Energy Levels of Krypton, Kr I through Kr XXXVI

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The energy levels of the krypton atom, in all stages of ionization for which experimental data are available, have been compiled. No data has yet been published for Kr XI through Kr XVII. For H-like krypton very accurate calculated level values are compiled. In all, data for 29 spectra are given. Experimental g-factors are included for Kr I and Kr II. Calculated percentage compositions of levels are given for 12 ions. A value for the ionzation energy of each ion, either experimental or theoretical, is included.

Key words: atomic; energy levels; ions; krypton; spectra.

Contents

1. Introduction

In 1952 Moore published a compilation of energy levels of krypton containing the results of extensive analyses of Kr I through Kr IV along with four levels of Kr IX (Ni-like). Today, we have energy levels for most stages of ionization of Kr and very accurate calculated levels for H-like ions. New work on Kr I through Kr IV has been published. Much of the new experimental data were obtained with light sources such as the sliding spark, low inductance triggered spark, laser, tokamak, and beam-foil, most of which were unheard of in 1952.

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The present critical compilation of the atomic energy levels of krypton in all stages of ionization is part of an ongoing program of the NIST (formerly NBS) Atomic Energy Levels Data Center to compile similar data for all the elements. Our publications include helium by Martin [1973, 1987], sodium, magnesium, aluminum, and silicon by Martin and Zalubas [1981, 1980, 1979, 1983], and phosphorus and sulfur by Martin, Zalubas, and Musgrove [1985, 1990], potassium through nickel by Sugar and Corliss [1985], copper and molybdenum by Sugar and Musgrove [1990, 1988], and lanthanum through lutetium by Martin, Zalubas, and Hagan [1978].

Companion works containing all published wavelengths for the higher stages of ionization have been prepared in collaboration with the Japanese Atomic Energy Research Institute in Tokai-Mura, Japan. These include titanium by Mori *et al.* [1986] and iron, nickel, copper ıd molybdenum by Shirai *et al.* [1990, 1987a, 1991,)87b]. In addition, wavelength compilations including ıta for all stages of ionization have been published for : by Kaufman and Sugar [1988] and for Mg and Al by aufman and Martin [1991a, 1991b].

The strong lines of Kr I to Kr V are contained in the *RC Handbook of Chemistry and Physics*, "Line Spectra : the Elements," edited by Reader and Corliss [1990]. compilation published by Kelly [1987] gives all wavengths of krypton ions below 2000 Å and their classificaons.

In the present work all energy levels are given in units : cm^{-1}. An estimate of the uncertainty of the energy vel values or wavelengths determining them is given ith each ion. Ionization energies are also given in eV ith the conversion factor 8065.5410(24) cm^{-1}/eV pubhed by Cohen and Taylor [1987].

We have included under the heading "Leading perntages" the results of calculations that express the cinvector percentage composition of levels (rounded to e nearest percent) in terms of the basis states of a ıgle configuration, or more than one configuration ıere configuration interaction has been included. We 'e first the percentage of the basis state corresponding the level's name; next the second largest percentage gether with the related basis state. Generally, when : leading percentage is less than 40%, no name is 'en. However, when two different parent states give e to the same final term and the sum of their percentes is ≥40%, the level is designated by the higher perntage term. For an unnamed level, the term symbol for : leading percentage follows the percentage. The user)uld of course bear in mind that the percentages are)del dependent, so that the results of different calculans may yield notably different percentages.

For configurations of equivalent d-electrons, several ms of the same *LS* type may occur. These are theoretlly distinguished by their seniority number. In our npilations they are designated in the notation of Niel1 and Koster [1963]. For example, in the $3d^5$ configuion there are three ^{2}D terms with seniorities of 1, 3, 1 5. These terms are denoted as ^{2}D1, ^{2}D2, and ^{2}D3 pectively, by Nielson and Koster.

We use without comment notations for various cou1g schemes as appropriate. Martin, Zalubas, and gan [1978] give a complete summary of the coupling ations used here, tables of the allowed terms for ıivalent electrons, etc.

The text for each ion does not include a complete iew of the literature but is intended to credit the macontributions. In assembling the data for each specn, we referred to the following bibliographies:

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L. Hagan and W. C. Martin (1972)
L. Hagan (1977)
R. Zalubas and A. Albright (1980)
A. Musgrove and R. Zalubas (1985)

vii. Bibliographic file of publications since December 1983 maintained by the NIST Atomic Energy Levels Data Center

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Kr I

$Z = 36$

Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6\ {}^1S_0$

Ionization energy 112 914.40 ± 0.03 cm^{-1} (13.999 606 ± 0.000 004 eV)

Meggers, de Bruin, and Humphreys [1929] gave the first extensive description of the neutral spectrum of krypton suitable for determining the energy level structure. They measured 205 lines in the range of 3302 − 9751 Å and classified nearly all of them. They utilized the vacuum ultraviolet measurements of the two resonance lines at 1164.88 Å and 1235.85 Å by Abbink and Dorgelo [1928] to connect their system of levels to the ground state.

Meggers *et al.* [1931] gave a new description of the spectrum obtained with a Geissler tube, increasing the number of observed lines to 460 and improving the accuracy of the measurements of most of the lines to ±0.05 Å. The level values were revised to take into account interferometric measurements in the infrared by Humphreys [1930]. Further observations in the infrared by Meggers and Humphreys [1933] increased the number of known lines in the range of 7601 Å to 12 124 Å to 200, and led to another extension of the term structure.

Independent observations and analysis of the spectrum by Gremmer [1929, 1932] confirmed the results of Meggers and Humphreys. Observations were extended to 2.19 μm by Sittner and Peck [1949] by means of a low voltage spark discharge in krypton. Most of these lines were predicted by the known levels.

Combining all the wavelength data available, Edlén [1946] redetermined the energy levels with an uncertainty of ±0.05 cm^{-1}. These were published by Moore [1952], in her compilation of *Atomic Energy Levels*.

In 1960 the meter was defined as a multiple of the line of Kr^{86} at 6057.802 10 Å in vacuum. In this connection Edlén, in 1964, urged the determination of a set of energy levels of Kr^{86} based on interferometric measurements that could be used to establish a set of wavelength standards. Kaufman and Humphreys [1969] undertook this project, utilizing the 235 interferometrically measured lines then available to establish the energy levels of Kr^{86}. From these levels 530 wavelengths were calculated in the range of 3300 − 40 700 Å with an uncertainty of ±0.000 10 Å. Relative to the lowest $4p^5 5s$ level, the uncertainty of these level values is ±0.0003 cm^{-1}. Their absolute uncertainty relative to the ground state of ±0.15 cm^{-1} was due to the uncertainty in the measurement of the resonance lines by Petersson [1964].

By means of a resonant two-photon ionization experiment Trickl *et al.* [1989] measured resonance lines from the $4p^5 5s$, $6s$, and $7s$ configurations with an average uncertainty of 1 part in 10^7. They found that 0.0679±0.0060 cm^{-1} must be subtracted from th[e] energy levels of Kaufman and Humphreys an[d] 0.805±0.010 cm^{-1} from the levels compiled by Moo[re] [1952].

We have compiled the levels given by Kaufman an[d] Humphreys as corrected by Trickl *et al.* [1989]. Thes[e] levels, given to four decimal places, have an uncertain[ty] of ±0.0003 cm^{-1} relative to the $4p^5({}^2P^\circ_{3/2})5s\ {}^2[{}^3/_2]^\circ_2$ lev[el] and ±0.0060 cm^{-1} relative to the ground state. Add[i]tional levels from Moore's publication, corrected b[y] Trickl *et al.*, are given here with two decimal place value[s] with an uncertainty of ±0.05 cm^{-1}. The more accura[te] levels are those of Kr^{86}. Since the uncertainty of th[e] Moore values is greater than the isotope shifts measure[d] by Jackson [1979], no correction for this needs to b[e] made to Moore's levels.

Many absorption experiments have been carried ou[t] with krypton in the ground state as well as in excite[d] states. These have provided many Rydberg series th[at] would be obscured by ordering these levels numericall[y]. Therefore, they are given in groups belonging to th[e] same series. Generally the first few members are not in[]cluded in the series group, but are given with their ter[m] group. For example, the $4s^2 4p^5({}^2P^\circ_{3/2})ns$ series group be[]gins at $n = 13$. The series members for $n = 6-12$ ar[e] combined in $J_1 l$-coupling pairs. The absorption experi[]ments are summarized in Table 1. There is little overla[p] of series observations except for Beutler [1935] an[d] Yoshino and Tanaka [1979]. The latter results are mor[e] accurate and more extensive, and are therefore quote[d] here.

Beutler [1935] observed $4p^5 ns$ and $4p^5 nd$ series t[o] $n = 12$ and $n = 14$, respectively. Yoshino and Tanak[a] [1979] extended the Beutler nd series to $n = 60$ and th[e] ns to $n = 33$, adding several more series of these configu[]rations. These results have a measurement uncertaint[y] of ±0.3 cm^{-1}. Delsart *et al.* [1981a] derived additiona[l] series terms as well as new np and nf series by optogal[]vanic detection, starting from an excited level. In an ad[]ditional paper, Delsart *et al.* [1981b] reported man[y] series observed by two-photon field ionization from [a] metastable state populated in a microwave discharge[.] Their measurement uncertainty is ±0.03 Å. These n[s] and nd series were observed from $n = 24-61$ with J values of $1-3$. We quote these results along with thos[e] of Yoshino and Tanaka for the remaining series mem[]bers. Delsart *et al.* [1981a, 1981b] derived a value for th[e] first series limit of 112 914.47±0.03 cm^{-1}. Because thei[r] vel values are derived relative to the excited levels re-)rted by Kaufman and Humphreys, we corrected the nization energy by subtracting 0.0679 cm^{-1}.

Both Beutler and Yoshino and Tanaka observed *ns* ıd *nd* series terminating on the second limit, the $)^5(^2P^\circ_{1/2})$ term of Kr II, the latter authors extending the *d* series to $n=59$. From this they derived a value for the ries limit of 118 284.6 ± 0.2 cm^{-1}. A more accurate ılue of 118 284.50 ± 0.05 cm^{-1} may be obtained from ıe first limit plus the $4p^5\ ^2P^\circ$ interval of Kr II.

Both $4p^5(^2P^\circ_{1/2})np$ and *nf* series were observed by)unning and Stebbings [1974] using a pulsed tunable ıser with a metastable Kr beam. They estimate their ıeasurement uncertainty to be ±8 cm^{-1}. These series ave also been populated by four-photon excitation from he ground state by Blazewicz *et al.* [1987]. They mea- ured level values with an uncertainty of ±4 cm^{-1}. They bserved sharp, intense *nf* peaks interleaved with much /eaker *np* peaks. Both consist of unresolved terms of a iven *n* with $J=2$ and 4.

By means of an optogalvanic double resonance xperiment, Wada *et al.* [1986] observed the $p^5(^2P^\circ_{1/2})7d\ ^2[^5/_2]^\circ_{2,3}$, the $4p^5(^2P^\circ_{1/2})7d\ ^2[^3/_2]^\circ_{1,2}$, and the $p^5(^2P^\circ_{1/2})9s\ ^2[^1/_2]^\circ_{0,1}$ levels. We quote these results.

Rydberg series arising from absorption from the 3*d* ınd 4*s* shells were obtained by Codling and Madden 1964, 1971] using synchrotron radiation. A total of 153 ıbsorption lines in the range of 337 − 500 Å are given by Codling and Madden [1971], but most of these are not classified. In the range 450 − 500 Å they identified the $ls4p^6np$ series from $n=5-19$ with a level uncertainty of ±15 cm^{-1}. Two series were observed at 131 − 136 Å by Codling and Madden [1964] arising from excitation of he 3*d* shell, and having the upper levels $3d^9(^2D_{3/2,5/2})$ ls^24p^6np for $n=5-8$. The measurement uncertainty is ±0.1 Å giving a level uncertainty of ±500 cm^{-1}. They ılso derived the series limits with these data. These re- sults are quoted here.

Some energy levels arising from inner shell excitations by electron impact have been located. The lowest-lying doubly excited state, $4s^24p^45s^2\ ^3P_2$ was identified by Valin and Marmet [1975] at 22.83 ± 0.05 eV. They also give the $4s^24p^45s^2\ ^3P^\circ_{0,1}$ blend at 23.39 ± 0.05 eV and the $^1D^\circ_2$ at 24.56 ± 0.05 eV. These are in agreement with the earlier assignments by Gerber *et al.* [1972]. Several other resonances observed by Valin and Marmet are identified as $4s^24p^45snl$ states. These results obtained by electron impact excitation are not included in the table of energy levels.

On the basis of a theoretical study of the odd parity series by Aymar *et al.* [1981] the levels 111 003 cm^{-1} and 111 072 cm^{-1} have been designated $4p^5(^2P^\circ_{1/2})7s\ [1/2]^\circ_1$ and $4p^5(^2P^\circ_{3/2})9d\ [1/2]^\circ_1$ respectively. Yoshino and Tanaka agree with this assignment. The second of these levels, however, has no major component greater than 32% while the first has 60% as given here.

The *g*-values of the $4p^55p$ levels given to five decimal places were observed by optically pumping $4p^55s$ metastable krypton atoms to magnetic sublevels of $4p^55p$. This work was done by Abu-Safia *et al.* [1981] and by Abu-Safia and Margerie [1983]. The remaining *g*-values were measured by Green *et al.* [1940] and Green [1943] who used an arc discharge in a magnetic field.

Sage and Lecler [1985] have measured a *g*-value for the $4p^5(^2P^\circ_{1/2})5s\ ^2[^1/_2]^\circ_0$ level of Kr^{83} of $0.974(4)\times10^{-4}$ by optical pumping and magnetic resonance.

TABLE 1. Observed Series in Kr I

Configuration	Term	*n*-range	Reference
$4s^24p^5(^2P^\circ_{3/2})nd$	$^2[^3/_2]^\circ_1$	4 − 8	Beutler [1935]
		4 − 60	Yoshino and Tanaka [1979]
		24 − 45	Delsart *et al.* [1981b]
$4s^24p^5(^2P^\circ_{3/2})nd$	$^2[^3/_2]^\circ_2$	15 − 25	Delsart *et al.* [1981a]
		24 − 61	Delsart *et al.* [1981b]
$4s^24p^5(^2P^\circ_{3/2})nd$	$^2[^1/_2]^\circ_1$	4 − 29	Yoshino and Tanaka [1979]
		24 − 35	Delsart *et al.* [1981b]
$4s^24p^5(^2P^\circ_{3/2})nd$	$^2[^5/_2]^\circ_2$	24 − 50	Delsart *et al.* [1981b]
$4s^24p^5(^2P^\circ_{3/2})nd$	$^2[^5/_2]^\circ_3$	24 − 46	Delsart *et al.* [1981b]
$4s^24p^5(^2P^\circ_{3/2})nd$	$^2[^7/_2]^\circ_3$	15 − 25	Delsart *et al.* [1981a]
		24 − 53	Delsart *et al.* [1981b]
$4s^24p^5(^2P^\circ_{3/2})ns$	$^2[^3/_2]^\circ_1$	6 − 11	Beutler [1935]
		5 − 33	Yoshino and Tanaka [1979]
$4s^24p^5(^2P^\circ_{1/2})ns$	$^2[^1/_2]^\circ_1$	8 − 12	Beutler [1935]
		5 − 30	Yoshino and Tanaka [1979]
$4s^24p^5(^2P^\circ_{3/2})ns$	$^2[^3/_2]^\circ_2$	26 − 60	Delsart *et al.* [1981b]
$4s^24p^5(^2P^\circ_{3/2})np$	$^2[^5/_2]_3$	15 − 19	Delsart *et al.* [1981a]
$4s^24p^5(^2P^\circ_{3/2})nf$	$^2[^7/_2]$	13 − 18	Delsart *et al.* [1981a]
$4s^24p^5(^2P^\circ_{3/2})nf$	$^2[^9/_2]$	13 − 18	Delsart *et al.* [1981a]
$4s^24p^5(^2P^\circ_{1/2})nd$	$^2[^3/_2]^\circ_1$	6 − 14	Beutler [1935]
		4 − 59	Yoshino and Tanaka [1979]
$4s^24p^5(^2P^\circ_{1/2})ns$	$^2[^1/_2]^\circ_1$	6 − 12	Beutler [1935]
		5 − 30	Yoshino and Tanaka [1979]
$4s^24p^5(^2P^\circ_{1/2})np$	$^2[^1/_2]_1$	8 − 25	Dunning and Stebbings [1974]
$4s^24p^5(^2P^\circ_{1/2})nf$		5 − 9	Dunning and Stebbings [1974]
		7 − 18	Blazewicz *et al.* [1987]
$4s^24p^5(^2P^\circ_{1/2})np$		10 − 14	Blazewicz *et al.* [1987]
$4s4p^6np$		5 − 19	Codling and Madden [1971]
$3d^9(^2D_{5/2})4s^24p^6np$	$(^5/_2,{}^3/_2)^\circ_1$	5 − 8	Codling and Madden [1964]
$3d^9(^2D_{3/2})4s^24p^6np$	$(^3/_2,{}^1/_2)^\circ_1$	5 − 8	Codling and Madden [1964]

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Kr I

Configuration	Term	J	Level (cm^{-1})	g
$4s^24p^6$	^1S	0	0.0000	
$4s^24p^5(^2P^\circ_{3/2})5s$	$^2[3/2]^\circ$	2	*79 971.7321*	1.502
		1	*80 916.7575*	1.242
$4s^24p^5(^2P^\circ_{1/2})5s$	$^2[1/2]^\circ$	0	*85 191.6075*	
		1	*85 846.6945*	1.259
$4s^24p^5(^2P^\circ_{3/2})5p$	$^2[1/2]$	1	91 168.5073	1.893
		0	94 092.8557	
$4s^24p^5(^2P^\circ_{3/2})5p$	$^2[5/2]$	3	92 294.3938	1.336
		2	92 307.3714	1.10108
$4s^24p^5(^2P^\circ_{3/2})5p$	$^2[3/2]$	1	92 964.3871	1.00958
		2	93 123.3337	1.38371
$4s^24p^5(^2P^\circ_{3/2})4d$	$^2[1/2]^\circ$	0	*96 771.4884*	
		1	*97 085.1882*	
$4s^24p^5(^2P^\circ_{1/2})5p$	$^2[3/2]$	1	97 595.9086	0.64687
		2	97 945.1597	1.18194
$4s^24p^5(^2P^\circ_{3/2})4d$	$^2[3/2]^\circ$	2	*97 687.7742*	
		1	*99 646.2086*	
$4s^24p^5(^2P^\circ_{3/2})4d$	$^2[7/2]^\circ$	4	*97 797.2818*	
		3	*98 226.2633*	
$4s^24p^5(^2P^\circ_{1/2})5p$	$^2[1/2]$	1	97 919.1400	1.452
		0	98 855.0632	
$4s^24p^5(^2P^\circ_{3/2})4d$	$^2[5/2]^\circ$	2	*98 867.4243*	
		3	*99 079.3619*	
$4s^24p^5(^2P^\circ_{3/2})6s$	$^2[3/2]^\circ$	2	*99 626.8753*	
		1	*99 894.0402*	
$4s^24p^5(^2P^\circ_{3/2})6p$	$^2[1/2]$	1	102 887.1878	1.834
		0	103 761.6280	

Configuration	Term	J	Level (cm^{-1})	g
$4s^24p^5(^2P^\circ_{3/2})6p$	$^2[5/2]$	3	103 115.6286	1.333
		2	103 121.1362	1.107
$4s^24p^5(^2P^\circ_{1/2})4d$	$^2[3/2]^\circ$	2	*103 266.3335*	
		1	*104 887.3097*	1.018
$4s^24p^5(^2P^\circ_{3/2})6p$	$^2[3/2]$	1	103 313.4669	1.034
		2	103 362.6067	1.403
$4s^24p^5(^2P^\circ_{1/2})4d$	$^2[5/2]^\circ$	2	*103 442.6852*	
		3	*103 701.4334*	
$4s^24p^5(^2P^\circ_{3/2})5d$	$^2[1/2]^\circ$	1	*103 801.7882*	1.098
		0	*104 073.4663*	
$4s^24p^5(^2P^\circ_{3/2})5d$	$^2[7/2]^\circ$	3	*104 916.4746*	1.050
		4	*104 630.56*	
$4s^24p^5(^2P^\circ_{3/2})5d$	$^2[3/2]^\circ$	2	*105 007.2398*	1.295
		1	*105 648.4287*	0.935
$4s^24p^5(^2P^\circ_{1/2})6s$	$^2[1/2]^\circ$	0	*105 091.34*	
		1	*105 146.32*	
$4s^24p^5(^2P^\circ_{3/2})5d$	$^2[5/2]^\circ$	2	*105 163.4940*	1.006
		3	*105 208.4706*	1.243
$4s^24p^5(^2P^\circ_{3/2})7s$	$^2[3/2]^\circ$	2	*105 647.4482*	1.496
		1	*105 770.6953*	1.097
$4s^24p^5(^2P^\circ_{3/2})4f$	$^2[3/2]$	1	105 964.4407	0.52
		2	105 965.5570	
$4s^24p^5(^2P^\circ_{1/2})4f$	$^2[9/2]$	5	105 988.80	
$4s^24p^5(^2P^\circ_{3/2})4f$	$^2[5/2]$	3	106 020.8375	
		2	106 021.6016	
$4s^24p^5(^2P^\circ_{3/2})4f$	$^2[7/2]$	3,4	106 047.38	
$4s^24p^5(^2P^\circ_{3/2})7p$	$^2[1/2]$	1	107 005.3663	1.795
		0	107 410.3742	
$4s^24p^5(^2P^\circ_{3/2})7p$	$^2[5/2]$	2	107 140.7949	
		3	107 141.1660	
$4s^24p^5(^2P^\circ_{3/2})7p$	$^2[3/2]$	1	107 221.3282	1.041
		2	107 246.6824	1.403
$4s^24p^5(^2P^\circ_{3/2})6d$	$^2[1/2]^\circ$	0	*107 603.5951*	
		1	*107 676.1446*	1.348
$4s^24p^5(^2P^\circ_{3/2})6d$	$^2[7/2]^\circ$	4	*107 778.9595*	1.231
		3	*107 876.9038*	1.073
$4s^24p^5(^2P^\circ_{3/2})6d$	$^2[3/2]^\circ$	2	*107 796.8747*	1.318
		1	*108 258.7507*	0.823
$4s^24p^5(^2P^\circ_{3/2})6d$	$^2[5/2]^\circ$	2	*107 992.7823*	0.965
		3	*108 046.3060*	1.254

Kr I — Continued

Configuration	Term	J	Level (cm^{-1})	g
$4s^24p^5(^2P^\circ_{3/2})8s$	$^2[3/2]^\circ$	2	*108 324.9779*	1.506
		1	*108 373.0375*	1.171
$4s^24p^5(^2P^\circ_{1/2})6p$	$^2[3/2]$	1	108 438.2555	0.648
		2	108 567.7650	1.158
$4s^24p^5(^2P^\circ_{3/2})5f$	$^2[3/2]$	2	108 471.1225	1.09
		1	108 480.7462	0.61
$4s^24p^5(^2P^\circ_{3/2})5f$	$^2[9/2]$	5	108 486.9391	
		4	108 487.0740	
$4s^24p^5(^2P^\circ_{3/2})5f$	$^2[5/2]$	3	108 503.2326	
		2	108 503.8663	
$4s^24p^5(^2P^\circ_{1/2})6p$	$^2[1/2]$	1	108 514.1776	1.401
		0	108 821.5639	
$4s^24p^5(^2P^\circ_{3/2})5f$	$^2[7/2]$	3,4	108 517.03	
$4s^24p^5(^2P^\circ_{3/2})8p$	$^2[1/2]$	1	109 082.7646	1.795
		0	109 296.1863	
$4s^24p^5(^2P^\circ_{3/2})8p$	$^2[5/2]$	3	109 103.2973	
		2	109 105.78	
$4s^24p^5(^2P^\circ_{3/2})8p$	$^2[3/2]$	1	109 149.6890	1.014
		2	109 160.9517	1.411
$4s^24p^5(^2P^\circ_{3/2})7d$	$^2[1/2]^\circ$	0	*109 330.9773*	
		1	*109 342.9326*	1.355
$4s^24p^5(^2P^\circ_{3/2})7d$	$^2[3/2]^\circ$	2	*109 375.2833*	1.315
		1	*109 688.7511*	0.797
$4s^24p^5(^2P^\circ_{3/2})7d$	$^2[7/2]^\circ$	4	*109 433.9038*	1.228
		3	*109 471.4165*	1.094
$4s^24p^5(^2P^\circ_{3/2})7d$	$^2[5/2]^\circ$	2	*109 527.5227*	0.954
		3	*109 578.9940*	1.231
$4s^24p^5(^2P^\circ_{3/2})9s$	$^2[3/2]^\circ$	2	*109 751.9593*	1.495
		1	*109 779.3081*	1.174
$4s^24p^5(^2P^\circ_{3/2})6f$	$^2[3/2]$	1	109 836.14	
		2	109 836.76	
$4s^24p^5(^2P^\circ_{3/2})6f$	$^2[9/2]$	4	109 843.1265	
$4s^24p^5(^2P^\circ_{3/2})6f$	$^2[5/2]$	3	109 852.3011	
		2	109 852.75	
$4s^24p^5(^2P^\circ_{3/2})6f$	$^2[7/2]$	3	109 860.3335	
		4	109 860.3609	
$4s^24p^5(^2P^\circ_{1/2})5d$	$^2[3/2]^\circ$	2	*110 103.2299*	1.169
		1	*110 733.26*	
$4s^24p^5(^2P^\circ_{1/2})5d$	$^2[5/2]^\circ$	2	*110 121.9917*	0.899
		3	*110 237.4160*	1.140

Configuration	Term	J	Level (cm^{-1})	g
$4s^24p^5(^2P^o_{3/2})9p$	$^2[^1/_2]$	1	110 180.07	
		0	110 308.13	
$4s^24p^5(^2P^o_{3/2})9p$	$^2[^5/_2]$	3	110 209.55	
		2	110 209.84	
$4s^24p^5(^2P^o_{3/2})9p$	$^2[^3/_2]$	1	110 234.84	
		2	110 242.82	
$4s^24p^5(^2P^o_{3/2})8d$	$^2[^1/_2]^o$	1	*110 290.3120*	1.294
		0	*110 355.6214*	
$4s^24p^5(^2P^o_{3/2})8d$	$^2[^7/_2]^o$	4	*110 403.6333*	1.236
		3	*110 470.9140*	1.037
$4s^24p^5(^2P^o_{3/2})8d$	$^2[^5/_2]^o$	2	*110 496.7083*	1.005
		3	*110 508.1304*	1.227
$4s^24p^5(^2P^o_{3/2})8d$	$^2[^3/_2]^o$	2	*110 512.8220*	
		1	*110 514.0901*	
$4s^24p^5(^2P^o_{3/2})10s$	$^2[^3/_2]^o$	2	*110 608.3537*	
		1	*110 619.0701*	1.161
$4s^24p^5(^2P^o_{3/2})7f$	$^2[^3/_2]$	1	110 655.44	
		2	110 656.00	
$4s^24p^5(^2P^o_{3/2})7f$	$^2[^9/_2]$	4,5	110 659.89	
$4s^24p^5(^2P^o_{3/2})7f$	$^2[^5/_2]$	3	110 665.44	
		2	110 665.74	
$4s^24p^5(^2P^o_{3/2})7f$	$^2[^7/_2]$	3,4	110 670.66	
$4s^24p^5(^2P^o_{3/2})10p$	$^2[^1/_2]$	1	110 872.42	
		0	110 956.23	
$4s^24p^5(^2P^o_{3/2})10p$	$^2[^3/_2]$	2	110 916.06	
$4s^24p^5(^2P^o_{3/2})9d$	$^2[^1/_2]^o$	0	*110 933.3525*	
		1	*111 002.9789*	1.208
$4s^24p^5(^2P^o_{1/2})7s$	$^2[^1/_2]^o$	1	*111 003.0*	
$4s^24p^5(^2P^o_{3/2})9d$	$^2[^7/_2]^o$	4	*111 018.8713*	
		3	*111 047.1626*	
$4s^24p^5(^2P^o_{3/2})9d$	$^2[^3/_2]^o$	2	*111 047.06*	
		1	*111 154.3*	
$4s^24p^5(^2P^o_{3/2})9d$	$^2[^5/_2]^o$	2	*111 071.44*	
		3	*111 079.05*	
$4s^24p^5(^2P^o_{3/2})11s$	$^2[^3/_2]^o$	2	*111 154.39*	
		1	*111 170.82*	
$4s^24p^5(^2P^o_{3/2})8f$	$^2[^3/_2]$	1	111 186.53	
$4s^24p^5(^2P^o_{3/2})8f$	$^2[^9/_2]$	4,5	111 189.49	

Kr I — Continued

Configuration	Term	J	Level (cm^{-1})	g
$4s^24p^5(^2P^\circ_{3/2})8f$	$^2[5/2]$	3	111 192.65	
		2	111 192.98	
$4s^24p^5(^2P^\circ_{1/2})4f$	$^2[7/2]$	4	111 377.9	
		3	111 378.41	
$4s^24p^5(^2P^\circ_{1/2})4f$	$^2[5/2]$	3	111 380.30	
		2	111 381.88	
$4s^24p^5(^2P^\circ_{3/2})11p$	$^2[1/2]$	0	111 390.6	
$4s^24p^5(^2P^\circ_{3/2})10d$	$^2[1/2]^\circ$	0	*111 412.43*	
		1	*111 428.56*	
$4s^24p^5(^2P^\circ_{3/2})10d$	$^2[7/2]^\circ$	4	*111 433.1407*	
		3	*111 450.42*	
$4s^24p^5(^2P^\circ_{3/2})10d$	$^2[3/2]^\circ$	2	*111 445.38*	
		1	*111 520.2*	
$4s^24p^5(^2P^\circ_{3/2})10d$	$^2[5/2]^\circ$	2	*111 467.34*	
		3	*111 474.07*	
$4s^24p^5(^2P^\circ_{3/2})12s$	$^2[3/2]^\circ$	2	*111 527.82*	
		1	*111 536.62*	
$4s^24p^5(^2P^\circ_{3/2})9f$	$^2[3/2]$	1	111 550.5	
$4s^24p^5(^2P^\circ_{3/2})9f$	$^2[9/2]$	5	111 552.36	
$4s^24p^5(^2P^\circ_{3/2})9f$	$^2[5/2]$	3	111 555.76	
$4s^24p^5(^2P^\circ_{3/2})11d$	$^2[1/2]^\circ$	0	*111 708.31*	
		1	*111 718.15*	
$4s^24p^5(^2P^\circ_{3/2})11d$	$^2[7/2]^\circ$	4	*111 725.2078*	
		3	*111 736.85*	
$4s^24p^5(^2P^\circ_{3/2})11d$	$^2[3/2]^\circ$	2	*111 731.13*	
		1	*111 786.1*	
$4s^24p^5(^2P^\circ_{3/2})11d$	$^2[5/2]^\circ$	3	*111 754.34*	
$4s^24p^5(^2P^\circ_{3/2})13s$	$^2[3/2]^\circ$	1	*111 799.9*	
$4s^24p^5(^2P^\circ_{3/2})14s$	$^2[3/2]^\circ$	1	*111 994.5*	
$4s^24p^5(^2P^\circ_{3/2})15s$	$^2[3/2]^\circ$	1	*112 142.4*	
$4s^24p^5(^2P^\circ_{3/2})16s$	$^2[3/2]^\circ$	1	*112 257.3*	
$4s^24p^5(^2P^\circ_{3/2})17s$	$^2[3/2]^\circ$	1	*112 348.3*	
$4s^24p^5(^2P^\circ_{3/2})18s$	$^2[3/2]^\circ$	1	*112 421.7*	
$4s^24p^5(^2P^\circ_{3/2})19s$	$^2[3/2]^\circ$	1	*112 481.6*	
$4s^24p^5(^2P^\circ_{3/2})20s$	$^2[3/2]^\circ$	1	*112 531.2*	
$4s^24p^5(^2P^\circ_{3/2})21s$	$^2[3/2]^\circ$	1	*112 572.8*	
$4s^24p^5(^2P^\circ_{3/2})22s$	$^2[3/2]^\circ$	1	*112 608.0*	
$4s^24p^5(^2P^\circ_{3/2})23s$	$^2[3/2]^\circ$	1	*112 637.9*	
$4s^24p^5(^2P^\circ_{3/2})24s$	$^2[3/2]^\circ$	1	*112 663.8*	
$4s^24p^5(^2P^\circ_{3/2})25s$	$^2[3/2]^\circ$	1	*112 686.1*	
$4s^24p^5(^2P^\circ_{3/2})26s$	$^2[3/2]^\circ$	1	*112 705.7*	
$4s^24p^5(^2P^\circ_{3/2})27s$	$^2[3/2]^\circ$	1	*112 722.7*	
$4s^24p^5(^2P^\circ_{3/2})28s$	$^2[3/2]^\circ$	1	*112 737.8*	
$4s^24p^5(^2P^\circ_{3/2})29s$	$^2[3/2]^\circ$	1	*112 751.1*	

Configuration	Term	J	Level (cm^{-1})	g
$4s^24p^5(^2P^o_{3/2})30s$	$^2[^3/_2]^o$	1	*112 762.9*	
$4s^24p^5(^2P^o_{3/2})31s$	$^2[^3/_2]^o$	1	*112 773.6*	
$4s^24p^5(^2P^o_{3/2})32s$	$^2[^3/_2]^o$	1	*112 783.1*	
$4s^24p^5(^2P^o_{3/2})33s$	$^2[^3/_2]^o$	1	*112 791.8*	
$4s^24p^5(^2P^o_{3/2})10f$	$^2[^3/_2]$	1	111 809.6	
$4s^24p^5(^2P^o_{3/2})10f$	$^2[^9/_2]$	5	111 811.5	
$4s^24p^5(^2P^o_{3/2})10f$	$^2[^5/_2]$	3	111 813.4	
$4s^24p^5(^2P^o_{3/2})13p$	$^2[^1/_2]$	0	111 914	
$4s^24p^5(^2P^o_{3/2})14p$	$^2[^1/_2]$	0	112 080	
$4s^24p^5(^2P^o_{3/2})15p$	$^2[^1/_2]$	0	112 208	
$4s^24p^5(^2P^o_{3/2})16p$	$^2[^1/_2]$	0	112 310	
$4s^24p^5(^2P^o_{3/2})12d$	$^2[^7/_2]^o$	4	*111 938.70*	
		3	*111 946.90*	
$4s^24p^5(^2P^o_{3/2})12d$	$^2[^3/_2]^o$	1	*111 983.3*	
$4s^24p^5(^2P^o_{3/2})13d$	$^2[^3/_2]^o$	1	*112 133.2*	
$4s^24p^5(^2P^o_{3/2})14d$	$^2[^3/_2]^o$	1	*112 249.7*	
$4s^24p^5(^2P^o_{3/2})15d$	$^2[^3/_2]^o$	1	*112 342.0*	
$4s^24p^5(^2P^o_{3/2})16d$	$^2[^3/_2]^o$	1	*112 416.4*	
$4s^24p^5(^2P^o_{3/2})17d$	$^2[^3/_2]^o$	1	*112 477.2*	
$4s^24p^5(^2P^o_{3/2})18d$	$^2[^3/_2]^o$	1	*112 527.5*	
$4s^24p^5(^2P^o_{3/2})19d$	$^2[^3/_2]^o$	1	*112 569.7*	
$4s^24p^5(^2P^o_{3/2})20d$	$^2[^3/_2]^o$	1	*112 605.2*	
$4s^24p^5(^2P^o_{3/2})21d$	$^2[^3/_2]^o$	1	*112 635.6*	
$4s^24p^5(^2P^o_{3/2})22d$	$^2[^3/_2]^o$	1	*112 661.8*	
$4s^24p^5(^2P^o_{3/2})23d$	$^2[^3/_2]^o$	1	*112 684.3*	
$4s^24p^5(^2P^o_{3/2})24d$	$^2[^3/_2]^o$	1	*112 703.95*	
$4s^24p^5(^2P^o_{3/2})25d$	$^2[^3/_2]^o$	1	*112 721.23*	
$4s^24p^5(^2P^o_{3/2})26d$	$^2[^3/_2]^o$	1	*112 736.46*	
$4s^24p^5(^2P^o_{3/2})27d$	$^2[^3/_2]^o$	1	*112 749.97*	
$4s^24p^5(^2P^o_{3/2})28d$	$^2[^3/_2]^o$	1	*112 762.00*	
$4s^24p^5(^2P^o_{3/2})29d$	$^2[^3/_2]^o$	1	*112 772.75*	
$4s^24p^5(^2P^o_{3/2})30d$	$^2[^3/_2]^o$	1	*112 782.40*	
$4s^24p^5(^2P^o_{3/2})31d$	$^2[^3/_2]^o$	1	*112 791.10*	
$4s^24p^5(^2P^o_{3/2})32d$	$^2[^3/_2]^o$	1	*112 798.97*	
$4s^24p^5(^2P^o_{3/2})33d$	$^2[^3/_2]^o$	1	*112 806.12*	
$4s^24p^5(^2P^o_{3/2})34d$	$^2[^3/_2]^o$	1	*112 812.59*	
$4s^24p^5(^2P^o_{3/2})35d$	$^2[^3/_2]^o$	1	*112 818.53*	
$4s^24p^5(^2P^o_{3/2})36d$	$^2[^3/_2]^o$	1	*112 823.96*	
$4s^24p^5(^2P^o_{3/2})37d$	$^2[^3/_2]^o$	1	*112 828.93*	
$4s^24p^5(^2P^o_{3/2})38d$	$^2[^3/_2]^o$	1	*112 833.50*	
$4s^24p^5(^2P^o_{3/2})39d$	$^2[^3/_2]^o$	1	*112 837.74*	
$4s^24p^5(^2P^o_{3/2})40d$	$^2[^3/_2]^o$	1	*112 841.62*	
$4s^24p^5(^2P^o_{3/2})41d$	$^2[^3/_2]^o$	1	*112 845.24*	
$4s^24p^5(^2P^o_{3/2})42d$	$^2[^3/_2]^o$	1	*112 848.58*	
$4s^24p^5(^2P^o_{3/2})43d$	$^2[^3/_2]^o$	1	*112 851.68*	
$4s^24p^5(^2P^o_{3/2})44d$	$^2[^3/_2]^o$	1	*112 854.58*	
$4s^24p^5(^2P^o_{3/2})45d$	$^2[^3/_2]^o$	1	*112 857.28*	
$4s^24p^5(^2P^o_{3/2})46d$	$^2[^3/_2]^o$	1	*112 860.0*	
$4s^24p^5(^2P^o_{3/2})47d$	$^2[^3/_2]^o$	1	*112 862.4*	
$4s^24p^5(^2P^o_{3/2})48d$	$^2[^3/_2]^o$	1	*112 864.6*	
$4s^24p^5(^2P^o_{3/2})49d$	$^2[^3/_2]^o$	1	*112 866.6*	
$4s^24p^5(^2P^o_{3/2})50d$	$^2[^3/_2]^o$	1	*112 868.6*	
$4s^24p^5(^2P^o_{3/2})51d$	$^2[^3/_2]^o$	1	*112 870.4*	
$4s^24p^5(^2P^o_{3/2})52d$	$^2[^3/_2]^o$	1	*112 872.1*	

Kr I — Continued

Configuration	Term	J	Level (cm^{-1})	g
$4s^24p^5(^2P^\circ_{3/2})53d$	$^2[3/2]^\circ$	1	*112 873.8*	
$4s^24p^5(^2P^\circ_{3/2})54d$	$^2[3/2]^\circ$	1	*112 875.3*	
$4s^24p^5(^2P^\circ_{3/2})55d$	$^2[3/2]^\circ$	1	*112 876.8*	
$4s^24p^5(^2P^\circ_{3/2})56d$	$^2[3/2]^\circ$	1	*112 878.1*	
$4s^24p^5(^2P^\circ_{3/2})57d$	$^2[3/2]^\circ$	1	*112 879.4*	
$4s^24p^5(^2P^\circ_{3/2})58d$	$^2[3/2]^\circ$	1	*112 880.6*	
$4s^24p^5(^2P^\circ_{3/2})59d$	$^2[3/2]^\circ$	1	*112 881.9*	
$4s^24p^5(^2P^\circ_{3/2})60d$	$^2[3/2]^\circ$	1	*112 883.4*	
$4s^24p^5(^2P^\circ_{3/2})13d$	$^2[7/2]^\circ$	4	*112 099.74*	
$4s^24p^5(^2P^\circ_{3/2})15p$	$^2[5/2]$	3	112 197.91	
$4s^24p^5(^2P^\circ_{3/2})16p$	$^2[5/2]$	3	112 301.11	
$4s^24p^5(^2P^\circ_{3/2})17p$	$^2[5/2]$	3		
$4s^24p^5(^2P^\circ_{3/2})18p$	$^2[5/2]$	3	112 450.30	
$4s^24p^5(^2P^\circ_{3/2})19p$	$^2[5/2]$	3	112 505.29	
$4s^24p^5(^2P^\circ_{3/2})13f$	$^2[9/2]$		112 262.63	
$4s^24p^5(^2P^\circ_{3/2})14f$	$^2[9/2]$		112 352.57	
$4s^24p^5(^2P^\circ_{3/2})15f$	$^2[9/2]$		112 425.11	
$4s^24p^5(^2P^\circ_{3/2})16f$	$^2[9/2]$		112 484.45	
$4s^24p^5(^2P^\circ_{3/2})17f$	$^2[9/2]$		112 533.61	
$4s^24p^5(^2P^\circ_{3/2})18f$	$^2[9/2]$		112 574.79	
$4s^24p^5(^2P^\circ_{3/2})13f$	$^2[7/2]$		112 264.35	
$4s^24p^5(^2P^\circ_{3/2})14f$	$^2[7/2]$		112 353.95	
$4s^24p^5(^2P^\circ_{3/2})15f$	$^2[7/2]$		112 426.22	
$4s^24p^5(^2P^\circ_{3/2})16f$	$^2[7/2]$		112 485.35	
$4s^24p^5(^2P^\circ_{3/2})17f$	$^2[7/2]$		112 534.35	
$4s^24p^5(^2P^\circ_{3/2})18f$	$^2[7/2]$		112 575.41	
$4s^24p^5(^2P^\circ_{3/2})15d$	$^2[3/2]^\circ$	2	*112 321.68*	
$4s^24p^5(^2P^\circ_{3/2})16d$	$^2[3/2]^\circ$	2	*112 399.80*	
$4s^24p^5(^2P^\circ_{3/2})17d$	$^2[3/2]^\circ$	2	*112 463.47*	
$4s^24p^5(^2P^\circ_{3/2})18d$	$^2[3/2]^\circ$	2	*112 516.01*	
$4s^24p^5(^2P^\circ_{3/2})19d$	$^2[3/2]^\circ$	2	*112 559.89*	
$4s^24p^5(^2P^\circ_{3/2})20d$	$^2[3/2]^\circ$	2	*112 596.91*	
$4s^24p^5(^2P^\circ_{3/2})21d$	$^2[3/2]^\circ$	2	*112 628.43*	
$4s^24p^5(^2P^\circ_{3/2})22d$	$^2[3/2]^\circ$	2	*112 655.48*	
$4s^24p^5(^2P^\circ_{3/2})23d$	$^2[3/2]^\circ$	2	*112 678.88*	
$4s^24p^5(^2P^\circ_{3/2})24d$	$^2[3/2]^\circ$	2	*112 699.26*	
$4s^24p^5(^2P^\circ_{3/2})25d$	$^2[3/2]^\circ$	2	*112 717.10*	
$4s^24p^5(^2P^\circ_{3/2})26d$	$^2[3/2]^\circ$	2	*112 732.73*	
$4s^24p^5(^2P^\circ_{3/2})27d$	$^2[3/2]^\circ$	2	*112 746.65*	
$4s^24p^5(^2P^\circ_{3/2})28d$	$^2[3/2]^\circ$	2	*112 759.01*	
$4s^24p^5(^2P^\circ_{3/2})29d$	$^2[3/2]^\circ$	2	*112 770.07*	
$4s^24p^5(^2P^\circ_{3/2})30d$	$^2[3/2]^\circ$	2	*112 779.99*	
$4s^24p^5(^2P^\circ_{3/2})31d$	$^2[3/2]^\circ$	2	*112 788.92*	
$4s^24p^5(^2P^\circ_{3/2})32d$	$^2[3/2]^\circ$	2	*112 796.99*	
$4s^24p^5(^2P^\circ_{3/2})33d$	$^2[3/2]^\circ$	2	*112 804.29*	
$4s^24p^5(^2P^\circ_{3/2})34d$	$^2[3/2]^\circ$	2	*112 810.96*	
$4s^24p^5(^2P^\circ_{3/2})35d$	$^2[3/2]^\circ$	2	*112 817.02*	
$4s^24p^5(^2P^\circ_{3/2})36d$	$^2[3/2]^\circ$	2	*112 822.58*	
$4s^24p^5(^2P^\circ_{3/2})37d$	$^2[3/2]^\circ$	2	*112 827.66*	
$4s^24p^5(^2P^\circ_{3/2})38d$	$^2[3/2]^\circ$	2	*112 832.34*	
$4s^24p^5(^2P^\circ_{3/2})39d$	$^2[3/2]^\circ$	2	*112 836.66*	
$4s^24p^5(^2P^\circ_{3/2})40d$	$^2[3/2]^\circ$	2	*112 840.67*	
$4s^24p^5(^2P^\circ_{3/2})41d$	$^2[3/2]^\circ$	2	*112 844.30*	
$4s^24p^5(^2P^\circ_{3/2})42d$	$^2[3/2]^\circ$	2	*112 847.73*	
$4s^24p^5(^2P^\circ_{3/2})43d$	$^2[3/2]^\circ$	2	*112 850.90*	

Configuration	Term	J	Level (cm^{-1})	g
$4s^24p^5(^2P^o_{3/2})44d$	$^2[^3/_2]^o$	2	*112 853.84*	
$4s^24p^5(^2P^o_{3/2})45d$	$^2[^3/_2]^o$	2	*112 856.60*	
$4s^24p^5(^2P^o_{3/2})46d$	$^2[^3/_2]^o$	2	*112 859.16*	
$4s^24p^5(^2P^o_{3/2})47d$	$^2[^3/_2]^o$	2	*112 861.57*	
$4s^24p^5(^2P^o_{3/2})48d$	$^2[^3/_2]^o$	2	*112 863.88*	
$4s^24p^5(^2P^o_{3/2})49d$	$^2[^3/_2]^o$	2	*112 865.91*	
$4s^24p^5(^2P^o_{3/2})50d$	$^2[^3/_2]^o$	2	*112 867.91*	
$4s^24p^5(^2P^o_{3/2})51d$	$^2[^3/_2]^o$	2	*112 869.76*	
$4s^24p^5(^2P^o_{3/2})52d$	$^2[^3/_2]^o$	2	*112 871.51*	
$4s^24p^5(^2P^o_{3/2})53d$	$^2[^3/_2]^o$	2	*112 873.16*	
$4s^24p^5(^2P^o_{3/2})54d$	$^2[^3/_2]^o$	2	*112 874.75*	
$4s^24p^5(^2P^o_{3/2})55d$	$^2[^3/_2]^o$	2	*112 876.21*	
$4s^24p^5(^2P^o_{3/2})56d$	$^2[^3/_2]^o$	2	*112 877.61*	
$4s^24p^5(^2P^o_{3/2})57d$	$^2[^3/_2]^o$	2	*112 878.92*	
$4s^24p^5(^2P^o_{3/2})58d$	$^2[^3/_2]^o$	2	*112 880.15*	
$4s^24p^5(^2P^o_{3/2})59d$	$^2[^3/_2]^o$	2	*112 881.33*	
$4s^24p^5(^2P^o_{3/2})60d$	$^2[^3/_2]^o$	2	*112 822.45*	
$4s^24p^5(^2P^o_{3/2})61d$	$^2[^3/_2]^o$	2	*112 883.51*	
$4s^24p^5(^2P^o_{3/2})15d$	$^2[^7/_2]^o$	3	*112 325.10*	
$4s^24p^5(^2P^o_{3/2})16d$	$^2[^7/_2]^o$	3	*112 402.74*	
$4s^24p^5(^2P^o_{3/2})17d$	$^2[^7/_2]^o$	3	*112 466.03*	
$4s^24p^5(^2P^o_{3/2})18d$	$^2[^7/_2]^o$	3	*112 518.23*	
$4s^24p^5(^2P^o_{3/2})19d$	$^2[^7/_2]^o$	3	*112 561.84*	
$4s^24p^5(^2P^o_{3/2})20d$	$^2[^7/_2]^o$	3	*112 598.64*	
$4s^24p^5(^2P^o_{3/2})21d$	$^2[^7/_2]^o$	3	*112 629.97*	
$4s^24p^5(^2P^o_{3/2})22d$	$^2[^7/_2]^o$	3	*112 656.92*	
$4s^24p^5(^2P^o_{3/2})23d$	$^2[^7/_2]^o$	3	*112 680.09*	
$4s^24p^5(^2P^o_{3/2})24d$	$^2[^7/_2]^o$	3	*112 700.35*	
$4s^24p^5(^2P^o_{3/2})25d$	$^2[^7/_2]^o$	3	*112 718.06*	
$4s^24p^5(^2P^o_{3/2})26d$	$^2[^7/_2]^o$	3	*112 733.60*	
$4s^24p^5(^2P^o_{3/2})27d$	$^2[^7/_2]^o$	3	*112 747.43*	
$4s^24p^5(^2P^o_{3/2})28d$	$^2[^7/_2]^o$	3	*112 759.73*	
$4s^24p^5(^2P^o_{3/2})29d$	$^2[^7/_2]^o$	3	*112 770.72*	
$4s^24p^5(^2P^o_{3/2})30d$	$^2[^7/_2]^o$	3	*112 780.60*	
$4s^24p^5(^2P^o_{3/2})31d$	$^2[^7/_2]^o$	3	*112 789.46*	
$4s^24p^5(^2P^o_{3/2})32d$	$^2[^7/_2]^o$	3	*112 797.48*	
$4s^24p^5(^2P^o_{3/2})33d$	$^2[^7/_2]^o$	3	*112 804.71*	
$4s^24p^5(^2P^o_{3/2})34d$	$^2[^7/_2]^o$	3	*112 811.37*	
$4s^24p^5(^2P^o_{3/2})35d$	$^2[^7/_2]^o$	3	*112 817.41*	
$4s^24p^5(^2P^o_{3/2})36d$	$^2[^7/_2]^o$	3	*112 822.94*	
$4s^24p^5(^2P^o_{3/2})37d$	$^2[^7/_2]^o$	3	*112 827.99*	
$4s^24p^5(^2P^o_{3/2})38d$	$^2[^7/_2]^o$	3	*112 832.64*	
$4s^24p^5(^2P^o_{3/2})39d$	$^2[^7/_2]^o$	3	*112 836.93*	
$4s^24p^5(^2P^o_{3/2})40d$	$^2[^7/_2]^o$	3	*112 840.87*	
$4s^24p^5(^2P^o_{3/2})41d$	$^2[^7/_2]^o$	3	*112 844.55*	
$4s^24p^5(^2P^o_{3/2})42d$	$^2[^7/_2]^o$	3	*112 847.94*	
$4s^24p^5(^2P^o_{3/2})43d$	$^2[^7/_2]^o$	3	*112 851.12*	
$4s^24p^5(^2P^o_{3/2})44d$	$^2[^7/_2]^o$	3	*112 854.04*	
$4s^24p^5(^2P^o_{3/2})45d$	$^2[^7/_2]^o$	3	*112 856.78*	
$4s^24p^5(^2P^o_{3/2})46d$	$^2[^7/_2]^o$	3	*112 859.34*	
$4s^24p^5(^2P^o_{3/2})47d$	$^2[^7/_2]^o$	3	*112 861.71*	
$4s^24p^5(^2P^o_{3/2})48d$	$^2[^7/_2]^o$	3	*112 863.96*	
$4s^24p^5(^2P^o_{3/2})49d$	$^2[^7/_2]^o$	3	*112 866.06*	
$4s^24p^5(^2P^o_{3/2})50d$	$^2[^7/_2]^o$	3	*112 868.03*	
$4s^24p^5(^2P^o_{3/2})51d$	$^2[^7/_2]^o$	3	*112 869.86*	
$4s^24p^5(^2P^o_{3/2})52d$	$^2[^7/_2]^o$	3	*112 871.61*	
$4s^24p^5(^2P^o_{3/2})53d$	$^2[^7/_2]^o$	3	*112 873.23*	

Kr I — Continued

Configuration	Term	J	Level (cm^{-1})	g
$4s^2 4p^5(^2P^\circ_{3/2})24d$	$^2[1/2]^\circ$	1	112 698.47	
$4s^2 4p^5(^2P^\circ_{3/2})25d$	$^2[1/2]^\circ$	1	112 716.38	
$4s^2 4p^5(^2P^\circ_{3/2})26d$	$^2[1/2]^\circ$	1	112 732.19	
$4s^2 4p^5(^2P^\circ_{3/2})27d$	$^2[1/2]^\circ$	1	112 746.16	
$4s^2 4p^5(^2P^\circ_{3/2})28d$	$^2[1/2]^\circ$	1	112 758.62	
$4s^2 4p^5(^2P^\circ_{3/2})29d$	$^2[1/2]^\circ$	1	112 769.70	
$4s^2 4p^5(^2P^\circ_{3/2})30d$	$^2[1/2]^\circ$	1	112 779.69	
$4s^2 4p^5(^2P^\circ_{3/2})31d$	$^2[1/2]^\circ$	1	112 788.65	
$4s^2 4p^5(^2P^\circ_{3/2})32d$	$^2[1/2]^\circ$	1	112 796.74	
$4s^2 4p^5(^2P^\circ_{3/2})33d$	$^2[1/2]^\circ$	1	112 804.12	
$4s^2 4p^5(^2P^\circ_{3/2})34d$	$^2[1/2]^\circ$	1	112 810.76	
$4s^2 4p^5(^2P^\circ_{3/2})35d$	$^2[1/2]^\circ$	1	112 816.85	
$4s^2 4p^5(^2P^\circ_{3/2})24d$	$^2[5/2]^\circ$	2	112 701.19	
$4s^2 4p^5(^2P^\circ_{3/2})25d$	$^2[5/2]^\circ$	2	112 718.79	
$4s^2 4p^5(^2P^\circ_{3/2})26d$	$^2[5/2]^\circ$	2	112 734.32	
$4s^2 4p^5(^2P^\circ_{3/2})27d$	$^2[5/2]^\circ$	2	112 748.06	
$4s^2 4p^5(^2P^\circ_{3/2})28d$	$^2[5/2]^\circ$	2	112 760.30	
$4s^2 4p^5(^2P^\circ_{3/2})29d$	$^2[5/2]^\circ$	2	112 771.21	
$4s^2 4p^5(^2P^\circ_{3/2})30d$	$^2[5/2]^\circ$	2	112 781.03	
$4s^2 4p^5(^2P^\circ_{3/2})31d$	$^2[5/2]^\circ$	2	112 789.86	
$4s^2 4p^5(^2P^\circ_{3/2})32d$	$^2[5/2]^\circ$	2	112 797.85	
$4s^2 4p^5(^2P^\circ_{3/2})33d$	$^2[5/2]^\circ$	2	112 805.06	
$4s^2 4p^5(^2P^\circ_{3/2})34d$	$^2[5/2]^\circ$	2	112 811.67	
$4s^2 4p^5(^2P^\circ_{3/2})35d$	$^2[5/2]^\circ$	2	112 817.66	
$4s^2 4p^5(^2P^\circ_{3/2})36d$	$^2[5/2]^\circ$	2	112 823.18	
$4s^2 4p^5(^2P^\circ_{3/2})37d$	$^2[5/2]^\circ$	2	112 828.22	
$4s^2 4p^5(^2P^\circ_{3/2})38d$	$^2[5/2]^\circ$	2	112 832.85	
$4s^2 4p^5(^2P^\circ_{3/2})39d$	$^2[5/2]^\circ$	2	112 837.13	
$4s^2 4p^5(^2P^\circ_{3/2})40d$	$^2[5/2]^\circ$	2	112 841.06	
$4s^2 4p^5(^2P^\circ_{3/2})41d$	$^2[5/2]^\circ$	2	112 844.71	
$4s^2 4p^5(^2P^\circ_{3/2})42d$	$^2[5/2]^\circ$	2	112 848.10	
$4s^2 4p^5(^2P^\circ_{3/2})43d$	$^2[5/2]^\circ$	2	112 851.26	
$4s^2 4p^5(^2P^\circ_{3/2})44d$	$^2[5/2]^\circ$	2	112 854.19	
$4s^2 4p^5(^2P^\circ_{3/2})45d$	$^2[5/2]^\circ$	2	112 856.91	
$4s^2 4p^5(^2P^\circ_{3/2})46d$	$^2[5/2]^\circ$	2	112 859.43	
$4s^2 4p^5(^2P^\circ_{3/2})47d$	$^2[5/2]^\circ$	2	112 861.84	
$4s^2 4p^5(^2P^\circ_{3/2})48d$	$^2[5/2]^\circ$	2	112 864.04	
$4s^2 4p^5(^2P^\circ_{3/2})49d$	$^2[5/2]^\circ$	2	112 866.11	
$4s^2 4p^5(^2P^\circ_{3/2})50d$	$^2[5/2]^\circ$	2	112 868.11	
$4s^2 4p^5(^2P^\circ_{3/2})24d$	$^2[5/2]^\circ$	3	112 701.80	
$4s^2 4p^5(^2P^\circ_{3/2})25d$	$^2[5/2]^\circ$	3	112 719.35	
$4s^2 4p^5(^2P^\circ_{3/2})26d$	$^2[5/2]^\circ$	3	112 734.80	
$4s^2 4p^5(^2P^\circ_{3/2})27d$	$^2[5/2]^\circ$	3	112 748.52	
$4s^2 4p^5(^2P^\circ_{3/2})28d$	$^2[5/2]^\circ$	3	112 760.71	
$4s^2 4p^5(^2P^\circ_{3/2})29d$	$^2[5/2]^\circ$	3	112 771.59	
$4s^2 4p^5(^2P^\circ_{3/2})30d$	$^2[5/2]^\circ$	3	112 781.37	
$4s^2 4p^5(^2P^\circ_{3/2})31d$	$^2[5/2]^\circ$	3	112 790.17	
$4s^2 4p^5(^2P^\circ_{3/2})32d$	$^2[5/2]^\circ$	3	112 798.11	
$4s^2 4p^5(^2P^\circ_{3/2})33d$	$^2[5/2]^\circ$	3	112 805.31	
$4s^2 4p^5(^2P^\circ_{3/2})34d$	$^2[5/2]^\circ$	3	112 811.90	
$4s^2 4p^5(^2P^\circ_{3/2})35d$	$^2[5/2]^\circ$	3	112 817.90	
$4s^2 4p^5(^2P^\circ_{3/2})36d$	$^2[5/2]^\circ$	3	112 823.37	
$4s^2 4p^5(^2P^\circ_{3/2})37d$	$^2[5/2]^\circ$	3	112 828.41	
$4s^2 4p^5(^2P^\circ_{3/2})38d$	$^2[5/2]^\circ$	3	112 833.02	
$4s^2 4p^5(^2P^\circ_{3/2})39d$	$^2[5/2]^\circ$	3	112 837.28	
$4s^2 4p^5(^2P^\circ_{3/2})40d$	$^2[5/2]^\circ$	3	112 841.20	
$4s^2 4p^5(^2P^\circ_{3/2})41d$	$^2[5/2]^\circ$	3	112 844.85	
$4s^2 4p^5(^2P^\circ_{3/2})42d$	$^2[5/2]^\circ$	3	112 848.27	

Configuration	Term	J	Level (cm^{-1})	g
$4s^24p^5(^2P^\circ_{3/2})43d$	$^2[5/2]^\circ$	3	*112 851.34*	
$4s^24p^5(^2P^\circ_{3/2})44d$	$^2[5/2]^\circ$	3	*112 854.26*	
$4s^24p^5(^2P^\circ_{3/2})45d$	$^2[5/2]^\circ$	3	*112 856.99*	
$4s^24p^5(^2P^\circ_{3/2})46d$	$^2[5/2]^\circ$	3	*112 859.56*	
$4s^24p^5(^2P^\circ_{3/2})26s$	$^2[3/2]^\circ$	2	*112 705.10*	
$4s^24p^5(^2P^\circ_{3/2})27s$	$^2[3/2]^\circ$	2	*112 722.26*	
$4s^24p^5(^2P^\circ_{3/2})28s$	$^2[3/2]^\circ$	2	*112 737.37*	
$4s^24p^5(^2P^\circ_{3/2})29s$	$^2[3/2]^\circ$	2	*112 750.74*	
$4s^24p^5(^2P^\circ_{3/2})30s$	$^2[3/2]^\circ$	2	*112 762.74*	
$4s^24p^5(^2P^\circ_{3/2})31s$	$^2[3/2]^\circ$	2	*112 773.41*	
$4s^24p^5(^2P^\circ_{3/2})32s$	$^2[3/2]^\circ$	2	*112 783.01*	
$4s^24p^5(^2P^\circ_{3/2})33s$	$^2[3/2]^\circ$	2	*112 791.61*	
$4s^24p^5(^2P^\circ_{3/2})34s$	$^2[3/2]^\circ$	2	*112 799.47*	
$4s^24p^5(^2P^\circ_{3/2})35s$	$^2[3/2]^\circ$	2	*112 806.56*	
$4s^24p^5(^2P^\circ_{3/2})36s$	$^2[3/2]^\circ$	2	*112 813.02*	
$4s^24p^5(^2P^\circ_{3/2})37s$	$^2[3/2]^\circ$	2	*112 818.92*	
$4s^24p^5(^2P^\circ_{3/2})38s$	$^2[3/2]^\circ$	2	*112 824.32*	
$4s^24p^5(^2P^\circ_{3/2})39s$	$^2[3/2]^\circ$	2	*112 829.25*	
$4s^24p^5(^2P^\circ_{3/2})40s$	$^2[3/2]^\circ$	2	*112 833.81*	
$4s^24p^5(^2P^\circ_{3/2})41s$	$^2[3/2]^\circ$	2	*112 838.01*	
$4s^24p^5(^2P^\circ_{3/2})42s$	$^2[3/2]^\circ$	2	*112 841.90*	
$4s^24p^5(^2P^\circ_{3/2})43s$	$^2[3/2]^\circ$	2	*112 845.48*	
$4s^24p^5(^2P^\circ_{3/2})44s$	$^2[3/2]^\circ$	2	*112 848.81*	
$4s^24p^5(^2P^\circ_{3/2})45s$	$^2[3/2]^\circ$	2	*112 851.91*	
$4s^24p^5(^2P^\circ_{3/2})46s$	$^2[3/2]^\circ$	2	*112 854.79*	
$4s^24p^5(^2P^\circ_{3/2})47s$	$^2[3/2]^\circ$	2	*112 857.48*	
$4s^24p^5(^2P^\circ_{3/2})48s$	$^2[3/2]^\circ$	2	*112 859.96*	
$4s^24p^5(^2P^\circ_{3/2})49s$	$^2[3/2]^\circ$	2	*112 862.33*	
$4s^24p^5(^2P^\circ_{3/2})50s$	$^2[3/2]^\circ$	2	*112 864.52*	
$4s^24p^5(^2P^\circ_{3/2})51s$	$^2[3/2]^\circ$	2	*112 866.57*	
$4s^24p^5(^2P^\circ_{3/2})52s$	$^2[3/2]^\circ$	2	*112 868.50*	
$4s^24p^5(^2P^\circ_{3/2})53s$	$^2[3/2]^\circ$	2	*112 870.35*	
$4s^24p^5(^2P^\circ_{3/2})54s$	$^2[3/2]^\circ$	2	*112 872.06*	
$4s^24p^5(^2P^\circ_{3/2})55s$	$^2[3/2]^\circ$	2	*112 873.63*	
$4s^24p^5(^2P^\circ_{3/2})56s$	$^2[3/2]^\circ$	2	*112 875.20*	
$4s^24p^5(^2P^\circ_{3/2})57s$	$^2[3/2]^\circ$	2	*112 876.63*	
$4s^24p^5(^2P^\circ_{3/2})58s$	$^2[3/2]^\circ$	2	*112 878.01*	
$4s^24p^5(^2P^\circ_{3/2})59s$	$^2[3/2]^\circ$	2	*112 879.28*	
$4s^24p^5(^2P^\circ_{3/2})60s$	$^2[3/2]^\circ$	2	*112 880.49*	
Kr II $(^2P^\circ_{3/2})$	***Limit***		***112 914.40***	
$4s^24p^5(^2P^\circ_{1/2})6d$	$^2[3/2]^\circ$	1	*113 530*	
$4s^24p^5(^2P^\circ_{1/2})5f$			113 866	
$4s^24p^5(^2P^\circ_{1/2})6f$			115 219	
$4s^24p^5(^2P^\circ_{1/2})7f$			116 043	
$4s^24p^5(^2P^\circ_{1/2})8f$			116 572	
$4s^24p^5(^2P^\circ_{1/2})9f$			116 932	
$4s^24p^5(^2P^\circ_{1/2})10f$			117 192	
$4s^24p^5(^2P^\circ_{1/2})11f$			117 381	
$4s^24p^5(^2P^\circ_{1/2})12f$			117 536	
$4s^24p^5(^2P^\circ_{1/2})13f$			117 644	
$4s^24p^5(^2P^\circ_{1/2})14f$			117 741	
$4s^24p^5(^2P^\circ_{1/2})15f$			117 800	
$4s^24p^5(^2P^\circ_{1/2})16f$			117 868	
$4s^24p^5(^2P^\circ_{1/2})17f$			117 917	
$4s^24p^5(^2P^\circ_{1/2})18f$			117 948	

Kr I — Continued

Configuration	Term	J	Level (cm^{-1})	g
$4s^24p^5(^2P^\circ_{1/2})8p$	$^2[1/2]$	1	114 494	
$4s^24p^5(^2P^\circ_{1/2})9p$	$^2[1/2]$	1	115 585	
$4s^24p^5(^2P^\circ_{1/2})10p$	$^2[1/2]$	1	116 271	
$4s^24p^5(^2P^\circ_{1/2})11p$	$^2[1/2]$	1	116 731	
$4s^24p^5(^2P^\circ_{1/2})12p$	$^2[1/2]$	1	117 047	
$4s^24p^5(^2P^\circ_{1/2})13p$	$^2[1/2]$	1	117 274	
$4s^24p^5(^2P^\circ_{1/2})14p$	$^2[1/2]$	1	117 440	
$4s^24p^5(^2P^\circ_{1/2})15p$	$^2[1/2]$	1	117 575	
$4s^24p^5(^2P^\circ_{1/2})16p$	$^2[1/2]$	1	117 677	
$4s^24p^5(^2P^\circ_{1/2})17p$	$^2[1/2]$	1	117 762	
$4s^24p^5(^2P^\circ_{1/2})18p$	$^2[1/2]$	1	117 826	
$4s^24p^5(^2P^\circ_{1/2})19p$	$^2[1/2]$	1	117 876	
$4s^24p^5(^2P^\circ_{1/2})20p$	$^2[1/2]$	1	117 921	
$4s^24p^5(^2P^\circ_{1/2})21p$	$^2[1/2]$	1	117 961	
$4s^24p^5(^2P^\circ_{1/2})22p$	$^2[1/2]$	1	117 998	
$4s^24p^5(^2P^\circ_{1/2})23p$	$^2[1/2]$	1	118 026	
$4s^24p^5(^2P^\circ_{1/2})24p$	$^2[1/2]$	1	118 050	
$4s^24p^5(^2P^\circ_{1/2})25p$	$^2[1/2]$	1	118 074	
$4s^24p^5(^2P^\circ_{1/2})7d$	$^2[5/2]^\circ$	2	*114 729*	
		3	*114 878*	
$4s^24p^5(^2P^\circ_{1/2})7d$	$^2[3/2]^\circ$	2	*114 833*	
		1	*115 019*	
$4s^24p^5(^2P^\circ_{1/2})9s$	$^2[1/2]^\circ$	0	*115 123*	
		1	*115 135*	
$4s^24p^5(^2P^\circ_{1/2})10p$			116 321	
$4s^24p^5(^2P^\circ_{1/2})11p$			116 767	
$4s^24p^5(^2P^\circ_{1/2})12p$			117 054	
$4s^24p^5(^2P^\circ_{1/2})13p$			117 306	
$4s^24p^5(^2P^\circ_{1/2})14p$			117 453	
Kr II ($^2P^\circ_{1/2}$)	*Limit*		*118 284.50*	
$4s4p^65p$	$(1/2,1/2)^\circ$	1	*201 005*	
$4s4p^66p$	$(1/2,1/2)^\circ$	1	*212 098*	
$4s4p^65p$	$(1/2,3/2)^\circ$	1	*201 584*	
$4s4p^66p$	$(1/2,3/2)^\circ$	1	*212 211*	
$4s4p^67p$	$(1/2,3/2)^\circ$	1	*216 118*	
$4s4p^68p$	$(1/2,3/2)^\circ$	1	*218 012*	
$4s4p^69p$	$(1/2,3/2)^\circ$	1	*219 241*	
$4s4p^610p$	$(1/2,3/2)^\circ$	1	*219 911*	
$4s4p^611p$	$(1/2,3/2)^\circ$	1	*220 395*	
$4s4p^612p$	$(1/2,3/2)^\circ$	1	*220 677*	
$4s4p^613p$	$(1/2,3/2)^\circ$	1	*220 907*	
$4s4p^614p$	$(1/2,3/2)^\circ$	1	*221 073*	
$4s4p^615p$	$(1/2,3/2)^\circ$	1	*221 205*	
$4s4p^616p$	$(1/2,3/2)^\circ$	1	*221 307*	
$4s4p^617p$	$(1/2,3/2)^\circ$	1	*221 391*	
$4s4p^618p$	$(1/2,3/2)^\circ$	1	*221 455*	
$4s4p^619p$	$(1/2,3/2)^\circ$	1	*221 508*	

Kr I – Continued

Configuration	Term	J	Level (cm^{-1})	g
....	....	....	....	....
Kr II ($^2S_{1/2}$)	*Limit*		221 914.76	
$3d^94s^24p^65p$	$(^5/_2,^3/_2)°$	1	*735 940*	
$3d^94s^24p^66p$	$(^5/_2,^3/_2)°$	1	*746 830*	
$3d^94s^24p^67p$	$(^5/_2,^3/_2)°$	1	*750 920*	
$3d^94s^24p^68p$	$(^5/_2,^3/_2)°$	1	*752 900*	
....	....	....	....	....
Kr II ($^2D_{5/2}$)	*Limit*		756 770	
$3d^94s^24p^65p$	$(^3/_2,^1/_2)°$	1	*745 770*	
$3d^94s^24p^66p$	$(^3/_2,^1/_2)°$	1	*756 890*	
$3d^94s^24p^67p$	$(^3/_2,^1/_2)°$	1	*760 860*	
$3d^94s^24p^68p$	$(^3/_2,^1/_2)°$	1	*762 830*	
....	....	....	....	....
Kr II ($^2D_{3/2}$)	*Limit*		766 580	

Kr II

$Z = 36$

Br I isoelectronic sequence

Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5\ {}^2P^o_{3/2}$

Ionization energy 196 475.4 ± 1.0 cm^{-1} (24.35985 ± 0.0001 eV)

An extensive analysis of this spectrum was given by de Bruin *et al.* [1933] who observed 1050 lines from 2080 – 10 660 Å. Boyce [1935] extended the measurements in the range of 559 – 964 Å, giving 82 classified lines, but obtained no new levels. The known configurations at that time were $4s^2 4p^5$, $4s4p^6$, and $4s^2 4p^4 nl$ with $nl = 4d$, $5s$, $5p$, $5f$, $5g$, $6s$, and $7s$.

New observations of the spectrum in the wavelength range of 550 – 2450 Å were made by Minnhagen *et al.* [1969], thus covering the gap between the published sets of data. The overall uncertainty of these new measurements is ±0.005 Å. Approximately 300 new lines were obtained in this work. They revised some of the earlier level designations and extended the number of known levels, particularly for the nf configurations. The $5g$ levels of de Bruin *et al.* were dropped. These new data were used to derive the value for the ionization energy.

All the level values and designations given here are from Minnhagen *et al.* except for 18 levels of the $4p^4 5s$ and $4p^4 5p$ configurations revised by Humphreys and Paul [1970] on the basis of interferometric measurements of 21 lines. These levels are given three decimal place values relative to the $4p^4(^3P)5s\ {}^4P_{5/2}$ level at 112 828.27 cm^{-1}. Their published values are relative to the level value 112 830.00 cm^{-1} given in Moore's [1952] compilation.

Bredice *et al.* [1988] have observed 52 new lines in the range of 1700 – 8700 Å using a pulsed capillary discharge. Classifications according to the level desig tions of Minnhagen are given.

Percentage compositions for the mixed configuratic $4s4p^6$, $4p^4 5s$, and $4p^4 4d$ were calculated by El Sherb and Farrag [1976]. Later Smid and Hansen [19 showed that ϵd continuum states must be included in t interaction with the $4s4p^6\ {}^2S_{1/2}$ as they contain 18% this state. We give the Smid and Hansen results for t distribution of this state in $4s4p^6$, $4s^2 4p^4(^1D)4d$, a $4s^2 4p^4(^1D)5d$ and take the remaining energy level co positions from El Sherbini and Farrag.

The g-values were derived by Bakker and de Bru [1931] and are included in the paper by de Bruin *et* [1933].

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Kr II

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$4s^2 4p^5$	$^2P^o$	3/2	*0.00*				
		1/2	*5 370.10*				
$4s4p^6$	^2S	1/2	109 000.36		57	43	$4s^2 4p^4(^1D)4d\ {}^2S$
$4s^2 4p^4(^3P)5s$	^4P	5/2	112 828.27	1.60	96	3	$4s^2 4p^4(^1D)5s\ {}^2D$
		3/2	115 092.012	1.54	59	36	$4s^2 4p^4(^3P)5s\ {}^2P$
		1/2	117 603.016	2.64	78	13	$4s^2 4p^4(^3P)4d\ {}^4D$
$4s^2 4p^4(^3P)5s$	^2P	3/2	118 474.359	1.52	58	38	$4s^2 4p^4(^3P)5s\ {}^4P$
		1/2	121 002.149	0.70	78	13	$4s^2 4p^4(^3P)4d\ {}^4D$
$4s^2 4p^4(^3P)4d$	^4D	7/2	120 209.87		93	5	$4s^2 4p^4(^3P)4d\ {}^4F$
		5/2	120 426.93		91	3	"
		3/2	121 000.37		89	3	$4s^2 4p^4(^3P)4d\ {}^4P$
		1/2	121 779.54	0.00	79	17	$4s^2 4p^4(^3P)5s\ {}^2P$

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$4s^24p^4(^3P)4d$	^4F	$^9/_2$	126 000.82		94		6	$4s^24p^4(^1D)4d\ ^2G$
		$^7/_2$	127 929.52		72		20	$4s^24p^4(^3P)4d\ ^2F$
		$^5/_2$	129 697.19		91		4	"
		$^3/_2$	130 512.73		96			
$4s^24p^4(^1D)5s$	^2D	$^3/_2$	127 597.49	0.80	76		8	$4s^24p^4(^1D)4d\ ^2D$
		$^5/_2$	127 861.51	1.20	89		4	"
$4s^24p^44d$		$^1/_2$	129 515.08		30	$4s^24p^4(^3P)4d\ ^4P$	29	$4s^24p^4(^1D)4d\ ^2P$
$4s^24p^4(^3P)4d$	^4P	$^1/_2$	130 893.45		61		21	$4s^24p^4(^3P)4d\ ^2P$
		$^5/_2$	132 970.49		68		11	$4s^24p^4(^3P)4d\ ^2F$
$4s^24p^4(^3P)4d$	^2P	$^3/_2$	131 375.45		76		9	$4s^24p^4(^1D)4d\ ^2P$
$4s^24p^4(^3P)4d$	^2F	$^7/_2$	131 632.11		65		22	$4s^24p^4(^3P)4d\ ^4F$
		$^5/_2$	134 566.95		47		26	$4s^24p^4(^3P)4d\ ^4P$
$4s^24p^44d$		$^3/_2$	132 965.52		35	$4s^24p^4(^3P)4d\ ^4P$	22	$4s^24p^4(^1D)4d\ ^2D$
$4s^24p^4(^3P)5p$	$^4P^\circ$	$^5/_2$	*133 923.859*	1.58				
		$^3/_2$	*134 286.667*	1.67				
		$^1/_2$	*135 781.264*	1.98				
$4s^24p^44d$		$^3/_2$	134 621.41		34	$4s^24p^4(^3P)4d\ ^2D$	33	$4s^24p^4(^1D)4d\ ^2P$
$4s^24p^4(^3P)5p$	$^4D^\circ$	$^7/_2$	*135 781.415*	1.43				
		$^5/_2$	*136 069.229*	1.23				
		$^3/_2$	*138 379.610*	1.26				
		$^1/_2$	*140 161.462*	0.00				
$4s^24p^44d$		$^5/_2$	137 098.16		34	$4s^24p^4(^3P)4d\ ^2D$	34	$4s^24p^4(^3P)4d\ ^2F$
$4s^24p^4(^3P)5p$	$^2P^\circ$	$^1/_2$	*139 101.568*	1.78				
		$^3/_2$	*140 135.395*	1.26				
$4s^24p^4(^3P)5p$	$^2D^\circ$	$^5/_2$	*140 117.228*	1.34				
		$^3/_2$	*141 993.940*	1.33				
$4s^24p^4(^3P)5p$	$^4S^\circ$	$^3/_2$	*141 720.955*	1.54				
$4s^24p^4(^3P)5p$	$^2S^\circ$	$^1/_2$	*142 361.840*	1.50				
$4s^24p^4(^1S)5s$	^2S	$^1/_2$	145 811.90	2.00	85		6	$4s^24p^4(^1D)4d\ ^2S$
$4s^24p^4(^1D)5p$	$^2F^\circ$	$^5/_2$	*149 171.64*	0.86				
		$^7/_2$	*149 702.80*	1.14				
$4s^24p^4(^1D)4d$	^2D	$^5/_2$	149 514.06		49		39	$4s^24p^4(^3P)4d\ ^2D$
		$^3/_2$	150 178.13		48		45	"
$4s^24p^4(^1D)5p$	$^2P^\circ$	$^3/_2$	*150 201.68*	1.33				
		$^1/_2$	*152 239.19*	0.70				
$4s^24p^4(^1D)4d$	^2P	$^3/_2$	151 826.36		59		37	$4s^24p^4(^3P)4d\ ^4P$
		$^1/_2$	152 185.02		53		45	$4s^24p^4(^3P)4d\ ^2P$
$4s^24p^4(^1D)5p$	$^2D^\circ$	$^3/_2$	*152 190.13*	0.80				
		$^5/_2$	*152 314.48*	1.20				

Kr II — Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$4s^24p^4(^3P)6s$	^4P	5/2	157 077.34	1.60	
		3/2	157 883.65	1.39	
		1/2	161 875.62	2.34	
$4s^24p^4(^1D)4d$	^2S	1/2	160 794.93	2.07	54 12 $4s4p^6\ ^2S$
$4s^24p^4(^1S)4d$	^2D	5/2	161 011.83	2.47	89 6 $4s^24p^4(^1D)4d\ ^2D$
		3/2	161 407.57		84 8 "
$4s^24p^4(^3P)5d$	^4D	7/2	161 283.59	1.40	
		5/2	161 450.10	1.37	
		3/2	162 057.31	1.33	
		1/2	162 564.41	0.92	
$4s^24p^4(^3P)6s$	^2P	3/2	161 800.17		
		1/2	163 031.91	0.88	
$4s^24p^4(^3P)5d$	^4F	9/2	162 207.13	1.33	
		7/2	162 530.21	1.17	
		5/2	165 075.60	1.12	
		3/2	165 140.18	1.40	
$4s^24p^4(^3P)6p$	$^4P^\circ$	5/2	*164 372.15*		
		3/2	*164 646.33*		
$4s^24p^4(^3P)5d$	^4P	1/2	164 437.45	1.94	
		3/2	167 045.38	0.52	
		5/2	167 517.16	1.04	
$4s^24p^4(^3P)6p$	$^4D^\circ$	7/2	*164 950.83*		
		5/2	*165 057.18*		
		3/2	*166 153.43*		
$4s^24p^4(^3P)5d$	^2F	7/2	166 578.05		
		5/2	166 999.69		
$4s^24p^4(^3P)5d$	^2P	1/2	166 951.56	0.51	
		3/2	167 911.34	1.18	
$4s^24p^4(^3P_2)4f$	$^2[4]^\circ$	9/2	*168 083.78*		
		7/2	*168 116.32*		
$4s^24p^4(^3P_2)4f$	$^2[3]^\circ$	5/2	*168 181.44*		
		7/2	*168 258.54*		
$4s^24p^4(^1S)5p$	$^2P^\circ$	1/2	*168 261.27*	1.24	
		3/2	*168 937.54*	0.90	
$4s^24p^4(^3P_2)4f$	$^2[2]^\circ$	3/2	*168 383.26*		
		5/2	*168 460.67*		
$4s^24p^4(^3P_2)4f$	$^2[5]^\circ$	11/2	*168 474.09*		
		9/2	*168 488.99*		
$4s^24p^4(^3P_2)4f$	$^2[1]^\circ$	1/2	*168 628.47*		
		3/2	*168 717.10*		
$4s^24p^4(^3P)5d$	^2D	5/2	169 703.13	1.15	
		3/2	170 569.38	1.00	

Kr II — Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$4s^24p^4(^1D)6s$	^2D	5/2	171 968.85	1.20	
		3/2	172 050.11	0.80	
$4s^24p^4(^3P_1)4f$	$^2[2]^{\circ}$	3/2	*172 712.56*		
		5/2	*172 771.65*		
$4s^24p^4(^3P_1)4f$	$^2[4]^{\circ}$	9/2	*172 800.24*		
		7/2	*172 855.40*		
$4s^24p^4(^3P_1)4f$	$^2[3]^{\circ}$	7/2	*173 128.92*		
		5/2	*173 154.78*		
$4s^24p^4(^3P)7s$	^4P	5/2	173 307.95		
		3/2	173 638.28		
		1/2	178 053.05		
$4s^24p^4(^3P_0)4f$	$^2[3]^{\circ}$	7/2	*173 673.73*		
		5/2	*173 686.12*		
$4s^24p^4(^3P)6d$	^4D	7/2	175 339.62		
		5/2	175 431.28		
$4s^24p^4(^3P)6d$	^4F	9/2	175 664.77		
		7/2	175 844.05		
$4s^24p^4(^1D)5d$	^2G	7/2	175 889.93	0.89	
		9/2	176 591.22	1.11	
$4s^24p^4(^1D)5d$	^2D	3/2	176 109.24		
		5/2	178 318.69	1.20	
$4s^24p^4(^1D)5d$	^2P	3/2	177 682.11	1.18	
		1/2	178 504.89?		
$4s^24p^4(^1D)5d$	^2F	5/2	177 708.50	0.89	
		7/2	177 907.24	1.14	
$4s^24p^4(^3P)7s$	^2P	3/2	177 955.08		
		1/2	178 785.88		
$4s^24p^4(^3P_2)5f$	$^2[4]^{\circ}$	9/2	*178 341.88*		
		7/2	*178 361.50*		
$4s^24p^4(^3P_2)5f$	$^2[3]^{\circ}$	5/2	*178 402.42*		
		7/2	*178 462.50*		
$4s^24p^4(^3P_2)5f$	$^2[2]^{\circ}$	3/2	*178 511.13*		
		5/2	*178 569.56*		
$4s^24p^4(^3P_2)5f$	$^2[5]^{\circ}$	11/2	*178 543.80*		
		9/2	*178 556.06*		
$4s^24p^4(^3P_2)5f$	$^2[1]^{\circ}$	1/2	*178 653.80*		
		3/2	*178 682.44*		
$4s^24p^4(^3P)8s$	^4P	5/2	181 199.76		
		3/2	181 378.63		
$4s^24p^4(^3P_1)5f$	$^2[4]^{\circ}$	9/2	*182 947.03*		
		7/2	*183 001.89*		

Kr II — Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$4s^24p^4(^3P_1)5f$	$^2[2]°$	5/2	*182 947.34*		
		3/2	*182 963.85*		
$4s^24p^4(^3P_1)5f$	$^2[3]°$	7/2	*183 126.90*		
		5/2	*183 154.58*		
$4s^24p^4(^3P_0)5f$	$^2[3]°$	7/2	*183 728.60*		
		5/2	*183 737.40*		
$4s^24p^4(^3P_2)6f$	$^2[4]°$	9/2	*183 938.95*		
		7/2	*183 983.37*		
$4s^24p^4(^3P_2)6f$	$^2[3]°$	5/2	*184 027.39*		
$4s^24p^4(^3P_2)6f$	$^2[5]°$	11/2	*184 041.28*		
		9/2	*184 049.68*		
$4s^24p^4(^3P_2)6f$	$^2[2]°$	3/2	*184 045.18*		
$4s^24p^4(^3P_2)6f$	$^2[1]°$	1/2	*184 109.22*		
		3/2	*184 134.64*		
$4s^24p^4(^3P_2)7f$	$^2[4]°$	9/2	*187 274.16*		
		7/2	*187 282.19*		
$4s^24p^4(^3P_2)7f$	$^2[5]°$	11/2	*187 355.52*		
		9/2	*187 360.53*		
$4s^24p^4(^3P_1)6f$	$^2[4]°$	9/2	*188 512.46*		
		7/2	*188 545.00*		
$4s^24p^4(^3P_1)6f$	$^2[3]°$	5/2	*188 618.25*		
$4s^24p^4(^3P_2)8f$	$^2[4]°$	9/2	*189 445.50*		
$4s^24p^4(^3P_2)8f$	$^2[5]°$	11/2	*189 503.65*		
		9/2	*189 507.85*		
$4s^24p^4(^3P_2)9f$	$^2[4]°$	9/2	*190 936.53*		
$4s^24p^4(^3P_2)9f$	$^2[5]°$	11/2	*190 974.91*		
		9/2	*190 977.53*		
$4s^24p^4(^3P_2)10f$	$^2[5]°$	11/2	*192 025.51*		
....	....	....	....	....	
Kr III ($^3P_2$)	***Limit***		**196 475.4**		

36

: isoelectronic sequence

›und state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^4\ {}^3P_2$

ization energy 298 020 ± 100 cm^{-1} (36.950 ± 0.010 eV)

Iumphreys [1935] identified 369 lines of this spectrum the range 2116−7353 Å from observations with a ›ed Geissler-tube discharge. He estimated his wave- ;th uncertainty as ±0.01 Å. An additional range of 'elengths from 500−2000 Å was observed by Boyce 35] with a wavelength uncertainty of ±0.01 Å. nbining their observations, Boyce and Humphreys ıtified levels of the configurations $4s^2 4p^4$, $4s4p^5$, and $\!p^3nl$ where $nl = 4d$, $5s$, $5p$, $5d$, and $6s$. All the levels given by Humphreys [1935] while Boyce [1935] gives ›sifications for the lines in his range of observations. : energy level uncertainty is ±0.3 cm^{-1}.

Ainnhagen *et al.* [1969] reobserved the spectrum from −1200 Å with a pulsed rf light source in order to ain more accurate values for the levels of the $4s^2 4p^4$ figuration. His wavelength uncertainty is ±0.005 Å. 'he spectrum was remeasured in the range of −8200 Å by Bredice *et al.* [1988]. The excitation was ained with a theta pinch for the vacuum ultraviolet 'elength region and a high-voltage spark for the visi- region. Measurement uncertainties of ±0.01 Å are orted for the theta-pinch data and ±0.01 to ±0.03 Å the spark data. About 140 new lines were classified l four new levels were found for the $4p^3 4d$ and $4p^3 5p$ figurations. Designations for several levels were nged based on comparisons along the isoelectronic uence. New values for all the energy levels, except se of the $4p^3 5d$ and $6s$ configurations were deter- ıed with an uncertainty of ±0.60 cm^{-1}. We have ›pted the level values derived by Bredice *et al.* The 5d and 6s levels are taken from Humphreys, with a rection of 1.10 cm^{-1} subtracted from his level values ıs to adjust them to those of Bredice *et al.*

ʌgentoft *et al.* [1984] measured the line .117±0.005 Å in a hollow cathode discharge, and ntified it as the $4s4p^5\ {}^1P^\circ_1 - 4p^6\ {}^1S_0$ transition. This was ıblished on the basis of the Auger identifications de by McGuire [1975] and the relative intensity of this : compared to other lines of Kr III produced in a hol- cathode discharge and in light sources where the itation is by electron impact, such as the theta pinch. ›ntoft *et al.* state that the cross section for excitation the $4p^6\ {}^1S_0$ state is much greater for ion-atom colli- ıal excitation, as in a hollow cathode discharge, than electron impact excitation. We take the $4p^6\ {}^1S_0$ value n this reference.

Iumphreys derived the value for the ionization energy n *ns* and *nd* series.

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Kr III

Configuration	Term	J	Level (cm^{-1})
$4s^2 4p^4$	^{3}P	2	0.0
		1	4 548.4
		0	5 312.9
$4s^2 4p^4$	^{1}D	2	14 644.3
$4s^2 4p^4$	^{1}S	0	33 079.6
$4s4p^5$	^{3}P°	2	115 930.93
		1	119 380.23
		0	121 542.96
$4s^2 4p^3(^4S^\circ)4d$	^{5}D°	0	138 446.69
		1	138 470.97
		2	138 480.60
		3	138 492.55
		4	138 649.15
$4s4p^5$	^{1}P°	1	141 876.16
$4s^2 4p^3(^4S^\circ)5s$	^{5}S°	2	145 718.87
$4s^2 4p^3(^4S^\circ)4d$	^{3}D°	2	147 804.55
		3	148 735.32
		1	149 071.85
$4s^2 4p^3(^4S^\circ)5s$	^{3}S°	1	151 580.19
$4s^2 4p^3(^2D^\circ)4d$	^{3}F°	2	153 563.20
		3	154 699.86
		4	156 081.96
$4s^2 4p^3(^2D^\circ)4d$	^{1}S°	0	154 399.71
$4s^2 4p^3(^2D^\circ)4d$	^{3}G°	3	159 996.43
		4	160 414.86
		5	161 108.61

Kr III — Continued

Configuration	Term	J	Level (cm^{-1})
$4s^24p^3(^2D^\circ)4d$	$^1G^\circ$	4	*162 841.05*
$4s^24p^3(^2D^\circ)5s$	$^3D^\circ$	1	*163 268.92*
		2	*163 635.84*
		3	*165 053.45*
$4s^24p^3(^2P^\circ)4d$	$^1D^\circ$	2	*165 463.40*
$4s^24p^3(^2P^\circ)4d$	$^3D^\circ$	1	*170 202.30*
		2	*172 465.48*
		3	*174 830.66*
$4s^24p^3(^2D^\circ)5s$	$^1D^\circ$	2	*170 898.94*
$4s^24p^3(^2P^\circ)4d$	$^3P^\circ$	0	*171 995.87*
		1	*172 983.11*
		2	*176 790.75*
$4s^24p^3(^2P^\circ)4d$	$^3F^\circ$	3	*174 450.95*
		4	*175 042.98*
		2	*175 211.16*
$4s^24p^3(^4S^\circ)5p$	^5P	1	175 543.82
		2	175 778.64
		3	176 520.02
$4s^24p^3(^2P^\circ)5s$	$^3P^\circ$	0	*178 243.52*
		1	*178 259.01*
		2	*180 247.09*
$4s^24p^3(^4S^\circ)5p$	^3P	1	179 628.83
		2	180 082.95
		0	180 237.12
$4s^24p^3(^2P^\circ)5s$	$^1P^\circ$	1	*181 263.46*
$4s^24p^3(^2D^\circ)4d$	$^3S^\circ$	1	*182 264.93*
$4s^24p^3(^2P^\circ)4d$	$^1F^\circ$	3	*182 966.83*
$4s^24p^3(^2D^\circ)4d$	$^3D^\circ$	3	*184 891.82*
		2	*188 569.14*
		1	*190 226.21*
$4s^24p^3(^2D^\circ)4d$	$^3P^\circ$	2	*185 688.63*
$4s^24p^3(^2D^\circ)4d$	$^1P^\circ$	1	*188 233.23*
$4s^24p^3(^2D^\circ)5p$	^3D	1	190 723.58
		2	193 855.36
		3	195 478.00
$4s^24p^3(^2D^\circ)5p$	^3F	2	192 701.85
		3	193 825.10
		4	195 674.50
$4s^24p^3(^2D^\circ)4d$	$^1D^\circ$	2	*193 651.72*
$4s^24p^3(^2D^\circ)5p$	^1P	1	194 120.25
$4s^24p^3(^2D^\circ)5p$	^1F	3	194 962.81
$4s^24p^3(^2D^\circ)4d$	$^1F^\circ$	3	*196 286.23*
$4s^24p^3(^2D^\circ)5p$	^3P	2	198 107.78
		0	198 788.86
		1	198 824.35
$4s^24p^3(^2D^\circ)5p$	^1D	2	202 895.94
$4s^24p^3(^2P^\circ)5p$	^3D	1	207 247.01
		2	208 508.99
		3	209 868.53
$4s^24p^3(^2D^\circ)5p$	^3S	1	208 609.54
$4s^24p^3(^2P^\circ)5p$	^3P	1	209 284.41
		0	209 786.34
		2	213 057.53
$4s^24p^3(^2P^\circ)5p$	^1D	2	212 123.41
$4s^24p^3(^2P^\circ)5p$	^1P	1	212 263.74
$4s^24p^3(^4S^\circ)6s$	$^5S^\circ$	2	*215 521.17*
$4s^24p^3(^4S^\circ)5d$	$^5D^\circ$	0	*216 500.19*
		1	*216 514.20*
		2	*216 528.22*
		3	*216 544.54*
		4	*216 604.06*
$4s^24p^3(^4S^\circ)5d$	$^3D^\circ$	2	*217 375.56*
		1	*219 294.34*
		3	*220 758.83*
$4s^24p^3(^4S^\circ)6s$	$^3S^\circ$	1	*221 842.30*
$4s^24p^3(^2D^\circ)6s$	$^3D^\circ$	2	*233 110.53?*
		3	*234 566.10*
$4s^24p^3(^2D^\circ)5d$	$^1D^\circ$	2	*233 346.28?*
$4s^24p^3(^2D^\circ)6s$	$^1D^\circ$	2	*236 182.57?*
$4s^24p^3(^2D^\circ)5d$	1°	1	*237 970.03*
$4s^24p^3(^2D^\circ)5d$	2°	2	*238 607.22*
$4s^24p^3(^2P^\circ)6s$	$^3P^\circ$	1	*249 166.88*
		2	*250 910.73*
$4p^6$	^1S	0	252 115.52
$4s^24p^3(^2P^\circ)6s$	$^1P^\circ$	1	*252 460.02*
$4s^24p^3(^2D^\circ)5d$	$^1G^\circ$	4	*253 356.26*
Kr IV ($^4S^\circ_{3/2}$)	*Limit*		*298 020*

Kr IV

=36

s I isoelectronic sequence

round state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^3\ {}^4S^{\circ}_{3/2}$

nization energy 423 400 ± 1600 (52.5 ± 0.2 eV)

With a Z-pinch light source Fawcett and Bromage 1980] observed 22 lines of the array $4s^2 4p^3 - 4s^2 4p^2 4d$, 6 nes of $4s^2 4p^3 - 4s4p^4$, and 4 tentative identifications of $s^2 4p^3 - 4s^2 4p^2 5s$. The $4s^2 4p^3\ {}^4S^{\circ} - 4s4p^4\ {}^4P$ multiplet was reviously reported by Boyce [1935].

The $4s^2 4p^3 - 4s4p^4$ array was greatly extended by 'ersson and Pettersson [1984] with observations of a heta-pinch discharge. They classified 31 lines in the ange of 611 − 1171 Å, measured with an uncertainty of ±0.01 Å for weak lines and ±0.005 Å for the strong nes. We give their values for the $4s^2 4p^3$ and $4s4p^4$ levls, and derive values for the $4s^2 4p^2 4d$ and $4s^2 4p^2 5s$ levels rom the classified lines of Fawcett and Bromage.

The value for the ionization energy was calculated by inkelnburg and Humbach [1955] by extrapolation of the ffective charge on the residual ion.

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Kr IV

Configuration	Term	J	Level (cm^{-1})
$4s^2 4p^3$	$^4S^{\circ}$	3/2	*0.0*
$4s^2 4p^3$	$^2D^{\circ}$	3/2	*17 036.8*
		5/2	*18 699.9*
$4s^2 4p^3$	$^2P^{\circ}$	1/2	*31 055.2*
		3/2	*33 404.9*
$4s4p^4$	^4P	5/2	118 760.4
		3/2	122 426.4
		1/2	124 109.3
$4s4p^4$	^2D	3/2	145 771.4
		5/2	146 644.1
$4s4p^4$	^2P	3/2	163 443.5
		1/2	166 159.7
$4s4p^4$	^2S	1/2	173 951.3
$4s^2 4p^2(^3P)5s$	^4P	1/2	200 381?
		5/2	208 069?
$4s^2 4p^2(^3P)4d$	^4P	5/2	201 426
		3/2	202 372
		1/2	204 733
$4s^2 4p^2(^3P)4d$	^2P	3/2	205 403
		1/2	210 352
$4s^2 4p^2(^3P)4d$	^2D	3/2	207 604?
		5/2	211 687
$4s^2 4p^2(^3P)5s$	^2P	1/2	208 920?
		3/2	213 571?
$4s^2 4p^2(^1D)4d$	^2D	5/2	217 420
		3/2	217 558
$4s^2 3p^2(^3P)4d$	^2F	5/2	219 994
		7/2	221 186
$4s^2 3p^2(^1D)4d$	^2P	1/2	224 217
		3/2	227 645
$4s^2 4p^2(^1S)4d$	^2D	5/2	231 940
		3/2	232 806
Kr V ($^3P_0$)	*Limit*		**423 400**

Kr V

Z = 36

Ge I isoelectronic sequence

Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^2\ ^3P_0$

Ionization energy 521 800 ± 1600 cm^{-1} (64.7 ± 0.2 eV)

Fawcett and Bromage [1980] classified 29 lines of this spectrum in the range of 463 – 810 Å, which they observed with a Z-pinch device. Their measurement uncertainty is ±0.03 Å. All levels of the $4s^24p^2$ configuration except for $^1S_0$ were found. In $4s4p^3$ only the $^5S^\circ_2$ and $^3D^\circ_1$ are missing, and in $4p4d$ the $^3F^\circ$ and $^1P^\circ$ terms were not found.

The spectrum was reobserved by Trigueiros *et al.* [1989] with a theta-pinch light source in the range of 432 – 2000 Å with an uncertainty of ±0.01 Å. We quote their improved values for the levels and include their two new levels $4s^24p^2\ ^1S_0$ and $4s^24p4d\ ^1P^\circ_1$. We also give th calculated percentage compositions for the levels.

The value for the ionization energy was calculated Finkelnburg and Humbach [1955] by extrapolation of effective charge on the residual ion.

References

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Kr V

Configuration	Term	*J*	Level (cm^{-1})	Leading percentages		
$4s^24p^2$	^3P	0	0.0	98		
		1	3 742.86	100		
		2	7 595.34	96		
$4s^24p^2$	^1D	2	19 722.93	96		
$4s^24p^2$	^1S	0	39 203.92	98		
$4s4p^3$	$^3D^\circ$	1	*129 658.16*	86	9	$4s^24p4d\ ^3D^\circ$
		2	*129 779.27*	85	8	"
		3	*131 016.42*	90	10	"
$4s4p^3$	$^3P^\circ$	0	*147 925.28*	90	10	$4s^24p4d\ ^3P^\circ$
		1	*148 286.78*	86	6	"
		2	*148 668.41*	77	6	$4s4p^3\ ^3D^\circ$
$4s4p^3$	$^1D^\circ$	2	*163 387.17*	50	31	$4s^24p4d\ ^1D^\circ$
$4s4p^3$	$^3S^\circ$	1	*185 063.54*	64	36	$4s4p^3\ ^1P^\circ$
$4s4p^3$	$^1P^\circ$	1	*194 041.06*	46	29	$4s4p^3\ ^3S^\circ$
$4s^24p4d$	$^3P^\circ$	2	*211 336.57*	58	9	$4s4p^3\ ^3D^\circ$
		1	*213 932.87*	56	34	$4s^24p4d\ ^3D^\circ$
		0	*216 420.28*	90	10	$4s4p^3\ ^3P^\circ$
$4s^24p4d$	$^1D^\circ$	2	*216 874.54*	40	44	$4s4p^3\ ^1D^\circ$
$4s^24p4d$	$^3D^\circ$	1	*218 746.81*	56	32	$4s^24p4d\ ^3P^\circ$
		3	*219 381.57*	88	10	$4s4p^3\ ^3D^\circ$
		2	*219 823.27*	66	14	$4s^24p4d\ ^1D^\circ$
$4s^24p4d$	$^1F^\circ$	3	*234 120.87*	100		
$4s^24p4d$	$^1P^\circ$	1	*237 720.58*	74	17	$4s4p^3\ ^1P^\circ$
Kr VI ($^2P^\circ_{1/2}$)	*Limit*		*521 800*			

Kr VI

$Z = 36$

Ga I isoelectronic sequence

Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p\ ^2P^\circ_{1/2}$

Ionization energy 633 100 ± 1600 cm^{-1} (78.5 ± 0.2 eV)

Fawcett *et al.* [1961] have observed the arrays $4s^2 4p - 4s4p^2$ and $4s^2 4p - 4s^2 4d$ by means of a Z-pinch device. They identified eight lines of this ion with an uncertainty of ±0.03 Å. By means of beam-foil excitation Druetta and Buchet [1976] observed the same lines as well as three additional: the $4s^2 4p\ ^2P^\circ_{1/2,3/2} - 4s4p^2\ ^2S_{1/2}$ and the $4s^2 4p\ ^2P^\circ_{3/2} - 4s4p^2\ ^2D_{3/2}$ line, with an uncertainty of ±1 Å, estimated from their ground term interval compared with Fawcett *et al.* and their measurements of Kr VIII compared with those of Reader *et al.* [1991].

Livingston [1976] identified the $4s4p^2\ ^4P - 4p^3\ ^4S^\circ$ multiplet in a beam-foil spectrum, but no connection to the doublet system of levels.

A new set of measurements of 15 lines in the wavelength range 450–956 Å with an uncertainty of ±0.01 Å was reported by Trigueiros *et al.* (1988) from a theta pinch discharge. We use these results to derive the doublet levels of $4s^2 4p$, $4s4p^2$, $4s^2 4d$, and $4s^2 5p$, and quote their percentage compositions.

In a beam-foil experiment Tauheed *et al.* [1990] were able to observe the intersystem transitions $4s^2 4p\ ^2P^\circ - 4s4p^2\ ^4P$ and $4s4p^2\ ^{2,4}P - 4p^3\ ^4S^\circ$ as well as other new lines of this spectrum, 22 in all, with an uncertainty of ±0.2 to ±0.5 Å. We give their values for the $4s4p^2\ ^4P$, $4p^3\ ^4S^\circ$, $^2D^\circ$ and $^2P^\circ$, $4s^2 5s\ ^2S$ and $4s^2 4f\ ^2F^\circ$ levels.

The value for the ionization energy was calculated by Finkelnburg and Humbach [1955] by extrapolation of the effective charge on the residual ion.

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Kr VI

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$4s^2 4p$	$^2P^\circ$	1/2	*0*			
		3/2	*8 108*			
$4s4p^2$	^4P	1/2	107 830			
		3/2	111 180			
		5/2	115 470			
$4s4p^2$	^2D	3/2	141 673	86	12	$4s^2 4d\ ^2D$
		5/2	142 728	86	13	"
$4s4p^2$	^2S	1/2	167 795	94	5	$4s4p^2\ ^2P$
$4s4p^2$	^2P	1/2	180 337	94	5	$4s4p^2\ ^2S$
		3/2	183 815	98		
$4s^2 4d$	^2D	3/2	222 125	86	13	$4s4p^2\ ^2D$
		5/2	223 037	86	13	"
$4s^2 5s$	^2S	1/2	275 340			
$4p^3$	$^2D^\circ$	3/2	*276 030*			
		5/2	*278 060*			

Kr VI — Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$4p^3$	$^4S^{\circ}$	$^3/_2$	*278 750*	
$4p^3$	$^2P^{\circ}$	$^1/_2$		
		$^3/_2$	*305 360*	
$4s^25p$	$^2P^{\circ}$	$^1/_2$	*326 724*	
		$^3/_2$	*328 965*	
$4s^24f$	$^2F^{\circ}$	$^7/_2$	*397 340*	
		$^5/_2$	*398 960*	
Kr VII ($^1S_0$)	***Limit***		**633 100**	

$Z=36$

Zn I isoelectronic sequence

Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2\ ^1S_0$

Ionization energy 895 300 ± 2400 cm^{-1} (111.0 ± 0.3 eV)

Fawcett *et al.* [1961] classified the resonance line $4s^2\ ^1S_0 - 4s4p\ ^1P_1^\circ$ at 585.37±0.03 Å and the $4s4p\ ^3P_2^\circ - 4p^2\ ^3P_2$ line at 618.67±0.03 Å using a Z-pinch device. Druetta and Buchet [1976] classified nine additional lines belonging to the $4s4p - 4p^2$ and $4s4p - 4s4d$ arrays from beam-foil spectra measured with an uncertainty of ±0.4 Å.

Pinnington *et al.* [1984] reobserved the spectrum generated by beam foil and identified the intersystem transition $4s^2\ ^1S_0 - 4s4p\ ^3P_1^\circ$ at 832.8±0.2 Å. This enabled them to derive the energy levels of $4s4p$, $4p^2$, and $4s4d$.

Trigueiros *et al.* [1986] observed the spectrum with a theta-pinch light source in the range of 430–1000 Å with a wavelength uncertainty of ±0.01 Å. They measured 22 lines, 13 of which were new. With these data they redetermined the energy levels, revising three of the known levels and reducing the uncertainty in the values of all the levels to ±3 cm^{-1}. They also give the percentage composition of the levels.

In a crossed beam of Kr ions colliding with He or H_2, Bouchama *et al.* [1989] identified radiation of Kr VII, including 14 lines measured with an uncertainty of ±0.5 Å. They tentatively identified them as $n=4-5$ transitions and derived five levels of the $4s5s$, $4s5p$, and $4s5d$ configurations. Trigueiros *et al.* [1989] also reported $n=4-5$ transitions, observed in a theta pinch with an uncertainty of ±0.01 Å, and derived levels of $4s5s$ and $4s5p$. Several level values disagree with those of Bouchama *et al.*, namely the $4s5s\ ^1S_0$ and the $4s5p\ ^1P_1^\circ$ and $^3P_0^\circ$. Newly observed lines by Pinnington *et al.* [1991] support the levels of Bouchama. Pinnington *et al.* added levels of $4s5d$ and $4s4f$.

We take the levels of $4s4p$, $4p^2$, and $4s4d$ configurations from Trigueiros *et al.* [1986], those of $4s5s$ and $4s5p$ from Trigueiros *et al.* [1989], and the $4s5d$ and $4s4f$ levels from Pinnington *et al.* [1991]. The disputed $4s5s\ ^1S_0$ and $4s5p\ ^1P_1^\circ$ and $^3P_0^\circ$ levels are also from Pinnington *et al.* The percentage compositions are from Trigueiros *et al.* [1986].

The value for the ionization energy was calculated by Finkelnburg and Humbach [1955] by extrapolation of the effective charge on the residual ion.

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Kr VII

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$4s^2$	^1S	0	0.0	98		
$4s4p$	$^3P^\circ$	0	*117 389.6*	100		
		1	*120 094.8*	100		
		2	*126 553.0*	100		
$4s4p$	$^1P^\circ$	1	*170 835.0*	100		
$4p^2$	^3P	0	274 931.7	98		
		1	279 414.5	100		
		2	288 190.2	72	22	$4p^2\ ^1D$
$4p^2$	^1D	2	279 714.8	62	27	$4p^2\ ^3P$
$4p^2$	^1S	0	321 794			

Kr VII — Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$4s4d$	^3D	1	349 973.1	100		
		2	350 416.8	100		
		3	351 116.2	100		
$4s4d$	^1D	2	379 488.3	85	15	$4p^2\ ^1D$
$4s5s$	^3S	1	438 643.9			
$4s5s$	^1S	0	447 400			
$4s5p$	$^3P°$	0	*492 810*			
		1	*493 250*			
		2	*495 578.4*			
$4s5p$	$^1P°$	1	*497 760*			
$4s4f$	$^3F°$	2	*530 380*			
		3	*530 550*			
		4	*530 820*			
$4s5d$	^3D	1	578 520			
		2	578 770			
		3	579 150			
$4s5d$	^1D	2	583 320			
Kr VIII ($^2S_{1/2}$)	***Limit***		**895 300**			

$Z=36$

Cu I isoelectronic sequence

Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s\ ^2S_{1/2}$

Ionization energy 1 014 665 ± 25 cm^{-1} (125.802 ± 0.003 eV)

The $4s-4p$ resonance lines were first identified by Fawcett *et al.* [1961] in a Z-pinch discharge. Using a beam-foil light source Druetta and Buchet [1976] identified the three $4p-4d$ lines, and with a similar device Livingston *et al.* [1980] observed 20 more lines of this spectrum, including the transitions $4d-4f$, $4f-5g$, $5g-6h$, and $6h-7i$. The very weak $4p-5d$ lines were identified by McPherson *et al.* [1987] by multiphoton excitation of neutral krypton. In this unusual form of excitation these lines were very strong.

By means of a low-inductance vacuum spark Reader *et al.* [1991] observed the spectrum from 115 Å to 696 Å with a wavelength uncertainty of ±0.008 Å. They identified and classified the inner-shell transition arrays $3d^{10}4s-3d^9 4s4p$ and $3d^{10}4p-3d^9 4p^2$, and added to the known one-electron classifications. Combining their data with measurements in the range of 1059 Å to 1929 Å obtained by Gallardo *et al.* [1989] with an uncertainty of ±0.02Å, they redetermined the values of all the energy levels. Earlier identifications of the $4f-5g$ lines by Livingston *et al.* and a $5p-6s$ line by Gallardo *et al.* were revised. The energy level uncertainty for the one-electron levels varies from ±2 to ±60 cm^{-1}, and that of the inner-shell excited levels is ±50 cm^{-1}. Reader *et al.* derived the value for the ionization energy by averaging values obtained from one-electron Rydberg series and from polarizing series. We give their results.

The transition array $3d^{10}4s-3d^9 4s4p$ observed by Reader *et al.* contains only lines arising from upper levels with $J=1/2$ and $3/2$ because of the constraint of the lower level J value of $1/2$. For a similar reason levels of the $3d^9 4p^2$ are limited to J values of $1/2$ to $5/2$. Reader *et al.* have derived the percentage composition of these levels from a fitted calculation of the radial energy integrals.

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Kr VIII

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$4s$	^{2}S	1/2	0.0	
$4p$	^{2}P°	1/2	*143 695.3*	
		3/2	*153 476.1*	
$4d$	^{2}D	3/2	374 046.5	
		5/2	375 381.0	
$5s$	^{2}S	1/2	490 090.2	
$5p$	^{2}P°	1/2	*546 683.7*	
		3/2	*550 448.0*	
$4f$	^{2}F°	5/2	*562 763.8*	
		7/2	*562 738.1*	
$5d$	^{2}D	3/2	641 075.6	
		5/2	641 623.1	
$6s$	^{2}S	1/2	692 482	

Kr VIII — Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$6p$	$^2P^\circ$	1/2	*720 565*			
		3/2	*722 429*			
$5f$	$^2F^\circ$	5/2	*724 997.3*			
		7/2	*725 010.6*			
$5g$	^2G	7/2	733 086.4			
		9/2	733 104.8			
$6d$	^2D	3/2	768 898			
		5/2	769 179			
$3d^9(^2D)4s4p(^3P^\circ)$	$^4P^\circ$	3/2	*782 852*	82	9	$3d^9(^2D)4s4p(^3P^\circ)\ ^4D^\circ$
		1/2	*789 316*	91	5	"
$3d^9(^2D)4s4p(^3P^\circ)$	$^4F^\circ$	3/2	*788 563*	92	5	$3d^9(^2D)4s4p(^3P^\circ)\ ^4P^\circ$
$7s$	^2S	1/2	796 490			
$3d^9(^2D)4s4p(^3P^\circ)$	$^2D^\circ$	3/2	*797 213*	52	24	$3d^9(^2D)4s4p(^3P^\circ)\ ^2P^\circ$
$3d^9(^2D)4s4p(^3P^\circ)$	$^2P^\circ$	3/2	*801 134*	61	28	$3d^9(^2D)4s4p(^3P^\circ)\ ^4D^\circ$
		1/2	*801 545*	93	5	$3d^9(^2D)4s4p(^3P^\circ)\ ^4P^\circ$
$3d^9(^2D)4s4p(^3P^\circ)$	$^4D^\circ$	1/2	*803 335*	93	4	$3d^9(^2D)4s4p(^3P^\circ)\ ^4P^\circ$
		3/2	*807 161*	49	38	$3d^9(^2D)4s4p(^3P^\circ)\ ^2D^\circ$
$7p$	$^2P^\circ$	1/2	*812 506*			
		3/2	*813 577*			
$6h$	$^2H^\circ$	9/2,11/2	*819 482.0*			
$3d^9(^2D)4s4p(^1P^\circ)$	$^2P^\circ$	3/2	*837 191*	94	3	$3d^9(^2D)4s4p(^3P^\circ)\ ^2P^\circ$
		1/2	*846 181*	98	1	$3d^9(^2D)4s4p(^3P^\circ)\ ^4D^\circ$
$7d$	^2D	3/2	840 501			
		5/2	840 686			
$8s$	^2S	1/2	857 086			
$8p$	$^2P^\circ$	3/2	*867 694*			
$7i$	^2I	11/2,13/2	871 319.5			
$3d^9(^2D)4p^2(^1D)$	^2S	1/2	951 580	61	16	$3d^9(^2D)4p^2(^1D)\ ^2P$
$3d^9(^2D)4p^2(^1D)$	^2P	3/2	953 414	66	12	$3d^9(^2D)4p^2(^3P)\ ^2P$
		1/2	962 734	61	9	"
$3d^9(^2D)4p^2(^3P)$	^4F	3/2	964 107	70	24	$3d^9(^2D)4p^2(^3P)\ ^2D$
$3d^9(^2D)4p^2(^3P)$	^2D	3/2	966 219	50	22	$3d^9(^2D)4p^2(^3P)\ ^4F$
		5/2	975 878	56	30	$3d^9(^2D)4p^2(^1D)\ ^2D$
$3d^9(^2D)4p^2(^1D)$	^2D	3/2	970 784	49	19	$3d^9(^2D)4p^2(^3P)\ ^4P$
$3d^9(^2D)4p^2(^3P)$	^4P	3/2	976 569	58	16	$3d^9(^2D)4p^2(^1D)\ ^2D$
		1/2	979 794	77	20	$3d^9(^2D)4p^2(^3P)\ ^2P$

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^9(^2D)4p^2(^3P)$	^2P	1/2	977 863	70	13	$3d^9(^2D)4p^2(^3P)$ ^4P
		3/2	980 229	77	8	"
$3d^9(^2D)4p^2(^1S)$	^2D	5/2	1 005 591	91	3	$3d^9(^2D)4p^2(^1D)$ ^2D
		3/2	1 015 205	92	3	"
Kr IX ($^1S_0$)	***Limit***		**1 014 665**			

Kr IX

$Z=36$

Ni I isoelectronic sequence

Ground state $1s^22s^22p^63s^23p^63d^{10}\ ^1S_0$

Ionization energy $1\,862\,900 \pm 800\ cm^{-1}$ $(230.85 \pm 0.10\ eV)$

The three resonance lines from the $3d^94f$ configuration were reported by Fawcett and Gabriel [1964] with an uncertainty of ± 0.03 Å. Those arising from the $3d^94p$ configuration were measured by F. W. Paul and published by Moore [1952] with no uncertainty given. These six lines have been remeasured by Reader *et al.* [1991] with an uncertainty of ± 0.005 Å and are used to determine the energy levels. These authors also gave the percentage composition of the levels. We give their results.

The value for the ionization energy was calculated by Kim [1968] from observations of three $3d^{10}\ ^1S_0 - 3d^9nf$ lines at 77.9 Å, 67.0 Å, and 62.2 Å, presumably of the $^1P_1^o$ series. No estimate of the uncertainty is given.

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Kr IX

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^{10}$	^1S	0	0			
$3d^94p$	$^3P^o$	1	*849 553*	93	6	$3d^94p\ ^3D^o$
$3d^94p$	$^1P^o$	1	*864 020*	76	24	$3d^94p\ ^3D^o$
$3d^94p$	$^3D^o$	1	*869 959*	70	23	$3d^94p\ ^1P^o$
$3d^94f$	$^3P^o$	1	*1 302 270*	92	8	$3d^94f\ ^3D^o$
$3d^94f$	$^3D^o$	1	*1 310 680*	87	7	$3d^94f\ ^3P^o$
$3d^94f$	$^1P^o$	1	*1 325 290*	93	5	$3d^94f\ ^3D^o$
Kr X ($^2D_{5/2}$)	*Limit*		**1 862 900**			

$Z = 36$

Co I isoelectronic sequence

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

Ionization energy 2 163 000 ± 22 000 cm^{-1} (268.2 ± 3 eV)

Fawcett and Gabriel [1964], using a theta pinch device, identified five lines belonging to the transition array $3d^9 - 3d^8 4p$. The observations were greatly expanded with a low-inductance vacuum spark by Reader *et al.* [1985]. They measured 46 lines in the range of 91 – 104 Å with an uncertainty of ±0.005 Å and classified them in the above array, as well as identifying the two principal lines of the multiplet $3p^6 3d^9\ ^2D - 3p^5 3d^{10}\ ^2P^{\circ}$. These authors have calculated eigenvectors for the mixture of these configurations and give percentage compositions in both *LS* and J_1j-coupling. We quote their results and give their *LS* designations.

The value for the ionization energy was calculated with the Cowan [1981] HFR code.

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Kr X

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3p^6 3d^9$	^2D	5/2	0				
		3/2	10 367				
$3p^6 3d^8(^3F)4p$	$^4D^{\circ}$	3/2	965 513	42		27	$3p^5 3d^{10}\ ^2P^{\circ}$
$3p^6 3d^8(^3F)4p$	$^4G^{\circ}$	5/2	966 252	75		8	$3p^6 3d^8(^3F)4p\ ^4F^{\circ}$
$3p^5 3d^{10}$	$^2P^{\circ}$	3/2	968 510	54		31	$3p^6 3d^8(^3F)4p\ ^4D^{\circ}$
		1/2	1 044 605	68		16	$3p^6 3d^8(^1D)4p\ ^2P^{\circ}$
$3p^6 3d^8(^3F)4p$		3/2	971 691	25	$3p^6 3d^8(^3F)4p\ ^2D^{\circ}$	21	$3p^6 3d^8(^1D)4p\ ^2D^{\circ}$
$3p^6 3d^8(^3F)4p$	$^2F^{\circ}$	7/2	972 410	46		34	$3p^6 3d^8(^3F)4p\ ^4F^{\circ}$
$3p^6 3d^8(^3F)4p$	$^2D^{\circ}$	5/2	973 832	46		26	$3p^6 3d^8(^3F)4p\ ^4F^{\circ}$
$3p^6 3d^8(^3F)4p$		5/2	978 945	34	$3p^6 3d^8(^3F)4p\ ^4F^{\circ}$	26	$3p^6 3d^8(^3F)4p\ ^2D^{\circ}$
$3p^6 3d^8(^3F)4p$	$^4F^{\circ}$	7/2	980 534	41		44	$3p^6 3d^8(^3F)4p\ ^2F^{\circ}$
		3/2	983 596	42		24	$3p^6 3d^8(^3P)4p\ ^4P^{\circ}$
$3p^6 3d^8(^3F)4p$	$^2G^{\circ}$	7/2	983 099	72		15	$3p^6 3d^8(^3F)4p\ ^4G^{\circ}$
$3p^6 3d^8 4p$		5/2	986 513	31	$3p^6 3d^8(^3F)4p\ ^2F^{\circ}$	21	$3p^6 3d^8(^3F)4p\ ^2D^{\circ}$
$3p^6 3d^8(^3P)4p$	$^4P^{\circ}$	3/2	987 902	43		38	$3p^6 3d^8(^3F)4p\ ^2D^{\circ}$
$3p^6 3d^8 4p$		5/2	988 265	32	$3p^6 3d^8(^3F)4p\ ^2F^{\circ}$	26	$3p^6 3d^8(^3P)4p\ ^4P^{\circ}$
$3p^6 3d^8(^1D)4p$	$^2F^{\circ}$	5/2	993 739	49		39	$3p^6 3d^8(^3P)4p\ ^4P^{\circ}$
		7/2	999 248	49		24	$3p^6 3d^8(^1G)4p\ ^2F^{\circ}$
$3p^6 3d^8(^1D)4p$		3/2	998 883	36	$3p^6 3d^8(^1D)4p\ ^2D^{\circ}$	22	$3p^6 3d^8(^3F)4p\ ^2D^{\circ}$

Kr x — Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages			
$3p^63d^8(^1D)4p$	$^2P^\circ$	1/2	*999 829*	55		23	$3p^63d^8(^3P)4p$ $^2P^\circ$
		3/2	*1 007 768*	43		24	$3p^63d^8(^1D)4p$ $^2D^\circ$
$3p^63d^8(^1D)4p$	$^2D^\circ$	5/2	*1 001 691*	50		25	$3p^63d^8(^3P)4p$ $^2D^\circ$
$3p^63d^8(^3P)4p$	$^4D^\circ$	3/2	*1 003 790*	51		12	$3p^63d^8(^3F)4p$ $^4D^\circ$
		1/2	*1 003 879*	71		12	$3p^63d^8(^3F)4p$ $^4D^\circ$
		7/2	*1 007 600*	50		43	$3p^63d^8(^1G)4p$ $^2F^\circ$
$3p^63d^84p$		5/2	*1 007 410*	32	$3p^63d^8(^3P)4p$ $^4D^\circ$	18	$3p^63d^8(^1D)4p$ $^2D^\circ$
$3p^63d^8(^3P)4p$	$^2P^\circ$	1/2	*1 013 897*	53		20	$3p^53d^{10}$ $^2P^\circ$
		3/2	*1 015 092*	54		24	$3p^63d^8(^3P)4p$ $^2D^\circ$
$3p^63d^8(^3P)4p$	$^2D^\circ$	5/2	*1 015 092*	52		35	$3p^63d^8(^3P)4p$ $^4D^\circ$
		3/2	*1 018 468*	63		13	"
$3p^63d^84p$		7/2	*1 016 153*	40	$3p^63d^8(^1D)4p$ $^2F^\circ$	28	$3p^63d^8(^3P)4p$ $^4D^\circ$
$3p^63d^8(^1G)4p$	$^2F^\circ$	5/2	*1 020 095*	73		10	$3p^63d^8(^1D)4p$ $^2F^\circ$
$3p^63d^8(^3P)4p$	$^2S^\circ$	1/2	*1 021 383*	91		3	$3p^53d^{10}$ $^2P^\circ$
$3p^63d^8(^1G)4p$	$^2G^\circ$	7/2	*1 030 797*	92		8	$3p^63d^8(^1G)4p$ $^2F^\circ$
$3p^63d^8(^1S)4p$	$^2P^\circ$	3/2	*1 089 708*	96		1	$3p^63d(^1D)4p$ $^2P^\circ$
Kr XI ($^3F_4$)	***Limit***		**2 163 000**				

Kr XI

$Z=36$

Fe I isoelectronic sequence

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

Ionization energy 2 486 000 ± 25 000 cm^{-1} (308.2 ± 3 eV)

No energy levels have been reported for this ion.
The value for the ionization energy was calculated with the Cowan [1981] HFR code.

Reference

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra,* (Univ. California Press, Berkeley, CA).

Kr XII

$Z=36$

Mn I isoelectronic sequence

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

Ionization energy 2 824 000 ± 28 000 cm^{-1} (350.1 ± 3 eV)

No energy levels have been reported for this ion.
The value for the ionization energy was calculated with the Cowan [1981] HFR code.

Reference

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra*, (Univ. California Press, Berkeley, CA).

Kr XIII

$Z=36$

Cr I isoelectronic sequence

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

Ionization energy 3 153 000 ± 32 000 cm^{-1} (390.9 ± 4 eV)

No energy levels have been reported for this ion.
The value for the ionization energy was calculated with the Cowan [1981] HFR code.

Reference

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra,* (Univ. California Press, Berkeley, CA).

Kr XIV

$Z=36$

V I isoelectronic sequence

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

Ionization energy 3 602 000 ± 36 000 cm^{-1} (446.6 ± 4 eV)

No energy levels have been reported for this ion.
The value for the ionization energy was calculated with the Cowan [1981] HFR Code.

Reference

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra,* (Univ. California Press, Berkeley, CA).

Kr XV

$Z=36$

Ti I isoelectronic sequence

Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4\ ^5D_0$

Ionization energy 3 967 000 ± 40 000 cm^{-1} (491.8 ± 4 eV)

No energy levels have been reported for this ion.
The value for the ionization energy was calculated with the Cowan [1981] HFR code.

Reference

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra,* (Univ. California Press, Berkeley, CA).

Kr XVI

$Z=36$

Sc I isoelectronic sequence

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

Ionization energy 4 361 000 ± 44 000 cm^{-1} (540.7 ± 5 eV)

No energy levels have been reported for this ion.
The value for the ionization energy was calculated with the Cowan [1981] HFR code.

Reference

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra,* (Univ. California Press, Berkeley, CA).

Kr XVII

$Z=36$

Ca I isoelectronic sequence

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

Ionization energy 4 771 000 ± 48 000 cm^{-1} (591.5 ± 6 eV)

No energy levels have been reported for this ion.

The value for the ionization energy was calculated with the Cowan [1981] HFR code.

Reference

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra*, (Univ. California Press, Berkeley, CA).

Kr XVIII

$Z=36$

K I isoelectronic sequence

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

Ionization energy 5 169 000 ± 52 000 cm^{-1} (640.9 ± 6 eV)

Wyart and the TFR Group [1985] observed the array $3p^6 3d - 3p^5 3d^2$ and derived the ground state splitting and four levels of the upper configuration. Wavelengths in the range of 91 − 94 Å were measured with an uncertainty of ±0.015 Å. Kaufman *et al.* [1989] reported observations of the same array with a tokamak discharge and measured the wavelengths with an uncertainty of ±0.005 Å. They obtained two additional levels of $3p^5 3d^2$, the (^{3}F) $^2F^\circ_{5/2}$ and (^{1}G) $^2F^\circ_{7/2}$ levels. Wyart *et al.* found the $3p^6 3d - 3p^6 4f$ doublet at 35 Å. We use the levels derived by Kaufman *et al.* for the ground term and the $3p^5 3d^2$ configuration, with an uncertainty of 60 cm^{-1}, and the levels of Wyart *et al.* for the $3p^6 4f$ term.

The value for the ionization energy was calculated with the Cowan [1981] HFR code.

References

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra*, (Univ. California Press, Berkeley, CA).

Kaufman, V., Sugar, J., and Rowan, W. L. [1989], J. Opt. Soc. Am. B **6**, 142.

Wyart, J. F., and TFR Group [1985], Phys. Scr. **31**, 539.

Kr XVIII

Configuration	Term	J	Level (cm^{-1})
$3p^6 3d$	^{2}D	3/2	0
		5/2	15 694
$3p^5(^2P^\circ)3d^2(^3F)$	^{2}F°	5/2	*980 380*
$3p^5(^2P^\circ)3d^2(^1G)$	^{2}F°	7/2	*1 022 440*
$3p^5(^2P^\circ)3d^2(^3P)$	^{2}P°	1/2	*1 075 860*
		3/2	*1 094 200*
$3p^5(^2P^\circ)3d^2(^3F)$	^{2}D°	3/2	*1 084 470*
		5/2	*1 086 940*
$3p^6 4f$	^{2}F°	7/2	*2 840 800*
		5/2	*2 841 700*
Kr XIX ($^1S_0$)	***Limit***		**5 169 000**

Kr XIX

$Z=36$

Ar I isoelectronic sequence

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

Ionization energy 6 339 000 ± 63 000 cm^{-1} (785.9 ± 8 eV)

Wyart and the TFR Group [1985] reported observations of the two resonance lines $3p^6\ ^1S_0 - 3p^5 3d\ ^1P_1$, $^3D_1$ at 96.263 Å and 118.546 Å, respectively. The spectrum was reobserved with a tokamak discharge by Sugar *et al.* [1987] who gave wavelengths for these lines of 96.232 Å and 118.667 Å with an uncertainty of ±0.010 Å. We use these improved values to derive energy levels with an uncertainty of ±100 cm^{-1}.

The value for the ionization energy was calculated with the Cowan [1981] HFR code.

References

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra*, (Univ. California Press, Berkeley, CA).
Sugar, J., Kaufman, V., and Rowan, W. L. [1987], J. Opt. Soc. Am. B **4**, 1927.
Wyart, J. F., and TFR Group [1985], Phys. Scr. **31**, 539.

Kr XIX

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^6$	^1S	0	0
$3s^2 3p^5 3d$	$^3D°$	1	*842 690*
$3s^2 3p^5 3d$	$^1P°$	1	*1 039 160*
Kr XX ($^2P°_{3/2}$)	***Limit***		***6 339 000***

Kr XX

$Z=36$

Cl I isoelectronic sequence

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

Ionization energy 6 719 000 ± 67 000 cm^{-1} (833.0 ± 8 eV)

Kaufman *et al.* [1989] have derived a value for the $^2P°$ ground state splitting by fitting the known data along the isoelectronic sequence to a polynomial expression. They find the value 87 287±50 cm^{-1}, which differs significantly from the M1 line reported by Roberts *et al.* [1987]. We quote the value by Kaufman *et al.*

The TFR Group and Wyart [1988] have classified four lines of the array $3s^2 3p^5 - 3s^2 3p^4 3d$ in the range of 99–104 Å, which they measured with an uncertainty of ±0.02 Å. The same transitions were observed in a tokamak plasma by Kaufman *et al.* and measured with an uncertainty of ±0.005 Å. We give the levels derived by the latter group with an uncertainty of ±50 cm^{-1}.

The value for the ionization energy was calculated with the Cowan [1981] HFR code.

References

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra*, (Univ. California Press, Berkeley, CA).
Kaufman, V., Sugar, J., and Rowan, W. L. [1989], J. Opt. Soc. Am. B **6**,
Roberts, J. R., Pittman, T. L., Sugar, J., Kaufman, V., and Rowan, W. L. [1987], Phys. Rev. A **35**, 2591.
TFR Group, and Wyart, J. F. [1988], Phys. Scr. **37**, 66.

Kr XX

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^5$	$^2P°$	3/2	*0*
		1/2	*[87 287]*
$3s^2 3p^4(^1D)3d$	^2S	1/2	97 680
$3s^2 3p^4(^3P)3d$	^2P	3/2	1 003 410
$3s^2 3p^4(^3P)3d$	^2D	5/2	1 008 510
		3/2	1 084 750
Kr XXI ($^3P_2$)	***Limit***		**6 719 000**

$Z=36$

S I isoelectronic sequence

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

Ionization energy 7 129 000 ± 70 000 cm^{-1} (883.9 ± 9 eV)

Kaufman *et al*. [1990] give predicted values for the M1 transitions in the ground configuration, which they then used to determine the energy levels. The predictions were made by graphing corrections to calculated values along the S I isoelectronic sequence. Their uncertainty estimates vary from ±20 to ±100 cm^{-1}. The value given for the $^3P_0$ was obtained from a fitted calculation. We quote these predicted values for the levels of $3s^2 3p^4$.

Kaufman *et al.* [1990] have also classified six lines of the array $3s^2 3p^4 - 3s^2 3p^3 3d$ in the range of 104 – 108 Å. They estimate the wavelength uncertainty to be ±0.007 Å. Taking into account the uncertainty of the predicted values for the levels of the ground configuration, the uncertainty of the levels of $3p^3 3d$ is ±140 cm^{-1}. They have calculated the percentage compositions of the levels, obtained with configuration interaction between $3s^2 3p^3 3d$ and $3s3p^5$. We quote these results.

The value for the ionization energy was calculated with the Cowan [1981] HFR code.

References

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra,* (Univ. California Press, Berkeley, CA).

Kaufman, V., Sugar, J., and Rowan, W. L. [1990], J. Opt. Soc. Am. B 7, 1169.

Kr XXI

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3s^2 3p^4$	^3P	2	0	84		16	$3s^2 3p^4\ ^1D$
		0	[46 900]	65		35	$3s^2 3p^4\ ^1S$
		1	[78 670]	100			
$3s^2 3p^4$	^1D	2	[114 820]	84		16	$3s^2 3p^4\ ^3P$
$3s^2 3p^4$	^1S	0	[225 100]	65		35	$3s^2 3p^4\ ^3P$
$3s^2 3p^3(^2P^\circ)3d$	$^3P^\circ$	2	*933 070*	50		15	$3s^2 3p^3(^2D^\circ)3d\ ^3D^\circ$
$3s^2 3p^3(^2D^\circ)3d$	$^3P^\circ$	2	*964 470*	55		15	$3s^2 3p^3(^2P^\circ)3d\ ^3P^\circ$
$3s^2 3p^3 3d$		3	*963 350*	38	$3s^2 3p^3(^2D)3d\ ^3D^\circ$	30	$3s^2 3p^3(^4S)3d\ ^3D^\circ$
$3s^2 3p^3 3d$		2	*1 007 100*	24	$3s^2 3p^3(^2D^\circ)3d\ ^1D^\circ$	21	$3s^2 3p^3(^4S^\circ)3d\ ^3D^\circ$
$3s^2 3p^3(^2D^\circ)3d$	$^1F^\circ$	3	*1 076 100*	50		32	$3s^2 3p^3(^2P^\circ)3d\ ^1F^\circ$
$3s^2 3p^3(^2P^\circ)3d$	$^1P^\circ$	1	*1 143 760*	68		11	$3s^2 3p^3(^4S^\circ)3d\ ^3D^\circ$
Kr XXII ($^4S^\circ_{3/2}$)	*Limit*		*7 129 000*				

Kr XXII

$Z=36$

P I isoelectronic sequence

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

Ionization energy 7 555 000 ± 75 000 cm^{-1} (936.7 ± 9 eV)

Sugar *et al.* [1990] give the only analysis of this spectrum in their study of the P I isoelectronic sequence. The ground configuration levels were derived from predicted M1 wavelengths obtained by graphing the corrections to theoretical values. The uncertainty of these energy levels is ±50 cm^{-1}. We quote these predicted values for the levels of $3s^23p^3$.

Six lines of the array $3s^23p^3-3s^23p^23d$ were identified in the range of 108−114 Å by Sugar *et al.* [1990]. The wavelength uncertainty is ±0.005 Å. Taking into account the uncertainty of the predicted level values of the ground configuration, the uncertainty of the levels of $3p^23d$ is ±120 cm^{-1}. Percentage compositions for the levels of the ground configuration were given. We quote these results.

The value for the ionization energy was calculated with the Cowan [1981] HFR code.

References

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra* (Univ. California Press, Berkeley, CA).

Sugar, J., Kaufman, V., and Rowan, W. L. [1991], J. Opt. Soc. Am. B 8 22.

Kr XXII

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3s^23p^3$	$^4S^\circ$	3/2	*0*	69	22	$3s^23p^3\ ^2P^\circ$
$3s^23p^3$	$^2D^\circ$	3/2	[*77 801*]	65	23	$3s^23p^3\ ^4S^\circ$
		5/2	[*106 960*]	100		
$3s^23p^3$	$^2P^\circ$	1/2	[*153 025*]	100		
		3/2	[*216 479*]	66	26	$3s^23p^3\ ^2D^\circ$
$3s^23p^2(^3P)3d$	^4P	5/2	895 500			
		3/2	908 570			
$3s^23p^2(^1D)3d$	^2D	3/2	989 810			
		5/2	995 430			
$3s^23p^2(^3P)3d$	^2F	7/2	1 029 790			
$3s^23p^2(^3P)3d$	^2D	5/2	1 093 630			
Kr XXIII ($^3P_0$)	***Limit***		**7 555 000**			

$Z = 36$

Si I isoelectronic sequence

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

Ionization energy 8 047 000 ± 80 000 cm^{-1} (997.7 ± 10 eV)

The levels of the ground configuration $3s^2 3p^2$ are determined completely by measured and interpolated M1 lines. The following transitions have been measured:

$^3P_0 - {}^3P_1$	1462.65 ± 0.03 Å	Benjamin *et al.* [1987]
$^3P_1 - {}^3P_2$	3840.9 ± 0.3 Å	Roberts *et al.* [1987]
$^3P_1 - {}^1D_2$	853.8 ± 1.0 Å	Roberts *et al.* [1987]

The following was predicted by plotting the observed minus calculated M1 wavelength along the isoelectronic sequence:

$^3P_1 - {}^1S_0$	537.2 ± 0.3 Å	Sugar *et al.* [1990]

The above values were used to derive the energy levels of the $3s^2 3p^2$ configuration.

The TFR Group and Wyart [1988] observed the spectra of Kr in a tokamak discharge and classified four lines in the transition array $3s^2 3p^2 - 3s^2 3p 3d$. The measurement uncertainty was given as ±0.02 Å. Sugar *et al.* identified eleven lines of this array which they measured with an uncertainty of ±0.005 Å. We give their values and designations for the energy levels. The uncertainty in the levels of the ground configuration varies from ±14 cm^{-1} for the lowest interval to ±100 cm^{-1} for the $^1S_0$. The uncertainty for the levels of the excited configuration is ±120 cm^{-1}. The percentage compositions for the levels were calculated by Sugar *et al.* who included configuration interaction between $3s3p^3$ and $3s^2 3p 3d$.

The value for the ionization energy was calculated with the Cowan [1981] HFR code.

References

Benjamin, R. D., Terry, J. L., and Moos, H. W. [1987], Phys. Rev. A 36, 4504.

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra*, (Univ. California Press, Berkeley, CA).

Roberts, J. R., Pittman, T. L., Sugar, J., Kaufman, V., and Rowan, W. L. [1987], Phys. Rev. A 35, 2591.

Sugar, J., Kaufman, V., and Rowan, W. L. [1990], J. Opt. Soc. Am. B7, 152.

TFR Group and Wyart, J. F. [1988], Phys. Scr. 37, 66.

Kr XXIII

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3s^2 3p^2$	^3P	0	0	86		14	$3s^2 3p^2\ {}^1S$
		1	68 369	100			
		2	94 397	59		41	$3s^2 3p^2\ {}^1D$
$3s^2 3p^2$	^1D	2	185 490	59		41	$3s^2 3p^2\ {}^3P$
$3s^2 3p^2$	^1S	0	[254 520]	86		14	$3s^2 3p^2\ {}^3P$
$3s3p^3$	$^3S°$	1	*785 644*	54		37	$3s3p^3\ {}^1P°$
$3s^2 3p 3d$	$^3P°$	2	*872 750*	51		20	$3s^2 3p 3d\ {}^3D°$
		0	*945 520*	92		8	$3s3p^3\ {}^3P°$
		1	*956 580*	63		22	$3s^2 3p 3d\ {}^3D°$
$3s^2 3p 3d$	$^3D°$	1	*888 210*	48		22	$3s3p^3\ {}^1P°$
		3	*950 580*	78		8	$3s3p^3\ {}^1F°$
$3s^2 3p 3d$		2	*938 520*	39	$3s^2 3p 3d\ {}^3D°$	32	$3s^2 3p 3d\ {}^1D°$
$3s^2 3p 3d$		2	*968 860*	40	$3s^2 3p 3d\ {}^3P°$	28	$3s^2 3p 3d\ {}^3D°$
$3s^2 3p 3d$	$^1F°$	3	*1 026 920*	89		9	$3s^2 3p 3d\ {}^3D°$
Kr XXIV ($^2P°_{1/2}$)	*Limit*		*8 047 000*				

Kr XXIV

$Z=36$

Al I isoelectronic sequence

Ground state $1s^22s^22p^63s^23p\ ^2P^o_{1/2}$

Ionization energy $8\,476\,000 \pm 80\,000\ cm^{-1}$ (1050.9 ± 10 eV)

Wyart and the TFR Group [1985] identified five lines of the transition arrays $3s^23p-3s3p^2$ and $3s^23d$. These were augmented by five additional lines by the TFR Group and Wyart [1988], including a doubly classified line at 152.07 Å. The uncertainty of their measurements was ±0.02 Å.

New observations of this spectrum were made by Sugar *et al.* [1988] with a tokamak plasma. They measured nine transitions between the doublets of the above arrays with an uncertainty of ±0.01 Å, and resolved the blend of two close lines at 152.016 Å and 152.111 Å. Their results are quoted here. The level uncertainty is $\pm 80\ cm^{-1}$.

With a more powerful tokamak discharge Jupén *et al.* [1990] were able to observe the intersystem transitions $3s^23p\ ^2P^o-3s3p^2\ ^4P$. The $^2P^o_{1/2}-^4P_{1/2}$ line, however, is blended with the Mg-like intersystem resonance line $3s^2\ ^1S_0-3s3p\ ^3P^o_1$ at 242.56 Å. Their wavelength unc tainty is ±0.02 Å. We quote their ^{4}P term.

We calculated the percentage composition of the ev levels with configuration interaction between $3s3p^2$ a $3s^23d$.

The value for the ionization energy was calculat with the Cowan [1981] HFR code.

References

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spec* (Univ. California Press, Berkeley, CA).

Jupén, C., Denne, B., and Martinson, I. [1990], Phys. Scr. **41**, 669.

Sugar, J., Kaufman, V., and Rowan, W. L. [1988], J. Opt. Soc. Am. I 2183.

TFR Group and Wyart, J. F. [1988], Phys. Scr. **37**, 66.

Wyart, J. F., and TFR Group [1985], Phys. Scr. **31**, 539.

Kr XXIV

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3s^23p$	$^2P^o$	1/2	*0*			
		3/2	*97 312*			
$3s3p^2$	^4P	1/2	412 270	92	7	$3s3p^2\ ^2S$
		3/2	464 230	98	1	$3s3p^2\ ^2D$
		5/2	500 420	81	18	"
$3s3p^2$	^2D	3/2	579 808	82	12	$3s^23d\ ^2D$
		5/2	611 662	70	19	$3s3p^2\ ^4P$
$3s3p^2$	^2P	1/2	657 825	61	33	$3s3p^2\ ^2S$
		3/2	765 062	90	8	$3s^23d\ ^2D$
$3s3p^2$	^2S	1/2	754 727	60	38	$3s3p^2\ ^2P$
$3s^23d$	^2D	3/2	843 013	80	15	$3s3p^2\ ^2D$
		5/2	856 066	87	13	"
Kr XXV ($^1S_0$)	*Limit*		**8 476 000**			

Kr XXV

$Z = 36$

Mg I isoelectronic sequence

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

Ionization energy $9\,287\,000 \pm 90\,000\ cm^{-1}$ (1151.4 ± 11 eV)

The resonance line $3s^2\ ^1S_0 - 3s3p\ ^1P_1^\circ$ was first reported by Hinnov [1976] at 159.0 ± 0.5 Å in a tokamak discharge. An observation of the M1 transition $3s3p\ ^3P_1^\circ - ^3P_2^\circ$ at 1277.1 ± 1.0 Å was made by Roberts *et al.* [1987] with a tokamak. Further tokamak observations were reported by Wyart and the TFR Group [1985] and the TFR Group and Wyart [1988]. In the first paper they give 12 lines included in the arrays $3s^2 - 3s3p$, $4p$, $3s3p - 3p^2$, and $3s3p - 3s3d$. In the second they reject the earlier classifications $3s3p\ ^3P_{1,2}^\circ - 3s3d\ ^3D_2$ at 129.895 Å and 144.665 Å, and identify the transition $^3P_1^\circ - ^3D_2$ as 129.36 ± 0.03 Å. Stewart *et al.* [1987], using a Z-pinch device, observed four of these lines and the additional transition $3s3p\ ^3P_0^\circ - 3s3d\ ^3D_1$ at 126.96 ± 0.05 Å.

Sugar *et al.* [1989] reported new measurements from a tokamak plasma of five of the eleven lines reported by Wyart *et al.* plus the additional transition at 126.96 Å given by Stewart *et al.* The uncertainty of the measurements by Sugar *et al.* is ± 0.005 Å. With these new data they derived all the levels except $3s3p\ ^3P_{0,1}^\circ$, $3p^2\ ^3P_1$, $^1D_2$ and $3s3d\ ^3D_1$. These are derived with the data of Jupén *et al.* [1990] obtained from a high energy tokamak discharge. They gave classifications for eight new lines measured with an uncertainty of ± 0.02 Å. The combined results of Sugar *et al.* and Jupén *et al.* provide our level values for the $3s3p$, $3p^2$, and $3s3d$ configurations except for the $3p^2\ ^1S_0$ level.

Churilov *et al.* [1989] investigated the isoelectronic behavior of levels of the $3p3d$ and $3d^2$ configurations. By comparing their transition energies with theory they were able to derive levels in Kr XXV from the tentatively classified wavelengths of Stewart *et al.* [1987] obtained with a Z-pinch device. The uncertainty of these measurements was ± 0.03 Å, giving a level uncertainty of $\pm 200\ cm^{-1}$. Churilov *et al.* also identified the transition $3p^2\ ^1S_0 - 3p3d\ ^1P_1^\circ$, permitting the $^1S_0$ level to be found. We combined their classified lines with the more accurately known lower levels to derive levels of the $3p3d$ and $3d^2$ configurations. We calculated the percentage composition of the levels by fitting the radial energy integrals to the known levels. The calculation included configuration interaction among all the even and all the odd parity levels. The $3p3d\ ^1F_3^\circ$ level given by Churilov *et al.* and based only on the line at 181.90 Å, is low by $6000\ cm^{-1}$ according to our calculation. Consequently the level $3d^2\ ^1G_4$, based only on a transition from the $3p3d\ ^1F_3^\circ$ level, does not fit the calculation. Also we find that the level $3p3d\ ^3D_3^\circ$ given by Churilov *et al.* at $1\,756\,964\ cm^{-1}$ should be $1\,765\,500\ cm^{-1}$. Wyart *et al.* identified the resonance line from the $3s4p\ ^1P_1^\circ$ level.

Cowan [1981] calculated the value for the ionization energy with an estimated uncertainty of 1%.

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Kr XXV

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3s^2$	^{1}S	0	0	98	2	$3p^2\ ^1$S
$3s3p$	^{3}P°	0	*389 580*	100		
		1	*412 290*	95	5	$3s3p\ ^1$P°
		2	*490 722*	100		
$3s3p$	^{1}P°	1	*632 187*	94	5	$3s3p\ ^3$P°
$3p^2$	^{3}P	0	930 645	86	13	$3p^2\ ^1$S
		1	1 001 890	100		
		2	1 092 830	73	17	$3p^2\ ^1$D
$3p^2$	^{1}D	2	996 610	60	26	$3p^2\ ^3$P
$3s3d$	^{3}D	1	1 177 690	100		
		2	1 184 970	100		
		3	1 196 618	100		
$3p^2$	^{1}S	0	1 206 900	84	14	$3p^2\ ^3$P
$3s3d$	^{1}D	2	1 319 434	76	22	$3p^2\ ^1$D
$3p3d$	^{3}F°	3	*1 645 700*	90	8	$3p3d\ ^3$D°
		4	*1 715 000*	100		
$3p3d$	^{1}D°	2	*1 664 300*	45	28	$3p3d\ ^3$P°
$3p3d$	^{3}D°	1	*1 689 400*	72	20	$3p3d\ ^3$P°
		2	*1 731 900*	41	32	$3p3d\ ^1$D°
		3	*1 765 500*	87	9	$3p3d\ ^3$F°
$3p3d$	^{3}P°	1	*1 771 700*	76	23	$3p3d\ ^3$D°
		2	*1 777 000*	55	40	"
$3p3d$	^{1}F°	3	*1 869 500?*	93	6	$3p3d\ ^3$D°
$3p3d$	^{1}P°	1	*1 891 300*	90	5	$3p3d\ ^3$D°
$3d^2$	^{3}F	2	2 381 900	97	3	$3d^2\ ^1$D
		3	2 396 500	100		
		4	2 410 000	98	2	$3d^2\ ^1$G
$3d^2$	^{1}G	4	2 464 200?	98	2	$3d^2\ ^3$F
$3s4p$	^{1}P°	1	*4 579 000*			
Kr XXVI ($^2S_{1/2}$)	***Limit***		**9 287 000**			

Kr XXVI

$Z=36$

Na I isoelectronic sequence

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

Ionization energy 9 721 300 ± 2000 cm^{-1} (1205.3 ± 0.3 eV)

Hinnov [1976] first identified the $3s-3p$ doublet in a tokamak plasma. Improved values were given by Wyart *et al.* [1985] for this doublet as well as new measurements of $3p-3d$, $3s-4p$, $3p-4s$, $3p-4d$, $3d-4f$, and $4f-5g$ from tokamak observations. The uncertainty of the $n=3-4$ transitions is ±0.015 Å.

Reader *et al.* [1987] fitted the differences between observed and calculated wavenumbers of the $3s-3p$, $3p-3d$, and $3d-4f$ doublets to simple formulas by least squares for all ions from Ar VIII to Xe XLIV. By this means they derived smoothed values for these transitions with an estimated uncertainty of ±0.007 Å. The level uncertainties are ±40 cm^{-1} for $n=3$ and ±2000 cm^{-1} for $n=4$. Burkhalter *et al.* [1979] have observed the $2p^6 3s-2p^5 3s^2$, $2p^6 3p-2p^5 3s 3p$, and $2p^6 3d-2p^5 3s 3d$ arrays in the range of 7.3−7.6 Å with a Z-pinch device. There is too much blending of lines to permit the derivation of reliable energy levels from these data.

We use the $n=3-3$ wavelengths of Reader *et al.* plus their $3d-4f$ value, and the wavelengths of Wyart *et al.* for the remaining $n=3-4$ transitions to derive the energy levels.

We derived the limit from the $4f$ and $5g$ level positions by means of a polarization calculation.

Kr XXVI

Configuration	Term	J	Level (cm^{-1})
$3s$	^2S	1/2	0
$3p$	$^2P°$	1/2	*454 413*
		3/2	*558 678*
$3d$	^2D	3/2	1 164 182
		5/2	1 183 991
$4s$	^2S	1/2	4 492 700
$4p$	$^2P°$	1/2	*4 679 700*
		3/2	*4 720 300*
$4d$	^2D	3/2	4 947 400
		5/2	4 955 600
$4f$	$^2F°$	5/2	*5 067 200*
		7/2	*5 070 800*
$5g$	^2G	7/2	6 751 400
		9/2	6 752 600
Kr XXVII ($^1S_0$)	*Limit*		**9 721 300**

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Wyart, J. F., and TFR Group [1985], Phys. Scr. **31**, 539.

Kr XXVII

$Z=36$

Ne I isoelectronic sequence

Ground state $1s^22s^22p^6\ ^1S_0$

Ionization energy $23\,616\,000 \pm 24\,000$ cm^{-1} (2928 ± 30 eV)

Using spectra obtained with a beam-foil device in the range of 140 to 270 Å, Buchet *et al.* [1988] established all the levels of the $2p^53s$ and $2p^53p$ configurations and 10 of the 12 levels of $2p^53d$. No connection was found between levels based on the two $2p^5\ ^2P^\circ_{1/2}$ and $^2P^\circ_{3/2}$ core states. The two systems of levels are given relative to calculated values for the $2p^53s$ $(^3/_2,{}^1/_2)^\circ_1$, and $2p^53s$ $(^1/_2,{}^1/_2)^\circ_1$ levels at 13 326 500 cm^{-1} and 13 758 000 cm^{-1}, respectively.

These systems were connected by the $2p^6-2p^53s$ resonance lines measured by Gordon *et al.* [1979] and Burkhalter *et al.* [1979] at 7 Å. These were observed by laser excitation and with a Z-pinch device, respectively, with wavelength uncertainties reported as ±0.005 Å and ±0.007 Å. Resonance lines $2p^6-2p^53d$ and $2s^22p^6-2s2p^63p$ were also given. The uncertainty of the Gordon *et al.* measurements is ±10 000 cm^{-1}, and they fall within 1000 cm^{-1} of Buchet's calculated values. We use the values of Buchet to connect these systems to the ground level with an uncertainty of ±10 000 cm^{-1}. Within each system the level uncertainties are ±500 cm^{-1} for the $2p^53s$ and $3p$ levels and ±1000 cm^{-1} for the $3d$ levels. Stewart *et al.* [1987] observed some of these transitions in Z-pinch plasmas and the values were compared by Buchet *et al.* with their own measurements.

The value for the ionization energy was calculated by Cowan [1981] with an uncertainty of 1%.

Kr XXVII

Configuration	Term	J	Level (cm^{-1}
$2s^22p^6$	^1S	0	0
$2s^22p^5(^2P^\circ_{3/2})3s$	$(^3/_2,{}^1/_2)^\circ$	2	*13 300 500*
		1	*13 326 500*
$2s^22p^5(^2P^\circ_{3/2})3p$	$(^3/_2,{}^1/_2)$	1	13 713 300
		2	13 738 200
$2s^22p^5(^2P^\circ_{1/2})3s$	$(^1/_2,{}^1/_2)^\circ$	0	*13 745 300*
		1	*13 758 000*
$2s^22p^5(^2P^\circ_{3/2})3p$	$(^3/_2,{}^3/_2)$	3	13 831 300
		1	13 835 900
		2	13 870 200
		0	14 004 200
$2s^22p^5(^2P^\circ_{1/2})3p$	$(^1/_2,{}^1/_2)$	1	14 172 300
		0	14 344 300
$2s^22p^5(^2P^\circ_{1/2})3p$	$(^1/_2,{}^3/_2)$	1	14 282 900
		2	14 293 600
$2s^22p^5(^2P^\circ_{3/2})3d$	$(^3/_2,{}^3/_2)^\circ$	0	*14 342 000*
		1	*14 369 400*
		3	*14 394 500*
		2	*14 424 300*
$2s^22p^5(^2P^\circ_{3/2})3d$	$(^3/_2,{}^5/_2)^\circ$	4	*14 399 700*
		2	*14 401 100*
		3	*14 448 200*
		1	*14 533 000*
$2s^22p^5(^2P^\circ_{1/2})3d$	$(^1/_2,{}^3/_2)^\circ$	2	*14 840 100*
		1	*14 928 000*
$2s^22p^5(^2P^\circ_{1/2})3d$	$(^1/_2,{}^5/_2)^\circ$	2	*14 857 30*
		3	*14 869 70*
$2s2p^63p$	$(^1/_2,{}^1/_2)^\circ$	1	*15 662 00*
$2s2p^63p$	$(^1/_2,{}^3/_2)^\circ$	1	*15 783 00*
Kr XXVIII ($^2P^\circ_{3/2}$)	***Limit***		***23 616 00***

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' I isoelectronic sequence

Ground state $1s^22s^22p^5\ ^2P^o_{3/2}$

onization energy 24 760 000 ± 250 000 cm^{-1} (3070 ± 30 eV)

Wyart *et al.* [1985] classified the two lines of the $s^22p^5-2s2p^6$ transition observed at 52 and 68 Å in a okamak plasma. They were also observed by Dietrich *et l.* [1986] in a Z-pinch, and by Denne *et al.* [1989] in a okamak. All are given with an uncertainty of ±0.03 Å, within which the values are all in agreement. Denne *et l.* observed the M1 line at 223.995±0.030 Å giving the P° ground term splitting with an uncertainty of ±60 cm^{-1}. We give the value for the $^2P^o$ ground term plitting derived from this M1 line and the $2s2p^6\ ^2S$ term rom an average of the $2s^22p^5-2s2p^6$ measurements.

With a Z-pinch device Burkhalter *et al.* [1979] observed spectra in the range of 6–8 Å, including the $2p^5-2p^43s$, $2p^5-2p^43d$, $2s^22p^5-2s2p^53p$, and $2s2p^6-2p^63p$ arrays. They estimate the uncertainty of their measurements to be ±0.007 Å, giving a level uncertainty of ±14 000 cm^{-1}. They also give the leading eigenvector percentage in LS and jj coupling, the latter giving the purer scheme for most levels. We have compiled all but the $2s2p^53p$ levels, which do not reproduce the correct ground term interval.

Cowan [1981] calculated the value for the ionization energy with an estimated uncertainty of 1%.

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Kr XXVIII

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$2s^22p^5$	$^2P^o$	3/2	*0*	
		1/2	*446 440*	
$2s2p^6$	^2S	1/2	1 901 350	
$2s^22p^4(^3P_2)3s$	(2,1/2)	5/2	13 872 000	78
		3/2	13 902 000	75
$2s^22p^4(^3P_0)3s$	(0,1/2)	1/2	14 039 000	51
$2s^22p^4(^3P_1)3s$	(1,1/2)	3/2	14 292 000	99
		1/2	14 337 000	99
$2s^22p^4(^1D_2)3s$	(2,1/2)	5/2	14 407 000	78
		3/2	14 409 000	75
$2s^22p^4(^3P_2)3d$	(2,3/2)	1/2	14 892 000	61
		3/2	15 062 000	41
$2s^22p^4(^3P_2)3d$	(2,5/2)	3/2	14 977 000	57
		5/2	15 008 000	68
$2s^22p^4(^3P_0)3d$	(0,5/2)	5/2	15 092 000	47
$2s^22p^4(^3P_0)3d$	(0,3/2)	3/2	15 312 000	72
$2s^22p^4(^3P_1)3d$	(1,3/2)	5/2	15 340 000	66

Kr XXVIII — Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2s^22p^4(^3P_1)3d$	$(1,{}^5/_2)$	$^3/_2$	15 374 000	60		
		$^5/_2$	15 380 000	81		
$2s^22p^4(^1D_2)3d$	$(2,{}^3/_2)$	$^1/_2$	15 434 000	60		
		$^5/_2$	15 466 000	63		
$2s^22p^4(^1D_2)3d$		$^3/_2$	15 460 000	37	$2p^4(^1D_2)3d$	$(2,{}^3/_2)$
$2s^22p^4(^1D_2)3d$		$^5/_2$	15 538 000	30	$2p^4(^1D_2)3d$	$(2,{}^5/_2)$
$2s^22p^4(^1D_2)3d$		$^3/_2$	15 557 000	30	$2p^4(^1D_2)3d$	$(2,{}^5/_2)$
$2s^22p^4(^1D_2)3d$	$(2,{}^5/_2)$	$^1/_2$	15 573 000	51		
$2s^22p^4(^1S_0)3d$	$(0,{}^3/_2)$	$^3/_2$	15 953 000	49		
$2p^63p$	$^2P^o$	$^1/_2$	*18 069 000*			
		$^3/_2$	*18 175 000*			
Kr XXIX ($^3P_2$)	***Limit***		**24 760 000**			

Kr XXIX

$Z=36$

O I isoelectronic sequence

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

Ionization energy 26 030 000 ± 250 000 cm^{-1} (3227 ± 30 eV)

Wyart *et al.* [1985] classified three lines of the $2s^2 2p^4 - 2s 2p^5$ array observed in a tokamak plasma. Observations with a *Z*-pinch by Dietrich *et al.* [1986] extended the number of classified lines to seven. New tokamak observations by Denne *et al.* [1989] provided seven lines of this array, two of which at 74.663 Å and 86.98 Å were newly identified. This group also reported two M1 transitions within the ground configuration: the $^3P_2 - ^1D_2$ at 190.515 ± 0.030 Å and the $^3P_2 - ^3P_1$ at 235.95 ± 0.10 Å. Dietrich *et al.* reported two E1 lines that were not given by Denne *et al.* We have used the wavelengths of Denne *et al.* to determine the energy levels, and supplemented them with the two lines of Dietrich *et al.* The uncertainty of the levels varies from ±100 to ±1000 cm^{-1}.

Cowan [1981] calculated the value for the ionization energy with an estimated uncertainty of 1%.

Kr XXIX

Configuration	Term	*J*	Level (cm^{-1})
$2s^2 2p^4$	^3P	2	0
		0	160 700
		1	423 820
$2s^2 2p^4$	^1D	2	524 890
$2s 2p^5$	$^3P°$	2	*1 674 650*
		1	*1 864 320*
		0	*2 133 800*
$2s 2p^5$	$^1P°$	1	*2 377 700*
Kr XXX ($^4S°_{3/2}$)	*Limit*		*26 030 000*

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Kr XXX

$Z=36$

N I isoelectronic sequence

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

Ionization energy 27 270 000 ± 200 000 cm^{-1} (3381 ± 25 eV)

Denne *et al.* [1989] reported seven lines of the transition array $2s^2 2p^3 - 2s 2p^4$ observed in the range of 54 − 110 Å in a tokamak plasma and measured with an uncertainty varying from ±0.02 to 0.05 Å. They also identified three M1 transitions among the ground configuration levels: the ${}^4S^\circ_{3/2} - {}^2P^\circ_{1/2}$ at 160.90 ± 0.10 Å tentatively, the ${}^4S^\circ_{3/2} - {}^2D^\circ_{5/2}$ at 205.247 ± 0.025 Å, and the ${}^4S^\circ_{3/2} - {}^2D^\circ_{3/2}$ at 259.807 ± 0.020 Å. The uncertainty in the determination of the levels of the ground configuration is ±50 cm^{-1}, and the average uncertainty for the levels of the $2s2p^4$ configuration is ±1000 cm^{-1}. We quote these results.

Cowan [1981] calculated the value for the ionization energy with an estimated uncertainty of 1%.

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Kr XXX

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p^3$	${}^4S^\circ$	3/2	*0*
$2s^2 2p^3$	${}^2D^\circ$	3/2	*384 900*
		5/2	*487 220*
$2s^2 2p^3$	${}^2P^\circ$	1/2	*621 500*'
$2s2p^4$	${}^4P$	5/2	1 391 300
		3/2	1 646 580
		1/2	1 657 500
$2s2p^4$	${}^2D$	3/2	1 955 480
$2s2p^4$	${}^2P$	3/2	2 318 860
Kr XXXI (${}^3P_0$)	***Limit***		**27 270 000**

Kr XXXI

Z = 36

C I isoelectronic sequence

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

Ionization energy 28 990 000 ± 300 000 cm^{-1} (3594 ± 40 eV)

Denne *et al.* [1989] reported eight lines of the transition array $2s^22p^2-2s2p^3$ observed in the range of 66 – 95 Å in a tokamak plasma with uncertainties varying from ±0.02 to 0.05 Å. They also identified the M1 transition $2s^22p^2$ ($^3P_0-{}^3P_1$) at 252.001 ± 0.020 Å, giving an interval of 396 820 ± 30 cm^{-1}. The average uncertainty of the levels of $2s2p^3$ is ±1000 cm^{-1}.

Martin *et al.* [1990] observed four lines of the $2s^22p^2-2s2p^3$ array with a beam-foil source and report a wavelength uncertainty of ±0.05 Å. They identified the $2s^22p^2\ ^3P_1-2s2p^3\ ^3P^\circ_0$ transition, not given by Denne *et al.* We quote the results of Denne *et al.* and include the $2s2p^3\ ^3P^\circ_0$ value of Martin *et al.*

Cowan [1981] calculated the value for the ionization energy with an estimated uncertainty of 1%.

Kr XXXI

Configuration	Term	J	Level (cm^{-1})
$2s^22p^2$	^3P	0	0
		1	396 820
		2	478 200
$2s2p^3$	$^3D^\circ$	1	*1 530 200*
		2	*1 653 800*
		3	*1 783 500*
$2s2p^3$	$^3P^\circ$	0	*1 955 900*
		1	*1 999 100*
		2	*2 002 900*
$2s2p^3$	$^3S^\circ$	1	*2 151 900*
Kr XXXII ($^2P^\circ_{1/2}$)	***Limit***		***28 990 000***

References

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra*, (Univ. California Press, Berkeley, CA).

Denne, B., Hinnov, E., Ramette, J., and Saoutic, B. [1989], Phys. Rev. A **40**, 1488.

Martin, S., Denis, A., Buchet-Poulizac, M. C., Buchet, J. P., and Desesquelles, J. [1990], Phys. Rev. A **42**, 6570.

Kr XXXII

$Z=36$

B I isoelectronic sequence

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

Ionization energy 30 330 000 ± 300 000 cm^{-1} (3760 ± 40 eV)

Denne *et al.* [1989] observed the line at 64.65±0.10 Å in a tokamak plasma and tentatively classified it as a blend of $2s^2 2p\ ^2P^{\circ}_{3/2} - 2s2p^2\ ^2P_{1/2,3/2}$. They also reported three other lines of this array: the $^2P^{\circ}_{1/2} - ^2S_{1/2}$ at 66.538±0.025 Å, the $^2P^{\circ}_{1/2} - ^2D_{3/2}$ at 69.957±0.020 Å, and the $^2P^{\circ}_{3/2} - ^2D_{5/2}$ at 84.94±0.10 Å which is weak and tentatively classified. In addition they observed the M1 transition $2s^2 2p$ ($^2P^{\circ}_{1/2} - ^2P^{\circ}_{3/2}$) at 203.021±0.020 Å, from which they determined the ground term interval.

The same transitions were measured in a beam-foil spectrum by Martin *et al.* [1990]. We average these two sets of data and obtain levels with an uncertainty of ±2000 cm^{-1}. Martin *et al.* also identified two transitions from the $2p^3$ configuration that we use to derive the two doublet levels.

The ionization energy was calculated by Cowan [1981] with an uncertainty of about 1%.

Kr XXXII

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p$	$^2P^{\circ}$	1/2	*0*
		3/2	*492 560*
$2s2p^2$	^2D	3/2	1 430 000
		5/2	1 671 000
$2s2p^2$	^2S	1/2	1 503 000
$2s2p^2$	^2P	1/2	2 031 000
		3/2	2 041 000
$2p^3$	$^2D^{\circ}$	5/2	*2 738 000*
$2p^3$	$^2P^{\circ}$	3/2	*3 308 000*
Kr XXXIII ($^1S_0$)	***Limit***		**30 330 000**

References

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra*, (Univ. California Press, Berkeley, CA).

Denne, B., Hinnov, E., Ramette, J., and Saoutic, B. [1989], Phys. Rev. A **40**, 1488.

Martin, S., Denis, A., Buchet-Poulizac, M. C., Buchet, J. P., and Desesquelles, J. [1990], Phys. Rev. A **42**, 6570.

Kr XXXIII

$Z = 36$

Be I isoelectronic sequence

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

Ionization energy 31 990 000 ± 300 000 cm^{-1} (3966 ± 40 eV)

Dietrich *et al.* [1980] identified the resonance line $2s^2\ ^1S_0 - 2s2p\ ^1P^\circ_1$ at 169.9±0.5 Å in a beam-foil device. Denne *et al.* [1989] observed both resonance lines $2s^2\ ^1S_0 - 2s2p\ ^{1,3}P^\circ_1$ at 72.756±0.020 Å and 169.845 ±0.025 Å in a tokamak plasma. They also observed the M1 transition $2s2p(^3P^\circ_1 - ^3P^\circ_2)$ at 235.48±0.05 Å. We use the results of Denne *et al.* to derive the levels of $2s2p$, except for the $^3P^\circ_0$ level.

Further beam-foil observations by Martin *et al.* [1990] enabled them to identify the $2s2p - 2p^2$ array. Their line identifications provided us with the $^3P^\circ_0$ level of $2s2p$ and the ^3P, ^1D, and ^1S levels of $2p^2$ with an uncertainty of ±1000 cm^{-1}.

The ionization energy was calculated by Cowan [1981] with a uncertainty of about 1%.

Kr XXXIII

Configuration	Term	J	Level (cm^{-1})
$2s^2$	^1S	0	0
$2s2p$	$^3P^\circ$	0	*505 500*
		1	*588 770*
		2	*1 013 440*
$2s2p$	$^1P^\circ$	1	*1 374 460*
$2p^2$	^3P	0	1 438 100
		1	1 827 200
		2	1 909 800
$2p^2$	^1D	2	2 391 300
$2p^2$	^1S	0	2 671 500
Kr XXXIV ($^2S_{1/2}$)	***Limit***		**31 990 000**

References

Cowan, R. D. [1981], *The Theory of Atomic Structure and Spectra,* (Univ. California Press, Berkeley, CA).

Denne, B., Hinnov, E., Ramette, J., and Saoutic, B. [1989], Phys. Rev. A **40**, 1488.

Dietrich, D. D., Leavitt, J. A., Gould, H., and Marrus, R. [1980], Phys. Rev. A **22**, 1109.

Martin, S., Denis, A., Buchet-Poulizac, M. C., Buchet, J. P., and Desesquelles, J. [1990], Phys. Rev. A **42**, 6570.

Kr XXXIV

$Z=36$

Li I isoelectronic sequence

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

Ionization energy 33 137 590 ± 800 cm^{-1} (4108.540 ± 0.1 eV)

The resonance $2s-2p$ doublet has been measured by Denne *et al.* [1989] at 174.036±0.026 Å and 91.049±0.025 Å from tokamak observations. Using a beam-foil apparatus Martin *et al.* [1990] obtained the values 173.93±0.04 Å and 91.00±0.03 Å. We use weighted averages of these measurements to obtain the values 174.005±0.022 Å and 91.029±0.025 Å. The energy levels are deduced from these values with uncertainties of ±70 cm^{-1} and ±80 cm^{-1}, respectively. These lines have been calculated by Indelicato [1989] with an MCDF code including radiative corrections. His values are 174.0025 Å and 91.0508 Å.

The value for the ionization energy was obtained from similar calculations by Indelicato [1986, 1989] of the binding energies of the ground states of He-like and Li-like krypton.

Kr XXXIV

Configuration	Term	J	Level (cm^{-}
$1s^2 2s$	^2S	$^1/_2$	
$1s^2 2p$	$^2P^\circ$	$^1/_2$	*574 70*
		$^3/_2$	*1 098 55*
Kr XXXV ($^1S_0$)	***Limit***		**33 137 59**

References

Denne, B., Hinnov, E., Ramette, J., and Saoutic, B. [1989], Phys. Rev. A **40**, 1488.

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Kr XXXV

$Z=36$

He I isoelectronic sequence

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

Ionization energy 139 510 800 ± 5000 cm^{-1} (17 297.14 ± 0.6 eV)

The following experimental data have been obtained by beam-foil excitation:

Transition	Energy (cm^{-1})	Authors
$1s^2\ ^1S_0-1s2s\ ^3S_1$	104 920 000 ± 270 000	Gould and Marrus [1975]
$1s^2\ ^1S_0-1s2p\ ^3P^\circ_1$	105 068 200 ± 2000	Indelicato *et al.* [1986]
$1s^2\ ^1S_0-1s2p\ ^1P^\circ_1$	105 783 200 ± 2000	Indelicato *et al.* [1986]
$1s^2\ ^1S_0-1s2p\ ^3P^\circ_2$	105 588 000 ± 12 000	Briand *et al.* [1984]
$1s2s\ ^3S_1-1s2p\ ^3P^\circ_2$	900 030 ± 250	Martin *et al.* [1990]
$1s2s\ ^3S_1-1s2p\ ^3P^\circ_0$	357 380 ± 250	Martin *et al.* [1990]

We quote the positions of the $1s2p\ ^1P^\circ_1$ and $^3P^\circ_1$ levels from Indelicato *et al.* [1986]. The $1s2p\ ^3P^\circ_0-{}^3P^\circ_1$ interval and the position of the $1s2s\ ^1S_0$ level are from multiconfiguration Dirac-Fock calculations with QED corrections by Indelicato [1990]. The $1s2p\ ^3P^\circ_2$ and the $1s2s\ ^3S_1$ levels were derived from the measurements by Martin *et al.* [1990]. The value for the ionization energy was calculated by Indelicato [1990]. His values for the $1s2p\ ^3P^\circ_1$ and $^1P^\circ_1$ and the $1s2s\ ^3S_1$ are about 5000 cm^{-1} lower than the observed values. We therefore increased his value for the ionization energy by this amount.

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Kr XXXV

Configuration	Term	J	Level (cm^{-1})
$1s^2$	^1S	0	0
$1s2s$	^3S	1	104 689 700
$1s2p$	$^3P^\circ$	0	[*105 047 100*]
		1	*105 068 200*
		2	*105 589 700*
$1s2s$	^1S	0	[105 070 100]
$1s2p$	$^1P^\circ$	1	*105 783 200*
Kr XXXVI ($^2S_{1/2}$)	*Limit*		**139 510 800**

ENERGY LEVELS OF KRYPTON, Kr I THROUGH Kr XXXVI

Kr XXXVI

$Z=36$

H I isoelectronic sequence

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

Ionization energy 144 665 280 ± 90 cm^{-1} (17 936.21 ± 0.01 eV)

A value for the $1s\ ^2S_{1/2}-2p\ ^2P^{\circ}_{3/2}$ transition of 13 508.95±0.5 eV or 108 957 000±4000 cm^{-1} has been measured by Tavernier *et al*. [1985] in a beam-foil experiment.

We give the theoretical values for the $1s$, $2s$, and $2p$ levels as well as the ionization energy calculated by Johnson and Soff [1985]. They estimate the uncertainty of these values relative to the ground state to be ±90 cm^{-1} and that of the $2p\ ^2P^{\circ}$ term splitting to be ±5 cm^{-1}. The position of the $2p\ ^2P^{\circ}_{3/2}$ level agrees with the measured value within the uncertainty of the measurement.

For $n=3$ to 5 the values of the energy levels were obtained by subtracting the binding energies calculated by Erickson [1977] from the Johnson and Soff value for the binding energy of the ground state. Assuming that the Lamb shift scales as n^{-3}, we estimate the error in Erickson's calculations for the ns levels as $8n^{-3}$ times his error of ±880 cm^{-1} for $2s$. The resulting errors for $3s$, $4s$, and $5s$ are ±260 cm^{-1}, ±110 cm^{-1}, and ±60 cm^{-1}, respectively. For the remaining levels with $n \geq 3$ and for $5s$ the limiting uncertainty is ±90 cm^{-1}.

Kr XXXVI

Configuration	Term	J	Level (cm^{-1}
$1s$	^2S	1/2	
$2p$	$^2P^{\circ}$	1/2	*[108 314 47*
		3/2	*[108 956 89*
$2s$	^2S	1/2	[108 328 40
$3p$	$^2P^{\circ}$	1/2	*[128 581 18*
		3/2	*[128 771 76*
$3s$	^2S	1/2	[128 585 64
$3d$	^2D	3/2	[128 771 40
		5/2	[128 832 86
$4p$	$^2P^{\circ}$	1/2	*[135 648 10*
		3/2	*[135 728 37*
$4s$	^2S	1/2	[135 649 99
$4d$	^2D	3/2	[135 728 22
		5/2	[135 754 18
$4f$	$^2F^{\circ}$	5/2	*[135 754 14*
		7/2	*[135 767 02*
$5p$	$^2P^{\circ}$	1/2	*[138 907 84*
		3/2	*[138 948 87*
$5s$	^2S	1/2	[138 908 81
$5d$	^2D	3/2	[138 948 79
		5/2	[138 962 09
$5f$	$^2F^{\circ}$	5/2	*[138 962 07*
		7/2	*[138 968 67*
$5g$	^2G	7/2	[138 968 66
		9/2	[138 972 60
....	....	....	....
	Limit		**[144 665 28**

References

Erickson, G. W. [1977], J. Phys. Chem. Ref. Data **6**, 831.

Johnson, W. R., and Soff, G. [1985], At. Data Nucl. Data Tables **33**, 405.

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