782*			
		1	*423 935*			
$3d^5(^6S)4f$	$^5F°$	2	*439 419*			
		1	*439 420*			
		3	*439 423*			
		4	*439 427*			
		5	*439 434*			
$3d^5(^6S)5f$	$^5F°$	5	*502 124*			
		4	*502 133*			
		3	*502 137*			
		1	*502 143*			
		2	*502 148*			
Ni VI ($^6S_{5/2}$)	*Limit*		613 500			

Ni VI

$Z=28$

V I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$ $^6S_{5/2}$

Ionization energy = 870 000 cm^{-1} (108 eV)

The resonance multiplet $3d^5$ ^{6}S–$3d^4 4p$ ^{6}P° was identified by Kruger and Gilroy (1935). Extensive work on this spectrum is in progress at the Zeeman Laboratorium. The $3d^5$, $3d^4 4s$, and $3d^4 4p$ configurations were analysed by Raassen (1980), who kindly supplied his results for inclusion here before publication. The percentage compositions of the levels are also due to Raassen.

The ionization energy is from Lotz (1967).

References

Kruger, P. G., and Gilroy, H. T. (1935), Phys. Rev. **48**, 720.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Raassen, A. J. J. (1980), Physica **100C**, 404.

Ni VI

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^5$	^{6}S	5/2	0.0	100			
$3d^5$	^{4}G	11/2	41 920.9	100			
		5/2	42 003.6	99		1	^{2}F1
		9/2	42 023.2	100			
		7/2	42 035.1	100			
$3d^5$	^{4}P	5/2	45 884.2	90		9	^{4}D
		3/2	46 104.4	92		7	
		1/2	46 324.8	97		3	
$3d^5$	^{4}D	7/2	50 331.0	99			
		1/2	50 643.5	97		3	^{4}P
		5/2	50 777.6	90		9	^{4}P
		3/2	50 780.5	92		7	^{4}P
$3d^5$	^{2}I	11/2	61 196.0	98		2	^{2}H
		13/2	61 279.5	100			
$3d^5$	^{2}D3	5/2	64 152.4	52		29	^{2}F1
		3/2	65 173.5	71		22	^{2}D1
$3d^5$	^{2}F1	7/2	67 085.1	93		3	^{4}F
$3d^5$	^{4}F	5/2	68 444.9	51		39	^{2}F1
		9/2	68 551.2	95		4	^{2}G2
		7/2	68 801.7	94		4	^{2}F1
		3/2	69 173.5	92		6	^{2}D3
$3d^5$		5/2	69 447.0	47	^{4}F	31	^{2}F1
$3d^5$	^{2}H	9/2	72 908.8	74		24	^{2}G2
		11/2	73 756.6	98		2	^{2}I
$3d^5$	^{2}G2	7/2	74 627.7	98		1	^{4}F
		9/2	75 441.7	72		25	^{2}H
$3d^5$	^{2}F2	5/2	79 391.4	98		1	^{4}F
		7/2	79 608.3	97		2	

Ni VI—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages		
$3d^5$	^{2}S	1/2	86 532.1	100		
$3d^5$	^{2}D2	3/2	96 461.2	100		
		5/2	96 566.5	99	1	^{2}F2
$3d^5$	^{2}G1	9/2	107 848.3	100		
		7/2	107 887.0	100		
$3d^5$	^{2}P	3/2	129 951.6	99	1	^{2}D1
		1/2	130 025.9	100		
$3d^5$	^{2}D1	5/2	140 922.2	77	23	^{2}D3
		3/2	141 006.8	76	23	
$3d^4(^5D)4s$	^{6}D	1/2	295 882.7	100		
		3/2	296 198.1	100		
		5/2	296 696.7	100		
		7/2	297 350.5	100		
		9/2	298 130.5	100		
$3d^4(^5D)4s$	^{4}D	1/2	307 843.9	99		
		3/2	308 323.8	100		
		5/2	309 054.9	100		
		7/2	309 977.1	100		
$3d^4(^3P2)4s$	^{4}P	1/2	328 437.2	59	38	(^{3}P1) ^{4}P
		3/2	330 001.6	60	38	
		5/2	332 344.8	61	38	
$3d^4(^3H)4s$	^{4}H	7/2	329 486.2	97	2	(^{3}G) ^{4}G
		9/2	329 754.2	96	3	(^{3}G) ^{4}G
		11/2	330 141.0	97	2	(^{3}G) ^{4}G
		13/2	330 580.5	100		
$3d^4(^3F2)4s$	^{4}F	3/2	332 031.8	78	22	(^{3}F1) ^{4}F
		5/2	332 051.6	74	20	
		7/2	332 175.4	72	19	
		9/2	332 343.6	73	18	
$3d^4(^3G)4s$	^{4}G	5/2	335 384.5	91	5	(^{3}F2) ^{4}F
		7/2	335 976.0	90	7	(^{3}F2) ^{4}F
		9/2	336 344.9	73	18	(^{3}H) ^{2}H
		11/2	336 430.4	78	19	(^{3}H) ^{2}H
$3d^4(^3P2)4s$	^{2}P	1/2	336 404.8	59	38	(^{3}P1) ^{2}P
		3/2	339 260.1	60	37	
$3d^4(^3H)4s$	^{2}H	9/2	337 007.7	78	19	(^{3}G) ^{4}G
		11/2	337 993.9	79	20	
$3d^4(^3F2)4s$	^{2}F	5/2	339 482.4	76	20	(^{3}F1) ^{2}F
		7/2	339 335.8	70	17	
$3d^4(^3G)4s$	^{2}G	7/2	343 052.0	90	6	(^{3}F2) ^{2}F
		9/2	343 842.6	96	2	(^{3}H) ^{2}H

Ni vi—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^4(^3D)4s$	^4D	7/2	343 999.6	99		
		5/2	344 203.5	98		
		3/2	344 447.4	98		
$3d^4(^1G2)4s$	^2G	9/2	347 278.5	64	31	$(^1G1)\ ^2G$
		7/2	347 445.2	62	30	
$3d^4(^1I)4s$	^2I	13/2	347 892.4	100		
		11/2	347 963.9	99	1	$(^3H)\ ^2H$
$3d^4(^3D)4s$	^2D	5/2	351 033.0	99		
		3/2	351 304.0	98	1	$(^1D2)\ ^2D$
$3d^4(^1S2)4s$	^2S	1/2	351 096.2	78	20	$(^1S1)\ ^2S$
$3d^4(^1D2)4s$	^2D	5/2	358 716.6	77	20	$(^1D1)\ ^2D$
		3/2	358 827.9	77	20	
$3d^4(^1F)4s$	^2F	5/2	366 289.8	98	1	$(^3F1)\ ^4F$
		7/2	366 299.8	98	1	
$3d^4(^3P1)4s$	^4P	5/2	374 843.9	61	38	$(^3P2)\ ^4P$
		3/2	376 343.7	60	38	
$3d^4(^3F1)4s$	^4F	9/2	375 673.0	81	19	$(^3F2)\ ^4F$
		3/2	375 870.8	78	22	
		7/2	375 927.1	79	20	
		5/2	375 949.8	78	21	
$3d^4(^5D)4p$	$^6F^\circ$	1/2	*380 756.7*	99	1	$(^5D)\ ^4D^\circ$
		3/2	*381 163.8*	99		
		5/2	*381 832.8*	99	1	$(^5D)\ ^4F^\circ$
		7/2	*382 758.9*	98	1	$(^5D)\ ^4F^\circ$
		9/2	*383 960.2*	98	1	$(^5D)\ ^4F^\circ$
		11/2	*385 520.9*	100		
$3d^4(^3F1)4s$	^2F	7/2	382 677.1	80	19	$(^3F2)\ ^2F$
		5/2	382 889.1	78	21	
$3d^4(^5D)4p$	$^6P^\circ$	3/2	*383 557.8*	91	6	$(^5D)\ ^4P^\circ$
		5/2	*383 739.8*	94	4	$(^5D)\ ^4P^\circ$
		7/2	*384 096.5*	98	1	$(^5D)\ ^6D^\circ$
$3d^4(^5D)4p$	$^4P^\circ$	1/2	*384 747.4*	68	29	$(^5D)\ ^6D^\circ$
		3/2	*386 157.3*	55	33	
		5/2	*389 760.4*	55	42	
$3d^4(^5D)4p$	$^6D^\circ$	5/2	*387 849.9*	54	38	$(^5D)\ ^4P^\circ$
		1/2	*388 918.6*	71	29	$(^5D)\ ^4P^\circ$
		3/2	*389 214.0*	64	35	$(^5D)\ ^4P^\circ$
		7/2	*389 243.4*	94	4	$(^5D)\ ^4F^\circ$
		9/2	*389 883.2*	88	10	$(^5D)\ ^4F^\circ$
$3d^4(^1G1)4s$	^2G	7/2	389 362.5	66	33	$(^1G2)\ ^2G$
		9/2	389 299.6	67	33	

Ni VI—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages			
$3d^4(^5\mathrm{D})4p$	$^4\mathrm{F}^\circ$	3/2	*392 808.1*	94		2	$(^3\mathrm{G})\ ^4\mathrm{F}^\circ$
		5/2	*393 072.0*	93		2	$(^3\mathrm{G})\ ^4\mathrm{F}^\circ$
		7/2	*393 468.2*	91		4	$(^5\mathrm{D})\ ^6\mathrm{D}^\circ$
		9/2	*394 061.0*	85		11	$(^5\mathrm{D})\ ^6\mathrm{D}^\circ$
$3d^4(^5\mathrm{D})4p$	$^4\mathrm{D}^\circ$	1/2	*400 962.1*	96		1	$(^3\mathrm{D})\ ^4\mathrm{D}^\circ$
		3/2	*401 280.9*	96		1	
		5/2	*401 720.9*	96		1	
		7/2	*402 171.3*	96		2	
$3d^4(^3\mathrm{H})4p$	$^4\mathrm{H}^\circ$	7/2	*411 669.4*	74		20	$(^3\mathrm{G})\ ^4\mathrm{H}^\circ$
		9/2	*412 095.6*	70		19	
		11/2	*412 751.1*	72		17	
		13/2	*413 631.6*	77		13	
$3d^4(^3\mathrm{P}2)4p$	$^4\mathrm{D}^\circ$	1/2	*412 248.2*	47		32	$(^3\mathrm{P}1)\ ^4\mathrm{D}^\circ$
		3/2	*413 553.1*	47		31	
		5/2	*415 144.5*	38		26	
$3d^4(^3\mathrm{F}2)4p$	$^4\mathrm{G}^\circ$	5/2	*415 382.0*	40		23	$(^3\mathrm{G})\ ^4\mathrm{G}^\circ$
		7/2	*415 640.8*	25		16	$(^3\mathrm{G})\ ^4\mathrm{G}^\circ$
		9/2	*420 080.0*	40		40	$(^3\mathrm{H})\ ^4\mathrm{G}^\circ$
		11/2	*420 623.4*	58		22	$(^3\mathrm{H})\ ^4\mathrm{G}^\circ$
$3d^4(^3\mathrm{H})4p$	$^4\mathrm{I}^\circ$	9/2	*415 754.3*	45		11	$(^3\mathrm{H})\ ^2\mathrm{G}^\circ$
		11/2	*417 164.1*	63		14	$(^3\mathrm{H})\ ^4\mathrm{G}^\circ$
		13/2	*418 553.6*	90		8	$(^3\mathrm{H})\ ^4\mathrm{H}^\circ$
		15/2	*419 533.5*	99		1	$(^1\mathrm{I})\ ^2\mathrm{K}^\circ$
$3d^4(^3\mathrm{H})4p$		9/2	*416 422.3*	43	$^4\mathrm{I}^\circ$	11	$(^3\mathrm{F}2)\ ^4\mathrm{G}^\circ$
$3d^4(^3\mathrm{P}2)4p$	$^4\mathrm{P}^\circ$	1/2	*416 459.0*	35		20	$(^3\mathrm{P}1)\ ^4\mathrm{P}^\circ$
		3/2	*418 491.4*	45		25	
		5/2	*420 308.9*	50		28	
$3d^4(^3\mathrm{F}2)4p$	$^4\mathrm{D}^\circ$	7/2	*416 493.0*	31		23	$(^3\mathrm{P}2)\ ^4\mathrm{D}^\circ$
		1/2	*422 369.4*	42		15	$(^3\mathrm{F}1)\ ^4\mathrm{D}^\circ$
		3/2	*422 437.2*	37		12	$(^3\mathrm{F}1)\ ^4\mathrm{D}^\circ$
$3d^4(^3\mathrm{H})4p$		11/2	*417 538.4*	34	$^4\mathrm{G}^\circ$	25	$(^3\mathrm{H})\ ^4\mathrm{I}^\circ$
$3d^4(^3\mathrm{H})4p$	$^2\mathrm{G}^\circ$	7/2	*417 717.7*	38		16	$(^3\mathrm{F}2)\ ^2\mathrm{G}^\circ$
		9/2	*418 368.8*	32		18	
$3d^4(^3\mathrm{F}2)4p$		3/2	*418 713.4*	28	$^4\mathrm{F}^\circ$	21	$(^3\mathrm{F}2)\ ^2\mathrm{D}^\circ$
$3d^4(^3\mathrm{H})4p$		5/2	*419 390.5*	30	$^4\mathrm{G}^\circ$	26	$(^3\mathrm{F}2)\ ^4\mathrm{G}^\circ$
$3d^4(^3\mathrm{F}2)4p$		5/2	*419 844.7*	39	$^4\mathrm{F}^\circ$	14	$(^3\mathrm{H})\ ^4\mathrm{G}^\circ$
$3d^4(^3\mathrm{H})4p$	$^4\mathrm{G}^\circ$	7/2	*419 863.3*	47		32	$(^3\mathrm{F}2)\ ^4\mathrm{G}^\circ$
$3d^4(^3\mathrm{P}2)4p$		1/2	*419 961.5*	23	$^4\mathrm{P}^\circ$	18	$(^3\mathrm{P}1)\ ^2\mathrm{S}^\circ$
$3d^4(^3\mathrm{F}2)4p$	$^4\mathrm{F}^\circ$	7/2	*420 553.2*	63		11	$(^3\mathrm{F}1)\ ^4\mathrm{F}^\circ$
		9/2	*420 835.3*	58		13	$(^3\mathrm{G})\ ^4\mathrm{F}^\circ$

Ni VI—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^4(^3P2)4p$		3/2	*420 722.0*	26	$^2P^\circ$	18	$(^3P2)\ ^4S^\circ$
$3d^4(^3F2)4p$		5/2	*421 324.3*	19	$^2D^\circ$	15	$(^3F2)\ ^4F^\circ$
$3d^4(^3F2)4p$		3/2	*421 607.2*	24	$^4F^\circ$	20	$(^3F2)\ ^2D^\circ$
$3d^4(^3F2)4p$		5/2	*421 894.0*	15	$^2D^\circ$	14	$^4D^\circ$
$3d^4(^3P2)4p$		7/2	*422 306.6*	21	$^4D^\circ$	20	$(^3G)\ ^4F^\circ$
$3d^4(^3H)4p$	$^2I^\circ$	11/2	*422 642.4*	80		6	$(^1I)\ ^2I^\circ$
		13/2	*422 711.8*	82		11	$(^3G)\ ^4H^\circ$
$3d^4(^3G)4p$		5/2	*422 897.8*	22	$^2F^\circ$	16	$(^3F2)\ ^4D^\circ$
$3d^4(^3H)4p$		9/2	*423 065.5*	36	$^2H^\circ$	20	$(^3G)\ ^4H^\circ$
$3d^4(^3G)4p$	$^4H^\circ$	7/2	*423 341.4*	70		20	$(^3H)\ ^4H^\circ$
		9/2	*424 537.0*	54		18	$(^3H)\ ^2H^\circ$
		11/2	*425 567.6*	39		39	$(^3H)\ ^2H^\circ$
		13/2	*426 451.9*	75		14	$(^3H)\ ^4H^\circ$
$3d^4(^3G)4p$		7/2	*423 645.8*	18	$^4F^\circ$	15	$(^3D)\ ^2F^\circ$
$3d^4(^3P2)4p$		1/2	*423 646.8*	29	$^2P^\circ$	18	$(^3F2)\ ^4D^\circ$
$3d^4(^3G)4p$		3/2	*423 710.5*	26	$^4F^\circ$	12	$(^3F2)\ ^4F^\circ$
$3d^4(^3G)4p$	$^4F^\circ$	9/2	*423 763.3*	52		15	$(^3F2)\ ^4F^\circ$
		5/2	*424 217.9*	39		16	$(^3F2)\ ^4D^\circ$
$3d^4(^3G)4p$		3/2	*424 235.1*	21	$^4F^\circ$	20	$(^3P2)\ ^2P^\circ$
$3d^4(^3F2)4p$		7/2	*424 346.1*	25	$^4D^\circ$	20	$(^3G)\ ^4F^\circ$
$3d^4(^3G)4p$		11/2	*424 363.7*	36	$^4H^\circ$	30	$(^3H)\ ^2H^\circ$
$3d^4(^3P2)4p$	$^2D^\circ$	3/2	*425 703.1*	39		27	$(^3P1)\ ^2D^\circ$
$3d^4(^3F2)4p$		5/2	*427 096.5*	26	$^2F^\circ$	20	$(^3P2)\ ^2D^\circ$
$3d^4(^3P2)4p$		5/2	*427 342.2*	27	$^2D^\circ$	26	$(^3F2)\ ^2F^\circ$
$3d^4(^3F2)4p$		7/2	*427 575.0*	24	$^2G^\circ$	13	$(^3F1)\ ^2G^\circ$
$3d^4(^3G)4p$		11/2	*427 702.7*	38	$^2H^\circ$	21	$(^3G)\ ^4G^\circ$
$3d^4(^3G)4p$		9/2	*427 995.6*	22	$^4G^\circ$	15	$(^3H)\ ^4G^\circ$
$3d^4(^3G)4p$		9/2	*428 051.5*	37	$^2H^\circ$	15	$(^3H)\ ^2G^\circ$
$3d^4(^3F2)4p$	$^2F^\circ$	7/2	*428 221.4*	46		32	$(^3G)\ ^2F^\circ$
$3d^4(^3G)4p$	$^4G^\circ$	5/2	*428 496.5*	50		29	$(^3H)\ ^4G^\circ$
		7/2	*428 866.5*	45		20	$(^3H)\ ^4G^\circ$
		9/2	*429 486.3*	36		15	$(^3G)\ ^2H^\circ$
		11/2	*430 033.3*	43		25	$(^3G)\ ^2H^\circ$

Ni VI—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^4(^3\mathrm{D})4p$	$^4\mathrm{D}^\circ$	1/2	430 898.8	78	9	$(^3\mathrm{D})\ ^2\mathrm{P}^\circ$
		3/2	430 971.9	69	12	$(^3\mathrm{D})\ ^4\mathrm{P}^\circ$
		7/2	431 912.6	77	6	$(^3\mathrm{D})\ ^4\mathrm{F}^\circ$
		5/2	432 295.7	46	33	$(^3\mathrm{D})\ ^4\mathrm{P}^\circ$
$3d^4(^3\mathrm{D})4p$	$^4\mathrm{P}^\circ$	5/2	431 019.9	56	32	$(^3\mathrm{D})\ ^4\mathrm{D}^\circ$
		3/2	433 462.5	74	9	$(^3\mathrm{D})\ ^4\mathrm{D}^\circ$
		1/2	434 281.6	88	7	$(^3\mathrm{P2})\ ^4\mathrm{P}^\circ$
$3d^4(^1\mathrm{I})4p$	$^2\mathrm{I}^\circ$	13/2	432 616.6	66	27	$(^1\mathrm{I})\ ^2\mathrm{K}^\circ$
		11/2	432 932.0	88	5	$(^3\mathrm{H})\ ^2\mathrm{I}^\circ$
$3d^4(^1\mathrm{G2})4p$	$^2\mathrm{F}^\circ$	7/2	432 800.1	46	21	$(^1\mathrm{G1})\ ^2\mathrm{F}^\circ$
		5/2	434 997.0	42	20	
$3d^4(^3\mathrm{G})4p$	$^2\mathrm{G}^\circ$	9/2	433 371.2	53	20	$(^3\mathrm{H})\ ^2\mathrm{G}^\circ$
		7/2	433 517.3	49	17	
$3d^4(^1\mathrm{S2})4p$	$^2\mathrm{P}^\circ$	1/2	433 936.9	37	33	$(^3\mathrm{D})\ ^2\mathrm{P}^\circ$
		3/2	440 168.6	30	16	
$3d^4(^1\mathrm{G2})4p$	$^2\mathrm{H}^\circ$	9/2	434 167.3	47	22	$(^1\mathrm{G1})\ ^2\mathrm{H}^\circ$
		11/2	435 011.5	53	20	
$3d^4(^3\mathrm{D})4p$	$^4\mathrm{F}^\circ$	3/2	434 200.9	63	21	$(^3\mathrm{G})\ ^4\mathrm{F}^\circ$
		5/2	434 625.7	54	15	
		7/2	435 116.2	65	19	
		9/2	435 459.4	77	19	
$3d^4(^3\mathrm{D})4p$	$^2\mathrm{P}^\circ$	3/2	434 995.8	54	26	$(^1\mathrm{S2})\ ^2\mathrm{P}^\circ$
		1/2	440 689.3	47	27	
$3d^4(^1\mathrm{I})4p$	$^2\mathrm{K}^\circ$	13/2	435 165.4	71	28	$(^1\mathrm{I})\ ^2\mathrm{I}^\circ$
		15/2	436 550.3	99	1	$(^3\mathrm{H})\ ^4\mathrm{I}^\circ$
$3d^4(^1\mathrm{G2})4p$	$^2\mathrm{G}^\circ$	7/2	437 919.7	45	29	$(^1\mathrm{G1})\ ^2\mathrm{G}^\circ$
		9/2	438 639.4	41	30	
$3d^4(^1\mathrm{I})4p$	$^2\mathrm{H}^\circ$	11/2	440 038.7	70	10	$(^3\mathrm{G})\ ^2\mathrm{H}^\circ$
		9/2	440 917.9	82	11	
$3d^4(^3\mathrm{D})4p$	$^2\mathrm{F}^\circ$	7/2	441 216.1	65	11	$(^3\mathrm{G})\ ^2\mathrm{F}^\circ$
		5/2	441 785.7	42	14	$(^3\mathrm{D})\ ^2\mathrm{D}^\circ$
$3d^4(^3\mathrm{D})4p$		5/2	441 401.2	30 $^2\mathrm{D}^\circ$	21	$(^3\mathrm{D})\ ^2\mathrm{F}^\circ$
$3d^4(^3\mathrm{D})4p$	$^2\mathrm{D}^\circ$	3/2	442 620.7	53	13	$(^1\mathrm{D2})\ ^2\mathrm{D}^\circ$
$3d^4(^1\mathrm{D2})4p$	$^2\mathrm{D}^\circ$	3/2	444 252.2	40	22	$(^3\mathrm{D})\ ^2\mathrm{D}^\circ$
		5/2	444 784.2	24	26	
$3d^4(^1\mathrm{D2})4p$	$^2\mathrm{F}^\circ$	5/2	446 061.2	44	11	$(^1\mathrm{D2})\ ^2\mathrm{D}^\circ$
		7/2	446 863.8	47	31	$(^1\mathrm{F})\ ^2\mathrm{F}^\circ$
$3d^4(^1\mathrm{F})4p$	$^2\mathrm{F}^\circ$	5/2	451 041.3	64	14	$(^1\mathrm{D2})\ ^2\mathrm{F}^\circ$
		7/2	451 859.4	47	27	

Ni VI—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^4(^1D2)4p$	$^2P^\circ$	3/2	451 622.9	65		13	$(^1D1)\ ^2P^\circ$
		1/2	451 642.0	72		14	
$3d^4(^1F)4p$	$^2G^\circ$	7/2	453 983.0	86		5	$(^1F)\ ^2F^\circ$
		9/2	455 890.5	92		4	$(^1G2)\ ^2G^\circ$
$3d^4(^1F)4p$	$^2D^\circ$	5/2	456 815.6	53		17	$(^3P1)\ ^2D^\circ$
		3/2	458 772.2	49		14	$(^3F1)\ ^4F^\circ$
$3d^4(^3F1)4p$	$^4F^\circ$	5/2	460 364.6	61		9	$(^3P1)\ ^4D^\circ$
		7/2	460 535.9	66		8	$(^3F2)\ ^4F^\circ$
		3/2	460 604.0	57		9	$(^3F2)\ ^4F^\circ$
		9/2	461 118.3	83		10	$(^3F2)\ ^4F^\circ$
$3d^4(^3P1)4p$	$^4P^\circ$	3/2	461 437.8	30		14	$(^3P2)\ ^4P^\circ$
		5/2	463 301.5	45		22	
$3d^4(^3P1)4p$		5/2	461 622.6	21	$^4D^\circ$	20	$(^3F1)\ ^4F^\circ$
$3d^4(^3P1)4p$		7/2	462 443.1	32	$^4D^\circ$	20	$(^3F1)\ ^4D^\circ$
$3d^4(^3P1)4p$		3/2	462 884.1	24	$^4P^\circ$	21	$(^3P1)\ ^4D^\circ$
$3d^4(^3P1)4p$		1/2	462 903.6	31	$^4P^\circ$	21	$(^3P1)\ ^4D^\circ$
$3d^4(^3F1)4p$	$^4G^\circ$	5/2	464 027.8	44		23	$(^3F1)\ ^2F^\circ$
		7/2	464 807.8	35		32	$(^3F1)\ ^2F^\circ$
		9/2	466 065.2	70		21	$(^3F2)\ ^4G^\circ$
		11/2	468 754.3	76		22	$(^3F2)\ ^4G^\circ$
$3d^4(^1F)4p$		5/2	465 552.7	25	$^2D^\circ$	19	$(^3P1)\ ^2D^\circ$
$3d^4(^1F)4p$		3/2	466 034.2	29	$^2D^\circ$	21	$(^3P1)\ ^2D^\circ$
$3d^4(^3F1)4p$	$^2F^\circ$	7/2	466 133.7	36		35	$(^3F1)\ ^4G^\circ$
		5/2	466 649.1	47		20	
$3d^4(^3P1)4p$	$^4S^\circ$	3/2	471 106.8	48		44	$(^3P2)\ ^4S^\circ$
$3d^4(^3F1)4p$	$^4D^\circ$	7/2	472 497.3	47		17	$(^3P1)\ ^4D^\circ$
		5/2	473 292.4	48		18	$(^3F2)\ ^4D^\circ$
		3/2	473 656.4	48		19	$(^3F2)\ ^4D^\circ$
		1/2	473 727.6	51		20	$(^3F2)\ ^4D^\circ$
$3d^4(^3F1)4p$	$^2G^\circ$	9/2	472 579.5	72		20	$(^3F2)\ ^2G^\circ$
		7/2	473 531.9	73		22	
$3d^4(^3P1)4p$	$^2P^\circ$	3/2	472 833.0	61		27	$(^3P2)\ ^2P^\circ$
		1/2	473 869.5	59		26	
$3d^4(^1G1)4p$	$^2H^\circ$	9/2	476 332.1	38		24	$(^1G1)\ ^2G^\circ$
		11/2	479 481.8	65		31	$(^1G2)\ ^2H^\circ$
$3d^4(^1G1)4p$	$^2G^\circ$	7/2	476 935.6	52		32	$(^1G2)\ ^2G^\circ$
$3d^4(^3P2)4p$	$^2S^\circ$	1/2	477 177.1	55		41	$(^3P1)\ ^2S^\circ$

Ni VI—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages			
$3d^4(^1G1)4p$		9/2	*479 046.3*	35	$^2G°$	26	$(^1G1)\ ^2H°$
$3d^4(^1G1)4p$	$^2F°$	7/2	*480 189.3*	54		18	$(^1G2)\ ^2F°$
		5/2	*480 724.2*	57		19	
$3d^4(^3F1)4p$	$^2D°$	5/2	*483 043.4*	47		18	$(^3F2)\ ^2D°$
		3/2	*483 480.9*	45		21	$(^3P1)\ ^2D°$
$3d^4(^1D1)4p$	$^2P°$	3/2	*498 773.0*	75		15	$(^1D2)\ ^2P°$
		1/2	*500 275.2*	75		16	
$3d^4(^1D1)4p$	$^2F°$	5/2	*505 150.5*	69		18	$(^1D2)\ ^2F°$
		7/2	*507 300.4*	73		19	
$3d^4(^1D1)4p$	$^2D°$	3/2	*511 217.4*	72		26	$(^1D2)\ ^2D°$
		5/2	*512 113.2*	71		25	
$3d^4(^1S1)4p$	$^2P°$	1/2	*540 394.1*	74		20	$(^1S2)\ ^2P°$
		3/2	*543 115.6*	74		20	
Ni VII $(^5D_0)$	***Limit***		**870 000**				

Ni VII

$Z=28$

Ti I isoelectronic sequence

Ground state: $1s^22s^22p^63s^23p^63d^4\ ^5D_0$

Ionization energy = 1 070 000 cm^{-1} (133 eV)

The $3d^4$–$3d^34p$ transition array of this spectrum between 205 and 231 Å was observed and analysed by Phillips and Kruger (1938). Henrichs (1975) has revised that work from new observations and isoelectronic comparisons. His results are given here. The uncertainty of the level values is about ±5 cm^{-1}.

The ionization energy is from Lotz (1967).

References

Henrichs, H. F. (1975), Astron. Astrophys. **44**, 41.
Phillips, L. W., and Kruger, P. G. (1938), Phys. Rev. **54**, 839.
Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Ni VII

Configuration	Term	J	Level (cm^{-1})
$3d^4$	^{5}D	0	0
		1	279
		2	804
		3	1 520
		4	2 392
$3d^4$	^{3}P2	0	30 077
		1	31 836
		2	34 555
$3d^4$	^{3}H	4	31 672
		5	32 286
		6	32 877
$3d^4$	^{3}F2	2	34 247
		3	34 317
		4	34 576
$3d^4$	^{3}G	3	38 160
		4	38 746
		5	39 247
$3d^3(^4F)4p$	^{3}D°	1	*467 015*
		2	*471 976*
		3	*473 360*
$3d^3(^4F)4p$	^{5}D°	2	*467 705*
		3	*468 690*
		1	*469 175*
		4	*469 844*
$3d^3(^4F)4p$	^{5}F°	2	*470 056*
		3	*471 096*
		1	*471 250*
		4	*472 067*
		5	*472 907*
$3d^3(^4F)4p$	^{3}G°	3	*476 258*
		4	*477 261*
		5	*478 534*

Ni VII—Continued

Configuration	Term	J	Level (cm^{-1})
$3d^3(^4F)4p$	$^3F^\circ$	2	*479 950*
		3	*481 091*
		4	*482 229*
$3d^3(^4P)4p$	$^5P^\circ$	1	*486 151*
		2	*487 207*
		3	*488 665*
$3d^3(^2G)4p$	$^3G^\circ$	3	*493 743*
		4	*495 087*
		5	*496 340*
$3d^3(^2H)4p$	$^3G^\circ$	5	*511 464*
		4	*511 698*
		3	*511 991*
Ni VIII ($^4F_{3/2}$)	***Limit***		**1 070 000**

Ni VIII

$Z=28$

Sc I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3\ ^4F_{3/2}$

Ionization energy = 1 310 000 cm^{-1} (162 eV)

Anderson and Mack (1941) observed and classified 132 lines between 163 and 189 Å in the $3d^3$–$3d^2 4p$ transition array. The uncertainty in the level values is about 10 cm^{-1}, which corresponds to an error of about 0.003 Å in the wavelengths.

The separation of the ^{4}F and ^{4}P terms in $3d^3$ is confirmed by the calculations of Racah (1954). The doublet system has been questioned by Bowen (1960), on the basis of isoelectronic extrapolations, but the objection does not seem to be well substantiated.

The configurations $3d^3$, $3d^2 4s$, and $3d^2 4p$ have been calculated by Kancerevicius, Ramonas, and Uspalis (1976), using Hartree-Fock methods.

The ionization energy is from Lotz (1967).

References

Anderson, E. E., and Mack, J. E. (1941), Phys. Rev. **59**, 717.
Bowen, I. S. (1960), Astrophys. J. **132**, 1.
Kancerevicius, A., Ramonas, A., and Uspalis, K. (1976), Lietuvos Fizikos Rinkinys **16**, 49.
Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.
Racah, G. (1954), Bull. Res. Council Israel **3**, 290.

Ni VIII

Configuration	Term	J	Level (cm^{-1})
$3d^3$	^{4}F	3/2	0
		5/2	1 012
		7/2	2 184
		9/2	3 721
$3d^3$	^{4}P	1/2	23 261
		3/2	23 710
		5/2	24 669
$3d^3$	^{2}G	7/2	26 977
		9/2	28 068
$3d^3$	^{2}D2	5/2	34 689
		3/2	35 120
$3d^3$	^{2}H	9/2	36 754
		11/2	37 475
$3d^2(^3F)4p$	^{4}G°	5/2	*565 124*
		7/2	*566 964*
		9/2	*569 564*
		11/2	*572 969*
$3d^2(^3F)4p$	^{4}F°	3/2	*565 388*
		5/2	*566 831*
		7/2	*568 746*
		9/2	*570 960*
$3d^2(^3F)4p$	^{2}D°	3/2	*569 667*
		5/2	*571 845*
$3d^2(^3F)4p$	^{4}D°	3/2	*569 839*
		1/2	*570 353*
		5/2	*571 517*
		7/2	*573 327*

Ni VIII—Continued

Configuration	Term	J	Level (cm⁻¹)
$3d^2(^3F)4p$	$^2F°$	5/2	*570 546*
		7/2	*571 804*
$3d^2(^3F)4p$	$^2G°$	7/2	*581 337*
		9/2	*583 241*
$3d^2(^3P)4p$	$^4S°$	3/2	*587 305*
$3d^2(^3P)4p$	$^4D°$	1/2	*590 764*
		3/2	*592 175*
		5/2	*594 068*
		7/2	*596 908*
$3d^2(^3P)4p$	$^4P°$	1/2	*596 770*
		3/2	*596 905*
		5/2	*598 570*
$3d^2(^1G)4p$	$^2G°$	7/2	*598 638*
		9/2	*599 079*
$3d^2(^1G)4p$	$^2H°$	9/2	*613 417*
		11/2	*615 725*
Ni IX ($^3F_2$)	*Limit*		1 310 000

Ni IX

$Z=28$

Ca I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$ $^3F_2$

Ionization energy = 1 560 000 cm^{-1} (193 eV)

Most of the analysis was given by Alexander, Feldman, Fraenkel, and Hoory (1966). The levels are obtained from the improved measurements and corrected classifications by Even-Zohar and Fraenkel (1968). The uncertainty of the level values is about ± 30 cm^{-1}. The singlet system, the $^3P_2$ of $3d^2$, and the $^3D_3$ of $3d4f$ are based on an estimated value for the $3d^2$ ^1D term by Alexander et al. The value of the systematic shift is expected to be a few hundred cm^{-1}.

Fawcett, Ridgeley, and Ekberg (1980) classified the transition array $3p^6 3d^2$–$3p^5 3d^3$. Their wavelength accuracy is given as ± 0.007 Å.

The $3d^2$ ^1G term is based on a tentative identification of a coronal line at 7144 Å by Pryce (1964).

The ionization energy is from Lotz (1967).

References

Alexander, E., Feldman, U., Fraenkel, B. S., and Hoory, S. (1966), J. Opt. Soc. Am. **56**, 651.

Even-Zohar, M., and Fraenkel, B. S. (1968), J. Opt. Soc. Am. **58**, 1420.

Fawcett, B.C., Ridgeley, A., and Ekberg, J.O. (1980), Phys. Scr. **21**, 155.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Pryce, M. H. L. (1964), Astrophys. J. **140**, 1192.

Ni IX

Configuration	Term	J	Level (cm^{-1})
$3p^6(^1S)3d^2$	^3F	2	0
		3	1 880
		4	4 070
$3p^6(^1S)3d^2$	^1D	2	21 900+x
$3p^6(^1S)3d^2$	^3P	2	27 160+x
$3p^6(^1S)3d^2$	^1G	4	35 898+x?
$3p^5(^2P^\circ)3d^3(^2H)$	$^3G^\circ$	3	*601 300*
		4	*604 000*
		5	*608 530*
$3p^5(^2P^\circ)3d^3(^2G)$	$^1H^\circ$	5	*640 360*+x
$3p^5(^2P^\circ)3d^3(^4F)$	$^3F^\circ$	2	*661 050*
		3	*664 080*
		4	*667 080*
$3p^5(^2P^\circ)3d^3(^4F)$	$^3D^\circ$	1	*709 210*
		3	*711 510*
		2	*711 520*
$3p^5(^2P^\circ)3d^3(^2H)$	$^1G^\circ$	4	*716 110*+x
$3p^6(^1S)3d4f$	$^3F^\circ$	2	*977 130*
		3	*977 680*
		4	*978 740*
$3p^6(^1S)3d4f$	$^3G^\circ$	3	*983 700*
		4	*985 140*
		5	*985 940*
$3p^6(^1S)3d4f$	$^1D^\circ$	2	*984 630*+x

Ni IX—Continued

Configuration	Term	J	Level (cm^{-1})
$3p^6(^1S)3d4f$	$^1F°$	3	*986 960+x*
$3p^6(^1S)3d4f$	$^3D°$	3	*988 760+x*
Ni X ($^2D_{3/2}$)	***Limit***		**1 560 000**

Ni X

$Z=28$

K I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d\ ^2D_{3/2}$

Ionization energy = 1 812 000 cm^{-1} (224.6 eV)

Observations of Ni X were first reported by Alexander, Feldman, and Fraenkel (1965), who reported the $3d$–$4f$ and $5f$ doublets. The series was extended to $7f$ by Even-Zohar and Fraenkel (1968), who noted that the $6f$ and $7f$ terms may be perturbed by the $3p^5 3d4d$ configuration. Their measurements are given here. We find that the nf terms do not follow a regular Rydberg series.

Gabriel, Fawcett, and Jordan (1966) identified the $3p^5 3d^2\ (^3F)^2D$ and $(^3F)^2F$ terms. The ^2P term was added by Goldsmith and Fraenkel (1970). With new observations, Ramonas and Ryabtsev (1980) determined the $(^1G)^2F$ and $(^1D)^2F$ terms and improved the level values. Their results are given for the $3p^5 3d^2$ levels and for the $3p^6 3d\ ^2D$ ground term interval. They also obtained the $3p^6 4p$ term.

The analysis of the $3p^5 3d4s$ configuration is by Hoory, Goldsmith, Fraenkel, and Feldman (1970). These levels have an uncertainty of about ±50 cm^{-1}.

The ionization energy is from Lotz (1967).

References

Alexander, E., Feldman, U., and Fraenkel, B. S. (1965), J. Opt. Soc. Am. **55**, 650.

Even-Zohar, M., and Fraenkel, B. S. (1968), J. Opt. Soc. Am. **58**, 1420.

Gabriel, A. H., Fawcett, B. C., and Jordan, C. (1966), Proc. Phys. Soc. **87**, 825.

Goldsmith, S., and Fraenkel, B. S. (1970), Astrophys. J. **161**, 317.

Hoory, S., Goldsmith, S., Fraenkel, B. S., and Feldman, U. (1970), Astrophys. J. **160**, 781.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Ramonas, A. A., and Ryabtsev, A. N. (1980), Opt. Spectrosc. **48**, 631.

Ni X

Configuration	Term	J	Level (cm^{-1})
$3p^6 3d$	^2D	3/2	0
		5/2	3 178
$3p^5(^2P^\circ)3d^2(^1G)$	$^2F^\circ$	5/2	*505 283*
		7/2	*509 751*
$3p^5(^2P^\circ)3d^2(^1D)$	$^2F^\circ$	7/2	*522 391*
		5/2	*540 725*
$3p^5(^2P^\circ)3d^2(^3F)$	$^2F^\circ$	5/2	*625 091*
		7/2	*634 583*
$3p^5(^2P^\circ)3d^2(^3P)$	$^2P^\circ$	1/2	*684 552*
		3/2	*689 365*
$3p^5(^2P^\circ)3d^2(^3F)$	$^2D^\circ$	5/2	*692 890*
		3/2	*693 404*
$3p^6 4p$	$^2P^\circ$	1/2	*773 647*
		3/2	*779 600*
$3p^6 4f$	$^2F^\circ$	5/2	*1 093 360*
		7/2	*1 093 440*
$3p^5 3d(^3P^\circ)4s$	$^2P^\circ$	1/2	*1 140 510*
		3/2	*1 148 420*
$3p^5 3d(^3F^\circ)4s$	$^4F^\circ$	7/2	*1 154 390*
		5/2	*1 156 550*

Ni x—Continued

Configuration	Term	J	Level (cm^{-1})
$3p^5 3d(^3F^\circ)4s$	$^2F^\circ$	7/2 5/2	*1 161 930* *1 169 300*
$3p^5 3d(^3D^\circ)4s$	$^4D^\circ$	7/2 5/2	*1 184 390* *1 187 750*
$3p^5 3d(^1F^\circ)4s$	$^2F^\circ$	7/2	*1 198 260*
$3p^5 3d(^3D^\circ)4s$	$^2D^\circ$	3/2 5/2	*1 203 270* *1 206 410*
$3p^6 5f$	$^2F^\circ$	5/2 7/2	*1 349 580* *1 349 690*
$3p^6 6f$	$^2F^\circ$	7/2 5/2	*1 502 720* *1 502 810*
$3p^6 7f$	$^2F^\circ$	5/2 7/2	*1 617 890* *1 618 310*
Ni XI ($^1S_0$)	***Limit***		1 812 000

Ni XI

$Z=28$

Ar-I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6\ ^1S_0$

Ionization energy = 2 589 000 cm^{-1} (321.0 eV)

Swartz et al. (1976) identified the transition array $3p^5 3d$–$3p^5 4f$ in the region of 81 Å–94 Å. With their classifications and the forbidden transitions within the $3p^5 3d$ configuration identified in the solar corona by Svensson et al. (1974) and by Sandlin and Tousey (1979), these configurations were determined. The $^1P°$ term is from the laboratory observations of Even-Zohar and Fraenkel (1968). The uncertainty in the $3p^5 3d$ level values varies from ± 10 cm^{-1} to ± 100 cm^{-1} while that of the $3p^5 4f$ levels is ~ 100 cm^{-1}.

The $3p^5 4s$ and $4d$ configurations are taken from observations of resonance lines by Even-Zohar and Fraenkel between 60 and 80 Å, and the level values are uncertain by about 300 cm^{-1}.

The ionization energy is from Lotz (1967).

References

Even-Zohar, M., and Fraenkel, B. S. (1968), J. Opt. Soc. Am. **58**, 1420.
Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.
Sandlin, G. D., and Tousey, R. (1979), Astrophys. J. **227**, L 107.
Svensson, L. A., Ekberg, J. O., and Edlén, B. (1974), Solar Physics **34**, 173.
Swartz, M., Kastner, S. O., Goldsmith, L., and Neupert, W. (1976), J. Opt. Soc. Am. **66**, 240.

Ni XI

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^6$	^1S	0	0
$3s^2 3p^5 3d$	$^3P°$	0	*469 310*
		1	*472 950*
		2	*480 770*
$3s^2 3p^5 3d$	$^3F°$	4	*493 060*
		3	*496 950*
$3s^2 3p^5 3d$	$^3D°$	3	*527 220*
		1	*534 810*
		2	*539 070*
$3s^2 3p^5 3d$	$^1D°$	2	*530 050*
$3s^2 3p^5 3d$	$^1F°$	3	*543 040*
$3s^2 3p^5 3d$	$^1P°$	1	*673 850*
$3s^2 3p^5 4s$	$^3P°$	1	*1 269 940*
$3s^2 3p^5 4s$	$^1P°$	1	*1 292 110*
$3s^2 3p^5 4d$	$^3P°$	1	*1 571 310*
$3s^2 3p^5 4d$	$^1P°$	1	*1 594 130*
$3s^2 3p^5(^2P°_{3/2})4f$	$^2[3/2]$	1	1 701 800
		2	1 704 300
$3s^2 3p^5(^2P°_{3/2})4f$	$^2[9/2]$	5	1 706 400
		4	1 708 600
$3s^2 3p^5(^2P°_{3/2})4f$	$^2[5/2]$	3	1 708 300

Ni XI—Continued

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^5(^2P^\circ_{3/2})4f$	$^2[7/2]$	4	1 716 400
$3s^2 3p^5(^2P^\circ_{1/2})4f$	$^2[5/2]$	3	1 732 900
		2	1 739 400
$3s^2 3p^5(^2P^\circ_{1/2})4f$	$^2[7/2]$	3	1 736 000
		4	1 736 400
Ni XII ($^2P^\circ_{3/2}$)	***Limit***		**2 589 000**

Ni XII

$Z=28$

Cl I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^5\ ^2P^\circ_{3/2}$

Ionization energy = 2 840 000 cm^{-1} (352 eV)

Laboratory observations of the $3p^5$–$3p^4 3d$ resonance array by Goldsmith and Fraenkel (1970) give a value for the ground term interval of 23 520±20 cm^{-1} or 4250.5 Å for the forbidden transition. This value is confirmed by the calculated interval of 23 511 cm^{-1} by Nussbaumer (1976).

The portion of the $3p^4 3d$ configuration below 600 000 cm^{-1} is taken from the study of coronal spectra by Edlén and Smitt (1978). Their level values are adjusted here to the calculated energies of Nussbaumer (1976), from which we adopted the value 454 000 for the $(^3P)^4D_{7/2}$ level. The value of "x" may be ±1000 cm^{-1} or larger. The higher $3p^4 3d$ terms are from Goldsmith and Fraenkel (1970); the uncertainty is ±20 cm^{-1}. The designations of the parent terms of $3p^4 3d$ are taken from the calculations of Bromage, Cowan, and Fawcett (1977) for the isoelectronic spectrum Fe X.

The $3p^5 4s$, $3p^5 4d$, and $3p^5 4f$ terms are from the observations of Fawcett, Cowan, and Hayes (1972) near 70 Å and are uncertain by ±500 cm^{-1}.

The ionization energy is from Lotz (1967).

References

Bromage, G. E., Cowan, R. D., and Fawcett, B. C. (1977), Physics Scripta **15**, 177.

Edlén, B., and Smitt, R. (1978), Solar Physics **57**, 329.

Fawcett, B. C., Cowan, R. D., and Hayes, R. W. (1972), J. Phys. **B5**, 2143.

Goldsmith, S., and Fraenkel, B. S. (1970), Astrophys. J. **161**, 317.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Nussbaumer, H. (1976), Astron. Astrophys. **48**, 93.

Ni XII

Configuration	Term	*J*	Level (cm^{-1})
$3p^5$	$^2P^\circ$	3/2	*0*
		1/2	*23 520*
$3p^4(^3P)3d$	^4D	7/2	454 000+x
$3p^4(^3P)3d$	^4F	9/2	485 570+x
		7/2	492 750+x
$3p^4(^3P)3d$	^2F	7/2	513 290+x
$3p^4(^1D)3d$	^2G	7/2	526 960+x
		9/2	527 230+x
$3p^4(^1D)3d$	^2F	7/2	567 200+x
$3p^4(^1D)3d$	^2S	1/2	622 840
$3p^4(^3P)3d$	^2P	3/2	648 620
		1/2	657 240
$3p^4(^3P)3d$	^2D	5/2	657 230
		3/2	676 370
$3p^4(^3P)4s$	^2P	3/2	1 374 200
		1/2	1 385 600
$3p^4(^1D)4s$	^2D	5/2	1 401 000
		3/2	1 401 600
$3p^4(^3P)4d$	^2D	5/2	1 666 100

Ni XII—Continued

Configuration	Term	J	Level (cm^{-1})
$3p^4(^3P)4f$	$^4F^\circ$	$9/2$	*1 797 400+x*
$3p^4(^3P)4f$	$^4G^\circ$	$11/2$	*1 808 000+x*
		$9/2$	*1 811 400+x*
$3p^4(^1D)4f$	$^2H^\circ$	$11/2$	*1 848 400+x*
Ni XIII ($^3P_2$)	***Limit***		**2 840 000**

Ni XIII

$Z=28$

S I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^4\ ^3P_2$

Ionization energy = 3 080 000 cm^{-1} (384 eV)

Svensson (1971) calculated the levels of the ground configuration with a stated accuracy of $\pm$10–50 cm^{-1}. From these he made the following classifications of solar coronal lines within this configuration: $^3P_2$–$^1D_2$ at 2126.7 Å (in vac.) and $^3P_2$–$^3P_1$ at 5115.8 Å (in air). New measurements of the coronal spectrum observed from Skylab by Sandlin, Brueckner, and Tousey (1977) provide the more accurate wavelength of 2126.17±0.02 Å for $^3P_2$–$^1D_2$, and a new line at 1277.23±0.01 Å for $^3P_1$–$^1S_0$. A predicted value for $^3P_0$ is taken from Svensson's calculation.

The $3s3p^5$ and $3s^2 3p^3 3d$ levels are from laboratory observations of Fawcett and Hayes (1972) between 155 and 305 Å and are uncertain by about ±50 cm^{-1}.

The $3p^3 4d$ levels are from the observations of Fawcett, Cowan, and Hayes (1972) at 56 Å. The uncertainty is about ±500 cm^{-1}. They also observed levels in $3p^3 4f$ terms, but they are not connected with this system.

The ionization energy is taken from Lotz (1967).

References

Fawcett, B. C., and Hayes, R. W. (1972), J. Phys. **B5**, 366.
Fawcett, B. C., Cowan, R. D., and Hayes, R. W. (1972), J. Phys. **B5**, 2143.
Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.
Sandlin, G. D., Brueckner, G. E., and Tousey, R. (1977), Astrophys. J. **214**, 898.
Svensson, L. A. (1971), Solar Physics **18**, 232.

Ni XIII

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^4$	^3P	2	0.0
		1	19 541.8
		0	20 000+x
$3s^2 3p^4$	^1D	2	47 032.9
$3s^2 3p^4$	^1S	0	97 836.2
$3s3p^5$	$^3P^\circ$	2	*329 700*
$3s^2 3p^3(^2D^\circ)3d$	$^3P^\circ$	2	*609 200*
$3s^2 3p^3(^4S^\circ)3d$	$^3D^\circ$	3	*634 000*
		2	*644 660*
		1	*649 840+x*
$3s^2 3p^3(^2D^\circ)3d$	$^1D^\circ$	2	*666 000*
$3s^2 3p^3(^2D^\circ)3d$	$^1F^\circ$	3	*681 750*
$3s^2 3p^3(^2D^\circ)3d$	$^1P^\circ$	1	*715 960*
$3s^2 3p^3(^4S^\circ)4d$	$^3D^\circ$	3	*1 767 700*
$3s^2 3p^3(^2D^\circ)4d$	$^1D^\circ$	2	*1 820 400*
$3s^2 3p^3(^2D^\circ)4d$	$^1F^\circ$	3	*1 827 000*
Ni XIV ($^4S^\circ_{3/2}$)	***Limit***		**3 080 000**

Ni XIV

$Z=28$

P I isoelectronic sequence

Ground state: $1s^22s^22p^63s^23p^3\ ^4S^\circ_{3/2}$

Ionization energy = 3 470 000 cm^{-1} (430 eV)

The levels of the $3s^23p^3$ configuration are determined from identifications of solar coronal lines by Svensson (1971) and Sandlin, Brueckner, and Tousey (1977). The values are from wavelengths given in the latter paper reporting spectra observed from Skylab and measured with an uncertainty of ±0.01 Å. The calculated value for $^2P_{3/2}$ is from Svensson, with an estimated uncertainty of ±50 cm^{-1}.

The $3s3p^4$ and $3s^23p^23d$ levels are from the observations of Fawcett and Hayes (1972) between 160 and 320 Å and are uncertain by about ±60 cm^{-1}.

The $3p^24d$ levels are from the observations of Fawcett, Cowan, and Hayes (1972). The uncertainty is about ±500 cm^{-1}.

The ionization energy is taken from Lotz (1967).

References

Fawcett, B. C., and Hayes, R. W. (1972), J. Phys. **B5**, 366.

Fawcett, B. C., Cowan, R. D., and Hayes, R. W. (1972), J. Phys. **B5**, 2143.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Sandlin, G. D., Brueckner, G. E., and Tousey, R. (1977), Astrophys. J. **214**, 898.

Svensson, L. A. (1971), Solar Physics **18**, 232.

Ni XIV

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^3$	$^4S^\circ$	3/2	*0.0*
$3s^2 3p^3$	$^2D^\circ$	3/2	*45 767.8*
		5/2	*53 569.0*
$3s^2 3p^3$	$^2P^\circ$	1/2	*85 126.7*
		3/2	*96 630+x*
$3s3p^4$	^4P	5/2	315 930
		3/2	330 830
$3s3p^4$	^2D	5/2	396 000
$3s3p^4$	^2P	3/2	447 750
$3s^2 3p^2(^3P)3d$	^4P	5/2	583 530
		3/2	589 310
		1/2	594 810
$3s^2 3p^2(^1D)3d$	^2D	3/2	632 280
		5/2	634 430
$3s^2 3p^2(^1D)3d$	^2P	1/2	648 320
		3/2	660 710+x
$3s^2 3p^2(^1D)3d$	^2F	7/2	662 780
$3s^2 3p^2(^3P)3d$	^2D	5/2	690 560+x
		3/2	691 930
$3s^2 3p^2 4d$	^2P	3/2	1 628 400
$3s^2 3p^2 4d$	^2D	5/2	1 653 100
Ni XV ($^3P_0$)	*Limit*		**3 470 000**

Ni XV

$Z=28$

Si I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^2\ {}^3P_0$

Ionization energy = 3 740 000 cm^{-1} (464 eV)

The levels of the $3s^2 3p^2$ configuration are determined from measurements of solar coronal lines and are uncertain by less than 1 cm^{-1}. The ^{3}P values are from Svensson's (1971) compilation and the ^{1}D value is from the measurement by Sandlin, Brueckner, and Tousey (1977) of spectra observed from Skylab.

The $3s3p^3$ and $3s^2 3p3d$ levels are from the analysis by Fawcett and Hayes (1972) based on observations between 170 and 320 Å; they are uncertain by about ±60 cm^{-1}.

The $3p4s$, $3p4d$, and $3p4f$ levels are from the observations of Fawcett, Cowan, and Hayes (1972) and of Kastner, Swartz, Bhatia, and Lapides (1978). The uncertainty is about ±500 cm^{-1}.

The ionization energy is from Lotz (1967).

References

Fawcett, B. C., and Hayes, R. W. (1972), J. Phys. **B5**, 366.
Fawcett, B. C., Cowan, R. D., and Hayes, R. W. (1972), J. Phys. **B5**, 2143.
Kastner, S. O., Swartz, M., Bhatia, A. K., and Lapides, J. (1978), J. Opt. Soc. Am. **68**, 1558.
Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.
Sandlin, G. D., Brueckner, G. E., and Tousey, R. (1977), Astrophys. J. **214**, 898.
Svensson, L. A. (1971), Solar Physics **18**, 232.

Ni XV

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^2$	^{3}P	0	0.0
		1	14 917.5
		2	27 376.5
$3s^2 3p^2$	^{1}D	2	62 852.1
$3s3p^3$	^{3}D°	2	*335 710*
		3	*340 850*
$3s3p^3$	^{3}S°	1	*478 010*
$3s3p^3$	^{1}P°	1	*509 200*
$3s^2 3p3d$	^{3}P°	2	*555 830*
		1	*565 930*
$3s^2 3p3d$	^{1}D°	2	*574 330*
$3s^2 3p3d$	^{3}D°	1	*582 760*
		3	*585 170*
		2	*586 410*
$3s^2 3p3d$	^{1}F°	3	*638 460*
$3s^2 3p4s$	^{3}P°	2	*1 730 700*
$3s^2 3p4d$	^{3}D°	2	*2 018 400*
		3	*2 020 500*
$3s^2 3p4d$	^{3}F°	3	*2 042 500*
$3s^2 3p4d$	^{1}F°	3	*2 053 000*
$3s^2 3p4f$	^{1}G	4	2 185 600
Ni XVI ($^2P^\circ_{1/2}$)	*Limit*		3 740 000

Ni XVI

$Z=28$

Al I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p\ ^2P^\circ_{1/2}$

Ionization energy = 4 020 000 cm^{-1} (499 eV)

The $3s^2 3p$, $3s3p^2$, and $3s^2 3d$ configurations are from the line classifications near 200 Å of Fawcett and Hayes (1972). They estimate the wavelength uncertainty to be ±0.03 Å (±75 cm^{-1}). The $3s^2 4d$ and $4f$ levels are from wavelengths near 50 Å classified by Fawcett, Cowan, and Hayes (1972) and are uncertain by several hundred cm^{-1}.

The ionization energy is from Lotz (1967).

References

Fawcett, B. C., Cowan, R. D., and Hayes, R. W. (1972), J. Phys. **B5**, 2143.
Fawcett, B. C., and Hayes, R. W. (1972), J. Phys. **B5**, 366.
Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Ni XVI

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p$	$^2P^\circ$	1/2	*0*
		3/2	*27 810*
$3s3p^2$	^2D	5/2	351 020
$3s3p^2$	^2S	1/2	417 480
$3s3p^2$	^2P	1/2	448 230
		3/2	457 920
$3s^2 3d$	^2D	3/2	539 870
		5/2	543 170
$3s^2 4d$	^2D	3/2	2 119 400
		5/2	2 121 100
$3s^2 4f$	$^2F^\circ$	7/2	*2 228 500*
		5/2	*2 228 600*
Ni XVII ($^1S_0$)	***Limit***		**4 020 000**

Ni XVII

$Z=28$

Mg I isoelectronic sequence

Ground state: $1s^22s^22p^63s^2$ $^1S_0$

Ionization energy = 4 607 800±1000 cm^{-1} (571.30±0.12 eV)

Wavelength identifications were first made by Fawcett, Gabriel, Irons, Peacock, and Saunders (1966) in the range of 42 Å to 52 Å. The measurements were improved and extended to 33 Å by Feldman, Katz, Behring, and Cohen (1971). Further work in this region and from 197 Å to 285 Å by Fawcett, Cowan, and Hayes (1972) completed the presently known energy levels, with the addition of $3s3p$ $^1P^\circ_1$ and $3s6f$ $^3F^\circ_4$ by Fawcett and Hayes (1972). The measurements by Feldman et al. served as the primary source of wavelengths. The levels of $3s4f$ $^3F^\circ$ are derived from the measurements of Behring, Cohen, and Feldman (1972).

The triplet system has not been connected to the ground state by observed lines. We calculated the position of $3s3p$ $^3P^\circ_1$ relative to $3s3p$ $^1P^\circ_1$ by the method of successive differences along the isoelectronic sequence. The value of "x" is within 1000 cm^{-1}.

The $3p3d$–$3p4f$ transition array has been observed at 55 Å by Kastner, Swartz, Bhatia, and Lapides (1978) but it is unconnected with the present configurations.

We derived the ionization energy from the three member $3snd$ ^3D series. The $6f$ term does not follow the nf series quantum defect trend.

References

Behring, W. E., Cohen, R., and Feldman, U. (1972), Astrophys. J. **175**, 493.

Fawcett, B. C., Cowan, R. D., and Hayes, R. W. (1972), J. Phys. **B5**, 2143.

Fawcett, B. C., Gabriel, A. H., Irons, F. E., Peacock, N. J., and Saunders, P. A. H. (1966), Proc. Phys. Soc. **88**, 1051.

Fawcett, B. C., and Hayes, R. W. (1972), J. Phys. **B5**, 366.

Feldman, U., Katz, L., Behring, W. E., and Cohen, L. (1971), J. Opt. Soc. Am. **61**, 91.

Kastner, S. O., Swartz, M., Bhatia, A. K., and Lapides, J. (1978), J. Opt. Soc. Am. **68**, 1558.

Ni XVII

Configuration	Term	J	Level (cm^{-1})
$3s^2$	^1S	0	0
$3s3p$	$^3P^\circ$	0	*267 720+x*
		1	*276 000+x*
		2	*296 980+x*
$3s3p$	$^1P^\circ$	1	*401 320*
$3p^2$	^3P	0	631 200+x
		1	647 100+x
		2	672 800+x
$3p^2$	^1D	2	638 800
$3s3d$	^3D	1	774 500+x
		2	776 300+x
		3	778 900+x
$3s3d$	^1D	2	864 500
$3s4s$	^3S	1	2 190 830+x
$3s4p$	$^1P^\circ$	1	*2 333 450*
$3s4d$	^3D	1	2 497 350+x
		2	2 498 460+x
		3	2 500 500+x
$3s4d$	^1D	2	2 499 400

Ni XVII—Continued

Configuration	Term	J	Level (cm^{-1})
$3p4s$	$^3P^\circ$	2	*2 546 100+x*
$3s4f$	$^3F^\circ$	2	*2 588 200+x*
		3	*2 588 400+x*
		4	*2 588 600+x*
$3s4f$	$^1F^\circ$	3	*2 601 200*
$3s5p$	$^1P^\circ$	1	*3 234 300*
$3s5d$	^3D	1	3 275 330+x
		2	3 275 400+x
		3	3 276 100+x
$3s5f$	$^3F^\circ$	4	*3 316 000+x*
		3,2	*3 316 100+x*
$3s6f$	$^3F^\circ$	4	*3 723 500?+x*
Ni XVIII ($^2S_{1/2}$)	***Limit***		**4 706 800**

Ni XVIII

$Z=28$

Na I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s\ ^2S_{1/2}$

Ionization energy = 4 895 900±300 cm^{-1} (607.02±0.04 eV)

From Edlén's (1978) study of the Na I isoelectronic sequence, smoothed-out values for the $3p\ ^2P$ and $3d\ ^2D$ term positions are adopted here. An uncertainty estimate of ±30 cm^{-1} is assigned to them, corresponding to the maximum deviation of the calculated wavelengths from those observed by Sandlin et al. (1976). We have rounded off the level values to the nearest 10 cm^{-1}.

Except for the $3d$–$4f$ doublet measured by Edlén (1936), we obtained the nf terms from the $3d$–nf measurements reported by Feldman et al. (1971). They also found the $4s$, $np(n=4$–$6)$, and $nd(n=4$–$8)$ terms. Their measurement uncertainty of ±0.01 Å leads to an energy level uncertainty of ±1000 cm^{-1}.

The $4f$–$5g$ doublet was found by Kononov et al. (1977) and confirmed by Edlén (1978) by using a polarization formula.

Feldman and Cohen (1967) identified the $2p^6 3s$–$2p^5 3s^2$ transitions at 14 Å.

Edlén derived the value for the ionization energy from the nf series.

References

Edlén, B. (1936), Z. Phys. **100**, 621.
Edlén, B. (1978), Physica Scripta **17**, 565.
Feldman, U., and Cohen, L. (1967), J. Opt. Soc. Am. **57**, 1128.
Feldman, U., Katz, L., Behring, W., and Cohen, L. (1971), J. Opt. Soc. Am. **61**, 91.
Kononov, E. Y., Kovalev, V. I., Ryabtsev, A. N., and Churilov, S. S. (1977), Sov. J. Quantum Electronics **7**, 111.
Sandlin, G. D., Brueckner, G. E. Scherrer, V. E., and Tousey, R. (1976), Astrophys. J. **205**, L47.

Ni XVIII

Configuration	Term	J	Level (cm^{-1})
$2p^6(^1S)3s$	^2S	1/2	0
$2p^6(^1S)3p$	$^2P°$	1/2	*311 980*
		3/2	*342 500*
$2p^6(^1S)3d$	^2D	3/2	765 640
		5/2	770 300
$2p^6(^1S)4s$	^2S	1/2	2 301 800
$2p^6(^1S)4p$	$^2P°$	1/2	*2 426 100*
		3/2	*2 438 100*
$2p^6(^1S)4d$	^2D	3/2	2 594 400
		5/2	2 596 500
$2p^6(^1S)4f$	$^2F°$	5/2	*2 666 240*
		7/2	*2 667 110*
$2p^6(^1S)5p$	$^2P°$	1/2	*3 352 400*
		3/2	*3 358 100*
$2p^6(^1S)5d$	^2D	3/2	3 433 700
		5/2	3 434 600
$2p^6(^1S)5f$	$^2F°$	5/2	*3 469 100*
		7/2	*3 469 400*
$2p^6(^1S)5g$	^2G	7/2	3 473 000
		9/2	3 473 300

Ni XVIII—Continued

Configuration	Term	J	Level (cm^{-1})
$2p^6(^1S)6p$	$^2P^\circ$	$1/2$	*3 839 400*
		$3/2$	*3 843 200*
$2p^6(^1S)6d$	^2D	$3/2$	3 885 700
		$5/2$	3 886 100
$2p^6(^1S)6f$	$^2F^\circ$	$5/2$	*3 905 800*
		$7/2$	*3 906 100*
$2p^6(^1S)7d$	^2D	$5/2$	4 156 700
$2p^6(^1S)7f$	$^2F^\circ$	$5/2$	*4 169 000*
		$7/2$	*4 169 100*
$2p^6(^1S)8d$	^2D	$3/2$	4 331 100
		$5/2$	4 331 300
$2p^6(^1S)8f$	$^2F^\circ$	$7/2$	*4 339 400*
Ni XIX ($^1S_0$)	*Limit*		**4 895 900**
$2p^5 3s^2$	$^2P^\circ$	$3/2$	*6 959 000*
		$1/2$	*7 092 000*

Ni XIX

$Z=28$

Ne I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6\ ^1S_0$

Ionization energy = 12 430 000±20 000 cm^{-1} (1541±2 eV)

Only resonance lines are classified by this system of energy levels. The first line identifications were made by Feldman, Cohen, and Swartz (1967), who reported transitions from the $2p^5 3s$, $2p^5 3d$ and $2s2p^6 3p$ configuration. To these were added terms of $2p^5 4d$ by Feldman and Cohen (1967). These were augmented by the work of Swartz, Kastner, Rothe, and Neupert (1971), who observed lines orginating from $2p^5 4s$, $2p^5 5d$, and $2p^5 6d$.

By means of a very low pressure laboratory light source (a tokamak), Klapisch, Bar Shalom, Schwob, Fraenkel, Breton, de Michelis, Finkenthal, and Mattoli (1978) observed the magnetic dipole transition from $2p^5 3s\ ^3P_2^\circ$ to the ground state. Their wavelengths for the $2p^5 3s$ and $2p^5 3d$ lines (at ~13 Å) are used here. They are given to the thousandths place with no uncertainty estimate.

We have assigned designations and given percentages to the $2p^5 3s$ and $2p^5 3d$ configurations based on our own calculations. Both Jl and LS-leading percentages are listed for the $2p^5 3s$ levels. The Jl-coupling designations for the $2p^5 4s$ and $2p^5 nd$ ($n=4,5,6$) levels were obtained by comparison with isoelectronic ions.

Kastner, Behring, and Cohen (1975) identified transitions between $2p^5 3p$ and $2p^5 4d$, but there is no connection with the levels given here.

We derived the ionization energy from the $2s^2 2p^5(^2P_{3/2}^\circ)nd\ ^2[3/2]^\circ$ series for $n=3$ to 6 (the $3d$ member is designated $^3D_1^\circ$).

References

Feldman, U., Cohen, L., and Swartz, M. (1967) Astrophys. J. **148**, 585.
Feldman, U., and Cohen, R. (1967) Astrophys. J. **149**, 45.
Kastner, S. O., Behring, W. E., and Cohen, L. (1975), Astrophys. J. **199**, 777.
Klapisch, M., Bar Shalom, A., Schwob, J. L., Fraenkel, B. S., Breton, C., de Michelis, C., Finkenthal, M., and Mattoli, M. (1978), Phys. Lett. **69A**, 34.
Swartz, M., Kastner, S., Rothe, E., and Neupert, W. (1971), J. Phys. **B4**, 1747.

Ni XIX

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$2s^2 2p^6$	^1S	0	0				
$2s^2 2p^5(^2P_{3/2}^\circ)3s$	$(3/2,1/2)^\circ$	2	*7 104 000*	100	or	100	$^3P^\circ$
		1	*7 125 000*	98	or	53	$^1P^\circ$
$2s^2 2p^5(^2P_{1/2}^\circ)3s$	$(1/2,1/2)^\circ$	1	*7 263 000*	98	or	53	$^3P^\circ$
$2s^2 2p^5 3d$	$^3P^\circ$	1	*7 813 000*	91		9	$^3D^\circ$
$2s^2 2p^5 3d$	$^3D^\circ$	1	*7 906 000*	67		28	$^1P^\circ$
$2s^2 2p^5 3d$	$^1P^\circ$	1	*8 052 000*	72		24	$^3D^\circ$
$2s2p^6 3p$	$^3P^\circ$	1	*8 628 000*				
$2s2p^6 3p$	$^1P^\circ$	1	*8 673 000*				
$2s^2 2p^5(^2P_{3/2}^\circ)4s$	$(3/2,1/2)^\circ$	1	*9 600 000*				
$2s^2 2p^5(^2P_{1/2}^\circ)4s$	$(1/2,1/2)^\circ$	1	*9 700 000*				
$2s^2 2p^5(^2P_{3/2}^\circ)4d$	$^2[3/2]^\circ$	1	*9 901 000*				
$2s^2 2p^5(^2P_{1/2}^\circ)4d$	$^2[3/2]^\circ$	1	*10 030 000*				

Ni XIX—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$2s^2 2p^5(^2P^\circ_{3/2})5d$	$^2[^3/_2]^\circ$	1	*10 820 000*	
$2s^2 2p^5(^2P^\circ_{1/2})5d$	$^2[^3/_2]^\circ$	1	*10 940 000*	
$2s^2 2p^5(^2P^\circ_{3/2})6d$	$^2[^3/_2]^\circ$	1	*11 310 000*	
$2s^2 2p^5(^2P^\circ_{1/2})6d$	$^2[^3/_2]^\circ$	1	*11 450 000*	
Ni XX ($^2P^\circ_{3/2}$)	***Limit***		**12 430 000**	

Ni XX

$Z=28$

F I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^5\ {}^2P^{\circ}_{3/2}$

Ionization energy = 13 290 000 cm^{-1} (1648 eV)

The $2s^2 2p^5$ and $2s2p^6$ configurations were determined by Doschek, Feldman, Cowan, and Cohen (1974) by the measurement of the ${}^2P^{\circ}-{}^2S$ doublet near 90 Å with a relative accuracy of ±0.01 Å. The higher levels are from Boiko, Pikuz, Safronova, and Faenov (1978), who measured 20 lines of this ion at 12 Å with an uncertainty of ±0.003 Å. Their classifications are based on Hartree-Fock calculations of the level structure.

The ionization energy was obtained from Lotz (1967).

References

Boiko, V. A., Pikuz, S. A., Safronova, A. S., and Faenov, A. Y. (1978), Opt. Spectrosc. **44**, 498.

Doschek, G. A., Feldman, U., Cowan, R. D., and Cohen, L. (1974), Astrophys. J. **188**, 417.

Lotz, W. J. (1967), J. Opt. Soc. Am. **57**, 873.

Ni XX

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p^5$	${}^2P^{\circ}$	3/2	*0*
		1/2	*144 100*
$2s2p^6$	${}^2S$	1/2	1 202 400
$2s^2 2p^4(^3P)3s$	${}^2P$	3/2	7 545 000
		1/2	7 677 000
$2s^2 2p^4(^3P)3s$	${}^4P$	3/2	7 649 000
$2s^2 2p^4(^1D)3s$	${}^2D$	5/2	7 736 000
		3/2	7 742 000
$2s^2 2p^4(^3P)3d$	${}^4P$	1/2	8 232 000
		3/2	8 249 000
		5/2	8 260 000
$2s^2 2p^4(^3P)3d$	${}^2D$	3/2	8 323 000
		5/2	8 358 000
$2s^2 2p^4(^3P)3d$	${}^2P$	3/2	8 359 000
$2s^2 2p^4(^1D)3d$	${}^2S$	1/2	8 429 000
$2s^2 2p^4(^1D)3d$	${}^2D$	5/2	8 450 000
		3/2	8 494 000
$2s^2 2p^4(^1D)3d$	${}^2P$	3/2	8 455 000
		1/2	8 503 000
$2s^2 2p^4(^1S)3d$	${}^2D$	3/2	8 667 000
Ni XXI ($^3P_2$)	*Limit*		**13 290 000**

Ni XXI

$Z=28$

O I isoelectronic sequence

Ground state: $1s^22s^22p^4\ {}^3P_2$

Ionization energy = 14 160 000 cm^{-1} (1756 eV)

The $2s^22p^4$–$2s2p^5$ transition array at 100 Å was identified by Doschek, Feldman, Cowan, and Cohen (1974). An intersystem transition, $2s^22p^4\ {}^3P_2$–$2s2p^5\ {}^1P^\circ_1$, has been observed by Kononov et al. (1976) at 69.62 Å. This is consistent with the solar flare line at 471.15 Å identified by Widing (1978) as the $2s^22p^4({}^3P_2$–${}^1D_2)$ transition. The $2p^6$ level is obtained from its combination with $2s2p^5$, found by Doschek, Feldman, Davis, and Cowan (1975).

The identification by Swartz, Kastner, Rothe, and Neupert (1971) of the $2s^22p^33s\ {}^3S^\circ_1$ level from three transitions to the ground term is inconsistent with the ground term splitting.

The ionization energy is from Lotz (1967).

References

Doschek, G. A., Feldman, U., Cowan, R. D., and Cohen, L. (1974), Astrophys. J. **188**, 417.

Doschek, G. A., Feldman, U., Davis, J., and Cowan, R. D. (1975), Phys. Rev. **A12**, 980.

Kononov, E. Y., Ryabtsev, A. N., Safronova, U. I., and Churilov, S. S. (1976), J. Phys. **B9**, L477.

Lotz, W. J. (1967), J. Opt. Soc. Am. **57**, 873.

Swartz, M., Kastner, S., Rothe, E., and Neupert, W. (1971), J. Phys. **B4**, 747.

Widing, K. G. (1978), Astrophys. J. **222**, 735.

Ni XXI

Configuration	Term	J	Level (cm^{-1})
$2s^2\,2p^4$	^{3}P	2	0
		0	92 800
		1	128 300
$2s^2\,2p^4$	^{1}D	2	212 300
$2s^2\,2p^4$	^{1}S	0	406 800
$2s2p^5$	^{3}P°	2	*1 043 300*
		1	*1 126 000*
		0	*1 193 200*
$2s2p^5$	^{1}P°	1	*1 436 400*
$2p^6$	^{1}S	0	2 404 200
Ni XXII ($^4S^\circ_{3/2}$)	*Limit*		**14 160 000**

Ni XXII

$Z=28$

N I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^3\ ^4S^\circ_{3/2}$

Ionization energy = 15 280 000 cm^{-1} (1894 eV)

The transition array $2s^2 2p^3$–$2s2p^4$ has been observed by Doschek, Feldman, Cowan, and Cohen (1974) between 80 and 118 Å. Since no intersystem transitions have been observed, we obtained a value for $2s^2 2p^3\ ^2D^\circ_{5/2}$ by extending the predicted values in the N I sequence, given by Fawcett (1975), to nickel.

The ionization energy is from Lotz (1967).

References

Doschek, G. A., Feldman, U., Cowan, R. D., and Cohen, L. (1974), Astrophys. J. **188**, 417.

Fawcett, B. C. (1975), Atomic Data and Nuclear Data Tables **16**, 135.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Ni XXII

Configuration	Term	*J*	Level (cm^{-1})
$2s^2 2p^3$	$^4S^\circ$	3/2	*0*
$2s^2 2p^3$	$^2D^\circ$	3/2	*129 600+x*
		5/2	*181 500+x*
$2s2p^4$	^4P	5/2	848 100
		3/2	943 000
$2s2p^4$	^2D	3/2	1 148 400+x
		5/2	1 175 500+x
$2s2p^4$	^2P	3/2	1 371 100+x
Ni XXIII ($^3P_0$)	*Limit*		**15 280 000**

Ni XXIII

$Z=28$

C I isoelectronic sequence

Ground state: $1s^22s^22p^2\ ^3P_0$

Ionization energy = 16 220 000 cm^{-1} (2011 eV)

No transition to the ground state of Ni XXIII has been identified. The excited levels are based on the value predicted by Feldman, Doschek, Cowan, and Cohen (1975) for $2s^22p^2\ ^3P_2$. They observed the transition $2s^22p^2\ ^3P_2$–$2s2p^3\ ^3S_1^\circ$ at 91.83 Å.

The ionization energy is from Lotz (1967).

References

Feldman, U., Doschek, G. A., Cowan, R. D., and Cohen, L. (1975), Astrophys. J. **196**, 613.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Ni XXIII

Configuration	Term	J	Level (cm^{-1})
$2s^2\,2p^2$	^{3}P	0	0
		1	
		2	162 800+x
$2s2p^3$	^{3}S°	1	*1 252 000+x*
Ni XXIV ($^2P^\circ_{1/2}$)	***Limit***		**16 220 000**

Ni XXIV

$Z=28$

B I isoelectronic sequence

Ground state: $1s^22s^22p\ ^2P^\circ_{1/2}$

Ionization energy = 17 190 000 cm^{-1} (2131 eV)

Fawcett and Cowan (1975) calculated the value of the $2s^22p\ ^2P^\circ_{3/2}$ level. Doschek, Feldman, and Cohen (1975) observed the $2s^22p\ ^2P^\circ_{3/2}$–$2s2p^2\ ^2P_{3/2}$ transition at 102.05±0.02 Å.

The ionization energy is from Lotz (1967).

References

Doschek, G. A., Feldman, U., and Cohen, L. (1975), J. Opt. Soc. Am. **65**, 463.

Fawcett, B. C., and Cowan, R. D. (1975), Mon. Not. R. Astron. Soc. **171**, 1.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Ni XXIV

Configuration	Term	J	Level (cm^{-1})
$2s^2\,2p$	$^2P^\circ$	½	*0*
		3/2	*164 000+x*
$2s2p^2$	^2P	3/2	1 144 000+x
Ni XXV ($^1S_0$)	***Limit***		**17 190 000**

Ni XXV

$Z=28$

Be I isoelectronic sequence

Ground state: $1s^2 2s^2\ ^1S_0$

Ionization energy = 18 510 000 cm^{-1} (2295 eV)

Edlén (1979) has tentatively identified the $2s^2\ ^1S_0-2s2p\ ^3P_1^\circ$ resonance line of Ni XXV in solar-flare spectra on the basis of his study of the Be I isoelectronic sequence. Its wavelength at 239.03±0.03 Å was from the observations by Dere (1978). The $2s^2\ ^1S_0-2s2p\ ^1P_1^\circ$ transition at 117.81±0.08 Å was obtained from the observations of Kastner, Neupert, and Swartz (1974). The rest of the level values are from the observations of laser-produced plasmas by Boiko, Pikuz, Safronova, and Faenov (1977) or by Fawcett, Ridgeley, and Hughes (1979) and have an uncertainty of ±3000 cm^{-1}.

The ionization energy is from Lotz (1967).

References

Boiko, V. A., Pikuz, S. A., Safronova, U. I., and Faenov, A. Y. (1977), J. Phys. B **10**, 1253.

Dere, K. P. (1978), Astrophy. J. **221**, 1062.

Edlén, B. (1979), Phys. Scr. **20**, 129.

Fawcett, B. C., Ridgeley, A., and Hughes, T. P. (1979), Mon. Not. R. Astr. Soc. **188**, 365.

Kastner, S. O., Neupert, W. M., and Swartz, M. (1974), Astrophys. J. **191**, 261.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Ni XXV

Configuration	Term	*J*	Level (cm^{-1})
$2s^2$	^1S	0	0
$2s2p$	$^3P^\circ$	0	*386 000*
		1	*418 360*
		2	*553 000*
$2s2p$	$^1P^\circ$	1	*848 800*
$2s3s$	^3S	1	10 451 000
$2s3p$	$^3P^\circ$	1	*10 689 000*
$2s3p$	$^1P^\circ$	1	*10 707 000*
$2p3p$	^3D	1	10 750 000
		2	11 153 000
		3	11 299 000
$2s3d$	^3D	1	10 802 000
		2	10 804 000
		3	10 816 000
$2s3d$	^1D	2	10 882 000
$2p3p$	^1P	1	11 163 000
$2p3p$	^3P	2	11 270 000
$2p3p$	^3S	1	11 311 000
$2s3s$	^1S	0	11 479 000
Ni XXVI ($^2S_{1/2}$)	***Limit***		**18 510 000**

Ni XXVI

$Z=28$

Li I isoelectronic sequence

Ground state: $1s^2 2s\ ^2S_{1/2}$

Ionization energy = 19 351 000±5000 cm^{-1} (2399.2±0.6 eV)

The $2s$–$2p$ resonance lines at 165 and 234 Å have been measured in the spectra of a solar flare by Sandlin, Brueckner, Scherrer, and Tousey (1976) with an uncertainty of ±0.05 Å. Fawcett, Ridgeley, and Hughes (1979) determined the $3s$, $3p$, and $3d$ terms from observations at 9 Å of a laser-produced plasma. Their measurement uncertainty is ±0.01 Å.

From measurements of spark spectra at ~1.6 Å, Safronova and Sidelnikov (1977) determined the levels above the ionization energy. No estimated uncertainty is given but wavelengths to four decimal places are reported.

The ionization energy was calculated by Edlén (1979) from a semi-empirical analysis of the Li I isoelectronic sequence. He has also given predicted values for wavelengths in this sequence.

References

Edlén, B. (1979), Phys. Scr. **19**, 255.

Fawcett, B. C., Ridgeley, A., and Hughes, T. P. (1979), Mon. Not. R. Astr. Soc. **188**, 365.

Safronova, U. I., and Sidelnikov, Y. V. (1977), Prikl. Spektrosk. **5**, 7.

Sandlin, G. D., Breuckner, G. E., Scherrer, V. E., and Tousey, R. (1976), Astrophys. J. **205**, L47.

Ni XXVI

Configuration	Term	*J*	Level (cm^{-1})
$1s^2 2s$	^2S	1/2	0
$1s^2 2p$	$^2P°$	1/2	*427 000*
		3/2	*604 500*
$1s^2 3s$	^2S	1/2	10 880 000
$1s^2 3p$	$^2P°$	1/2	*10 983 000*
		3/2	*11 036 000*
$1s^2 3d$	^2D	3/2	11 077 000
		5/2	11 092 000
Ni XXVII ($^1S_0$)	***Limit***		**19 351 000**
$1s(^2S)2s2p(^3P°)$	$^4P°$	1/2	*62 193 000*
		3/2	*62 228 000*
$1s(^2S)2s2p(^1P°)$	$^2P°$	1/2	*62 516 000*
		3/2	*62 617 000*
$1s(^2S)2p^2(^3P)$	^4P	3/2	62 697 000
		1/2	62 783 000
$1s(^2S)2s2p(^3P°)$	$^2P°$	1/2	*62 755 000*
$1s(^2S)2p^2(^3P)$	^2P	1/2	62 997 000
		3/2	63 210 000
$1s(^2S)2p^2(^1D)$	^2D	3/2	63 008 000
		5/2	63 085 000
$1s(^2S)2p^2(^1S)$	^2S	1/2	63 397 000

Ni XXVII

$Z=28$

He I isoelectronic sequence

Ground state: $1s^2\ ^1S_0$

Ionization energy = 82 990 000±10 000 cm^{-1} (10 289.54±1.2 eV)

The theoretical values calculated by Ermolaev and Jones (1974) for the singlet and triplet S and P° terms of this two-electron ion are expected to be as accurate as the observed values, and we have quoted them up to $n=5$. They have also calculated the mixing coefficients for the $^1P_1^\circ$ and $^3P_1^\circ$ states which we give as percentage compositions. The uncertainty of the ionization energy and level values is estimated to be of the order of ±10 000 cm^{-1}, due to the uncertainty of the Lamb shift. For comparison, the $1s^2\ ^1S_0$–$1s2p\ ^1P_1^\circ$ transition of this ion has been observed by Safronova and Sidelnikov (1977) in a vacuum spark. They place $1s2p\ ^1P_1^\circ$ at 62 925 000 cm^{-1}. Theoretical values for levels above the ionization energy are reported by Vainshtein and Safronova (1976). The low terms are quoted here with bracketed values.

References

Ermolaev, A. M., and Jones, M. (1974), J. Phys. B 7, 199.
Safronova, U. I., and Sidelnikov, Y. V. (1977), Prikl. Spektrosk. 5, 7.
Vainshtein, L. A., and Safronova, U. I. (1976), Preprint No. 146, P. N. Lebedev Phys. Inst. Acad. Sci. USSR, Moscow.

Ni XXVII

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$1s^2$	^1S	0	0			
$1s2s$	^3S	1	[62 368 000]			
$1s2p$	$^3P^\circ$	0	*[62 625 000]*			
		1	*[62 644 000]*	89	11	$^1P^\circ$
		2	*[62 806 000]*			
$1s2s$	^1S	0	[62 644 000]			
$1s2p$	$^1P^\circ$	1	*[62 962 000]*	89	11	$^3P^\circ$
$1s3s$	^3S	1	[73 909 000]			
$1s3p$	$^3P^\circ$	0	*[73 980 000]*			
		1	*[73 985 000]*	88	12	$^1P^\circ$
		2	*[74 034 000]*			
$1s3s$	^1S	0	[73 982 000]			
$1s3p$	$^1P^\circ$	1	*[74 076 000]*	88	12	$^3P^\circ$
$1s4s$	^3S	1	[77 907 000]			
$1s4s$	^1S	0	[77 936 000]			
$1s4p$	$^3P^\circ$	0	*[77 936 000]*			
		1	*[77 938 000]*	88	12	$^1P^\circ$
		2	*[77 959 000]*			
$1s4p$	$^1P^\circ$	1	*[77 976 000]*	88	12	$^3P^\circ$
$1s5s$	^3S	1	[79 746 000]			
$1s5s$	^1S	0	[79 761 000]			

Ni XXVII—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$1s5p$	$^3P^\circ$	0	[*79 762 000*]			
		1	[*79 763 000*]	87	13	$^1P^\circ$
		2	[*79 773 000*]			
$1s5p$	$^1P^\circ$	1	[*79 782 000*]	87	13	$^3P^\circ$
Ni XXVIII ($^2S_{1/2}$)	*Limit*		**82 990 000**			
$2s^2$	^1S	0	[127 153 000]			
$2s2p$	$^3P^\circ$	0	[*127 187 000*]			
		1	[*127 229 000*]			
		2	[*127 399 000*]			
$2p^2$	^3P	0	[127 479 000]			
		1	[127 595 000]			
		2	[127 654 000]			
$2s2p$	$^1P^\circ$	1	[*127 700 000*]			
$2p^2$	^1D	2	[127 866 000]			
$2p^2$	^1S	0	[128 156 000]			

Ni XXVIII

$Z=28$

H I isoelectronic sequence

Ground state: 1*s* $^2S_{1/2}$

Ionization energy = 86 908 200±500 cm^{-1} (10 775.33±0.06 eV)

No observations of this spectrum are available. Theoretical values calculated by Erikson for terms of this hydrogen-like ion are given below through $n=5$. The binding energy of the 1*s* electron is reported with an uncertainty of ±500 cm^{-1}; the levels measured from the ground state taken as zero will also have this uncertainty.

Reference

Erikson, G. W. (1977), J. Phys. Chem. Ref. Data **6**, 831.

Ni XXVIII

Configuration	Term	*J*	Level (cm^{-1})
1*s*	^2S	1/2	0
2*p*	$^2P°$	1/2	[*65 112 810*]
		3/2	[*65 343 770*]
2*s*	^2S	1/2	[65 118 940]
3*p*	$^2P°$	1/2	[*77 247 110*]
		3/2	[*77 315 600*]
3*s*	^2S	1/2	[77 248 950]
3*d*	^2D	3/2	[77 315 480]
		5/2	[77 337 860]
4*p*	$^2P°$	1/2	[*81 484 660*]
		3/2	[*81 513 530*]
4*s*	^2S	1/2	[81 485 440]
4*d*	^2D	3/2	[81 513 480]
		5/2	[81 522 930]
4*f*	$^2F°$	5/2	[*81 522 910*]
		7/2	[*81 527 620*]
5*p*	$^2P°$	1/2	[*83 442 020*]
		3/2	[*83 456 780*]
5*s*	^2S	1/2	[83 442 420]
5*d*	^2D	3/2	[83 456 760]
		5/2	[83 461 600]
5*f*	$^2F°$	5/2	[*83 461 590*]
		7/2	[*83 464 000*]
5*g*	^2G	7/2	[83 463 990]
		9/2	[83 465 430]
	Limit		**86 908 200**