

Improved Description of Hafnium Spectra

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Earlier descriptions of atomic hafnium spectra, from conventional arcs or sparks, have been handicapped by the absence of pure samples and by the presence of a strong background of molecular spectra. Recent availability of highly purified hafnium metal, and the development of a new light source, removed these handicaps. This improved description of hafnium spectra was made by employing electrodeless metal-halide lamps excited, at relatively low pressure and temperature, by microwaves. Lamps of hafnium iodide, hafnium bromide, and hafnium chloride were compared to recognize the spectra of halogens or their compounds and thus arrive at the atomic hafnium lines common to different lamps. The number of lines now ascribed to hafnium spectra exceeds 6,200 as compared with about 2,400 heretofore. The wavelengths range from 1284.88 to 12043.08 Å, and estimated relative intensities in different light sources (including arcs, sparks, and electrodeless lamps) indicate which lines belong to Hf I, Hf II, Hf III, and Hf IV. The splitting of spectral lines in magnetic fields (Zeeman effect) has also been improved by using magnetic fields of higher intensity, and greater spectrographic resolving power than before. The number of lines for which Zeeman patterns have been observed has been increased from 280 to 1,030, and the types of complex patterns invariably confirm the assignments of lines to Hf I or Hf II.

Hafnium was the next to the last stable element to be discovered in the earth's crust; its discovery was announced by Coster and Von Hevesy [1]¹ in a letter to Nature on January 20, 1923. That year Hansen and Werner [2] published the first description of the optical spectra of hafnium, consisting of wavelengths of 807 lines ranging from 2253.98 to 7240.9 Å, and estimated relative intensities in arc and spark spectra.

In 1925 Professors Bohr and von Hevesy generously presented about 0.2 gram of their purest hafnium to Meggers [3] who made another description of hafnium arc and spark spectra for the purpose of finding regularities among the lines. Spectrograms were made by burning small portions of the sample in a silver arc or spark, and wavelengths from 2155.72 to 9250.27 Å were measured for some 2,100 spectral lines. However, careful comparison with known spectra proved that 609 of the observed lines were due to impurities, among which niobium, zirconium, and titanium were the most abundant. Nevertheless this list of about 1,500 hafnium lines, because of its effective separation of Hf I and Hf II spectra by comparing arc and spark intensities, permitted the detection of regularities in both spectra.

In 1928 Meggers and Scribner reported [4] the first multiplets in Hf II, and in 1930 they published [5] the first regularities in Hf I. It was recognized that extension and confirmation of these first regularities would require further improvements in the basic descriptions of hafnium spectra and also observation of the Zeeman effect. Both requirements were partially met in 1932 when hafnium spectra were reobserved with purified oxide donated by Prof. von Hevesy, and the first Zeeman-effect spectrograms were made with a small rod of hafnium metal presented for this purpose by Dr. G. Holst of Eindhoven. The arc and spark spectra were remeasured, and extended from 1990.73 to 10637.92 Å. The new sample of hafnium oxide was entirely free from

titanium and showed only a trace of niobium, but it contained considerable amounts of zirconium and nickel. The number of spectral lines positively identified with hafnium atoms or ions was increased from about 1,500 to 2,400, including nearly 1,400 Hf I, about 1,000 Hf II, and several dozen Hf III lines. Magnetic splitting (Zeeman effect) was observed for 280 hafnium lines (2393 to 4817 Å), 70 belonging to the first and 210 to the second spectrum. These confirmed the first reported [4, 5] regularities in the spectra, and full details of the new wavelengths, intensities, Zeeman data, and quantum interpretation of the second spectrum of hafnium were published by Meggers and Scribner [6] who promised that "Further data and analysis of the Hf I spectrum will be published after they have been supplemented by additional observations of Zeeman effects, since the data at present available have proved insufficient for the complete identification of Hf I spectral terms"

Further progress in the investigation and interpretation of the Hf I spectrum was delayed many years for the following reasons: it was proved that the Zeeman data were inadequate, many impurity lines were always present, and it was suspected that the line list was far from complete. In his 1928 paper on wavelength measurements in spectra of hafnium Meggers stated [2] "The greatest difficulty in describing the arc spectrum of hafnium arises from the band spectrum which probably originates with the oxides. Some of these bands are very strong and extremely complex over long spectral ranges. In many cases it is impossible to decide if faint lines belong to Hf I or to the HfO₂ spectrum". Attempts to improve the description of the hafnium arc spectrum with electrodes of solid hafnium metal kindly donated in 1951 by C. P. Keim of the Oak Ridge National Laboratory were frustrated by the strong background of HfO spectra from 3000 Å to the infrared limit of photography, and by the presence of metallic impurities, mostly zirconium.

Before hafnium was discovered, the accepted

¹ Figures in brackets indicate the literature references on page 272.

Zeeman patterns for odd multiplicities - Hf I

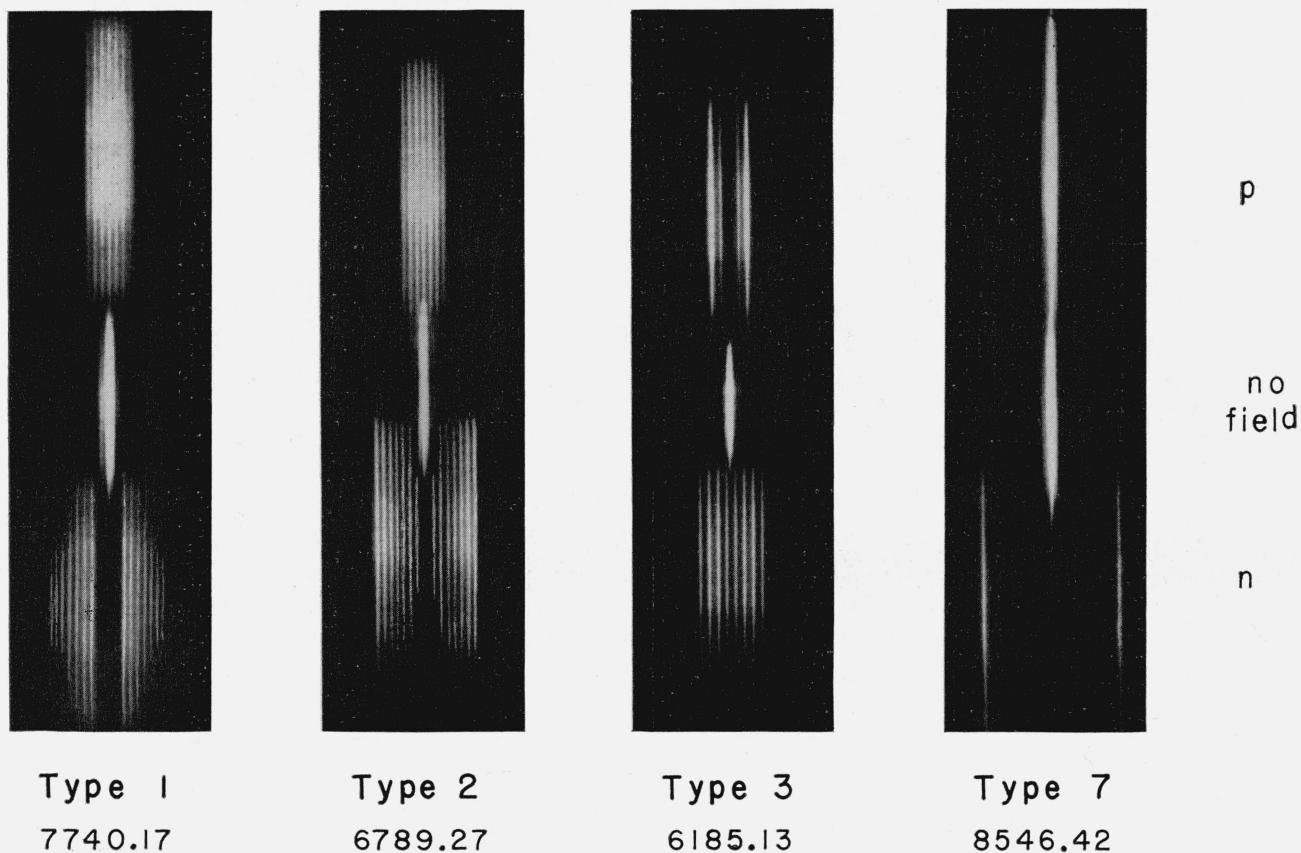


FIGURE 1. Types of Zeeman patterns for Hf I observed at NBS using electrodeless lamps in a field of 37,000 oersteds.

chemical atomic weight of zirconium [7] was more than a half-unit larger than its present value, 91.22. This difference was later explained [8] by the unsuspected presence of hafnium as an impurity in the earlier samples of zirconium. Likewise, after information about the spectra of hafnium became available it was found [3] that all earlier descriptions of zirconium spectra contained many hafnium lines. The complete separation of hafnium and zirconium is one of the most difficult chemical operations, and to this day neither has been obtained spectroscopically free from the other. However, since certain properties of these metals have recently been found to be useful in the construction and operation of nuclear reactors, greater efforts have been made to provide large quantities of high-purity hafnium and zirconium.

In December, 1955, two rods of hafnium metal, $\frac{1}{4}$ -in. diameter, 4-in. length, were generously provided for our further spectroscopic investigations by Stephen M. Shelton of the U. S. Department of Interior, Bureau of Mines. A complete quantitative spectrochemical analysis of these samples was also provided; it expressed the impurities in parts per million as follows: Cd <0.5 , B 0.2, Al 20, Fe 500,

Cu 40, Pb <10 , Cr <30 , Si 150, Mg 40, Ti 100, Zn <50 , Ni 40, Mn <10 , Mo 60, V 40, Co <5 , Sn <5 , Zr 80. Thus the total impurities of these samples approximate 0.1 percent, and zirconium, which was always the most troublesome, constitutes only 0.008 percent. Of these impurities, only the stronger lines of Fe, Si, Ti, Zr, Zn, and Al were observed in the electrodeless lamps described below.

Recently, a new type of light source was described by Corliss, Bozman, and Westfall [9], who showed that a bright emission spectrum of any metal could be obtained from out-gassed quartz tubes inclosing a minute amount of any volatile compound of that metal, when excited by microwaves. The first hafnium lamp of this type was made by producing, in an evacuated quartz tube, a chemical reaction between filings of the above-mentioned hafnium metal and a small crystal of iodine. The spectrum emitted by this lamp was photographed from 2000 to 12000 Å; it was much richer than any hafnium arc spectrum because it completely suppressed the usual HfO bands that always obscured several thousand hafnium lines of low or moderate intensity. The only defect was the presence of some strong iodine lines and an entirely new system of bands, presum-

Zeeman patterns for even multiplicities - Hf II

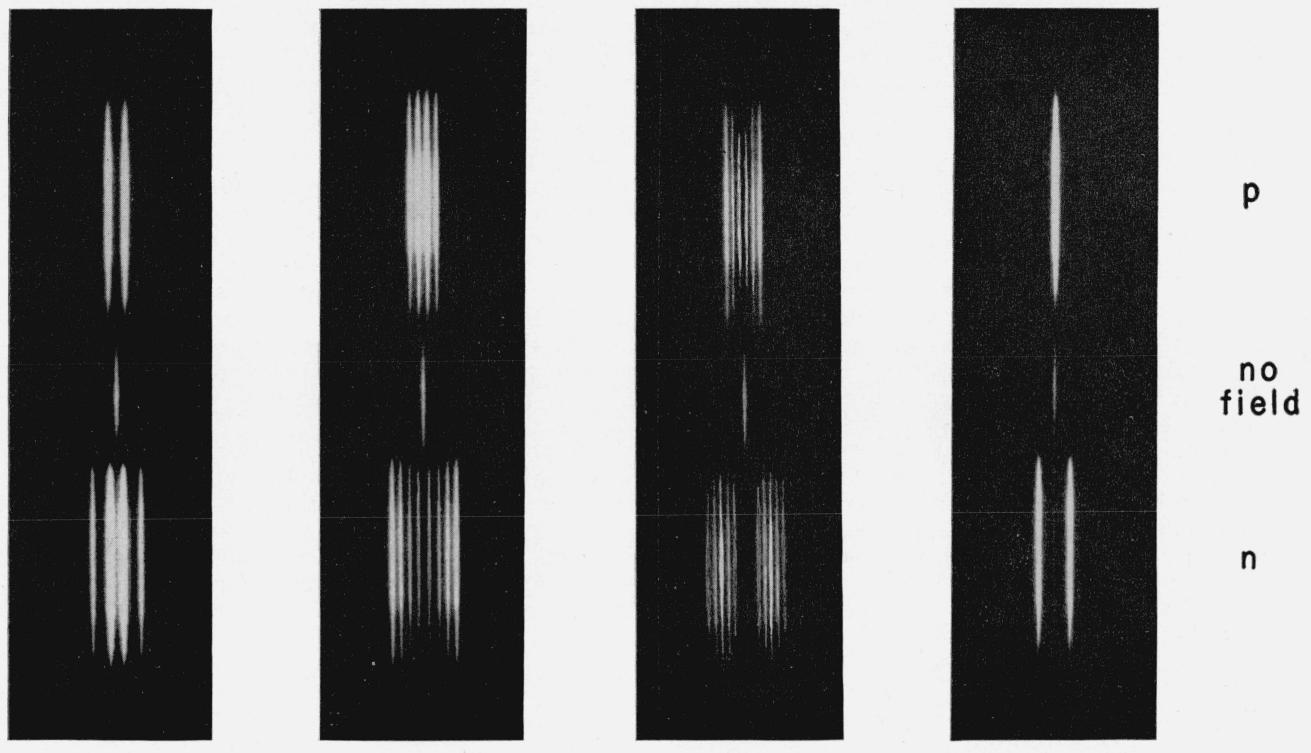


FIGURE 2. *Types of Zeeman patterns for Hf II observed at NBS using electrodeless lamps in a field of 37,000 oersteds.*

ably due to hafnium iodide which appeared with low intensity in several short intervals of spectra. These lines and bands were replaced by others when the lamps were made either with hafnium bromide or with hafnium chloride. Thus by observing and comparing the spectra of two different halides the halogen lines and molecular bands are completely recognized as differences whereas the atomic spectra of hafnium (and its impurities) are mutually confirmed. Such a comparison between hafnium iodide and hafnium bromide spectra was made between 2000 and 6500 Å, but, because many very intense bromine lines appear in the red and near infrared, a lamp containing hafnium chloride was used in these regions to confirm hafnium spectra emitted by the hafnium iodide lamp. Among the three hafnium halides, hafnium iodide was the easiest to prepare and its hafnium spectra were more intense and less blended with halogen lines because iodine emits no strong lines between 2062 and 4100 Å.

These lamps were excited with a commercial diathermy unit of 125 w power and 2,450 mc frequency, and were observed end on. The spectra above 2000 Å were dispersed by 22 ft radius concave

diffraction gratings in Wadsworth stigmatic mountings. Two 6-in. gratings were used, one ruled 15,000 and the other 30,000 lines per inch. The spectrographs and photographic plates employed in recording hafnium spectra have been described [10] in a paper on the spectra of rhenium. When the hafnium spectrograms were made no effective way of varying the excitation of the metal halide lamps was available to distinguish Hf I from Hf II lines. Therefore, on each spectrogram a series of exposures was made of successive increments of slit illuminated by the d-c arc in air, the high-voltage condensed spark in air, the spectrum of the hafnium halide lamp, and the arc spectrum of iron. The last provided international standards of wavelength for measurements of hafnium lines by interpolation and the others permitted the assignment of all hafnium lines to the proper atom or ion. It was observed that the hafnium halide lamp emitted Hf I lines with the greatest intensity, sharpness, and number, but it also gave with lower intensity but equal sharpness practically all of the Hf II lines, which usually appear as broad, hazy, or unsymmetrical lines in the spark. Because the metal

halide lamps operate at a much lower pressure and temperature than the conventional arcs and sparks they emit sharper lines, and one should apologize for measuring their wavelengths relative to the international standards obtained from an iron arc at atmospheric pressure.

Below 2000 Å a normal incidence vacuum spectrograph containing a 2-m radius glass grating ruled with 30,000 lines per inch was used to photograph hafnium vacuum arc and spark spectra with reciprocal dispersion of 4.2 Å/mm.

In addition to wavelengths and relative intensities of lines in different light sources, it is desirable, for an improved description of hafnium spectra, to observe the Zeeman effect on as many lines as possible. Back and Landé [11] have shown that only 6 types of resolved Zeeman patterns exist, 3 for even multiplicities and 3 for odd. A 7th type has a single undisplaced *p* component and two symmetrically displaced *n* components; it is generally characteristic of singlet terms or other transitions between levels with equal *g* values. These 7 types have all been observed in hafnium spectra; typical patterns are reproduced in figures 1 and 2 where types 1, 2, 3 are uniquely characteristic of Hf I, and 4, 5, 6 of Hf II. This sorting of Hf I and Hf II on the basis of Zeeman types was in perfect agreement with the separation of these spectra according to relative intensities in different light sources.

Besides of great value for sorting spectra, resolved Zeeman patterns are almost indispensable for the quantum interpretation because the quantum numbers (*j*) associated with the total angular momentum of the radiating atom are given directly by the number of components, and the intervals between neighboring components equal the difference between the magnetic splitting factors (*g*) of the combining levels. The first observations of Zeeman-effect in hafnium spectra have already been mentioned [6]; they greatly facilitated the analysis of Hf II, but were inadequate for an extensive analysis of Hf I because they were made with a spark operated in a 6-mm pole gap of a Weiss magnet producing a field intensity of 35,000 oersteds. In August 1949 greatly improved Zeeman spectrograms were obtained by courtesy of G. R. Harrison of the Massachusetts Institute of Technology, by using an arc in a magnetic field of 83,000 oersteds produced by the Bitter magnet [12]. The gratings available at MIT also had 2 or 3 times the resolving power of the one employed at the Bureau, but the MIT gratings had very low efficiency for waves longer than

about 5000 Å. The MIT Zeeman spectrograms of hafnium were therefore supplemented from 5000 to 9000 Å by recent observations at the Bureau with a hafnium-iodide lamp in a magnetic field of 37,000 oersteds. The patterns reproduced in figures 1 and 2 were taken from these spectrograms.

The results of the final effort to provide an improved description of hafnium spectra are presented in table 1, where measured wavelengths, estimated relative intensities in arc, spark, and tube spectra, assignment of individual lines to successive spectra, and Zeeman types are shown in successive columns. Notation in the table conforms to the report of Subcommittee *e* of the Joint Commission for Spectroscopy [13]. Further details of the Zeeman effect are reserved for reports on the quantum interpretation of Hf I and Hf II; in the present paper the Zeeman-type numbers suffice to confirm the assignment of particular lines to their proper spectrum as inferred from relative intensities in different light sources.

The generous donations by C. P. Keim and by S. M. Shelton of massive metallic electrodes of hafnium for our investigations of hafnium spectra are gratefully acknowledged by the authors. Also we thank G. R. Harrison for letting us use the excellent equipment at MIT for observing the Zeeman effect.

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TABLE 1. *Emission spectra of hafnium*

Wavelength in vacuum	Intensity		Spectrum	Wavelength in vacuum	Intensity		Spectrum
	Arc	Spark			Arc	Spark	
<i>A</i>							
1284. 88	-----	1	-----	1628. 90	8	18	II
1305. 24	-----	15e	IV	1630. 07	-----	3	-----
1337. 08	-----	3	-----	1630. 83	5	15	II
1357. 40	-----	12e	IV	1631. 58	-----	1	IV
1366. 34	-----	3	-----	1633. 64	-----	2	IV
1386. 69 ^a	-----	5	III	1633. 82	-----	1	IV
1390. 39	-----	40	IV	1634. 70	-----	1	IV
1396. 66	-----	3	IV	1638. 51	-----	1	IV
1400. 12	-----	1	IV	1638. 66	-----	1h	IV
1407. 18	-----	2	IV	1640. 41	-----	4h	IV
1408. 39	-----	2	IV	1641. 38	-----	1	-----
1412. 23	-----	1	IV	1641. 91	-----	5	-----
1413. 53	-----	2	IV	1642. 36	-----	2	-----
1433. 44	-----	2	IV	1644. 22	-----	4	-----
1437. 29	-----	4	IV	1647. 40	-----	1	IV
1437. 76	-----	8e	IV	1649. 87	1	2	II
1445. 42	-----	4	IV	1652. 75	1	10	III
1449. 83	3	20	III	1658. 59	-----	1	IV
1457. 17	-----	1	-----	1659. 65	-----	1	-----
1457. 95	-----	3	IV	1660. 64	-----	4	IV
1462. 81	-----	4	-----	1661. 64	-----	1	-----
1487. 50	-----	4	-----	1662. 55	-----	4	III
1491. 67	1	50e	IV	1663. 29	-----	1	-----
1495. 73	-----	1	II	1664. 77	-----	4	-----
1497. 42	-----	1	-----	1666. 86	-----	1	IV
1507. 82	15e	30	III	1667. 85	-----	1	-----
1508. 52	-----	1	-----	1672. 58	-----	1	IV
1520. 13	-----	2	-----	1673. 38	5	5	II
1526. 63	-----	1	-----	1674. 37	10	10	II
1528. 82	-----	35e	IV	1679. 62	6	8	II
1530. 51	1	12	III	1683. 95	20	50	III
1541. 26	-----	1	-----	1691. 18	-----	1	II
1542. 04	3	10	II	1692. 53	-----	2	-----
1546. 45	2	3	II	1693. 34	7	18	III
1548. 19	-----	12	IV	1698. 01	-----	1	IV
1550. 78	-----	8	IV	1698. 50	-----	1	-----
1555. 68	1	3	II	1700. 19	1	12	III
1557. 00	-----	1	IV	1711. 86	-----	6	-----
1560. 18	-----	15e	IV	1716. 24	7	10	II
1561. 07	-----	2	-----	1717. 21	2	100	IV
1567. 27	8	10	II	1718. 57	-----	20	IV
1572. 03	-----	25e	IV	1719. 33	-----	1	IV
1577. 07	-----	5	-----	1720. 12	1	5	III
1585. 99	-----	1	-----	1720. 32	2	10	III
1592. 99	5	8	II	1722. 70	1	8	III
1593. 45	-----	2	-----	1728. 03	3	3	II
1596. 54	-----	5	III	1729. 11	-----	3	IV
1601. 02	-----	6	III	1731. 84	-----	4	IV
1603. 98	-----	2	IV	1733. 90	-----	2	II
1604. 49	-----	1	IV	1733. 97	-----	6	IV
1606. 70	-----	12	III	1735. 16	1	15	III
1614. 17	2	3	II	1738. 32	1	10	III
1617. 80	-----	1	IV	1738. 74	1	6	III
1618. 27	-----	4	-----	1739. 60	1	8	III
1619. 31	-----	1h	-----	1741. 75	-----	2	IV
1621. 32	-----	1h	-----	1746. 80	-----	5	III
1623. 03	6	15	II	1747. 17	4	10	III
1626. 76	-----	1	-----	1749. 12	-----	10e	IV
1627. 61	-----	1	-----	1750. 20	-----	10e	IV
1628. 04	-----	1	-----	1756. 91	25e	50	III

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in vacuum	Intensity		Spectrum	Wavelength in vacuum	Intensity		Spectrum
	Arc	Spark			Arc	Spark	
<i>A</i>							
1759. 87	-----	1	-----	1875. 81	-----	6	III
1760. 92	-----	3	IV	1877. 74	6	15	III
1761. 27	-----	1	IV	1879. 26	1	1	II
1764. 63	1	2	III	1879. 77	-----	1	---
1764. 90	-----	3	-----	1883. 34	-----	5	III
1765. 23	-----	3	-----	1885. 15	50	150	III
1765. 64	-----	2	IV	1885. 21	1	3	III
1770. 22	-----	4	III	1888. 21	8	20	III
1772. 63	1	2	II	1888. 90	2	10	III
1774. 05	-----	1	-----	1889. 42	30	80	III
1774. 47	-----	1	-----	1892. 30	-----	1	II
1774. 76	20	12	II	1893. 86	-----	1	---
1775. 36	1	2	-----	1897. 49	3	4	II
1779. 60	-----	1	-----	1900. 85	18	25	III
1782. 66	-----	1	IV	1901. 39	8	8	II
1783. 27	-----	1	IV	1903. 10	-----	1	---
1784. 40	-----	2	-----	1904. 26	2	12	III
1784. 58	-----	3	-----	1905. 61	10	15	III
1785. 22	25	25	III	1909. 18	-----	3	---
1786. 96	-----	4	III	1909. 45	2	4	II
1788. 35	-----	6h	III	1910. 21	-----	4	---
1790. 09	-----	1	II	1912. 99	1	10	III
1791. 48	-----	1	-----	1913. 47	-----	2	---
1792. 27	-----	7	III	1916. 69	25	60	III
1793. 17	3	8	II	1917. 73	3	-----	I
1793. 43	1	10	III	1919. 52	15	30	II
1793. 84	-----	1	IV	1922. 13	12	15	II
1797. 01	20	20	III	1922. 74	20	25	II
1801. 28	-----	2	-----	1927. 52	-----	1	---
1805. 66	-----	4	III	1928. 12	12	30	III
1813. 64	2	15	III	1929. 78	-----	1	IV
1815. 65	10	18	II	1931. 65	20	40	III
1815. 98	3	4	II	1934. 00	1	12	III
1816. 20	4	5	II	1935. 50	-----	1	---
1819. 56	-----	4h	IV	1936. 39	-----	2	II
1823. 63	-----	2	IV	1937. 80	-----	7	III
1825. 31	3	5	II	1937. 92	1	1	II
1826. 03	20	35	III	1938. 33	1	8	III
1828. 36	-----	1	II	1939. 65	-----	1	---
1832. 97	-----	2	-----	1941. 98	-----	1	---
1835. 52	-----	1	-----	1942. 27	2	-----	I
1838. 79	3	18	III	1942. 74	-----	1	---
1839. 50	-----	2	-----	1943. 41	-----	1	---
1841. 51	-----	1	-----	1944. 32	3	3	II
1843. 64	40	60	III	1944. 91	-----	1	II
1847. 77	-----	3	-----	1947. 03	-----	1	---
1848. 47	-----	1	-----	1949. 32	1	6	III
1849. 19	-----	2	-----	1950. 81	2	8	III
1850. 64	1	-----	I	1952. 04	-----	1	IV
1852. 50	-----	3	-----	1952. 37	-----	1	---
1853. 97	2	9	III	1952. 77	4	20	III
1854. 23	-----	4	-----	1955. 68	12	18	II
1856. 33	5	40	III	1959. 73	3	3	II
1863. 04	1	5	III	1959. 89	-----	1	II
1869. 37	10	10	II	1961. 24	-----	1	---
1870. 58	30	60	III	1962. 49	4	3	II
1871. 70	-----	5	III	1963. 06	8e	50	III
1873. 54	-----	1	-----	1963. 82	12	5	II
1873. 71	2	1	II	1964. 26	20	15	II
1874. 81	20	50	III	1966. 59	-----	1	---

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in vacuum	Intensity		Spectrum	Wavelength in vacuum	Intensity		Spectrum
	Arc	Spark			Arc	Spark	
<i>A</i>					<i>A</i>		
1972. 81		1		1988. 22	1	6	
1974. 01	35	50	III	1989. 00	5		I III
1974. 21	18	25	III	1989. 61	2	10	III
1976. 19		1	IV	1991. 44	100	100	
1977. 61	2		I	1993. 01		1	
1979. 19	2d		I	1993. 15	5	4	II
1979. 72		1		1993. 58	1	1	
1980. 63	12	8	II	1993. 82	10	8	II
1982. 44	10	7	II	1996. 61	1	1	
1983. 24	3		I	1998. 04	40	40	II
1983. 75		3	III	1999. 21		1	III
1986. 38	1		I				

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>					<i>A</i>				
2000. 62		4			2041. 78	1	2		
2001. 78		1			2042. 14	3		I	
2002. 06	40	40	III		2043. 87	3	12	III	
2002. 72	1	4	III		2044. 96	1	3		
2003. 03		1			2047. 56	6	10	II	
2005. 37	3	3	II		2047. 84	1		I	
2006. 53		1			2051. 70	1	10h	III	
2007. 64	1	2			2053. 14		3		
2007. 77		2	II		2053. 54	2		I	
2011. 96		1	II		2054. 46	4	100		IV
2012. 78	30	15	II		2054. 87	2	1	II	
2013. 37	12	8	II		2055. 30	2		I	
2014. 06		7			2055. 35		4h	II	
2015. 69	10	8	II		2056. 16	1		I	
2016. 30	2	3	II		2057. 40	1	3	II	
2017. 21	1	1	I II		2058. 56		1	II	
2017. 90	1		I		2060. 48	4	9h	II	
2018. 81		2			2061. 48	4	8	II	
2020. 07	15	10	II		2063. 24	1	2	II	
2022. 13	4e	20	III		2064. 46	1	2	II	
2022. 59	2		I		2064. 79	10	12	II	
2024. 08		1			2065. 55		2h	II	
2024. 62		1			2065. 72	1		I	
2025. 02		1	II		2066. 20	1	2h	II	
2025. 37	7	10	II		2068. 59	3	5		
2025. 50		1	II		2068. 84	10	10H	II	
2028. 18	30	25	II		2070. 94		300	III	
2029. 03	1h	2h	II		2071. 48	3		I	
2029. 89	10	18	II		2072. 87	2		I	
2031. 68	1	1	II		2075. 95	3		I	
2035. 93		3			2076. 10		4H	II	
2036. 25	9	8	II		2076. 48	2		I	
2037. 32	1	1	II		2076. 72	1	3h	II	
2037. 76	60	100	III		2079. 12	1	1	II	
2039. 09	15	15	II		2079. 72	1	1	II	

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2082.80	5	6		II	2132.28	1	3	II	
2083.80	7	20		II	2133.36	1	2H	II	
2084.59	2	---	I	I	2134.53	3	15	II	
2085.19	2	---			2135.65	2	---	I	
2085.33	---	150h		III	2136.48	---	20h	III	
2086.30	3	5h		II	2137.20	2	3	II	
2086.80	1	2		II	2137.54	1	---	I	
2087.43	3	---	I		2138.57	3	---	I	
2087.67	3	---	I		2139.22	7	30	II	
2087.71	---	2h			2139.86	1	---	I	
2088.77	10	30		II	2139.93	---	5H	III	
2089.39	1	---	I		2141.82	4	10	II	
2089.56	2	---	I		2142.36	5	---	I	
2089.95	4	15		II	2144.16	2	5h	II	
2090.83	8	20		II	2144.71	1	---	I	
2093.22	2	---	I		2146.97	---	10	III	
2093.27	---	3h	---		2149.83	3	---	I	
2094.33	1	2h		II	2149.94	---	5H	III	
2094.54	3	---	I		2150.06	2	2	II	
2096.18	20	100		II	2150.17	2	---	I	
2097.35	---	3H		III	2150.27	3	---	I	
2099.30	---	200h		III	2150.34	---	8h	II	
2100.59	1	---	I		2151.67	5	---	I	
2102.80	---	50		III	2152.65	---	20h	III	
2104.92	---	40		III	2153.54	2	---	I	
2105.20	2	---	I		2154.21	3	---	I	
2106.20	---	40h		III	2154.66	2	4h	II	
2106.25	4	---	I		2155.66	---	200	III	
2107.47	7	20		II	2156.42	10	20	II	
2108.25	3	---	I		2158.10	4	---	I	
2108.56	2	---	I		2158.16	---	10H	III	
2108.61	---	4H		III	2159.57	2	---	I	
2108.98	3	---	I		2160.46	---	2H	---	
2110.31	---	200h		III	2161.57	4	---	I	
2110.42	5	10		II	2161.62	---	10H	III	
2111.24	1	---	I		2162.462	6	10	II	
2111.47	1	---	I		2162.95	3	---	I	
2111.84	1	---	I		2163.48	---	20	III	
2113.14	3d	---	I		2164.06	4	---	I	
2113.92	2	5H		II	2164.65	---	10h	III	
2115.02	5	10		II	2165.20	4	---	I	
2116.80	1	---	I		2168.81	---	6H	III	
2117.95	2	3h		II	2170.214	5	20	I	
2118.69	6	---	I		2171.88	3	---	II	
2119.12	---	40	---		2171.92	---	4h	II	
2119.59	2	---	I		2172.77	3	---	I	
2119.69	---	100h		III	2172.959	2	4	II	
2122.81	3	---	I		2173.422	5	10	II	
2122.94	3	10h		II	2174.327	---	80	III	
2123.32	1	---	I		2175.354	15	20	II	
2123.68	5	25		II	2175.76	2	---	I	
2124.58	10	50		II	2176.41	1	---	I	
2126.61	1	6H		III	2177.393	---	10	III	
2127.50	1	---	I		2178.511	---	20	III	
2128.17	2	---	I		2178.908	30	50	II	
2129.09	8	70		II	2180.23	---	3H	III	
2130.08	2	---	I		2181.95	2	4h	II	
2130.12	---	4h		II	2182.65	---	4h	III	
2130.98	4	---	I		2182.73	1	---	I	
2131.88	---	7H		III	2183.505	---	200	III	

TABLE 1. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2184.30	3	-----	I	II	2231.42	2	4h	II	---
2184.35	-----	10H	-----	II	2234.59	-----	200	III	---
2184.97	2	4	-----	---	2235.13	2	-----	I	---
2186.29	2	-----	I	---	2235.41	1	-----	I	---
2187.43	2	-----	I	---	2235.461	-----	10	III	---
2187.91	3	-----	I	---	2235.635	4	-----	I	---
2188.428	3	-----	I	---	2236.35	2	3H1	II	---
2188.72	1	-----	I	---	2239.85	2	3h	II	---
2188.87	4	10	II	---	2240.20	1	-----	I	---
2190.212	10	20	II	---	2241.34	-----	8h	III	---
2190.388	-----	30	III	---	2243.16	5	-----	I	---
2191.26	1	3h	II	---	2243.19	-----	15h1	II	---
2191.32	-----	2h	II	---	2244.24	2	-----	I	---
2191.78	6	8	II	---	2246.29	1	-----	I	---
2192.31	2	3	II	---	2246.62	-----	2h	III	---
2193.196	4	-----	I	---	2248.20	1	3h	II	---
2193.84	2	-----	I	---	2248.33	1	-----	I	---
2194.12	1	-----	I	---	2248.95	3	-----	I	---
2194.968	10	-----	I	---	2249.01	-----	5H	III	---
2195.435	-----	200	III	---	2249.85	3	7H	II	---
2195.52	3	-----	I	---	2251.85	3	6	II	---
2196.03	4	-----	I	---	2253.995	30	80	II	---
2196.404	5	7	II	---	2255.162	20	60	II	---
2199.58	3	5h	II	---	2257.894	4	10	II	---
2199.84	2	-----	I	---	2258.32	2	-----	I	---
2201.67	1	3h	II	---	2258.685	5	15	II	---
2202.18	2	-----	I	II	2260.25	2	-----	I	---
2202.97	1	2h	II	---	2261.54	2	-----	I	---
2203.40	1	-----	I	---	2262.015	5	-----	I	---
2204.17	4	-----	I	---	2262.20	1	-----	I	---
2204.63	2	-----	I	---	2263.37	2	2h	I	---
2206.09	6	-----	I	---	2264.847	-----	30h	III	---
2206.11	-----	10H	II	---	2266.521	10	15	II	---
2210.05	2	-----	I	---	2266.832	20	40	II	---
2210.84	2	2h	II	---	2267.35	2	3h	II	---
2211.32	2	-----	I	---	2267.582	2	-----	I	---
2211.86	2	3	II	---	2267.91	2	-----	I	---
2212.45	7	20	II	---	2268.686	4	-----	I	---
2213.54	-----	100	III	---	2268.92	1	-----	I	---
2214.675	2	-----	I	---	2269.483	3	-----	I	---
2214.86	-----	15	III	---	2269.86	4	-----	I	---
2217.67	1	2h	II	---	2269.91	-----	6h1	III	---
2218.36	1	7	II	---	2270.69	2	4	II	---
2218.45	1	-----	I	---	2271.14	2	2h	II	---
2219.45	1	-----	I	---	2271.453	5	-----	I	---
2219.50	-----	2h	II	---	2273.147	20	40	II	---
2219.60	1	-----	I	---	2273.92	3	-----	I	---
2220.48	2	-----	I	---	2274.18	1	-----	I	---
2220.55	-----	5h1	III	---	2274.545	2	-----	I	---
2221.59	1	-----	I	---	2274.64	4	15	II	---
2221.88	-----	10h	III	---	2275.26	1	-----	I	---
2223.35	1	2	II	---	2275.483	6	-----	I	---
2223.94	1	-----	I	---	2276.43	2	3h	II	---
2224.26	6	10H	II	---	2277.166	40	150	II	---
2224.30	-----	5	II	---	2279.195	4	-----	I	---
2225.352	5	6	II	---	2280.072	4	-----	I	---
2228.180	5	6	II	---	2281.683	5	-----	I	---
2228.45	3	3h	II	---	2281.82	1	3h	II	---
2228.772	3	5	II	---	2282.80	3	-----	I	---
2230.35	4	-----	I	---	2283.089	5	-----	I	---

TABLE 1. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type	
	Tube	Spark				Tube	Spark			
<i>A</i>										
2283. 555	---	40h			2339. 15	3	---	I	---	
2284. 60	10	20	II	III	2339. 66	1	20	II	III	
2285. 42	3	5h	II		2340. 39	3	6hl		---	
2288. 551	4	---	I		2340. 59	5	---	I	---	
2288. 630	2	3	II		2342. 06	1	---	I	---	
2289. 28	2	---	I		2342. 40	2	---	I	---	
2291. 06	2	---	I		2343. 320	30	70	II	7	
2291. 64	8	10	II		2344. 957	8	---	I	---	
2292. 34	1	2h	II		2345. 42	3	5	II	---	
2292. 77	2	3Hl	I		2345. 565	2	---	I	---	
2294. 88	1	---	I	II	2347. 444	40	100	II	6	
2296. 13	4	6h	II		2347. 88	1	---	I	---	
2297. 42	1	---	I		2349. 33	2	2h	II	---	
2297. 71	2	---	I		2349. 751	5	---	I	---	
2298. 336	9	20	II		2350. 48	2	---	I	---	
2298. 57	1	---	I		2351. 211	50	150	II	6	
2298. 80	1	3	II		2352. 04	8	---	I	---	
2299. 190	5	---	I		2352. 60	5	---	I	---	
2302. 116	1	3h	II		2353. 02	10	1	I	---	
2303. 22	1	2h	II		2353. 31	1	---	I	---	
2304. 343	6	---	I		2353. 506	1	---	I	---	
2304. 51	---	1h	II		2355. 38	5	---	I	---	
2305. 34	1	4	II		2355. 48	---	150h	III	---	
2306. 81	---	2	II		2355. 65	2	---	I	---	
2308. 04	2	---	I		2355. 78	3	---	I	---	
2308. 75	---	2	II		2356. 55	---	1h	II	---	
2310. 22	---	70h	III		2357. 05	3	---	I	---	
2310. 92	1	---	I		2358. 01	8	---	I	---	
2312. 82	2	---	I		2358. 90	10	---	I	---	
2313. 437	---	200h	III		2359. 08	2	---	I	---	
2315. 32	3	---	I		2359. 27	3	---	I	---	
2315. 93	4	---	I		2360. 29	5	2Hl	I	---	
2316. 48	4	15hl	II		2360. 29	5	2Hl	II	---	
2318. 49	3	6	II		2361. 290	1	---	I	---	
2319. 08	---	80	III		2362. 02	1	---	I	---	
2319. 21	4	---	I		2362. 34	4	5Hl	II	---	
2319. 54	3	---	I		2362. 394	7	10hl	II	---	
2320. 98	3	5	II		2362. 546	4	---	I	---	
2321. 153	15	40	II		2363. 23	8	---	I	---	
2322. 471	40	100	II		2363. 39	10	---	I	---	
2323. 253	20	50	II		2365. 45	1	---	I	---	
2324. 512	10	20	II		2365. 982	15	20	II	7	
2324. 885	20	50	II		2366. 365	9	---	I	---	
2326. 76	3	---	I		2366. 814	8	---	I	---	
2329. 09	1	2	II		2367. 20	1	---	I	---	
2330. 70	5	---	I		2367. 64	2	3	II	---	
2332. 18	1	1	II		2368. 48	10	10hl	II	---	
2332. 45	3	7	II		2370. 44	1	---	I	---	
2332. 960	20	30	II		4	2370. 92	2	---	I	---
2333. 79	1	3hl	II		2371. 41	8	15	II	---	
2334. 10	1	---	I		2371. 54	3	---	I	---	
2335. 24	1	2	II		2371. 92	6	4Hl	I	II?	
2335. 50	1	1	II		2372. 23	2	---	I	---	
2335. 772	9	---	I		2372. 348	7	10	II	---	
2336. 467	1	300	III		2373. 12	2	---	I	---	
2336. 693	9	---	I		2373. 296	1	100	III	---	
2337. 335	15	15	II		6	2373. 530	8	---	I	---
2337. 597	1	---	I		2374. 186	15	---	I	---	
2338. 245	5	8hl	II		2374. 516	2	---	I	---	
2338. 555	7	---	I		2375. 937	6	---	I	---	

TABLE 1. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2376. 46	1	-----	I		2410. 137	200	300	I	II
2377. 237	2	-----	I		2410. 97	3	-----	I	II
2377. 471	4	-----	I		2411. 14	2	3h	I	II
2377. 57	1	120	I	III	2411. 425	8	-----	I	---
2377. 98	3	-----	I		2411. 605	15	3	I	---
2378. 163	15	-----	I		2412. 036	4	5h	I	II
2378. 32	1	-----	I		2412. 261	2	-----	I	II
2378. 513	1	-----	I		2412. 51	7	-----	I	---
2378. 81	4	3h	I	II	2412. 622	6	-----	I	---
2378. 925	4	-----	I		2412. 85	4	-----	I	---
2379. 716	5	-----	I		2413. 348	20	60	I	II
2380. 305	50	100	I	II	2413. 871	4	-----	I	---
2381. 002	30	60	I	II	2414. 045	1	-----	I	---
2381. 51	1	1	I	II	2415. 11	2	4H1	I	II
2382. 047	2	3	I	II	2415. 59	3	-----	I	---
2382. 980	15	-----	I	III	2415. 72	5	-----	I	---
2383. 540	1	250	I	III	2415. 84	4	-----	I	---
2384. 467	15	-----	I	II	2415. 965	15	30	I	II
2385. 180	3	4H1	I	II	2416. 427	15	1	I	---
2385. 79	2	3	I	II	2416. 504	6	-----	I	---
2386. 014	1	-----	I	II	2416. 886	3	5H1	I	II
2386. 33	3	6H1	I	II	2417. 030	4	-----	I	---
2386. 562	2	-----	I		2417. 26	-----	20	I	III
2386. 70	1	-----	I		2417. 690	200	300	II	---
2387. 38	5	-----	I		2418. 074	2	-----	I	7
2387. 89	-----	6h	I	III	2418. 29	1	-----	I	---
2388. 50	2	-----	I		2418. 76	1	-----	I	---
2390. 20	4	-----	I		2419. 17	2	-----	I	---
2390. 794	8	-----	I		2419. 371	2	-----	I	---
2392. 008	3	4H1	I	II	2420. 08	1	-----	I	---
2393. 185	40	60	II		2420. 22	2	5h	I	II
2393. 37	80	100	II		2420. 554	2	-----	I	---
2393. 828	100	150	II		2420. 78	3	9h	I	II
2394. 973	2	-----	I	II	2422. 09	20	-----	I	---
2395. 625	2	3	II		2422. 856	4	5h	I	II
2396. 02	1	1	II		2423. 73	2	4h	I	II
2396. 98	4	-----	I		2424. 003	15	30h	I	II
2397. 21	2	-----	I		2424. 92	1	-----	I	II
2397. 565	10	-----	I		2425. 975	100	200	I	6
2397. 780	20	-----	I		2426. 52	5	-----	I	---
2398. 121	10	-----	I		2426. 804	9	-----	I	---
2399. 144	6	-----	I		2426. 86	7	20h	I	II
2399. 726	20	-----	I		2428. 740	30	-----	I	---
2400. 325	2	-----	I		2428. 993	50	200	I	II
2400. 804	30	80	II		2430. 144	20	3	I	5
2401. 31	2	2h	II		2430. 92	2	-----	I	---
2401. 522	1	-----	I		2431. 152	1	-----	I	---
2402. 02	4	10h	II		2431. 414	5	-----	I	---
2403. 12	8	-----	I		2432. 303	2	-----	I	---
2403. 296	4	-----	I		2432. 854	1	3h	I	---
2403. 606	10	20	II		2433. 216	2	-----	I	---
2404. 566	24	60	II		2433. 564	60	300	I	4
2405. 421	250	400	II		2433. 798	9	-----	I	---
2405. 679	3	-----	I		2433. 88	1	2	I	---
2406. 051	5	-----	I		2434. 266	2	-----	I	---
2406. 440	50	100	II		2434. 522	1	-----	I	---
2407. 132	9	-----	I		2434. 764	30	80	I	7
2407. 692	20	-----	I		2435. 472	3	-----	I	---
2409. 140	2	-----	I		2435. 767	2	-----	I	---
2409. 54	2	-----	I		2436. 16	7	10h	I	---

TABLE 1. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2437.00	2	3hl	II	----	2469.179	150	500	II	4
2437.79	3	----	I	----	2469.965	15	----	I	----
2438.316	5	----	I	----	2470.998	20	----	I	----
2438.535	9	----	I	----	2471.21	10	5Hl	I	II
2440.814	15	----	I	----	2471.77	6	6Hl	I	II
2441.05	20	40hl	II	----	2471.84	----	1h	II	----
2441.22	1	----	I	----	2471.92	7	----	I	II
2441.28	----	10	II	----	2472.54	6	3hl	I	II
2441.53	1	----	I	----	2472.89	1	----	I	----
2441.920	30	1	I	----	2473.00	1	----	I	----
2443.27	2	5hl	II	----	2473.736	4	----	I	----
2443.766	6	----	I	----	2473.908	50	200	II	4
2444.994	50	1	I	----	2474.089	15	30	II	----
2445.58	4	9Hl	II	----	2475.573	9	----	I	----
2446.248	2	----	I	----	2476.05	6	10hl	II	----
2446.731	7	3hl	I	II	2476.30	1	----	I	----
2447.251	200	500	II	----	2476.36	3	2h	I	II
2447.65	1	----	I	----	2476.92	3	4Hl	II	----
2448.216	----	15h	III	----	2478.542	20	50	II	5
2448.624	1	----	I	----	2479.076	3	----	I	----
2449.053	6	----	I	II	2479.428	20	----	I	----
2449.440	80	200	II	----	2479.76	1	----	I	----
2450.05	4	5hl	II	----	2480.57	1	----	I	----
2450.080	10	----	I	----	2481.436	30	100	II	5
2450.66	1	----	I	----	2481.96	3	3h	II	----
2451.885	20	----	I	II	2482.010	20	----	I	----
2452.296	20	40	II	----	2482.518	3	5	II	----
2452.474	----	80	III	----	2482.647	40	2	I	----
2453.013	30	----	I	II	2482.934	15	----	I	----
2453.336	60	300	II	----	2483.346	50	80	II	5
2453.990	20	60	II	----	2484.990	10	----	I	----
2455.200	10	20	II	----	2485.354	3	----	I	----
2455.711	1	----	I	----	2485.555	20	----	I	----
2456.061	30	----	I	----	2485.83	3	8Hl	II	----
2456.31	1	----	I	----	2486.09	3	4hl	II	----
2456.65	8	10Hl	II	----	2487.153	60	2	I	----
2456.957	4	----	I	----	2487.90	3	3Hl	II	----
2457.871	15	----	I	----	2488.14	4	----	I	----
2458.653	30	----	I	----	2488.867	6	----	I	----
2459.470	15	20	II	----	2489.236	15	----	I	----
2460.493	200	500	II	----	2489.892	2	----	I	----
2461.12	1	----	I	----	2490.237	3	4h	II	----
2461.602	3	----	I	----	2490.650	2	----	I	II
2461.74	----	400	III	----	2490.89	9	30Hl	I	II
2462.76	9	10Hl	II	----	2491.058	3	----	I	----
2462.926	4	----	I	----	2491.156	2	----	I	----
2463.378	3	----	I	----	2491.64	1	----	I	----
2463.547	6	----	I	----	2491.871	2	----	I	----
2463.725	3	----	I	----	2492.919	3	3h	I	II
2463.933	40	100	II	----	2493.06	5	----	I	----
2464.193	200	600	II	7	2493.25	----	3h	II	----
2464.83	1	----	I	----	2493.61	1	----	I	II
2465.059	50	150	II	----	2494.364	30	40Hl	I	6
2465.46	1	----	I	----	2494.74	2	----	I	----
2465.676	30	1	I	----	2495.16	5	2000	III	----
2466.464	8	----	I	----	2495.675	1	----	I	----
2466.665	10	----	I	----	2496.058	40	1	I	----
2467.518	6	----	I	----	2496.818	30	----	I	----
2467.966	60	100	II	5	2496.991	100	500	II	5
2468.378	15	----	I	----	2497.730	8	----	I	----

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
2497. 914	3	-----	I	-----	2529. 14	1	-----	I	-----
2498. 168	1	-----	I	-----	2529. 554	3	-----	I	-----
2498. 56	10	10hl	II	-----	2529. 78	10	20H _I	II	7
2498. 70	2	5	II	-----	2531. 196	200	1000	II	5
2499. 32	1	-----	I	-----	2531. 73	2	-----	I	-----
2499. 825	20	-----	I	-----	2531. 94	3	-----	I	-----
2500. 096	2	-----	I	-----	2532. 12	5	3H _I	I	II
2500. 178	1	-----	I	-----	2532. 578	30	1	I	-----
2500. 739	30	500	II	4	2532. 94	30	-----	I	-----
2501. 130	20	-----	I	-----	2532. 972	20	30	II	5
2501. 234	10	-----	I	-----	2533. 60	3	-----	I	-----
2501. 32	4	-----	I	-----	2533. 926	1	-----	I	-----
2501. 36	3	5hl	II	-----	2534. 29	2	-----	I	-----
2501. 702	1	-----	I	-----	2534. 33	2	100	III	-----
2502. 25	2	-----	I	-----	2534. 774	8	-----	I	-----
2502. 663	50	-----	I	-----	2535. 045	10	-----	I	-----
2502. 97	2	-----	I	-----	2535. 526	2	-----	I	-----
2503. 28	1	-----	I	-----	2537. 115	10	-----	I	-----
2503. 83	3	4H _I	II	-----	2537. 337	50	400	II	4
2504. 13	3	4H _I	II	-----	2538. 266	2	-----	I	-----
2505. 18	10	15hl	II	-----	2539. 00	1	-----	I	-----
2506. 21	5	10H _I	II	-----	2540. 338	3	-----	I	-----
2506. 25	10	15H _I	II	-----	2540. 73	1	2hl	I	II
2506. 535	9	-----	I	-----	2540. 815	3	-----	I	-----
2507. 42	3	3hl	II	-----	2541. 062	2	2hl	I	II
2508. 038	2	-----	I	-----	2541. 195	2	2h	I	II
2509. 790	2	-----	I	-----	2542. 12	6	-----	I	-----
2509. 892	3	-----	I	-----	2543. 12	8	15H _I	I	II
2510. 38	10	20	II	5	2543. 92	5	9H _I	I	II
2510. 76	3	-----	I	-----	2544. 62	2	-----	I	-----
2511. 36	5	-----	I	-----	2544. 664	2	2H _I	II	-----
2512. 702	200	800	II	5	2544. 82	2	2H _I	II	-----
2512. 963	100	300	II	-----	2544. 87	3	-----	I	-----
2513. 033	200	1000	II	7	2545. 330	60	1	I	-----
2515. 16	3	1000	III	-----	2545. 98	2	-----	I	-----
2515. 486	50	400	II	4	2547. 802	3	-----	I	-----
2516. 886	300	2000	II	7	2548. 187	50	300	I	II
2517. 52	15	-----	I	-----	2548. 528	10	10	I	II
2517. 858	30	-----	I	7	2548. 971	6	10	I	II
2518. 36	1	-----	I	-----	2549. 141	8	15	I	II
2518. 59	3	3hl	II	-----	2549. 53	1	-----	I	-----
2519. 46	2	2hl	II	-----	2549. 93	1	-----	I	-----
2520. 41	8	-----	I	-----	2550. 46	1	-----	I	-----
2520. 425	20	30H _I	II	-----	2550. 73	2	-----	I	-----
2521. 486	40	100	II	5	2551. 38	80	500	II	7
2521. 695	10	-----	I	-----	2551. 428	40	300	II	4
2522. 220	3	-----	I	-----	2551. 848	20	30	II	5
2522. 749	1	-----	I	-----	2552. 36	-----	50h	III	-----
2522. 85	3	-----	I	-----	2552. 66	2	-----	I	-----
2523. 552	2	-----	I	-----	2553. 402	10	-----	I	-----
2523. 648	-----	70h	III	-----	2553. 71	3	3hl	II	-----
2523. 79	3	-----	I	-----	2553. 89	2	-----	I	-----
2523. 901	3	5h	II	-----	2554. 31	1	-----	I	-----
2524. 64	20	-----	I	-----	2554. 502	1	2	II	-----
2525. 32	20	30H _I	II	-----	2554. 502	1	2	II	-----
2526. 236	4	-----	I	-----	2555. 05	10	-----	I	-----
2526. 33	2	10H _I	II	-----	2555. 08	4	5h	II	-----
2527. 43	3	-----	I	-----	2555. 32	2	8H _I	II	-----
2527. 87	10	-----	I	-----	2556. 39	5	8H _I	II	-----
2528. 25	2	4H _I	II	-----	2556. 924	20	2hl	I	II

TABLE 1. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2557. 41	2	-----	I	-----	2586. 118	30	-----	I	-----
2558. 21	6	-----	I	-----	2586. 72	3	-----	I	-----
2559. 018	60	2	I	II	2586. 80	2	2h	I	II
2559. 20	80	500			2587. 49	2	-----	I	-----
2559. 834	2	-----	I	-----	2587. 53	1	5hl	I	-----
2560. 372	1	-----	I	III	2587. 674	1	-----	I	-----
2560. 74	-----	400h			2588. 536	4	-----	I	-----
2561. 30	20	-----	I		2588. 668	3	-----	I	-----
2561. 82	7	10hl			2589. 472	15	-----	I	-----
2562. 448	2	-----	I	-----	2589. 776	5	-----	I	-----
2562. 80	10	20hl	II	-----	2589. 842	10	-----	I	-----
2563. 613	100	400	II	6	2590. 277	2	2h	II	-----
2564. 386	6	-----	I	II	2591. 329	100	300	II	5
2564. 844	2	4hl			2592. 162	10	-----	I	-----
2565. 194	15	-----	I	-----	2593. 334	1	1h	II	-----
2565. 238	4	6	II	-----	2593. 420	3	30	II	-----
2565. 90	8	-----	I	-----	2593. 458	5	-----	I	-----
2566. 244	10	-----	I	-----	2594. 131	50	2	I	-----
2566. 351	8	-----	I	-----	2595. 584	10	50	II	6
2566. 635	15	30Hl	II	-----	2595. 807	3	-----	I	-----
2567. 05	2	-----	I	-----	2596. 35	7	8Hl	II	-----
2567. 288	7	-----	I	-----	2596. 67	6	8hl	II	-----
2567. 418	20	-----	I	III	2597. 522	2	-----	I	-----
2567. 46	2	300h			2597. 811	15	-----	I	-----
2567. 950	15	-----	I		2598. 432	2	-----	I	-----
2568. 69	2	-----	I	-----	2598. 804	1	-----	I	II
2569. 860	20	-----	I	-----	2599. 197	30	200	II	4
2570. 395	8	-----	I	-----	2599. 39	3	-----	I	-----
2570. 701	30	100	II	6	2600. 230	2	-----	I	-----
2571. 118	10	10Hl	II	-----	2600. 736	2	-----	I	-----
2571. 678	300	2000	II	6	2601. 295	3	3h	II	-----
2572. 24	2	-----	I	-----	2601. 842	8	-----	I	-----
2572. 42	2	2	II	-----	2602. 663	60	3	I	-----
2572. 775	30	-----	I	-----	2602. 863	30	2	I	-----
2572. 937	15	40	II	4	2603. 404	2	-----	I	-----
2573. 912	150	1000	II	6	2603. 555	8	-----	I	-----
2574. 28	10	30	II	-----	2603. 92	3	-----	I	-----
2574. 896	50	2	I	3	2606. 018	20	-----	I	-----
2575. 483	15	30Hl	II	7	2606. 375	200	1500	II	4
2576. 410	2	-----	I	-----	2607. 032	250	2000	II	6
2576. 830	150	800	II	5	2607. 246	50	200	II	5
2577. 55	2	4hl	II	-----	2608. 450	60	5	I	3
2578. 155	150	600	II	6	2608. 628	30	1	I	-----
2579. 07	8	10Hl	II	-----	2609. 13	2	-----	I	-----
2579. 752	1	-----	I	-----	2609. 274	6	20h	II	-----
2580. 08	7	6Hl	II	-----	2609. 559	1	-----	I	-----
2580. 820	20	-----	I	-----	2609. 713	2	-----	I	-----
2581. 21	2	2h	II	-----	2609. 959	40	4	I	-----
2581. 688	2	2h	II	-----	2610. 742	2	-----	I	-----
2581. 924	3	-----	I	-----	2610. 940	3	4hl	II	-----
2582. 508	200	700	II	6	2611. 340	30	1	I	-----
2582. 786	10	-----	I	III	2611. 617	3	-----	I	-----
2582. 89	1	30h			2612. 585	40	1	I	7
2582. 982	3	-----	I		2613. 604	200	1500	II	6
2584. 06	2	2h	II	-----	2614. 294	20	100	II	5
2584. 411	2	-----	I	-----	2614. 664	2	2h	II	-----
2585. 068	1	-----	I	-----	2616. 164	1	2hl	II	-----
2585. 268	1	-----	I	-----	2616. 606	80	8	I	1
2585. 552	2	-----	I	-----	2617. 048	4	-----	I	-----
2585. 697	2	-----	I	-----	2617. 15	3	-----	I	-----

TABLE I.—*Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2617. 649	2	3hl	II	----	2649. 440	4	----	I	----
2617. 804	5	----	I	----	2649. 864	3	----	I	----
2618. 424	2	----	I	----	2650. 022	2	----	I	----
2619. 46	2	----	I	----	2650. 28	----	50	I	III
2620. 33	1	----	I	----	2650. 737	1	----	I	----
2620. 466	3	----	I	----	2651. 166	100	300	II	7
2620. 590	20	2	I	----	2651. 785	3	----	I	II
2620. 772	10	----	I	----	2652. 330	6	20	I	6
2620. 930	9	25	II	6	2652. 781	50	1	I	----
2621. 781	15	20hl	II	7	2653. 040	2	4Hl	II	----
2622. 739	400	2000	II	5	2653. 826	30	1	I	----
2623. 318	40	1	I	----	2654. 30	1	----	I	----
2623. 665	4	----	I	----	2654. 35	1	1hl	II	----
2623. 906	3	----	I	----	2655. 03	3	2h	I	----
2624. 308	2	----	I	----	2655. 394	4	5	II	----
2624. 576	5	----	I	----	2655. 657	3	----	I	----
2624. 79	60	5Hl	I	II	2655. 68	----	2h	II	----
2625. 533	20	40	II	6	2656. 95	2	----	I	----
2626. 081	1	----	I	----	2657. 487	50	100	II	4
2626. 948	50	100	II	6	2657. 847	100	200	II	5
2627. 720	1	----	I	----	2659. 130	5	----	I	----
2627. 805	1	1h	II	----	2659. 25	5	5h	II	----
2628. 353	1	----	I	----	2659. 704	----	60	II	----
2629. 490	10	10hl	II	----	2660. 523	3	3h	III	----
2629. 756	3	----	I	----	2661. 15	20	----	I	----
2629. 983	8	----	I	II	2661. 883	200	500	II	5
2630. 168	9	15h	II	----	2662. 396	15	----	I	----
2630. 34	2	----	I	----	2662. 994	30	----	I	----
2630. 907	100	3	I	----	2663. 572	3	----	I	----
2631. 518	1	2	II	----	2663. 717	10	----	I	----
2632. 017	6	20h	II	----	2664. 02	6	2h	I	II
2632. 737	1	----	I	----	2664. 583	1	----	I	----
2633. 42	2d	----	I	----	2664. 786	5	----	I	----
2633. 504	2	----	I	----	2665. 051	9	----	I	----
2634. 248	30	----	I	----	2665. 974	100	300	II	7
2634. 425	20	----	I	----	2666. 93	4	3h	II	----
2635. 104	3	----	I	----	2667. 12	2	3h	II	----
2635. 570	40	1	I	----	2667. 514	20	20hl	II	----
2635. 780	60	300	II	5	2668. 290	90	6	I	1
2636. 686	4	----	I	----	2669. 003	80	200	II	6
2636. 997	50	5	I	----	2669. 558	8	20	II	----
2637. 510	2	----	I	----	2669. 924	2	----	I	----
2637. 853	15	----	I	----	2670. 305	3	3	II	----
2638. 712	200	400	II	7	2670. 638	1	----	I	----
2638. 975	-----	80	III	----	2670. 76	2	----	I	----
2639. 183	40	----	I	----	2670. 895	6	----	I	----
2639. 960	3	----	I	----	2671. 022	2	----	I	----
2640. 121	1	----	I	----	2671. 24	30	100	II	6
2640. 829	4	----	I	----	2671. 721	40	1	I	----
2641. 410	300	1000	II	4	2672. 122	3	----	I	----
2642. 076	60	2	I	2	2672. 454	1	----	I	----
2642. 751	80	6	I	2	2673. 007	9	----	I	----
2643. 886	4	----	I	----	2673. 060	5	----	I	----
2643. 999	15	1	I	----	2673. 191	2	----	I	----
2644. 443	4	5Hl	II	----	2673. 542	1	----	I	----
2645. 262	20	1	I	----	2673. 78	1	----	I	----
2647. 294	200	600	II	6	2674. 50	1	4Hl	I	U
2648. 045	5	5hl	II	----	2674. 80	5	----	I	----
2649. 136	30	100	II	5	2675. 250	10	2h	I	----
2649. 397	2	----	I	----	2675. 47	8	----	I	----

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2675.957	30	-----	I	-----	2706.734	70	400	II	5
2676.27	1	-----	I	-----	2707.87	8	-----	I	-----
2676.426	3	-----	I	-----	2708.154	1	-----	I	-----
2676.612	20	100	II	4	2708.652	2	-----	I	-----
2677.558	15	30	II	5	2709.166	2	-----	I	-----
2677.914	2	-----	I	-----	2709.702	3	-----	I	-----
2677.99	1	-----	I	-----	2709.963	10	20H1	II	-----
2678.403	20	100	II	7	2710.63	4	8H1	II	-----
2678.925	2	-----	I	-----	2711.17	2	-----	I	-----
2679.40	2	-----	I	-----	2711.595	5	-----	I	-----
2679.761	2	-----	I	-----	2711.823	40	5	I	-----
2679.840	2	2h	I	II	2711.93	10	40	II	-----
2680.592	1	-----	I	II	2712.00	20	40	II	-----
2680.770	2	2h	I	II	2712.14	10	60	II	-----
2681.72	4	-----	I	-----	2712.424	50	500	II	7
2682.180	40	1	I	-----	2712.96	1	-----	I	-----
2683.269	80	-----	I	-----	2713.49	6	15h	II	7
2683.350	200	1000	II	6	2713.837	50	5	I	3
2684.008	10	20	II	6	2714.06	15	1	I	-----
2685.209	50	200	II	7	2714.56	2	3hl	II	-----
2685.701	4d	-----	I	-----	2715.423	3	-----	I	-----
2685.72	3	-----	II	-----	2716.55	1	-----	I	-----
2686.360	20	1	I	-----	2716.87	7	-----	I	-----
2686.547	6	-----	I	-----	2717.36	1	-----	I	-----
2686.88	2	-----	I	-----	2717.54	1	-----	I	-----
2687.220	-----	200	III	-----	2717.87	6	20H1	II	-----
2687.846	5	-----		-----	2718.445	30	4	I	-----
2688.360	50	2		-----	2718.496	10	200	II	7
2688.980	6	-----		-----	2718.593	50	10	I	3
2689.322	3	-----		-----	2719.755	10	-----	I	-----
2690.319	7	-----	I	-----	2720.91	1	-----	I	-----
2690.656	1	-----	I	-----	2721.160	3	7H1	II	-----
2690.715	-----	4H	II	-----	2721.462	2	-----	I	-----
2691.04	1	-----		I	2721.90	8	-----	I	-----
2693.082	2	-----		I	2722.893	4	-----	I	-----
2693.80	2	-----		-----	2723.58	1	2h	II	-----
2694.058	3	-----	I	-----	2723.99	2	10H1	II	-----
2694.460	1	-----	I	-----	2726.70	60	7	I	3
2694.76	2	-----	I	-----	2726.972	5	-----	I	-----
2696.180	80	10	I	1	2727.17	5	20hl	II	-----
2696.552	8	-----	I	-----	2727.644	1	-----	I	-----
2696.77	2	-----	I	-----	2727.797	1	-----	I	-----
2697.157	1	-----	I	-----	2728.10	1	-----	I	-----
2697.70	9	-----	I	-----	2728.22	2	3H1	II	-----
2698.054	2	-----	I	-----	2729.098	40	5	I	2
2698.314	2	-----	I	-----	2729.376	7	-----	I	-----
2698.82	1	-----	I	-----	2729.44	2	4hl	II	-----
2699.632	70	10	I	7	2729.88	1	-----	I	-----
2700.12	1	-----	I	-----	2730.13	2	-----	I	-----
2700.834	3	-----	I	-----	2730.700	50	5	I	2
2701.43	1	-----	I	-----	2730.86	60	6	I	-----
2701.545	2	-----	I	II	2731.154	10	60	I	4
2702.004	3	-----	I	-----	2732.146	4	-----	I	-----
2702.37	1	-----	I	-----	2732.662	10	40h	II	4
2702.507	5	10H1	II	-----	2732.882	15	100hl	II	-----
2703.163	10	30	II	4	2733.310	2	-----	I	-----
2704.34	2	-----	I	-----	2735.099	10	30	I	4
2704.554	15	-----	I	-----	2735.638	2	-----	I	-----
2705.612	100	20	I	2	2735.740	3	5H1	II	7
2706.645	40	200	II	-----	2736.024	20	1	I	-----

TABLE 1. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2737.150	2	----	I	---	2770.94	1	----	I	-----
2737.816	50	3	I	7	2771.328	3	----	I	-----
2738.759	300	1000	II	4	2772.335	40	200	II	6
2740.357	10	50H1	II	6	2773.021	60	10	I	-----
2741.067	3	----	I	---	2773.360	300	2000	II	4
2741.46	1	----	I	---	2773.500	30	300	II	-----
2742.091	20	1	I	---	2774.018	100	400	II	5
2742.56	2	2	II	---	2775.268	40	100	II	4
2742.633	7	----	I	---	2776.26	3	----	I	-----
2743.637	100	20	I	3	2776.62	2	----	I	-----
2744.23	1	----	I	---	2776.93	2	2H1	II	-----
2744.51	1	----	I	---	2777.281	3	7H1	II	-----
2745.095	1	----	I	---	2778.20	2	6H1	II	-----
2746.163	1	----	I	---	2778.40	1	----	I	-----
2746.606	40	2	I	---	2778.884	4	----	I	-----
2746.940	2	----	I	---	2779.370	150	30	I	1
2748.111	1	----	I	---	2780.938	2	----	I	-----
2748.338	2	----	I	---	2781.421	2	----	I	-----
2748.445	3	3h	II	---	2781.53	2	----	I	-----
2748.68	2	7h	II	---	2782.465	15	----	I	-----
2749.49	2	----	I	---	2783.698	60	10	I	3
2749.51	1	2h1	II	---	2784.10	1	----	I	-----
2750.252	1	----	I	---	2784.457	3	10h	I	II
2750.677	1	----	I	---	2785.874	2	----	I	-----
2750.89	1	----	I	---	2786.314	20	200	I	5
2751.194	2	15h1	II	---	2787.211	10	----	I	-----
2751.243	5	----	I	---	2787.922	3	10h	I	II
2751.814	150	500	II	5	2788.42	1	----	I	-----
2752.53	3	----	I	---	2788.460	3	----	I	-----
2752.58	1	4H1	II	---	2789.496	100	400	I	7
2753.60	1	500	III	---	2789.714	200	700	II	5
2753.83	3	----	I	---	2789.825	40	100	II	-----
2754.219	2	----	I	---	2790.436	5	10h1	II	-----
2754.368	1	----	I	---	2791.338	3	----	I	-----
2754.552	1	----	I	---	2791.73	1	----	I	-----
2755.666	2	----	I	---	2792.309	3	----	I	-----
2755.991	10	----	I	---	2792.659	3	----	I	-----
2756.918	60	200	II	6	2792.800	3	20h1	II	5
2757.633	2	----	I	---	2793.61	2	7H1	II	-----
2757.72	1	----	I	---	2793.762	5	----	I	-----
2758.314	40	5	I	---	2794.10	1	1	II	-----
2758.771	80	10	I	2	2794.703	10	----	I	II
2759.08	1	6h1	II	---	2795.093	3	2H1	I	II
2759.635	2	----	I	---	2795.747	3	----	I	-----
2760.006	1	----	I	---	2795.826	3	----	I	-----
2761.165	8	80h1	II	4	2796.951	1	----	I	-----
2761.634	200	20	I	7	2797.980	10	----	I	-----
2761.78	10	----	I	---	2798.440	10	20H1	II	-----
2762.688	60	10	I	1	2799.740	6	10H1	II	-----
2763.493	3	----	I	---	2799.93	1	----	I	-----
2763.594	1	----	I	---	2800.652	1	----	I	-----
2763.68	2	----	I	---	2801.426	20	----	I	-----
2764.462	2	10h1	II	---	2802.106	6	----	I	-----
2764.892	10	100	II	6	2802.479	50	2	I	-----
2765.048	20	----	I	---	2802.73	2	8H1	II	-----
2766.301	3	----	I	---	2803.29	1	----	I	-----
2766.966	80	10	I	3	2803.48	3	----	I	-----
2767.09	9	----	I	---	2804.35	2	5h1	II	-----
2767.32	10	60h1	II	---	2805.00	3	8H1	II	-----
2770.438	40	300	II	4	2805.745	2	----	I	-----

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2806. 275	3	-----	I	-----	2843. 530	30	1	I	-----
2806. 624	6	-----	I	-----	2844. 890	10	-----	I	-----
2806. 80	2	-----	I	-----	2845. 11	3	-----	I	-----
2807. 49	-----	5hl	I	II	2845. 57	2	-----	I	-----
2807. 506	10	-----	I	-----	2845. 832	200	20	I	2
2808. 00	200	1000	I	II	2846. 383	5	15H1	II	-----
2808. 60	1	-----	I	-----	2846. 633	9	-----	I	-----
2808. 80	2	-----	I	-----	2846. 829	1	-----	I	-----
2809. 39	2	-----	I	-----	2847. 047	2	3hl	II	-----
2809. 595	10	15	I	II	2847. 21	1	-----	I	-----
2810. 20	2	3H1	I	II	2847. 656	3	-----	I	-----
2810. 78	2	-----	I	-----	2849. 215	300	1000	I	II
2811. 692	10	-----	I	-----	2849. 648	10	-----	I	II
2812. 326	40	3	I	II	2850. 156	40	200	I	II
2813. 87	150	600	I	II	2850. 967	100	20	I	7
2814. 478	100	500	I	II	2851. 211	200	400	II	6
2814. 762	60	300	I	II	2852. 018	100	300	II	6
2815. 815	50	2	I	-----	2853. 757	2	-----	I	-----
2816. 068	20	60hl	I	II	2854. 168	1	-----	I	-----
2816. 88	1	4hl	I	II	2854. 565	1	-----	I	-----
2817. 685	100	10	I	-----	2855. 30	1	-----	I	-----
2818. 000	2	-----	I	-----	2855. 828	5	-----	I	-----
2818. 942	60	5	I	-----	2855. 997	2	-----	I	-----
2819. 194	3	-----	I	-----	2856. 975	6	20	II	-----
2819. 746	100	15	I	-----	2857. 652	50	100	II	4
2820. 227	500	2000	I	II	2858. 658	10	40	II	4
2820. 417	20	100	I	II	2859. 103	6	-----	I	-----
2820. 664	2	-----	I	-----	2859. 66	1	-----	I	-----
2822. 355	5	-----	I	-----	2859. 97	1	-----	I	-----
2822. 678	300	1500	I	II	2860. 314	40	100	II	4
2823. 40	2	-----	I	-----	2860. 558	100	15	I	3
2824. 50	1	-----	I	-----	2861. 009	500	2000	II	5
2827. 27	1	-----	I	-----	2861. 695	600	2500	II	5
2828. 078	2	-----	I	-----	2862. 632	20	1	I	-----
2828. 148	5	20h	I	II	2863. 41	60	4	I	2
2828. 430	3	-----	I	-----	2863. 64	4	-----	I	-----
2828. 49	4	-----	I	-----	2864. 722	9	-----	I	-----
2828. 506	2	4hl	I	II	2865. 054	1	-----	I	-----
2829. 08	2	-----	I	-----	2865. 422	3	-----	I	-----
2829. 327	40	200	I	II	2865. 562	5	30hl	II	-----
2830. 511	20	1	I	-----	2866. 373	500	100	I	2
2830. 985	2	-----	I	-----	2867. 06	2	-----	I	-----
2831. 934	1	-----	I	-----	2867. 70	60	7	I	-----
2832. 54	10	20H1	I	II	2868. 107	15	1	I	-----
2833. 285	150	20	I	-----	2868. 950	4	-----	I	-----
2834. 130	60	10	I	-----	2869. 82	80	200	II	5
2835. 140	10	40H1	I	II	2870. 744	2	3h	II	-----
2836. 028	2	-----	I	-----	2871. 72	2	-----	I	-----
2836. 13	3	-----	I	-----	2871. 90	-----	50h	III	-----
2836. 82	2	-----	I	-----	2872. 246	2	-----	I	-----
2837. 55	1	-----	I	-----	2872. 480	10	-----	I	-----
2837. 96	2	-----	I	-----	2872. 730	4	-----	I	-----
2838. 02	2	-----	I	-----	2873. 632	50	3	I	-----
2838. 65	1	-----	I	-----	2874. 486	1	-----	I	-----
2838. 76	1	5hl	I	II	2874. 82	1	-----	I	-----
2840. 387	15	1	I	-----	2876. 328	200	1000	II	5
2841. 493	70	7	I	II	2877. 18	80	7	I	3
2841. 884	20	100H1	I	-----	2878. 66	10	-----	I	-----
2842. 773	2	-----	I	-----	2879. 12	30	100	II	4
2843. 10	3	-----	I	-----	2879. 418	2	-----	I	-----

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2879. 72	10	30Hl	II	----	2918. 591	300	40	I	3
2880. 211	2	10Hl	II	----	2919. 60	300	2000	II	6
2880. 84	1	----	I	----	2922. 15	4	----	----	----
2882. 259	15	----	I	----	2924. 613	150	20	I	7
2882. 57	1	----	I	----	2925. 965	10	----	I	----
2883. 02	1	----	I	----	2926. 04	4	20	II	----
2884. 12	1	----	I	----	2926. 22	10	----	I	----
2885. 474	40	200	II	5	2926. 328	10	40	II	4
2886. 91	10	10hl	II	----	2926. 58	7	----	I	----
2887. 132	200	60	I	1	2927. 65	3	----	I	----
2887. 542	100	30	I	2	2928. 980	40	6	I	1
2888. 23	1	1h	II	----	2929. 642	400	2000	II	7
2888. 633	8	----	I	----	2929. 895	200	50	I	1
2889. 001	8	50	II	4	2930. 55	7	50Hl	II	4
2889. 62	300	50	I	1	2930. 69	4	----	I	----
2891. 019	40	4	I	----	2932. 92	1	2h	II	----
2891. 46	1	----	I	----	2934. 641	20	1	I	----
2891. 89	2	----	I	----	2935. 365	40	2	I	7
2891. 954	3	----	I	----	2935. 725	10	----	I	----
2892. 285	4	5hl	II	----	2936. 338	2	----	I	----
2892. 565	60	7	I	7	2937. 782	400	3000	II	6
2892. 98	3	----	I	----	2938. 235	4	----	I	----
2893. 03	2	----	I	----	2938. 656	2	----	I	----
2893. 751	10	----	I	----	2940. 23	1	5hl	II	----
2894. 028	10	20h	II	6	2940. 762	800	100	I	3
2894. 840	30	3	I	----	2942. 73	10	----	I	----
2896. 260	10	----	I	----	2943. 70	2	----	I	----
2897. 11	1	----	I	----	2944. 71	200	40	I	2
2897. 34	----	50h	III	----	2947. 135	20	300	II	4
2898. 256	500	50	I	7	2947. 474	2	----	I	----
2898. 702	50	200	II	5	2947. 72	2	----	I	----
2900. 12	1	----	I	----	2948. 390	6	----	I	----
2900. 750	20	----	I	----	2949. 58	2	50Hl	II	----
2901. 16	4	----	I	----	2949. 81	5	----	I	----
2901. 31	1	2hl	II	----	2950. 67	600	100	I	3
2901. 925	10	----	I	----	2951. 900	20	5	I	----
2902. 641	30	1	I	----	2952. 55	2	5Hl	II	----
2902. 81	10	----	I	----	2953. 12	1	----	I	----
2904. 412	400	70	I	3	2953. 36	1	----	I	----
2904. 531	20	100h	II	----	2953. 647	3	30	II	----
2904. 760	300	60	I	1	2954. 201	500	100	I	1
2905. 17	5	----	I	----	2954. 53	6	----	I	----
2906. 61	1	2h	II	----	2954. 935	2	7	II	----
2907. 012	30	1	I	----	2955. 64	4	----	I	----
2907. 318	3	----	I	----	2955. 99	1	3h	II	----
2907. 63	1	7Hl	II	----	2956. 376	30	1	I	----
2908. 831	10	30Hl	II	5	2957. 27	2	20hl	II	----
2909. 912	200	300	II	5	2958. 01	300	40	I	3
2910. 46	1	----	I	----	2958. 55	4	----	I	----
2911. 836	2	----	I	----	2959. 144	2	20Hl	II	----
2912. 760	10	20	II	4	2960. 180	5	----	I	----
2913. 179	10	50hl	II	4	2960. 813	20	200	II	5
2913. 56	5	----	I	----	2961. 80	40	400	II	6
2913. 64	2	----	I	----	2962. 592	1	----	I	----
2915. 08	5	----	I	----	2962. 921	2	----	I	----
2915. 27	5	----	I	----	2963. 547	5	----	I	----
2915. 72	1	----	I	----	2963. 72	2	5Hl	II	----
2916. 48	800	100	I	1	2963. 90	1	----	I	----
2917. 308	8	----	I	----	2963. 97	1	----	I	----
2917. 487	20	200	II	5	2964. 885	400	80	I	7

TABLE 1. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
2965. 46	1	-----	I	-----	3000. 464	6	-----	I	-----
2966. 054	7	-----	I	-----	3000. 82	2	-----	I	-----
2966. 953	150	30	I	-----	3001. 840	4	40	II	6
2967. 230	60	500	II	6	3002. 46	4	-----	I	-----
2967. 85	5	-----		-----	3002. 90	20	1	I	-----
2967. 98	1	-----	I	-----	3003. 287	10	-----	I	-----
2968. 338	10	-----	I	-----	3003. 62	2	-----	I	-----
2968. 805	300	2000	II	6	3004. 06	20	-----	I	-----
2968. 94	20	200		-----	3004. 337	3	-----	I	-----
2970. 486	4	-----	I	-----	3004. 725	4	10H1	II	-----
2970. 60	-----	30	III	-----	3005. 556	300	100	I	3
2971. 24	1	-----	I	-----	3005. 84	10	-----	I	-----
2972. 00	2	-----	I	-----	3006. 39	10	-----	I	-----
2972. 805	4	-----	I	-----	3006. 83	1	-----	I	-----
2973. 058	20	-----	I	-----	3007. 03	2	-----	I	-----
2973. 390	100	30	I	1	3007. 49	3	-----	I	-----
2974. 07	20	70	II	6	3008. 63	3	10H1	II	-----
2975. 886	600	3000		7	3009. 86	10	1	I	-----
2976. 394	10	-----	I	-----	3010. 251	4	-----	I	-----
2977. 109	6	-----	I	-----	3010. 97	3	-----	I	-----
2977. 587	30	500	II	7	3011. 214	15	300	II	5
2979. 288	100	30	I	2	3012. 19	3	20	II	5
2979. 934	4	-----	I	-----	3012. 893	400	3000	II	5
2980. 204	2	40	II	5	3014. 10	1	-----	I	-----
2980. 815	500	100	I	3	3014. 84	10	-----	I	-----
2981. 43	1	-----	I	-----	3014. 947	2	10H1	II	-----
2981. 81	1	-----	I	-----	3015. 90	1	-----	I	-----
2982. 43	10	-----	I	-----	3016. 28	2	-----	I	-----
2982. 56	3	-----	I	-----	3016. 69	150	40	I	2
2982. 727	150	40	I	7	3016. 80	200	50	I	1
2984. 058	50	10	I	2	3016. 96	20	100	II	4
2984. 352	2	10H1	II	-----	3017. 36	30	4	I	-----
2984. 456	7	-----	I	-----	3017. 80	2	-----	I	-----
2985. 80	1	-----	I	-----	3018. 30	250	70	I	3
2985. 938	2	-----	I	-----	3019. 37	1	-----	I	-----
2986. 74	1	-----	I	-----	3019. 78	2	-----	I	-----
2986. 943	1	5H1	II	-----	3020. 01	1	-----	I	-----
2987. 244	7	-----	I	-----	3020. 530	300	100	I	3
2987. 62	5	-----	I	-----	3020. 99	10	-----	I	-----
2988. 576	5	-----	I	-----	3022. 10	10	100	II	4
2989. 46	8	-----	I	-----	3023. 118	10	-----	I	-----
2989. 76	1	-----	I	-----	3024. 335	2	6h	II	-----
2990. 228	4	-----	I	-----	3024. 592	50	4	I	-----
2990. 800	10	80	II	4	3024. 780	40	200	II	4
2991. 756	2	-----	I	-----	3025. 287	80	300	II	5
2992. 074	30	5	I	-----	3026. 61	2	-----	I	-----
2992. 624	1	6H1	II	-----	3028. 111	4	-----	I	-----
2993. 011	3	-----	I	-----	3029. 446	20	1	I	-----
2993. 413	2	10H1	II	7	3030. 36	1	-----	I	-----
2993. 647	3	-----	I	-----	3031. 159	300	2000	II	5
2993. 86	2	-----	I	-----	3031. 566	3	-----	I	-----
2994. 036	8	-----	I	-----	3031. 790	20	-----	I	-----
2994. 43	1	-----	I	-----	3032. 48	10	-----	I	-----
2995. 76	1	-----	I	-----	3034. 21	7	-----	I	-----
2996. 278	6	-----	I	-----	3034. 556	30	3	I	-----
2996. 731	5	20H1	II	7	3035. 23	2	30H1	II	-----
2998. 44	1	-----	I	-----	3036. 773	10	1	I	-----
2999. 32	2	-----	I	-----	3037. 28	30	-----	I	-----
2999. 523	20	-----	I	-----	3037. 63	6	-----	I	-----
3000. 092	300	1000	II	4	3038. 666	15	1	I	-----

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3039. 025	7	-----	I	-----	3075. 315	40	7	I	-----
3039. 647	15	-----	I	II	3075. 874	20	1	I	II
3039. 70	3	10H _I	I	-----	3076. 665	4	100	I	6
3041. 004	2	-----	I	-----	3076. 885	30	1	I	-----
3041. 41	9	-----	I	-----	3077. 76	2	-----	I	-----
3042. 085	30	4	I	1	3078. 04	2	-----	I	-----
3042. 271	20	-----	I	-----	3078. 77	6	-----	I	-----
3042. 552	15	-----	I	II	3079. 10	2	3H _I	I	II
3042. 654	3	15H _I	I	-----	3080. 27	4	-----	I	-----
3043. 30	3	-----	I	-----	3080. 635	100	2000	I	6
3043. 905	10	-----	I	-----	3080. 842	200	50	I	1
3044. 103	20	1	I	-----	3081. 844	7	-----	I	-----
3045. 28	1	-----	I	-----	3082. 14	6	-----	I	-----
3045. 40	2	-----	I	-----	3082. 526	7	-----	I	-----
3046. 030	40	400	II	4	3083. 085	8	-----	I	-----
3046. 68	1	-----	I	-----	3083. 151	15	-----	I	-----
3047. 492	20	1	I	-----	3083. 53	3	30H _I	I	II
3049. 06	3	-----	I	-----	3083. 628	30	-----	I	-----
3049. 300	60	15	I	3	3084. 743	20	-----	I	-----
3049. 74	1	3h	II	-----	3085. 17	2	-----	I	-----
3050. 760	300	80	I	2	3086. 580	2	-----	I	-----
3051. 16	5	-----	I	-----	3087. 196	60	6	I	-----
3051. 30	10	-----	I	-----	3087. 947	8	1	I	-----
3052. 75	1	-----	I	-----	3088. 533	60	5	I	-----
3053. 28	2	4	II	-----	3088. 985	4	-----	I	-----
3053. 74	1	-----	I	-----	3089. 39	1	-----	I	-----
3054. 53	100	300	II	6	3089. 527	7	-----	I	-----
3055. 415	30	400	II	5	3090. 170	30	1	I	-----
3056. 702	20	2	I	-----	3090. 516	20	-----	I	-----
3057. 010	400	100	I	3	3091. 397	40	6	I	-----
3057. 59	7	-----	I	-----	3091. 770	8	80h _I	II	6
3058. 31	2	-----	I	-----	3092. 250	60	500h _I	II	5
3058. 61	3	-----	I	-----	3093. 65	1	2	II	-----
3058. 66	1	1h	II	-----	3095. 186	4	-----	I	-----
3058. 77	1	-----	I	-----	3096. 764	150	40	I	3
3059. 343	10	-----	I	III	3097. 602	3	-----	I	-----
3060. 084	-----	100h	III	-----	3098. 482	3	-----	I	-----
3060. 18	1	-----	I	-----	3098. 59	1	-----	I	5
3063. 778	80	10	I	7	3099. 085	2	20H _I	II	-----
3064. 355	5	20	II	-----	3100. 47	2	-----	I	-----
3064. 686	40	500	II	5	3100. 792	30	1	I	II
3066. 18	30	1	I	-----	3101. 391	300	1000	I	5
3066. 515	5	30H _I	II	-----	3102. 391	8	-----	I	-----
3067. 426	200	40	I	1	3103. 19	1	-----	I	-----
3067. 614	60	10	I	-----	3103. 410	-----	15h	III	-----
3068. 18	15	1	I	-----	3103. 66	20	-----	I	-----
3069. 213	80	15	I	1	3103. 712	50	1	I	-----
3069. 645	2	10	II	-----	3104. 49	1	4h	II	-----
3069. 726	7	-----	I	-----	3104. 822	10	-----	I	-----
3069. 804	2	-----	I	-----	3105. 51	2	-----	I	-----
3069. 950	8	70H _I	II	-----	3106. 01	2	-----	I	-----
3070. 095	20	-----	I	-----	3106. 14	1	1h	I	II
3070. 498	15	-----	I	-----	3106. 43	1	-----	I	-----
3070. 85	1	-----	I	-----	3106. 51	2	-----	I	-----
3071. 77	10	-----	I	-----	3106. 75	1	-----	I	-----
3072. 365	20	-----	I	-----	3106. 93	1	-----	I	-----
3072. 881	400	100	I	2	3107. 815	3	7H _I	II	-----
3073. 48	10	-----	I	-----	3107. 91	2	-----	I	-----
3074. 104	60	20	I	3	3108. 043	10	-----	I	-----
3074. 789	100	40	I	2	3108. 63	2	-----	I	-----

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3109. 121	400	2000	I	II	6	3147. 22	2	-----	I
3109. 852	4	-----				3147. 28	4	-----	I
3110. 882	50	400		II	4	3148. 10	3	-----	I
3111. 472	4	20		II		3148. 415	100	40	I
3111. 99	1	-----	I			3148. 898	5	-----	I
3112. 43	1	2hl		II		3149. 064	20	2	I
3112. 82	1	-----	I			3149. 824	15	1	I
3113. 447	7	-----	I			3150. 332	15	1	I
3113. 68	2	3hl		II		3151. 64	80	20	I
3114. 059	1	-----	I			3151. 962	8	-----	I
3114. 56	2	-----	I			3152. 59	20	2	I
3114. 896	15	-----	I			3152. 841	7	-----	I
3116. 19	1	-----	I			3152. 952	30	6	I
3116. 506	30	-----	I			3153. 52	3	-----	I
3116. 947	20	200		II	6	3154. 64	2	-----	I
3118. 33	10	-----	I			3156. 48	20	2	I
3118. 63	2	-----	I			3156. 688	200	100	I
3118. 77	4	-----	I			3157. 08	3	-----	I
3119. 24	1	-----	I			3158. 44	1	-----	I
3119. 31	2	-----	I			3158. 71	4	-----	I
3119. 980	100	40	I		7	3158. 82	7	-----	I
3120. 645	15	1	I			3159. 84	300	40	I
3122. 09	1	6Hl		II		3159. 96	10	50	II
3122. 322	7	-----	I			3160. 231	10	-----	I
3122. 55	2	-----	I			3161. 09	2	-----	I
3122. 87	-----	7h		II		3161. 23	1	-----	I
3122. 948	10	-----	I			3161. 536	20	3	-----
3123. 51	1	-----	I			3162. 575	300	30	I
3123. 68	1	-----	I			3162. 624	100	500	II
3123. 973	1	-----	I			3163. 360	30	3	I
3124. 510	20	1	I			3163. 90	3	5hl	II
3124. 89	1	-----	I			3164. 385	100	20	I
3126. 278	20	100		II	5	3165. 27	1	-----	I
3126. 655	20	4	I			3165. 730	50	10	I
3126. 95	5	-----	I			3166. 97	3	-----	I
3127. 390	10	-----	I			3167. 15	1	-----	I
3128. 760	100	20	I			3167. 454	10	30	II
3129. 588	80	15	I			3168. 26	8	-----	I
3130. 40	3	-----	I			3168. 390	100	40	I
3130. 60	1	2hl		II		3168. 957	2	3hl	II
3131. 812	400	200	I		7	3169. 50	-----	7hl	II
3132. 236	20	3	I			3169. 60	4	-----	I
3133. 03	1	-----	I			3169. 762	10	-----	I
3133. 078	3	60		II		3170. 83	2	-----	I
3133. 30	1	-----	I			3172. 08	1	-----	I
3133. 83	1	-----	I			3172. 24	6	-----	I
3134. 725	600	5000		II	6	3172. 949	300	70	I
3135. 562	30	2	I			3173. 65	1	4hl	II
3135. 770	20	1	I			3174. 882	30	6	I
3137. 520	70	30	I		1	3175. 957	10	-----	I
3138. 43	20	1	I			3176. 858	200	600	II
3138. 651	200	20	I			3178. 05	10	-----	I
3139. 29	4	-----	I		5	3178. 436	40	5	I
3139. 663	100	500		II	7	3179. 62	40	5	I
3140. 771	40	500		II		3180. 19	10	-----	I
3142. 57	1	-----	I			3180. 81	20	2	I
3144. 46	7	-----	I			3181. 008	80	10	I
3145. 315	200	500		II	6	3181. 148	70	10	I
3146. 22	2	-----	I			3181. 756	5	50	II
3146. 95	-----	40h		III		3182. 57	2	-----	I

TABLE 1. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3182.742	10	-----	I	-----	3216.94	10	-----	I	-----
3183.18	1	-----	I	-----	3217.289	100	200	II	5
3183.27	1	-----	I	II	3218.165	5	100	II	7
3183.67	2	8hl	-----	-----	3218.770	70	5	I	1
3184.056	20	2	I	-----	3220.032	10	-----	I	-----
3184.51	1	-----	I	-----	3220.650	100	500	II	5
3185.03	4	-----	I	-----	3222.538	30	1	I	-----
3185.307	4	10H1	I	II	3223.45	1	-----	I	-----
3186.04	1	-----	I	-----	3223.864	5	15hl	II	-----
3186.26	2	5H1	II	-----	3224.77	1	-----	I	-----
3186.44	3	-----	I	-----	3225.020	5	50hl	II	7
3187.15	2	-----	I	-----	3225.78	1	-----	I	-----
3189.632	100	20	I	-----	3226.44	5	15H1	II	-----
3190.27	3	-----	I	-----	3226.991	10	50	II	4
3191.938	10	-----	I	-----	3227.868	40	3	I	-----
3192.362	7	-----	I	-----	3228.320	2	-----	I	-----
3193.16	10	-----	I	-----	3228.43	1	-----	I	-----
3193.530	200	1000	II	-----	3229.493	15	1	I	-----
3194.199	400	2000	II	-----	3230.058	100	10	I	7
3194.486	10	50	II	-----	3232.204	20	2	I	-----
3194.776	20	-----	I	-----	3232.593	1	-----	I	-----
3195.162	5	-----	I	-----	3232.999	2	-----	I	-----
3195.630	20	100	II	5	3233.23	1	-----	I	-----
3195.87	10	-----	I	-----	3233.797	4	40h	II	4
3196.10	4	-----	I	-----	3234.11	7	10H1	II	-----
3196.916	60	10	I	7	3235.25	4	-----	I	-----
3197.39	2	-----	I	-----	3235.80	2	-----	I	-----
3198.00	2	-----	I	-----	3235.878	1	5H1	II	-----
3198.310	2	7H1	II	-----	3236.76	100	10	I	2
3198.69	2	-----	I	-----	3238.274	10	-----	I	-----
3198.841	10	-----	I	-----	3238.38	2	7H1	II	-----
3199.262	20	2	I	-----	3239.010	20	2	I	-----
3199.996	40	300	II	6	3239.393	80	8	I	7
3200.40	8	-----	I	-----	3240.62	4	-----	I	-----
3201.020	20	1	I	-----	3240.77	7	-----	I	-----
3201.065	10	-----	I	-----	3240.991	80	15	I	-----
3202.149	10	80	II	6	3241.734	9	-----	I	-----
3202.37	10	-----	I	-----	3242.130	30	2	I	-----
3202.74	30	2	I	-----	3242.42	1	7hl	II	-----
3203.10	10	1	I	-----	3242.98	5	100	II	5
3203.657	30	100	II	4	3243.343	100	10	I	7
3204.39	1	-----	I	-----	3243.735	7	-----	I	-----
3205.545	10	1	I	-----	3243.82	2	5hl	II	-----
3206.108	150	30	I	2	3244.42	4	-----	I	-----
3206.741	5	80h	II	5	3244.66	1	-----	I	-----
3206.80	7	-----	I	-----	3245.472	10	-----	I	-----
3207.51	1	1hl	II	-----	3245.960	15	-----	I	-----
3207.77	1	-----	I	-----	3246.923	40	2	I	-----
3208.12	2	-----	I	-----	3247.67	400	80	I	3
3209.21	5	-----	I	-----	3247.88	30	3	I	-----
3209.25	5	-----	I	-----	3248.41	-----	6h	II	-----
3209.757	3	-----	I	-----	3248.49	10	1	I	-----
3210.70	10	-----	I	-----	3249.154	7	-----	I	-----
3210.965	100	10	I	7	3249.529	200	20	I	1
3211.976	30	4	I	-----	3250.04	1	20hl	II	-----
3212.64	4	-----	I	-----	3252.144	9	-----	I	-----
3213.708	70	5	I	3	3253.695	400	1000	II	5
3214.230	20	1	I	-----	3254.854	40	5	I	-----
3215.269	2	7hl	II	-----	3255.28	200	500	II	5
3216.01	1	-----	I	-----	3256.16	10	10hl	II	-----

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3256. 37	-----	4h	II	-----	3291. 043	150	100	I	3
3256. 66	1	-----	I	II	3291. 340	30	-----	I	-----
3256. 87	1	5H1	II	-----	3291. 600	50	3	I	-----
3256. 96	4	-----	I	-----	3292. 095	4	-----	I	-----
3258. 50	2	-----	I	-----	3292. 312	10	-----	I	-----
3258. 57	3	-----	I	-----	3293. 116	60	4	I	-----
3258. 84	1	-----	I	-----	3293. 457	10	-----	I	-----
3258. 88	2	-----	I	-----	3293. 998	3	-----	I	-----
3259. 35	5	60H1	II	-----	3294. 649	2	200	II	4
3259. 97	1	-----	I	-----	3294. 745	15	-----	I	-----
3260. 12	1	-----	I	-----	3295. 585	30	1	I	-----
3260. 63	1	-----	I	-----	3296. 027	20	1	I	-----
3260. 947	2	-----	I	-----	3296. 445	4	-----	I	-----
3261. 39	3	-----	I	-----	3297. 673	10	-----	I	-----
3261. 52	2	-----	I	-----	3298. 350	40	2	I	-----
3261. 898	50	10	I	-----	3298. 495	10	-----	I	-----
3262. 469	100	15	I	3	3298. 934	80	6	I	-----
3263. 92	1	1hl	II	-----	3299. 662	40	-----	I	-----
3264. 485	15	-----	I	-----	3300. 11	-----	6h	III	-----
3264. 903	7	-----	I	-----	3300. 290	10	-----	I	-----
3265. 281	80	10	I	2	3301. 06	1	-----	I	-----
3265. 570	15	-----	I	-----	3302. 164	20	2	I	-----
3265. 97	1	-----	I	-----	3302. 26	2	-----	I	-----
3266. 525	2	30h	II	5	3302. 94	7	-----	I	-----
3267. 000	70	10	I	1	3303. 317	7	-----	I	-----
3267. 165	80	10	I	1	3303. 871	30	2	I	II
3268. 25	3	-----	I	-----	3304. 07	2	5H1	I	-----
3268. 32	1	-----	I	-----	3304. 42	1	-----	I	-----
3268. 653	7	-----	I	-----	3304. 60	3	-----	I	-----
3269. 65	1	-----	I	-----	3306. 110	300	30	I	3
3270. 58	2	7	II	-----	3306. 374	60	2	I	-----
3272. 03	1	-----	I	-----	3307. 36	1	-----	I	-----
3272. 930	30	-----	I	7	3308. 390	10	-----	I	-----
3273. 646	40	300	II	6	3309. 193	100	10	I	7
3273. 94	3	20	II	-----	3309. 54	9	-----	I	-----
3275. 065	8	-----	I	-----	3310. 274	300	70	I	1
3275. 44	15	-----	I	-----	3310. 825	5	200	II	6
3276. 431	30	1	I	-----	3311. 115	1	10h	II	-----
3277. 83	4	-----	I	-----	3312. 06	1	-----	I	-----
3278. 080	40	1	I	-----	3312. 869	600	100	I	3
3279. 002	10	-----	I	-----	3313. 98	4	-----	I	II
3279. 67	-----	200H	III	-----	3314. 020	3	60h	I	-----
3279. 971	100	500	II	6	3314. 11	8	-----	I	-----
3282. 977	100	40	I	-----	3314. 77	2	-----	I	-----
3283. 382	20	200	II	5	3316. 167	100	10	I	-----
3284. 81	3	-----	I	-----	3316. 54	1	7h	II	-----
3285. 213	8	-----	I	-----	3317. 252	5	30	II	5
3285. 472	6	-----	I	-----	3317. 985	100	400	II	6
3285. 644	30	-----	I	-----	3318. 281	40	2	I	-----
3286. 26	1	-----	I	-----	3318. 727	4	10	II	-----
3286. 50	1	-----	I	-----	3319. 257	10	-----	I	-----
3286. 88	4	5h	II	-----	3319. 43	8	-----	I	-----
3287. 286	70	10	I	2	3320. 06	3	-----	I	-----
3288. 31	2	-----	I	-----	3320. 228	3	-----	I	-----
3288. 46	1	5h	II	-----	3320. 97	6	-----	I	-----
3288. 722	15	-----	I	-----	3321. 146	2	-----	I	-----
3288. 78	-----	9H1	III	-----	3321. 274	4	-----	I	-----
3289. 720	10	70	II	6	3321. 50	3	-----	I	-----
3290. 05	1	-----	I	-----	3321. 946	15	1	I	-----
3290. 25	2	-----	I	-----	3322. 48	1	-----	I	-----

TABLE I. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3322. 719	5	-----	I	-----	3358. 906	50	10	I	-----
3323. 03	3	-----	I	-----	3358. 965	100	20	I	7
3323. 09	2	-----	I	-----	3360. 060	200	30	I	3
3323. 324	20	500	II	5	3361. 22	6	-----	I	-----
3323. 77	3	-----	I	-----	3361. 44	3	10H1	II	-----
3324. 168	10	100	II	5	3362. 52	1	-----	I	-----
3324. 395	5	-----	I	-----	3363. 44	2	-----	I	-----
3326. 063	4	-----	I	-----	3363. 74	15	-----	I	-----
3326. 315	7	-----	I	-----	3364. 157	10	-----	I	-----
3326. 92	3	-----	I	-----	3364. 600	20	-----	I	-----
3327. 46	2	-----	I	-----	3365. 20	1	-----	I	-----
3327. 705	15	-----	I	-----	3365. 452	2	-----	I	-----
3328. 211	40	300	II	6	3365. 778	10	100H1	I	7
3328. 42	10	-----	I	-----	3366. 681	100	20	I	3
3328. 73	2	-----	I	-----	3367. 078	4	10	II	-----
3329. 40	10	-----	I	-----	3368. 50	3	-----	I	-----
3330. 183	20	1	I	-----	3368. 850	4	-----	I	-----
3331. 44	10	-----	I	-----	3370. 677	10	200H1	II	-----
3331. 857	50	4	I	-----	3371. 04	20	-----	I	-----
3332. 737	600	100	I	2	3371. 46	10	-----	I	-----
3333. 47	1	70H1	II	-----	3371. 92	7	-----	I	-----
3333. 906	20	-----	I	-----	3372. 201	60	5	I	2
3334. 388	10	-----	I	-----	3372. 78	10	1	I	-----
3335. 108	30	1	I	-----	3374. 974	10	-----	I	-----
3336. 08	20	-----	I	-----	3375. 265	15	-----	I	-----
3336. 39	1	-----	I	-----	3375. 548	2	-----	I	-----
3336. 77	2	10H1	II	-----	3375. 844	7	-----	I	-----
3337. 73	5	-----	I	-----	3376. 055	15	-----	I	-----
3337. 995	7	-----	I	-----	3376. 517	9	-----	I	-----
3338. 594	9	-----	I	-----	3376. 669	12	80	II	6
3339. 02	6	-----	I	-----	3376. 90	2	-----	I	-----
3339. 34	7	-----	I	-----	3377. 02	5	-----	I	-----
3340. 13	1	-----	I	-----	3378. 876	60	6	I	-----
3340. 459	9	-----	I	-----	3378. 932	150	10	I	-----
3340. 98	1	-----	I	-----	3379. 712	7	-----	I	-----
3341. 05	6	-----	I	-----	3380. 062	15	-----	I	-----
3341. 29	1	-----	I	-----	3380. 79	1	4hl	I	II
3341. 870	4	-----	I	-----	3381. 377	40	3	I	-----
3342. 73	5	-----	I	-----	3382. 334	30	1	I	-----
3344. 305	20	1	I	-----	3382. 79	1	-----	I	-----
3345. 01	1	-----	I	-----	3383. 040	2	-----	I	-----
3345. 10	6	-----	I	-----	3383. 80	3	-----	I	-----
3345. 334	1	-----	I	-----	3384. 14	40	700	II	-----
3346. 05	5	-----	I	-----	3384. 694	70	500	II	5
3346. 95	4	-----	I	-----	3385. 196	10	150h	II	-----
3348. 38	5	-----	I	-----	3386. 214	150	20	I	3
3348. 710	7	-----	I	-----	3386. 907	6	-----	I	-----
3349. 167	4	100	II	6	3388. 534	3	-----	I	-----
3349. 24	20	-----	I	-----	3389. 833	200	2000	II	5
3350. 33	40	-----	I	-----	3390. 465	50	5	I	-----
3352. 063	400	1000	II	7	3391. 43	1	-----	I	-----
3353. 028	50	4	I	-----	3391. 97	7	20	I	II
3353. 50	7	-----	I	-----	3392. 450	30	1	I	-----
3354. 70	7	-----	I	-----	3392. 815	150	40	I	3
3355. 01	20	-----	I	-----	3393. 900	15	-----	I	-----
3356. 012	10	50	II	-----	3394. 162	10	-----	I	-----
3356. 34	4	-----	I	-----	3394. 575	200	1000	II	6
3356. 788	80	10	I	-----	3394. 980	150	2000	II	6
3358. 187	20	-----	I	-----	3395. 888	100	4	I	-----
3358. 288	30	300	II	5	3396. 65	4	-----	I	-----

TABLE 1. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3397. 257	200	20	I	3	3440. 860	100	6	I	2
3397. 602	100	20	I	7	3441. 835	150	8	I	II
3398. 54	3	---	I	---	3443. 412	2	10h	---	---
3399. 793	1000	5000	II	5	3444. 140	7	---	I	---
3400. 218	200	20	I	---	3445. 068	10	---	I	---
3401. 73	3	2	I	---	3446. 481	10	10h	II	---
3402. 512	200	20	I	2	3447. 446	30	2	I	---
3405. 304	6	---	I	---	3448. 284	100	8	I	7
3405. 89	4	---	I	---	3448. 969	50	3	I	---
3407. 140	50	10	I	3	3449. 82	6	---	I	---
3407. 750	40	700	II	5	3450. 33	2	10H ₁	II	---
3407. 928	20	---	I	---	3450. 54	1	---	I	---
3408. 63	7	---	I	---	3451. 522	20	1	I	II
3408. 679	8	---	I	---	3451. 64	1	7H ₁	---	---
3409. 546	20	1	I	---	3452. 304	70	10	I	2
3409. 724	10	---	I	---	3452. 576	15	---	I	---
3410. 157	150	2000	II	6	3452. 619	10	---	I	---
3410. 892	7	---	I	---	3453. 136	40	3	I	---
3411. 253	10	---	I	---	3453. 525	40	3	I	---
3411. 734	5	---	I	---	3455. 858	10	---	I	---
3412. 016	20	---	I	---	3455. 998	10	---	I	---
3412. 374	100	10	I	2	3456. 39	2	---	I	---
3412. 687	8	---	I	---	3456. 831	30	---	I	II
3413. 732	30	400h	II	5	3457. 559	1	1h	II	---
3414. 313	7	---	I	---	3458. 18	1	---	I	---
3414. 543	2	---	I	---	3458. 69	8	---	I	---
3415. 20	2	9H ₁	II	---	3459. 98	2	---	I	---
3416. 04	3	15H ₁	II	---	3460. 720	20	---	I	---
3416. 52	1	---	I	---	3461. 250	6	---	I	---
3416. 82	3	---	I	---	3461. 33	5	---	I	---
3417. 34	300	30	I	2	3461. 77	3	---	I	---
3419. 171	500	90	I	1	3462. 12	5	---	I	---
3419. 80	5	---	I	---	3462. 646	150	300	II	5
3419. 87	2	---	I	---	3464. 12	2	---	I	---
3420. 00	1	---	I	---	3464. 720	50	2	I	---
3420. 775	20	---	I	---	3465. 120	30	1	I	II
3421. 435	40	100	II	5	3465. 93	5	40	I	6
3422. 542	15	---	I	---	3467. 410	20	1	I	---
3423. 08	7	---	I	---	3467. 569	150	15	I	2
3423. 500	20	---	I	---	3468. 810	3	15	II	---
3423. 656	8	---	I	---	3468. 99	5	---	I	II
3426. 478	30	1	I	---	3469. 260	5	20	II	---
3427. 430	150	20	I	1	3469. 91	1	---	I	---
3428. 363	200	500	II	5	3470. 300	7	---	I	---
3431. 189	10	---	I	---	3470. 800	15	---	I	---
3431. 79	3	---	I	---	3470. 910	10	---	I	---
3432. 28	2	---	I	---	3472. 410	800	100	I	1
3432. 577	9	---	I	---	3473. 982	30	---	I	---
3434. 639	50	4	I	---	3475. 16	60	3	I	---
3434. 969	15	1	I	---	3475. 483	30	2	I	---
3435. 277	15	---	I	---	3475. 59	6	20H ₁	II	---
3435. 58	1	8hl	II	---	3476. 450	20	---	I	---
3436. 438	40	2	I	---	3476. 573	40	---	I	---
3436. 81	9	---	I	---	3477. 96	2	10hl	II	---
3437. 15	1	---	I	---	3478. 978	100	1000	II	6
3437. 30	---	10H	III	---	3479. 284	250	1500	II	7
3438. 29	---	5H	III	---	3481. 05	7	---	I	---
3438. 428	300	30	I	7	3481. 410	15	---	I	---
3439. 669	20	1	I	---	3481. 895	70	3	I	---
3440. 07	1	10H ₁	II	---	3483. 111	50	2	I	---

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3484. 14	2	8H1		II	3532. 500	5	—	I	—
3484. 718	100	6	I	—	3532. 978	40	2	I	—
3485. 167	20	50	II	—	3534. 041	4	—	I	—
3487. 573	20	300	II	—	3534. 498	30	2	I	—
3487. 886	10	—	I	—	3535. 549	500	2000	II	7
3488. 018	30	2	I	—	3536. 630	400	50	I	3
3488. 324	10	—	I	—	3537. 75	2	8H1	II	—
3489. 29	2	—	I	—	3540. 166	10	—	I	—
3489. 628	10	—	I	—	3541. 33	3	—	I	—
3489. 918	6	—	I	—	3541. 45	1	—	I	—
3490. 540	70	2	I	—	3541. 65	2	—	I	—
3491. 587	60	1	I	—	3542. 503	60	4	I	—
3492. 012	6	—	I	—	3543. 56	10	—	I	—
3492. 242	10	—	I	—	3543. 828	3	—	I	—
3493. 20	1	—	I	—	3544. 760	5	40	II	—
3493. 551	15	—	I	—	3545. 017	20	1	I	—
3493. 726	7	—	I	—	3545. 937	50	2	I	—
3494. 174	60	3	I	—	3547. 865	30	1	I	—
3494. 99	20	—	I	—	3548. 816	300	30	I	—
3495. 750	150	700	II	5	3549. 218	10	—	I	—
3495. 934	50	400	II	5	3549. 632	20	—	I	—
3497. 168	400	60	I	—	3550. 283	2	10	II	—
3497. 498	1500	150	I	—	3550. 696	30	1	I	—
3498. 988	100	10	I	—	3551. 743	20	—	I	—
3499. 96	2	3h	II	—	3552. 706	400	1000	II	6
3500. 575	6	—	I	—	3553. 44	5	—	I	—
3502. 831	2	5h	II	—	3554. 015	150	20	I	—
3505. 227	2000	6000	II	4	3555. 004	30	1	I	—
3506. 872	10	—	I	—	3556. 05	5	—	I	—
3508. 248	30	1	I	—	3556. 995	20	—	I	—
3509. 077	30	1	I	—	3557. 083	10	—	I	—
3510. 418	20	—	I	—	3558. 470	100	10	I	—
3511. 039	5	10H1	II	—	3559. 83	2	4h	II	—
3511. 297	100	5	I	—	3561. 654	1500	3000	II	6
3511. 847	30	200	II	5	3563. 253	7	—	I	—
3513. 271	300	30	I	—	3563. 634	30	3	I	7
3513. 535	40	1	I	—	3564. 207	200	30	I	7
3515. 06	2	—	I	—	3564. 652	40	2	I	—
3515. 606	10	20	II	—	3564. 868	10	—	I	—
3516. 105	4	—	I	—	3566. 59	1	—	I	—
3516. 817	80	4	I	—	3567. 360	600	50	I	3
3517. 732	60	3	I	—	3569. 036	1000	3000	II	4
3518. 360	10	40	II	—	3570. 971	4	—	I	—
3518. 742	100	400	II	6	3572. 016	20	2	I	—
3519. 62	10	—	I	—	3573. 074	8	—	I	—
3520. 270	10	—	I	—	3574. 39	1	—	I	—
3521. 560	100	10	I	—	3574. 785	10	1	I	—
3522. 223	30	—	I	—	3574. 813	20	2	I	—
3523. 025	1000	100	I	—	3575. 44	1	—	I	—
3523. 50	10	40H1	II	—	3576. 43	1	—	I	—
3525. 547	90	5	I	—	3577. 546	7	—	I	—
3526. 651	20	1	I	—	3577. 96	1	—	I	—
3526. 872	80	4	I	—	3579. 899	150	15	I	—
3528. 217	30	—	I	—	3580. 466	10	100	II	4
3529. 358	10	—	I	—	3581. 564	15	—	I	—
3529. 694	3	—	I	—	3582. 006	4	—	I	—
3530. 870	80	4	I	—	3583. 267	100	10	I	3
3530. 947	50	2	I	—	3583. 646	3	10H1	II	—
3531. 224	200	15	I	—	3584. 215	3	—	I	—
3531. 83	3	—	I	—	3585. 073	6	—	I	—

TABLE 1. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3586. 383	15	1	I	----	3627. 850	70	10	I	1
3587. 142	20	4	I	----	3628. 116	10	-----	I	----
3587. 23	5	-----	I	----	3628. 96	2	-----	I	----
3587. 884	2	-----	I	----	3630. 872	700	100	I	1
3588. 258	7	-----	I	----	3632. 02	2	10H1	II	----
3588. 849	10	1	I	----	3632. 323	4	20h	II	----
3589. 557	2	-----	I	----	3632. 694	40	5	I	----
3589. 684	3	-----	I	----	3633. 181	10	90	II	5
3590. 349	9	-----	I	----	3633. 513	5	-----	I	----
3590. 86	1	-----	I	----	3634. 12	4	-----	I	----
3591. 113	2	20	II	----	3634. 144	5	-----	I	----
3592. 12	1	-----	I	----	3635. 254	20	2	I	2
3592. 67	1	-----	I	----	3635. 425	150	10	I	----
3593. 55	5	-----	I	----	3636. 31	1	-----	I	----
3593. 608	30	2	I	----	3637. 06	1	-----	I	----
3594. 434	5	30	II	5	3637. 594	90	7	I	3
3595. 06	1	-----	I	----	3638. 728	15	-----	I	----
3595. 888	2	-----	I	----	3638. 885	1	-----	I	----
3596. 11	1	-----	I	----	3639. 95	1	-----	I	----
3596. 27	3	-----	I	----	3639. 97	1	-----	I	----
3597. 403	30	300	II	6	3641. 80	1	-----	I	----
3597. 501	60	10	I	3	3642. 552	5	20h	II	----
3598. 510	6	-----	I	----	3644. 357	1000	3000	II	7
3598. 614	7	-----	I	----	3645. 351	6	-----	I	----
3599. 108	10	100	II	6	3646. 63	1	-----	I	----
3599. 284	3	30	II	----	3647. 467	1	15	II	----
3599. 867	200	60	I	1	3647. 54	5	-----	I	----
3600. 04	2	70h1	II	6	3648. 348	5	100	II	5
3601. 68	1	-----	I	----	3649. 106	700	60	I	1
3602. 202	3	-----	I	----	3650. 535	100	10	I	----
3602. 42	1	-----	I	----	3651. 838	400	40	I	3
3602. 914	2	-----	I	----	3652. 902	1	7	II	----
3603. 626	40	4	I	----	3653. 34	1	-----	I	----
3603. 994	15	-----	I	----	3653. 46	1	-----	I	----
3605. 26	1	-----	I	----	3654. 57	1	-----	I	----
3605. 322	2	-----	I	----	3654. 756	5	-----	I	----
3605. 50	1	-----	I	----	3655. 652	30	2	I	----
3606. 231	2	-----	I	----	3656. 406	2	-----	I	----
3606. 784	5	-----	I	----	3656. 60	2	15H1	II	----
3607. 844	3	-----	I	----	3657. 428	2	-----	I	----
3608. 646	8	-----	I	----	3657. 776	15	-----	I	----
3609. 116	50	8	I	----	3658. 22	1	-----	I	----
3610. 851	8	-----	I	----	3658. 49	6	-----	I	----
3611. 42	2	-----	I	----	3658. 50	2	-----	I	----
3611. 462	4	-----	I	----	3659. 031	10	100	II	4
3612. 127	10	-----	I	----	3660. 36	1	-----	I	----
3612. 479	30	4	I	----	3661. 046	30	400	II	5
3615. 034	300	30	I	2	3661. 385	30	2	I	----
3616. 892	2000	200	I	3	3661. 711	3	-----	I	----
3617. 699	50	8	I	----	3661. 734	3	30	II	----
3618. 684	20	-----	I	----	3662. 92	1	3h	II	----
3618. 732	30	2	I	----	3663. 36	10	-----	I	----
3620. 041	100	10	I	7	3664. 020	1	-----	I	----
3620. 432	6	-----	I	----	3664. 57	80	8	I	----
3621. 79	1	-----	I	----	3665. 343	200	1000	II	4
3622. 311	4	-----	I	----	3666. 279	20	-----	I	----
3622. 450	15	100	II	4	3666. 597	1	20h	II	----
3623. 994	70	300	II	4	3666. 818	5	50	II	4
3625. 42	1	-----	I	----	3667. 24	5	-----	I	----
3625. 93	3	-----	I	----	3668. 19	100	10	I	1

TABLE 1. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3668. 59	2	---	I	---	3716. 054	30	2	I	---
3669. 49	15	1	I	---	3717. 144	80	7	I	---
3672. 13	1	10H1	II	---	3717. 802	1000	100	I	7
3672. 304	300	30	I	7	3718. 781	2	30	II	---
3673. 06	3	---	I	---	3719. 278	300	3000	II	4
3674. 07	2	---	I	---	3721. 500	80	7	I	---
3675. 742	400	150	I	1	3722. 66	1	20	II	6
3676. 34	9	---	I	---	3722. 904	4	---	I	---
3676. 716	3	---	I	---	3723. 38	5	---	I	---
3677. 50	1	---	I	---	3724. 444	2	---	I	---
3677. 681	3	---	I	---	3725. 68	1	---	I	---
3678. 028	2	60hl	II	5	3726. 485	150	15	I	2
3681. 384	20	100	II	4	3727. 092	3	---	I	---
3682. 247	3000	200	I	3	3728. 179	2	---	I	---
3683. 57	5	---	I	---	3728. 378	3	---	I	---
3685. 352	3	---	I	---	3729. 093	150	15	I	7
3685. 94	4	---	I	---	3730. 760	20	1	I	---
3687. 42	9	---	I	---	3732. 99	2	---	I	---
3687. 76	2	---	I	---	3733. 786	1000	100	I	1
3687. 84	2	---	I	---	3735. 364	5	---	I	---
3688. 756	9	---	I	---	3736. 303	20	1	I	---
3690. 10	3	---	I	---	3737. 866	30	1000	II	7
3691. 185	20	2	I	---	3739. 030	150	10	I	3
3691. 45	2	---	I	---	3739. 68	2	---	I	---
3692. 770	4	---	I	---	3739. 835	2	7H1	II	---
3693. 156	10	---	I	---	3741. 12	2	---	I	---
3693. 60	20	3	I	---	3741. 396	6	---	I	---
3694. 16	40	4	I	---	3741. 94	---	100H	III	---
3695. 72	2	---	I	---	3744. 002	30	2	I	---
3696. 524	400	40	I	1	3744. 958	20	500	II	6
3697. 08	50	4	I	---	3745. 765	2	7H1	II	---
3697. 61	4	---	I	---	3746. 810	400	60	I	1
3698. 392	30	400	II	4	3747. 481	20	200	II	7
3698. 83	3	---	I	---	3748. 554	5	---	I	---
3699. 55	---	10	II	---	3748. 672	3	---	I	---
3699. 57	5	---	I	---	3748. 71	1	---	I	---
3699. 73	70	1000	II	7	3749. 829	8	---	I	---
3701. 158	80	2000	II	4	3750. 55	1	---	I	---
3701. 83	15	---	I	---	3751. 778	10	---	I	---
3702. 31	3	60hl	II	7	3751. 824	15	1	I	---
3702. 93	1	---	I	---	3752. 784	20	2	I	---
3703. 154	2	---	I	---	3753. 225	100	20	I	3
3703. 816	10	---	I	---	3754. 26	1	---	I	---
3704. 067	15	---	I	---	3755. 024	5	---	I	---
3704. 351	6	---	I	---	3755. 620	4	---	I	---
3704. 657	2	30hl	II	---	3755. 71	2	---	I	---
3704. 938	40	3	I	---	3755. 99	1	---	I	---
3705. 404	20	500	II	6	3756. 17	1	---	I	---
3707. 02	1	---	I	---	3756. 645	2	---	I	---
3707. 374	70	7	I	1	3756. 850	3	---	I	---
3707. 92	1	---	I	---	3756. 98	1	---	I	---
3708. 500	3	---	I	---	3757. 554	20	1	I	---
3708. 85	1	---	I	---	3758. 020	7	100	II	4
3709. 044	4	---	I	---	3760. 75	1	---	I	---
3711. 142	4	50hl	II	---	3761. 79	2	---	I	---
3711. 692	3	---	I	---	3762. 500	30	1000	II	4
3711. 83	1	---	I	---	3763. 232	20	2	I	---
3712. 22	4	---	I	---	3763. 524	1	---	I	---
3712. 52	1	---	I	---	3763. 943	4	---	I	---
3712. 642	7	---	I	---	3764. 528	90	8	I	7

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3765.046	100	9	I		3811.781	400	40	I	3
3765.558	100	10	I		3813.34	1	-----	I	-----
3766.917	20	2000	II		3813.69	1	-----	I	-----
3768.254	200	10	I		3813.848	9	-----	I	-----
3770.32	1	-----	I		3813.972	5	-----	I	-----
3770.603	3	60hl	II		3814.992	4	-----	I	-----
3771.350	20	200	II		3815.542	30	2	I	-----
3771.98	7	-----	I		3816.069	60	6	I	-----
3772.824	2	15hl	II		3816.59	1	-----	I	-----
3773.122	50	4	I		3817.196	30	400	II	4
3776.78	5	-----	I		3818.112	15	-----	I	-----
3777.10	5	-----	I		3818.834	2	-----	I	-----
3777.658	2000	200	I		3819.348	50	7	I	-----
3779.87	5	-----	I		3819.882	1	10hl	II	-----
3780.092	20	100	II		3819.90	3	-----	I	-----
3780.620	3	-----	I		3820.728	1000	100	I	3
3781.016	2	-----	I		3822.64	4	-----	I	-----
3781.46	5	-----	I		3822.819	6	-----	I	-----
3781.550	5	-----	I		3823.510	5	100hl	II	6
3782.437	60	5	I		3823.838	5	-----	I	-----
3782.782	15	200	II		3824.58	6	-----	I	-----
3785.46	3000	250	I		3824.961	50	4	I	-----
3787.375	50	4	I		3826.46	3	-----	I	-----
3787.980	10	-----	I		3828.506	30	1	I	-----
3788.110	5	-----	I		3829.686	100	20	I	3
3788.368	6	-----	I		3830.018	200	50	I	2
3788.520	15	-----	I		3830.658	15	1	I	-----
3788.837	10	-----	I		3831.120	40	3	I	-----
3789.27	7	-----	I		3831.94	1	-----	I	-----
3790.718	2	-----	I		3833.502	40	3	I	-----
3790.87	1	-----	I		3833.667	60	5	I	1
3791.14	3	-----	I		3834.23	3	-----	I	-----
3791.398	3	-----	I		3834.423	4	-----	I	-----
3791.592	6	-----	I		3834.484	7	-----	I	-----
3791.907	4	-----	I		3834.703	1	7hl	II	-----
3791.94	4	-----	I		3837.196	4	-----	I	-----
3792.56	1	-----	I		3838.355	5	50hl	II	4
3793.384	500	1000	II		3839.55	4	-----	I	-----
3794.66	2	-----	I		3841.107	8	-----	I	-----
3794.964	15	1	I		3842.782	9	-----	I	-----
3795.366	10	-----	I		3843.214	5	-----	I	-----
3795.704	7	-----	I		3843.402	2	-----	I	-----
3796.29	1	6hl	II		3844.11	1	-----	I	-----
3796.66	1	-----	I		3845.962	8	-----	I	-----
3797.935	20	200	II		3846.521	7	-----	I	-----
3798.68	150	15	I		3849.19	1000	70	I	3
3799.230	4	-----	I		3849.517	40	1000	II	7
3799.49	5	50	II		3850.364	50	4	I	-----
3799.83	10	-----	I		3851.676	20	1	I	-----
3800.38	1000	100	I		3852.52	1	-----	I	-----
3800.452	300	50	I		3852.716	20	1	I	-----
3801.92	1	-----	I		3852.978	2	-----	I	-----
3802.652	15	-----	I		3854.354	40	3	I	-----
3804.198	50	4	I		3854.638	5	-----	I	-----
3804.533	100	10	I		3854.95	1	-----	I	-----
3805.44	1	-----	I		3858.31	800	80	I	1
3806.065	30	1000	II		3860.910	200	20	I	1
3809.882	3	-----	I		3861.885	7	-----	I	-----
3810.575	10	200	II		3863.436	20	2	I	-----
3810.61	7	-----	I		3863.655	2	-----	I	-----

TABLE I. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3864. 10	1	-----	I	II	3914. 060	1	-----	I	-----
3864. 730	30	800			3915. 53	1	-----	I	-----
3865. 684	10	-----	I		3916. 074	20	1	I	-----
3865. 979	10	-----	I		3916. 368	30	2	I	-----
3866. 16	1	-----	I		3917. 25	1	-----	I	-----
					<i>A</i>				
3867. 310	30	400		II	3917. 442	30	200	II	6
3867. 95	1	-----	I		3918. 096	300	600	II	4
3870. 962	50	3	I		3919. 417	3	-----	I	-----
3871. 605	2	-----	I		3919. 740	9	-----	I	-----
3872. 546	40	300		II	3920. 137	3	-----	I	-----
3873. 74	1	-----	I		3922. 312	4	-----	I	-----
3874. 08	2	-----	I		3922. 784	8	-----	I	-----
3874. 99	1	-----	I		3923. 714	20	1	I	II
3875. 77	1	-----	I		3923. 898	150	400	II	4
3876. 280	30	1	I		3926. 434	100	8	I	2
3877. 095	40	600		II	3927. 108	10	-----	I	-----
3878. 947	20	1	I		3927. 585	100	15	I	3
3879. 216	60	5	I		3928. 044	1	7hl	II	-----
3880. 814	300	600		II	3928. 722	10	-----	I	-----
3882. 216	6	60		II	3929. 49	2	20hl	II	7
3882. 527	100	10	I	II	3930. 895	-----	5hl	II	-----
3883. 762	100	400		II	3931. 38	700	70	I	7
3885. 35	1	-----	I		3931. 761	20	2	I	-----
3885. 420	10	-----	I		3931. 94	1	10hl	II	-----
3885. 624	2	-----	I		3932. 386	20	70h	II	4
3885. 804	30	2	I	II	3933. 166	2	15h	II	-----
3886. 42	-----	5H		II	3933. 653	40	100h	II	5
3886. 767	2	7h		II	3935. 11	1	-----	I	-----
3889. 228	150	20	I		3935. 634	30	200	II	5
3889. 362	200	30	I		3937. 28	1	-----	I	-----
3890. 683	15	-----	I		3938. 20	1	-----	I	-----
3891. 470	10	-----	I		3938. 48	10	1	I	-----
3891. 90	3	-----	I		3939. 042	100	5	I	3
3892. 03	1	-----	I		3939. 604	-----	6hl	II	-----
3892. 472	60	4	I		3940. 346	20	1	I	-----
3893. 118	10	-----	I		3941. 92	15	1	I	-----
3893. 26	1	-----	I		3942. 73	20	1	I	-----
3893. 594	10	-----	I		3943. 06	40	3	I	-----
3894. 08	7	-----	I		3943. 60	3	-----	I	-----
3899. 937	1000	80	I		3944. 16	1	-----	I	-----
3900. 619	20	500		II	3944. 59	3	-----	I	-----
3901. 44	20	1	I		3945. 33	7	100hl	I	II
3902. 937	90	8	I		3945. 87	2	-----	I	-----
3903. 20	10	-----	I		3945. 96	5	80hl	I	II
3903. 824	6	-----	I		3947. 977	9	-----	I	-----
3905. 520	20	-----	I		3948. 299	4	-----	I	-----
3905. 79	3	-----	I		3948. 423	2	-----	I	-----
3906. 107	1	-----	I		3949. 497	20	2	I	-----
3906. 888	80	5	I		3949. 80	7	-----	I	-----
3908. 800	30	-----	I		3950. 78	50	6	I	-----
3909. 185	100	10	I		3951. 18	8	-----	I	-----
3909. 67	2	-----	I		3951. 822	1000	100	I	3
3910. 29	10	-----	I		3955. 80	3	-----	I	-----
3910. 876	4	-----	I		3956. 080	5	-----	I	-----
3911. 748	15	-----	I		3956. 39	1	-----	I	-----
3912. 21	1	-----	I		3957. 026	40	2	I	-----
3912. 436	7	-----	I		3957. 440	10	-----	I	-----
3912. 67	2	-----	I		3957. 73	9	-----	I	-----
3913. 89	1	-----	I		3958. 982	15	-----	I	-----
3913. 93	2	-----	I		3959. 702	20	1	I	-----

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
3960.54	1	-----	I	-----	4007.337	8	80	I	II
3961.68	1	-----	I	-----	4007.59	1	-----	I	II
3962.04	1	-----	I	-----	4008.452	15	60	-----	6
3962.764	3	-----	I	-----	4008.95	1	-----	I	-----
3963.472	4	-----	I	-----	4009.862	20	-----	I	-----
3963.944	1	-----	I	II	4011.503	100	4	I	-----
3964.956	20	300	I	II	4012.24	1	-----	I	-----
3966.162	10	-----	I	-----	4013.259	7	-----	I	-----
3966.938	3	-----	I	-----	4013.58	1	-----	I	-----
3967.254	30	2	I	-----	4015.672	40	2	I	-----
3968.008	400	20	I	-----	4016.99	1	-----	I	-----
3968.985	10	-----	I	-----	4017.685	3	-----	I	-----
3969.79	2	-----	I	-----	4018.912	9	-----	I	-----
3972.228	20	1	I	-----	4019.274	1	-----	I	-----
3972.642	3	-----	I	-----	4019.68	1	-----	I	-----
3973.477	600	20	I	II	4020.247	15	30	I	II
3975.132	3	30hl	I	II	4021.593	7	-----	I	-----
3975.624	2	-----	I	-----	4022.151	3h	-----	I	-----
3977.383	40	2	I	-----	4022.830	40	2	I	-----
3979.370	20	500	II	-----	4023.976	1	-----	I	-----
3981.148	10	1	I	-----	4024.918	20	-----	I	-----
3981.698	80	3	I	-----	4026.22	1	-----	I	-----
3983.87	3	-----	I	-----	4026.29	2	-----	I	-----
3984.02	20	100	II	-----	4026.470	2	-----	I	-----
3984.83	7	200hl	II	-----	4027.72	1	-----	I	-----
3985.32	1	-----	I	-----	4029.158	30	70	I	II
3985.57	3	-----	I	-----	4030.03	1	-----	I	-----
3985.67	6	-----	I	-----	4030.68	1	-----	I	-----
3987.270	20	-----	I	-----	4031.924	20	2	I	-----
3988.128	4	-----	I	-----	4032.266	300	15	I	2
3988.70	2	-----	I	-----	4033.861	10	40	I	II
3989.28	1	-----	I	-----	4034.48	4	-----	I	-----
3989.37	1	-----	I	-----	4035.65	2	-----	I	-----
3989.48	2	-----	I	-----	4035.76	1	-----	I	-----
3989.61	3	-----	I	-----	4035.888	3	-----	I	-----
3990.00	1	-----	I	-----	4036.15	1	3h	I	II
3990.524	2	-----	I	-----	4037.224	5	-----	I	-----
3991.25	4	-----	I	-----	4037.64	1	-----	I	-----
3991.77	1	-----	I	-----	4038.379	30	2	I	-----
3991.82	2	-----	I	-----	4038.646	20	-----	I	-----
3992.75	40	2	I	-----	4039.56	1	-----	I	-----
3993.35	3	-----	I	-----	4040.35	1	-----	I	-----
3995.99	1	2	II	-----	4041.63	1	-----	I	-----
3996.53	1	-----	I	-----	4041.768	40	2	I	-----
3996.79	15	60	II	-----	4043.571	2	-----	I	-----
3997.09	30	-----	I	-----	4044.370	80	8	I	2
3997.807	20	-----	I	-----	4045.198	6	-----	I	-----
3998.001	15	-----	I	-----	4045.444	5	-----	I	-----
3998.15	2	-----	I	-----	4046.041	3	-----	I	-----
3998.38	5	20hl	II	-----	4046.64	1	-----	I	-----
3998.54	7	40	II	6	4047.600	20	1	I	-----
3999.79	1	-----	I	-----	4047.790	15	-----	I	-----
4001.53	40	2	I	-----	4047.950	10	300hl	II	5
4003.432	3	-----	I	-----	4048.443	2	20hl	II	-----
4003.715	10	1	I	-----	4048.664	40	2	I	-----
4004.385	40	2	I	-----	4049.446	10	100hl	II	6
4004.679	15	1	I	-----	4049.702	30	2	I	II
4005.490	3	-----	I	-----	4050.670	7	60	I	5
4006.480	2	-----	I	-----	4050.883	100	5	I	2
4006.90	1	-----	I	-----	4053.246	40	4	I	-----

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
4054. 686	20	2	I	----	4105. 10	2	----	I	----
4055. 70	1	----	I	----	4105. 58	8	----	I	----
4055. 928	6	----	I	----	4105. 63	8	----	I	----
4057. 439	80	6	I	3	4105. 81	15	1	I	----
4058. 124	2	----	I	----	4106. 553	200	15	I	2
4058. 626	1	----	I	----	4107. 09	4	----	I	----
4060. 085	4	----	I	----	4107. 21	----	6H	I	II
4062. 84	400	60	I	3	4107. 76	1	----	I	II
4063. 754	5	----	I	----	4108. 73	----	6h	I	II
4064. 880	20	1	I	----	4108. 821	7	----	I	----
4066. 21	200	30	I	3	4109. 44	1	----	I	----
4067. 830	100	10	I	1	4109. 52	1	----	I	----
4068. 256	70	3	I	----	4110. 412	2	----	I	----
4070. 168	2	----	I	----	4111. 108	60	3	I	----
4070. 297	3	----	I	----	4111. 946	6	----	I	----
4070. 669	3	----	I	----	4112. 301	3	----	I	II
4071. 006	9	----	I	----	4113. 573	60	150	I	4
4071. 20	5	20hl	II	5	4115. 132	6	----	I	----
4071. 438	4	----	I	----	4115. 88	50	4	I	1
4072. 641	3	----	I	----	4116. 385	10	----	I	----
4072. 885	7	1	I	----	4118. 583	100	8	I	7
4074. 34	1	----	I	----	4118. 882	40	3	I	----
4074. 760	2	----	I	----	4119. 518	10	1	I	----
4074. 92	1	----	I	----	4120. 44	2	----	I	----
4076. 962	4	----	I	----	4120. 96	1	----	I	----
4077. 80	40	2	I	----	4123. 22	1	----	I	----
4078. 413	90	5	I	----	4123. 51	7	60	II	4
4078. 880	7	----	I	----	4125. 071	5	30	II	4
4079. 380	2	----	I	----	4127. 628	10	----	I	----
4080. 442	200	400	II	6	4127. 788	30	200	II	4
4082. 172	5	----	I	----	4129. 11	1	----	I	----
4082. 477	4	----	I	----	4129. 22	3h	----	I	----
4082. 578	3	----	I	----	4130. 42	1	----	I	----
4082. 65	----	8hl	II	----	4131. 64	1	----	I	----
4083. 36	300	30	I	2	4132. 70	15	----	I	----
4086. 194	1	4hl	II	----	4134. 15	1h	----	I	----
4087. 00	2	----	I	----	4136. 13	1h	----	I	----
4087. 942	50	5	I	1	4138. 304	2	----	I	----
4088. 18	9	----	I	----	4138. 64	8	20	II	6
4093. 160	600	1000	II	6	4138. 905	10	1	I	----
4094. 00	10	----	I	----	4139. 44	3	----	I	----
4094. 66	2	----	I	----	4140. 20	2	10	II	----
4094. 93	9	----	I	----	4140. 89	1	----	I	----
4095. 49	30	2	I	----	4141. 720	40	4	I	----
4096. 41	1	----	I	----	4141. 83	2	10	II	4
4097. 140	2	7	II	5	4142. 64	1	----	I	----
4097. 43	1	----	I	----	4142. 824	3	----	I	----
4097. 975	30	2	I	----	4144. 77	3	----	I	----
4099. 17	3	----	I	----	4145. 759	150	15	I	3
4099. 35	2	----	I	----	4147. 84	1	----	I	----
4099. 69	4	----	I	----	4149. 76	1	----	I	----
4100. 13	1	----	I	----	4150. 93	4	----	I	----
4100. 38	1	----	I	----	4152. 17	1	----	I	----
4100. 993	7	----	I	----	4155. 347	20	2	I	----
4101. 464	2	----	I	----	4156. 75	6	10	II	4
4102. 22	2	----	I	----	4157. 64	1	----	I	----
4103. 103	8	----	I	----	4158. 20	3	----	I	----
4103. 578	4	----	I	----	4158. 60	10	----	I	----
4104. 234	150	8	I	2	4158. 910	20	100	II	4
4104. 90	1	----	I	----	4160. 49	1	----	I	----

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
4160. 97	2	-----	I	II	4251. 51	6	-----	I	-----
4162. 404	30	300	I	II	4256. 643	6	-----	I	-----
4162. 706	100	8	I	II	4260. 98	80	8	I	3
4163. 41	5	20	I	II	4262. 72	8	30	I	6
4163. 90	3	-----	I	II	4263. 45	150	15	I	2
4164. 50	1h	-----	I	II	4268. 09	2	20	II	1
4165. 35	4	-----	I	II	4268. 49	4	-----	I	-----
4166. 26	1h	-----	I	II	4269. 256	40	4	I	-----
4167. 24	1	-----	I	II	4269. 695	10	80	II	6
4167. 87	7	-----	I	II	4270. 42	2	-----	I	-----
4168. 08	2	-----	I	II	4272. 854	40	200	II	7
4169. 02	15	-----	I	II	4275. 42	2	-----	I	-----
4170. 997	20	2	I	II	4275. 78	2	-----	I	-----
4171. 248	7	-----	I	II	4276. 305	10	-----	I	-----
4172. 190	8	-----	I	II	4280. 021	10	-----	I	-----
4174. 348	1500	150	I	II	4280. 59	4	-----	I	-----
4177. 522	20	500	I	II	4281. 89	4	-----	I	-----
4177. 81	1	-----	I	II	4283. 34	3h	-----	I	-----
4178. 13	1	-----	I	II	4283. 65	2	-----	I	-----
4179. 51	3	100h	I	II	4287. 26	40	4	I	-----
4180. 61	3	-----	I	II	4287. 98	4	-----	I	-----
4182. 59	2	-----	I	II	4292. 980	10	-----	I	-----
4183. 40	1	-----	I	II	4294. 02	20	2	I	-----
4183. 69	15	1	I	II	4294. 78	300	30	I	1
4184. 29	3	-----	I	II	4296. 45	50	5	I	7
4184. 80	3h	-----	I	II	4299. 698	7	-----	I	-----
4186. 10	1	2	I	II	4300. 03	2	-----	I	-----
4186. 54	3	-----	I	II	4302. 596	4	-----	I	-----
4187. 45	5	-----	I	II	4303. 661	40	3	I	-----
4187. 69	4	20	I	II	4304. 46	1	-----	I	-----
4190. 95	50	5	I	II	4306. 171	15	1	I	-----
4193. 19	6	-----	I	II	4309. 362	20	2	I	-----
4195. 26	10	-----	I	II	4310. 27	1	-----	I	-----
4197. 43	4	-----	I	II	4314. 35	10	-----	I	-----
4201. 55	80	10	I	II	4315. 83	1	-----	I	-----
4201. 75	-----	5	I	II	4317. 51	20	2	I	-----
4206. 566	50	300	I	II	4318. 138	100	10	I	2
4207. 07	20	1	I	II	4319. 51	10	40	II	6
4207. 40	-----	4	I	II	4320. 68	40	200	II	6
4209. 743	100	10	I	II	4321. 342	10	150	II	6
4210. 59	15	-----	I	II	4321. 608	7	-----	I	-----
4212. 72	10	-----	I	II	4323. 50	2	-----	I	-----
4218. 01	2	-----	I	II	4323. 58	2	-----	I	-----
4218. 57	2	-----	I	II	4325. 46	2	-----	I	-----
4218. 83	-----	3	I	II	4327. 51	5	20	II	5
4219. 40	6	-----	I	II	4328. 13	10	-----	I	-----
4220. 45	4	-----	I	II	4328. 84	7	-----	I	-----
4221. 765	15	-----	I	II	4330. 282	150	20	I	2
4223. 54	2	-----	I	II	4333. 75	7	-----	I	-----
4226. 52	3	-----	I	II	4333. 86	30	2	I	-----
4228. 074	100	10	I	II	4334. 63	10	150	II	4
4231. 187	15	1	I	II	4335. 15	10	20	II	5
4232. 42	10	200	I	II	4336. 656	40	500	II	6
4235. 08	3	-----	I	II	4339. 65	15	2	I	-----
4241. 90	1	40	I	II	4340. 30	30	2	I	-----
4245. 168	40	4	I	II	4342. 63	3	-----	I	-----
4245. 85	4	50	I	II	4347. 113	5	-----	I	-----
4246. 20	2	-----	I	II	4347. 59	2	-----	I	-----
4248. 005	4	-----	I	II	4348. 332	15	-----	I	-----
4249. 344	7	80	I	II	4349. 736	50	3	I	-----

TABLE 1. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
4350. 506	30	400	II	6	4428. 459	7	-----	I	-----
4351. 172	30	2	I	-----	4429. 17	1	-----	I	-----
4352. 567	60	7	I	1	4429. 60	4	-----	I	-----
4353. 36	30	5	I	-----	4430. 652	15	-----	I	-----
4354. 05	10	1	I	-----	4431. 155	4	-----	I	-----
4354. 16	10	-----	I	-----	4431. 86	4	-----	I	-----
4356. 306	300	40	I	3	4432. 024	7	-----	I	-----
4357. 000	60	7	I	-----	4432. 14	3	-----	I	-----
4358. 70	5	-----	I	-----	4432. 78	1	-----	I	-----
4359. 90	1	-----	I	-----	4434. 123	10	-----	I	-----
4360. 19	7	-----	I	-----	4434. 340	20	-----	I	-----
4360. 32	10	2	I	-----	4435. 63	3	-----	I	-----
4362. 12	20	2	I	-----	4435. 95	3	-----	I	-----
4362. 85	3	-----	I	-----	4437. 44	6	-----	I	-----
4365. 377	60	6	I	2	4438. 038	200	30	I	7
4365. 679	3	40	II	6	4442. 40	3	-----	I	-----
4367. 893	70	150	II	5	4443. 076	50	10	I	7
4368. 83	5	-----	I	-----	4443. 74	15	-----	I	-----
4370. 02	2	-----	I	-----	4444. 07	1	-----	I	-----
4370. 948	80	300	II	7	4445. 92	4	-----	I	-----
4374. 44	2	-----	I	-----	4448. 086	15	-----	I	-----
4376. 58	15	1	I	-----	4448. 41	1	-----	I	-----
4379. 064	40	3	I	-----	4448. 76	2	10H1	I	-----
4379. 175	50	3	I	1	4452. 67	6	40	II	7
4380. 70	7	-----	I	-----	4452. 92	80	8	I	3
4380. 966	7	-----	I	-----	4453. 728	10	-----	I	-----
4382. 429	5	-----	I	-----	4454. 582	7	-----	I	-----
4383. 88	2	-----	I	-----	4457. 347	300	40	I	2
4384. 180	9	-----	I	-----	4459. 992	15	1	I	-----
4384. 629	7	-----	I	-----	4461. 181	200	30	I	1
4385. 490	8	30	II	4	4462. 465	10	-----	I	-----
4386. 075	4	-----	I	-----	4464. 29	5	-----	I	-----
4386. 668	3	-----	I	-----	4465. 196	2	-----	I	-----
4389. 926	15	1	I	-----	4466. 39	15	150	II	5
4390. 720	20	2	I	-----	4466. 88	1	-----	I	-----
4391. 27	20	2	I	-----	4468. 882	10	-----	I	-----
4392. 10	1	10H1	II	-----	4468. 96	2	-----	I	-----
4392. 311	15	1	I	-----	4473. 042	20	3	I	-----
4396. 528	4	-----	I	-----	4473. 313	15	1	I	-----
4397. 14	3	10	II	4	4473. 72	1	-----	I	-----
4397. 382	4	-----	I	-----	4474. 063	5	-----	I	-----
4397. 69	5	-----	I	-----	4474. 511	15	2	I	-----
4402. 59	-----	3	II	-----	4477. 60	5	-----	I	-----
4403. 62	2	-----	I	-----	4478. 824	3	-----	I	-----
4404. 14	20	3	I	-----	4478. 94	2	-----	I	-----
4406. 98	3	-----	I	-----	4480. 044	4	-----	I	-----
4407. 84	2	-----	I	-----	4481. 38	1	-----	I	-----
4407. 96	3	-----	I	-----	4482. 20	10	-----	I	-----
4408. 81	1	3h	II	-----	4482. 57	2	-----	I	-----
4412. 386	20	3	I	-----	4482. 86	1	-----	I	-----
4415. 33	1	-----	I	-----	4483. 28	3	20	II	7
4416. 19	40	3	I	2	4483. 61	2	-----	I	-----
4417. 37	60	300	II	7	4485. 253	15	2	I	-----
4417. 91	150	20	I	7	4486. 126	40	150	II	6
4418. 247	70	9	I	3	4486. 612	3	80hl	II	6
4418. 60	10	-----	I	-----	4487. 057	2	-----	I	-----
4419. 76	3	-----	I	-----	4488. 00	1	-----	I	-----
4422. 26	60	6	I	-----	4489. 03	1	-----	I	-----
4422. 80	90	400	II	5	4490. 580	10	70	II	5
4426. 18	4	50hl	II	5	4490. 90	1	-----	I	-----

TABLE 1. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
4491.37	1	----	I	----	4550.16	40	3	I	7
4492.16	30	2	I	2	4550.576	8	1	I	----
4493.23	2	----	I	----	4553.776	80	8	I	7
4494.235	3	----	I	----	4556.85	9	----	I	----
4495.08	1	----	I	----	4559.76	20	2	I	3
4495.83	2	----	I	----	4561.12	2	----	I	----
4496.474	10	----	I	----	4561.57	2	----	I	----
4497.52	1	----	I	----	4561.84	1	----	I	----
4498.94	8	----	I	----	4562.638	15	1	I	7
4499.662	50	5	I	3	4563.75	1	30hl	II	7
4501.49	3	----	I	----	4565.95	300	50	I	1
4501.78	2h	----	I	----	4569.910	7	----	I	----
4502.01	4	----	I	----	4570.510	8	----	I	----
4503.095	15	----	I	----	4570.680	10	150hl	II	4
4504.01	1	----	I	----	4573.80	20	100	II	4
4504.328	4	----	I	----	4575.05	1	----	I	----
4506.669	15	2	I	----	4576.60	1	----	I	----
4508.874	2	5	II	----	4577.06	1	----	I	----
4510.52	1	----		I	4577.78	2	----	I	----
4510.96	2	----	I	----	4578.18	2	----	I	----
4511.970	3	----	I	----	4579.05	2	----	I	----
4512.51	1	----	I	----	4579.38	8	----	I	----
4512.60	1	----	I	----	4581.030	10	----	I	----
4512.87	1	----	I	----	4582.08	1	----	I	----
4513.62	2h	----	I	----	4582.26	1	----	I	----
4514.35	2	----	I	----	4583.53	1	----	I	----
4514.603	5	----	I	----	4583.86	2	----	I	----
4517.068	10	----	I	----	4585.00	1	----	I	----
4517.32	3	----	I	----	4585.10	2	----	I	----
4518.305	50	5	I	3	4586.240	20	70	II	6
4518.98	3	60h	II	6?	4588.22	5	----	I	----
4519.69	2	----		I	4588.81	1	----	I	----
4520.587	30	4	I	7	4589.13	3	----	I	----
4521.477	4	----	I	----	4590.537	40	4	I	----
4522.182	8	1	I	----	4592.70	1	----	I	----
4523.32	4	----	I	----	4597.945	60	6	I	7
4523.575	4	----	I	----	4598.801	300	30	I	2
4524.728	10	200	II	6	4598.92	200	20	I	----
4525.92	15	----		I	4599.44	15	150	II	6
4527.31	1	----	I	----	4602.61	2	40hl	II	4
4527.67	1	----	I	----	4602.75	30	4	I	----
4527.95	2	----	I	----	4603.524	15	----	I	----
4530.133	12	----	I	----	4604.97	3hl	----	I	----
4531.14	1	----	I	----	4605.309	4	----	I	----
4531.87	1d	----	I	----	4605.782	20	80	II	5
4532.74	2	----	I	----	4606.07	4hl	----	I	----
4533.165	30	100	I	II	4606.75	6	----	I	----
4534.77	1	----	I	II	4606.91	5	20Hl	II	----
4535.37	10	100	I	II	4607.48	5h	----	I	----
4537.548	10	----	I	----	4608.093	100	10	I	1
4539.76	3	7	II	----	4610.288	2	----	I	----
4540.934	200	20		I	4611.63	1d	----	I	----
4541.29	10	60	II	----	4612.29	9	----	I	----
4541.71	40	4		I	4613.222	3	----	I	----
4543.01	20	3	I	----	4613.744	15	300	II	6
4544.02	100	10	I	7	4614.192	40	4	I	----
4544.775	1	----	I	----	4614.60	10	1	I	----
4546.90	10	1	I	----	4617.78	2	----	I	----
4546.98	15	2	I	7	4619.52	20	2	I	7
4547.87	30	2	I	3	4620.862	300	30	I	2

TABLE 1. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
4622.705	20	300	II	6	4692.706	4	-----	I	-----
4626.36	7	20	II	5	4693.422	5	-----	I	-----
4627.07	3h	-----	I	-----	4693.56	5	-----	I	-----
4629.002	7	-----	I	-----	4695.49	1	-----	I	-----
4630.608	40	-----	I	3	4698.439	8	-----	I	-----
4632.042	10	-----	I	-----	4699.008	150	30	I	II
4633.25	1	-----	I	-----	4699.716	15	300	I	II
4635.60	2	-----	I	-----	4700.30	1	-----	I	-----
4636.52	15	-----	I	-----	4702.89	2	-----	I	-----
4637.06	1	-----	I	-----	4703.116	1	4	II	-----
4637.16	1	-----	I	-----	4703.60	12	100	II	5
4637.39	1	-----	I	-----	4704.21	4	-----	I	-----
4640.12	10	200	II	5	4706.06	12	-----	I	-----
4642.25	30	4	I	1	4707.59	2	-----	I	-----
4643.14	3h	-----	I	-----	4708.053	30	4	I	7
4643.61	1	-----	I	-----	4708.85	40	5	I	3
4644.57	1	-----	I	-----	4709.762	15	2	I	-----
4645.23	1	-----	I	-----	4711.022	12	-----	I	-----
4645.40	3	-----	I	-----	4712.205	20	2	I	-----
4647.47	2	-----	I	-----	4712.296	10	-----	I	-----
4648.35	10	-----	I	3	4713.47	2	10	II	-----
4650.59	20	2	I	7	4713.68	3	-----	I	-----
4650.94	5	-----	I	-----	4713.82	1	-----	I	-----
4651.13	1	-----	I	-----	4714.67	1	-----	I	II
4651.766	5	-----	I	-----	4714.99	6	20	II	6
4652.258	20	2	I	-----	4716.42	2	-----	I	-----
4655.198	300	50	I	3	4717.43	30	2	I	II
4655.53	5	30h	II	-----	4719.11	30	200	I	II
4659.219	4	40	II	6	4720.25	2	-----	I	-----
4660.86	6	-----	I	-----	4720.86	7	-----	I	-----
4661.75	3	-----	I	-----	4721.32	2	-----	I	-----
4663.187	8	-----	I	-----	4721.71	50	5	I	2
4664.134	60	400	II	4	4722.46	2	-----	I	-----
4667.292	30	2	I	-----	4722.95	3	-----	I	-----
4668.23	1	-----	I	-----	4724.21	2	-----	I	-----
4669.245	50	7	I	3	4724.54	1	-----	I	-----
4670.94	20	2	I	3	4725.60	2	-----	I	-----
4671.82	2	-----	I	-----	4727.567	5	-----	I	-----
4672.43	3	10	II	-----	4728.42	6	-----	I	-----
4673.176	20	2	I	0	4729.37	1	-----	I	-----
4673.318	8	-----	I	-----	4729.81	3	-----	I	-----
4675.454	7	150hl	II	5	4730.396	7	-----	I	-----
4676.71	3	-----	I	-----	4730.648	15	-----	I	-----
4677.35	2	-----	I	-----	4731.36	20	200	II	4
4677.61	2	-----	I	-----	4731.72	1	-----	I	-----
4678.43	1	-----	I	-----	4733.72	3	15	II	5
4681.22	1	-----	I	-----	4734.29	3	-----	I	-----
4681.86	8	-----	I	-----	4735.51	40	4	I	-----
4682.29	1	-----	I	-----	4735.66	10	30	II	6
4682.66	4	70	II	4	4735.88	3	15	II	-----
4683.94	40	6	I	-----	4737.67	4	-----	I	-----
4684.33	4	-----	I	-----	4738.112	20	3	I	-----
4685.36	2	-----	I	-----	4738.23	4	-----	I	-----
4686.388	30	4	I	-----	4738.574	80	10	I	2
4687.155	8	-----	I	-----	4739.83	40	4	I	-----
4687.42	4	-----	I	-----	4741.02	10	-----	I	-----
4688.37	40	8	I	-----	4741.13	4	-----	I	-----
4688.99	4	-----	I	-----	4742.530	10	-----	I	-----
4690.48	1	-----	I	-----	4742.92	1	-----	I	-----
4691.453	9	-----	I	-----	4743.20	1	-----	I	-----

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
4746.78	6	-----	I	-----	4808.70	10	-----	I	-----
4748.35	10	-----	I	-----	4809.189	5	30	II	-----
4748.409	15	1	I	-----	4810.11	3	-----	I	-----
4748.89	1	-----	I	-----	4811.146	40	5	I	1
4749.39	1	6	II	-----	4812.19	1h	-----	I	-----
4750.66	7	-----	I	-----	4813.500	7	-----	I	-----
4751.492	15	-----	I	-----	4814.62	1	-----	I	-----
4753.124	10	-----	I	-----	4814.79	2	-----	I	-----
4753.89	3	-----	I	-----	4814.91	2	-----	I	-----
4753.97	4	-----	I	-----	4817.227	20	400	II	4
4756.08	3d	-----	I	-----	4818.84	100	15	I	2
4756.35	2	-----	I	-----	4822.43	1	-----	I	-----
4756.94	1h	-----	I	-----	4823.80	3	-----	I	-----
4757.611	50	5	II	7	4823.98	1	-----	I	-----
4758.789	6	-----	I	-----	4824.38	3	-----	I	-----
4760.55	5	100hl	II	6	4824.50	2	-----	I	-----
4760.907	7	-----	I	-----	4825.37	2h	-----	I	-----
4765.75	5	80	II	-----	4825.85	1	6hl	II	-----
4766.507	100	10	I	7	4826.50	1	-----	I	-----
4768.23	2h	-----	I	-----	4826.89	1	10hl	II	-----
4769.372	20	2	I	3	4827.57	1h	-----	I	-----
4769.83	1	-----	I	-----	4828.58	1h	-----	I	-----
4770.58	1	-----	I	-----	4828.97	5	-----	I	-----
4771.262	4	-----	I	-----	4830.45	3H	-----	I	-----
4773.262	15	2	I	-----	4832.25	-----	5hl	II	-----
4773.72	150	20	I	7	4834.20	80	10	I	3
4774.904	30	4	I	7	4834.78	-----	20hl	II	-----
4774.994	7	-----	I	-----	4835.32	7	-----	I	-----
4776.50	1	-----	I	-----	4837.238	150	20	I	2
4777.216	20	2	I	1	4837.80	12	1	I	-----
4779.66	6	-----	I	-----	4838.740	8	-----	I	-----
4782.737	200	50	I	1	4838.79	6	-----	I	-----
4783.392	3	-----	I	-----	4839.12	2	-----	I	-----
4783.83	3	-----	I	-----	4839.29	1	-----	I	-----
4784.80	5	-----	I	-----	4839.82	7	-----	I	-----
4785.17	2	-----	I	-----	4841.51	3H	-----	I	-----
4786.16	1	-----	I	-----	4842.185	15	1	I	-----
4787.42	3	-----	I	-----	4842.984	3	-----	I	-----
4787.52	1	-----	I	-----	4844.00	15	50	II	5
4787.62	1	-----	I	-----	4844.19	10	-----	I	-----
4788.966	7	-----	I	II	4846.02	1	-----	I	-----
4790.73	10	300	I	I	4846.91	1	-----	I	-----
4791.26	7	-----	I	-----	4848.458	5	150	II	4
4791.588	9	-----	I	-----	4849.19	1	-----	I	-----
4792.45	1	-----	I	-----	4850.60	40	4	I	7?
4793.11	5h	-----	I	-----	4851.69	1	-----	I	-----
4793.52	3	-----	I	-----	4852.53	5	-----	I	-----
4794.00	4h	-----	I	-----	4853.58	1	-----	I	-----
4794.89	3h	-----	I	-----	4853.993	3	-----	I	-----
4795.98	15	2	I	3	4857.01	1	5h	II	-----
4796.88	2	-----	I	-----	4857.17	1	-----	I	-----
4797.69	3	-----	I	-----	4858.42	70	7	I	1
4798.49	1	-----	I	-----	4859.24	200	30	I	7
4800.50	500	100	I	2	4860.52	3	8hl	II	-----
4804.05	2	-----	I	-----	4860.91	2	-----	I	-----
4805.076	10	-----	I	-----	4861.51	10	-----	I	-----
4805.27	4	-----	I	-----	4863.282	150	20	I	2
4805.55	1	-----	I	-----	4864.17	2	-----	I	-----
4805.723	3	-----	I	-----	4865.08	2	-----	I	-----
4807.14	15	80	II	6	4865.43	4	100	II	4

TABLE I. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
4865. 546	2	-----	I	-----	4925. 214	15	1	I	-----
4865. 82	1	-----	I	-----	4926. 189	30	2	I	-----
4866. 33	3	-----	I	-----	4926. 594	10	2	I	-----
4868. 84	1	-----	I	-----	4926. 983	8	30	II	4
4872. 949	50	5	I	1	4927. 15	2	-----	I	-----
<i>A</i>									
4875. 63	1	-----	I	-----	4927. 60	2h	-----	I	-----
4875. 76	1	-----	I	-----	4928. 194	6	-----	I	-----
4875. 92	2	-----	I	-----	4929. 55	1	-----	I	-----
4877. 587	150	20	I	7	4932. 260	7	-----	I	2
4878. 166	20	4	I	7	4934. 458	30	150	II	4
4881. 27	1	-----	I	-----	4934. 595	6	-----	I	-----
4881. 74	3	-----	I	-----	4936. 35	3	-----	I	-----
4882. 48	2	-----	I	-----	4937. 810	5	-----	I	-----
4882. 649	2	8hl	II	-----	4938. 717	3	-----	I	-----
4883. 21	1	15hl	II	-----	4942. 74	1	-----	I	-----
4883. 66	2	-----	I	-----	4943. 42	15	2	I	7
4884. 258	10	-----	I	-----	4944. 82	10	1	I	-----
4884. 65	10	-----	I	-----	4945. 370	7	40	II	5
4885. 69	2	40hl	II	4	4945. 84	3	-----	I	-----
4886. 47	4	-----	I	-----	4947. 336	15	2	I	3
4886. 84	1	-----	I	-----	4948. 951	100	15	I	3
4887. 73	1	-----	I	-----	4950. 02	3h	-----	I	-----
4888. 05	3	-----	I	-----	4950. 36	1	-----	I	-----
4889. 609	7	1	I	-----	4950. 69	2	-----	I	-----
4889. 932	20	2	I	2	4951. 095	4	-----	I	-----
4890. 754	6	-----	I	-----	4955. 65	1	-----	I	-----
4892. 993	5	-----	I	-----	4955. 94	1	-----	I	-----
4893. 62	2	-----	I	-----	4956. 813	5	-----	I	-----
4894. 82	1	-----	I	-----	4958. 24	2	-----	I	-----
4895. 086	5	-----	I	-----	4960. 074	5	-----	I	-----
4895. 301	6	-----	I	-----	4960. 32	1	-----	I	-----
4895. 48	1	-----	I	-----	4960. 53	-----	4h	II	-----
4896. 34	40	4	I	3	4962. 381	50	6	I	1
4897. 26	2	-----	I	-----	4964. 740	4	-----	I	-----
4898. 38	1	-----	I	-----	4965. 28	2	-----	I	-----
4898. 73	3	-----	I	-----	4965. 83	2	-----	I	-----
4900. 179	8	1	I	-----	4966. 03	1	-----	I	-----
4901. 356	6	-----	I	-----	4967. 616	5	-----	I	-----
4901. 44	4	-----	I	-----	4975. 26	400	50	I	7
4901. 767	5	-----	I	-----	4978. 724	4	-----	I	-----
4903. 06	20	2	I	2	4981. 73	2	-----	I	-----
4904. 480	7	300h	II	4	4982. 72	2h	-----	I	-----
4906. 17	8	1	I	-----	4983. 07	1h	-----	I	-----
4906. 400	6	2	I	7	4983. 70	3h	-----	I	-----
4907. 079	6	-----	I	-----	4984. 766	3	15	II	6
4907. 244	6	-----	I	-----	4985. 17	2	-----	I	-----
4907. 33	3	15h	II	6	4985. 33	3	-----	I	-----
4907. 56	3	-----	I	-----	4986. 37	1	-----	I	-----
4908. 30	1	-----	I	-----	4986. 55	1	-----	I	-----
4910. 10	30	2	I	2	4987. 28	1	-----	I	-----
4911. 40	1	-----	I	-----	4988. 712	2	-----	I	-----
4912. 11	5	-----	I	-----	4988. 88	1	-----	I	-----
4914. 888	7	-----	I	-----	4991. 06	1	-----	I	-----
4915. 32	40	6	I	3	4994. 795	4h	-----	I	-----
4916. 98	8	-----	I	-----	4995. 831	2	-----	I	-----
4918. 094	4	-----	I	-----	4998. 03	4hs	-----	I	-----
4920. 16	2	-----	I	-----	4998. 76	1	-----	I	-----
4920. 95	10	40Hl	II	7	4999. 21	7	-----	I	-----
4923. 92	2	-----	I	-----	4999. 702	30	100	II	5
4924. 54	1	-----	I	-----	5000. 54	20	2	I	3

TABLE 1. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
5000.81	1	----	I	----	5082.21	3	----	I	----
5001.96	3	----	I	----	5082.770	2	----	I	----
5002.06	2h	----	I	----	5084.74	1	----	I	----
5004.50	1	----	I	----	5085.07	2	----	I	----
5005.18	2	----	I	----	5086.482	4	----	I	----
5007.21	1	----	I	----	5086.96	10	1	I	----
5007.94	2	----	I	----	5087.37	2	----	I	----
5008.068	3	----	I	----	5087.46	2	----	I	----
5011.01	1h	----	I	----	5089.50	1	----	I	----
5012.185	10	1	I	----	5090.876	15	2	I	3
5012.89	1h	----	I	----	5090.996	6	----	I	----
5013.82	1	8H1	I	II	5091.28	3	----	I	----
5014.28	1	----	I		5093.698	5	----	I	----
5018.20	200	20	I	----	5094.117	2	----	I	----
5021.13	40	5	I	----	5094.683	5	----	I	----
5021.745	40	5	I	----	5096.21	1	----	I	----
5023.09	70	5	I	----	5097.40	1	----	I	----
5025.91	15	1	I	----	5097.74	2	----	I	----
5029.46	3	----	I	----	5098.80	2	----	I	----
5029.71	2	----	I	----	5100.64	60	4	I	1
5929.99	1h	----	I	----	5101.668	40	4	I	1
5033.32	1	----	I	----	5102.634	2	----	I	----
5034.14	2	----	I	----	5105.64	1	----	I	----
5034.33	4	30	I	II	5107.319	4	----	I	----
5034.92	30	3	I		5108.55	1	----	I	----
5035.50	1	----	I	----	5109.04	1h	----	I	II
5035.899	6	----	I	----	5110.56	2	50hl	I	4
5037.74	9	----	I	----	5111.148	20	2	I	----
5038.08	3	----	I	----	5112.130	100	10	I	1
5039.15	3	----	I	----	5117.09	10	----	I	----
5040.202	15	----	I	----	5122.727	4	----	I	----
5040.815	50	400	I	II	5126.81	3	----	I	----
5042.30	1	----	I		5127.05	-----	5h	I	II
5043.102	2	----	I	----	5128.116	8	----	I	----
5047.440	300	30	I	----	5128.504	20	100	I	4
5049.915	1	20h	I	II	5128.96	-----	6hl	I	----
5051.319	50	3	I		5130.28	1	----	I	----
5053.68	2	----	I	----	5131.38	1	----	I	----
5055.93	2	----	I	----	5133.10	15	----	I	----
5056.89	10	----	I	----	5133.66	1	----	I	----
5057.037	5	80h	II	----	5135.81	5	----	I	----
5058.166	7	40	II	----	5136.20	30	2	I	1
5058.778	4	----	I	----	5136.52	2	----	I	----
5060.584	5	----	I	----	5137.86	1	----	I	----
5061.80	3h	----	I	----	5139.51	5h	----	I	----
5064.15	3h	----	I	----	5140.202	4	----	I	----
5064.67	2	----	I	----	5141.044	5	----	I	----
5067.65	2h	----	I	----	5141.19	2	----	I	----
5068.62	-----	7H1	II	----	5141.81	2h	----	I	----
5069.810	20	1	I	----	5142.997	9	----	I	----
5071.21	5	40	I	II	5144.30	2	----	I	----
5072.295	8	1	I		5145.22	2h	----	I	----
5073.131	4	----	I	----	5145.72	2	----	I	----
5074.72	1	7H1	II	----	5146.14	1	7hl	I	II
5075.920	10	50	II	----	5147.401	7	----	I	----
5076.29	2	----	I	----	5148.62	1h	----	I	----
5077.614	6	----	I	----	5148.899	8	----	I	----
5079.629	20	300	II	----	5153.122	40	4	I	4
5080.406	2	40	II	----	5156.04	1	50hl	I	6
5081.77	10	1	I	----	5157.21	5	----	I	----

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
5157. 95	200	20	I	1	5241. 697	4	----	I	----
5160. 05	2	----	I	----	5243. 460	40	3	I	----
5161. 570	15	2	I	----	5243. 984	250	30	I	1
5162. 32	1	----	I	----	5244. 67	50	4	I	7
5164. 15	2	----	I	----	5247. 031	40	3	I	----
5164. 516	2	50hl	II	6	5247. 130	15	400	II	7
5166. 390	20	2	I	3	5249. 12	1	----	I	----
5167. 376	30	4	I	2	5250. 11	2	----	I	----
5168. 23	2	----	I	----	5251. 309	7	----	I	----
5170. 173	100	20	I	1	5252. 452	9	1	I	----
5171. 02	10h	----	I	----	5252. 91	2	----	I	----
5171. 44	3h	----	I	----	5253. 615	10	1	I	----
5171. 76	2h	----	I	----	5254. 48	20	3	I	2
5172. 15	2	----	I	----	5255. 09	2	----	I	----
5172. 67	2	----	I	----	5255. 464	15	----	I	7
5173. 162	15	2	I	7	5255. 71	----	8hl	II	----
5176. 614	1	----	I	----	5258. 736	40	5	I	3
5177. 644	10	1	I	----	5260. 43	30	150	II	7
5177. 860	4	----	I	----	5262. 60	4	----	I	----
5178. 02	2	----	I	----	5264. 942	40	300	II	6
5181. 87	300	60	I	2	5266. 72	1	----	I	----
5182. 90	8	----	I	----	5268. 37	1	----	I	----
5184. 295	20	2	I	3	5268. 88	2	----	I	----
5186. 13	3h	----	I	----	5271. 38	2	----	I	----
5186. 825	50	10	I	7	5272. 53	8	----	I	----
5187. 732	20	150	II	4	5274. 018	8	1	I	----
5189. 38	4h	----	I	----	5275. 04	150	20	I	7
5190. 28	1	----	I	----	5275. 81	3h	----	I	----
5191. 168	4	----	I	----	5276. 22	1	----	I	----
5191. 46	2	----	I	----	5276. 355	1	20H1	II	7
5192. 234	7	----	I	----	5277. 16	10	1	I	----
5192. 58	1	----	I	----	5280. 03	1	----	I	----
5192. 99	1	----	I	----	5281. 07	3	----	I	----
5193. 63	3	----	I	----	5284. 06	1	----	I	----
5194. 567	7	20h	II	6	5284. 28	1	----	I	----
5196. 46	1	----	I	----	5284. 591	10	1	I	----
5199. 545	10	1	I	1	5286. 098	70	7	I	3
5200. 866	20	2	I	1?	5288. 40	1	----	I	----
5208. 84	15	2	I	----	5289. 97	3	100hl	II	1
5212. 045	3	----	I	----	5290. 212	10	1	I	----
5212. 325	7	1	I	----	5290. 812	20	2	I	1
5214. 549	1	8h	II	----	5292. 783	30	3	I	1
5216. 40	3	----	I	----	5294. 870	300	30	I	7
5217. 26	2	----	I	----	5298. 063	70	500	II	7
5220. 201	1	----	I	----	5299. 84	10	60	II	6
5222. 43	10	1	I	7	5300. 09	4	----	I	----
5225. 23	6	----	I	----	5300. 18	1	----	I	----
5225. 755	4	----	I	----	5303. 35	2	----	I	----
5226. 03	1h	----	I	----	5304. 178	40	4	I	3
5226. 64	1h	----	I	----	5304. 44	1	----	I	----
5226. 89	1h	----	I	----	5305. 83	4	----	I	----
5227. 30	2h	----	I	----	5307. 812	60	8	I	2
5229. 594	6	----	I	----	5309. 681	100	15	I	2
5230. 04	1h	----	I	----	5311. 598	80	500	II	7
5232. 315	3	----	I	----	5314. 016	2	----	I	----
5239. 15	1	----	I	----	5315. 578	7	----	I	----
5240. 05	1	----	I	----	5315. 928	15	1	I	3
5240. 424	10	1	I	----	5316. 888	6	----	I	----
5240. 90	1	----	I	----	5317. 82	2	----	I	----
5241. 040	3	----	I	----	5320. 22	2	----	I	----

TABLE 1. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
5322.365	9	----	I	----	5405.23	2	----	I	----
5324.035	7	----	I	----	5410.27	2	----	I	----
5324.25	15	100hl	II	5	5411.806	2	----	I	----
5324.59	2	----	I	----	5412.17	4	----	I	----
5324.78	1	----	I	----	5415.99	1	----	I	----
5327.31	1	----	I	----	5418.75	1	----	I	----
5327.89	3	----	I	----	5419.305	3	----	I	----
5328.89	10	----	I	----	5420.408	2	15hl	II	6
5330.85	1	----	I	----	5420.84	1	----	I	----
5331.94	2	----	I	----	5421.21	2	----	I	----
5332.40	1	----	I	----	5421.91	1	----	I	----
5334.34	6	1	I	----	5423.37	1	----	I	----
5337.10	2	----	I	----	5423.981	60	9	I	2
5338.386	8	1	I	----	5426.35	1h	----	I	----
5340.027	2	----	I	----	5428.304	15	2	I	----
5341.48	1	----	I	----	5430.034	2	15hl	II	5
5341.956	2	----	I	----	5430.17	1	----	I	----
5343.75	1	----	I	----	5430.708	7	----	I	----
5343.99	1	----	I	----	5432.732	2	----	I	----
5344.31	1	----	I	----	5433.190	6	----	I	----
5344.93	1	----	I	----	5433.728	7	----	I	----
5345.40	1	----	I	----	5434.20	1	----	I	----
5346.283	10	400	II	6	5434.74	6	----	I	----
5347.00	1	----	I	----	5434.970	6	----	I	----
5347.65	1	----	I	----	5435.781	30	4	I	7
5348.394	15	70	II	6	5438.75	100	10	I	2
5349.774	4	----	I	----	5439.698	15	2	I	----
5354.724	200	40	I	1	5441.93	2h	----	I	----
5357.355	10	----	I	----	5442.565	5	----	I	----
5358.338	40	6	I	2	5442.950	3	----	I	----
5358.54	4	----	I	----	5444.055	15	200	II	7
5360.33	2	----	I	----	5445.06	1	----	I	----
5361.02	1	----	I	----	5445.23	1	----	I	----
5361.35	1	15hl	II	6	5448.55	1	----	I	----
5361.466	3	----	I	----	5448.86	1	2h	II	----
5366.764	2	----	I	----	5450.42	1	----	I	----
5368.52	20	2	I	7	5450.56	1	----	I	----
5370.804	9	1	I	----	5450.978	3	----	I	----
5371.112	15	2	I	----	5451.50	1	----	I	----
5371.767	2	30hl	II	4	5452.02	2h	----	I	----
5373.863	300	50	I	2	5452.92	300	30	I	7
5376.302	10	1	I	7	5456.542	7	----	I	----
5381.02	2	----	I	----	5463.31	150	20	I	7
5382.083	2	----	I	----	5463.36	10	100	II	5
5383.04	40	4	I	1	5465.73	20	2	I	3
5384.65	3h	----	I	----	5467.32	10	1	I	1
5385.26	2	----	I	----	5468.66	1	----	I	----
5385.37	2	----	I	----	5470.149	6	----	I	----
5389.336	100	20	I	7	5470.66	1	----	I	----
5391.343	10	60	II	6	5471.290	3	----	I	----
5391.59	3	----	I	----	5474.54	1	4h?	II	----
5393.122	8	----	I	----	5480.633	2	----	I	----
5394.896	20	3	I	2	5480.83	1	----	I	----
5396.11	4	----	I	----	5485.778	8	----	I	----
5397.484	3	----	I	----	5486.12	2	----	I	----
5398.655	10	1	I	3	5486.72	1	----	I	----
5399.40	1	----	I	----	5488.40	3	----	I	----
5403.60	2h	----	I	----	5488.87	2	----	I	----
5404.457	50	7	I	3	5490.48	1	----	I	----
5405.12	1	----	I	----	5491.87	1	----	I	----

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
5492. 287	3	-----	I	-----	5568. 76	1	-----	I	-----
5492. 56	1	-----	I	-----	5569. 61	3	-----	I	-----
5492. 89	1	-----	I	-----	5572. 30	4	-----	I	-----
5493. 212	3	60hl	II	4	5573. 529	6	-----	I	-----
5494. 54	2	-----		-----	5575. 158	8	-----	I	-----
5497. 301	50	5	I	2	5575. 857	200	30	I	3
5498. 70	1	-----	I	-----	5578. 008	15	2	I	3
5501. 01	1	-----	I	-----	5578. 35	1	-----	I	-----
5501. 53	4	-----	I	-----	5579. 90	1	-----	I	-----
5502. 63	10	1	I	-----	5580. 148	8	-----	I	-----
5503. 294	20	2	I	-----	5580. 69	1	-----	I	-----
5506. 20	1	-----	I	-----	5581. 45	9	1	I	-----
5510. 116	60	6	I	1	5583. 934	10	1	I	-----
5510. 436	40	7	I	7	5585. 013	2	-----	I	-----
5512. 302	10	1	I	-----	5589. 54	1	-----	I	-----
5513. 28	1	-----	I	-----	5590. 691	3	9hl	II	6
5513. 97	1	-----	I	-----	5594. 98	1	-----		-----
5514. 998	3	10	II	5	5595. 60	5	-----	I	-----
5516. 75	1	-----		-----	5595. 73	3	-----	I	-----
5517. 09	2	-----	I	-----	5597. 546	8	-----	I	-----
5517. 73	1	-----	I	-----	5599. 08	5	-----	I	-----
5518. 443	10	1	I	-----	5599. 42	1	-----	I	-----
5520. 01	10	1	I	1	5600. 192	6	-----	I	-----
5521. 75	5	-----	I	-----	5600. 762	60	6	I	2
5522. 05	-----	2h	II	-----	5601. 15	3	-----	I	-----
5522. 554	20	2	I	7	5602. 03	1	-----	I	-----
5522. 84	1	-----	I	-----	5606. 07	1	-----	I	-----
5523. 55	3	-----	I	-----	5606. 613	20	2	I	3
5524. 348	40	200	II	5	5609. 05	2	-----	I	-----
5524. 95	10	1	I	-----	5609. 38	2	-----	I	-----
5525. 01	10	-----	I	-----	5611. 61	6	-----	I	-----
5525. 631	7	1	I	-----	5613. 259	400	70	I	7
5529. 01	20	-----	I	-----	5614. 004	80	10	I	?
5530. 268	30	2	I	7	5615. 63	2	-----	I	-----
5531. 19	1	-----	I	-----	5615. 84	1	-----	I	-----
5531. 334	5	-----	I	-----	5618. 57	2	-----	I	-----
5532. 23	5	-----	I	-----	5624. 45	1	-----	I	-----
5534. 638	8	1	I	3	5625. 66	1	-----	I	-----
5535. 31	1	-----	I	-----	5628. 293	40	4	I	1
5535. 47	2	-----	I	-----	5630. 10	1	-----	I	-----
5538. 023	200	20	I	-----	5631. 13	1	-----	I	II
5538. 275	150	15	I	-----	5631. 319	2	20hl	I	
5538. 559	20	2	I	-----	5631. 55	3	-----	I	-----
5539. 51	1	-----	I	-----	5631. 93	1	4	I	II
5541. 03	1	-----	I	-----	5632. 84	3	-----	I	
5541. 920	15	2	I	3	5633. 02	2	-----	I	-----
5545. 26	1	-----	I	-----	5633. 450	20	2	I	1
5545. 609	4	-----	I	-----	5633. 95	10	-----	I	-----
5547. 83	-----	8hl	II	-----	5634. 45	3h	-----	I	-----
5548. 127	9	1	I	-----	5635. 81	2h	-----	I	-----
5550. 61	1000	100	I	3	5635. 92	2h	-----	I	II
5552. 128	1000	100	I	1	5636. 570	2	8h	I	
5561. 69	3	-----	I	-----	5637. 555	2	-----	I	-----
5561. 77	2	-----	I	-----	5638. 51	1	-----	I	-----
5563. 19	3	-----	I	-----	5641. 39	1	-----	I	-----
5563. 32	2	-----	I	II	5642. 65	1	-----	I	-----
5565. 54	2	20hl	6	5644. 67	30	3	I	1	
5566. 87	2	-----	I	-----	5645. 61	3	-----	I	-----
5567. 22	1	-----	I	-----	5648. 563	5	-----	I	-----
5568. 44	2	-----	I	-----	5649. 229	2	-----	I	-----

TABLE 1. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
5650.811	50	6	I		3	5745.22	2	-----	I
5654.645	80	9	I		3	5748.72	80	9	I
5658.777	1	10hl	II		-----	5751.510	3	-----	I
5660.38	1	7hl	II		-----	5751.718	4	-----	I
5660.97	1	-----	I		-----	5752.18	3	-----	I
5662.078	40	4	I		1	5752.531	2	20hl	II
5662.982	20	2	I		2	5756.51	3	-----	I
5664.37	-----	6hl	II		-----	5756.83	10	-----	I
5664.824	4	-----	I		-----	5758.96	10	-----	I
5668.716	20	2	I		2	5762.41	2	-----	I
5673.565	4	100hl	II		7	5765.37	40	4	I
5677.210	8	-----	I		-----	5765.96	30	4	I
5679.553	30	-----	I		2	5766.50	-----	2	II
5680.444	10	-----	I		-----	5767.20	20	60	II
5681.110	4	-----	I		-----	5771.397	15	-----	I
5682.34	2	-----	I		-----	5773.33	1	-----	I
5682.47	1	-----	I		-----	5774.016	8	-----	I
5683.738	6	-----	I		7	5774.89	3	-----	I
5684.807	15	1	I		-----	5776.00	1	-----	I
5686.18	1	-----	I		-----	5778.92	1	-----	I
5688.12	15	-----	I		-----	5780.46	-----	7	II
5688.81	1	2	II		-----	5784.75	2h	-----	I
5689.77	1	8hl	II		-----	5791.71	10	-----	I
5690.41	1	-----	I		-----	5794.72	10	-----	I
5690.58	1	-----	I		-----	5796.329	30	2	I
5691.15	1	-----	I		-----	5799.760	50	5	I
5691.914	3	-----	I		-----	5800.567	4	-----	I
5692.72	1	-----	I		-----	5801.693	5	70	II
5693.02	4	-----	I		-----	5801.83	6	-----	I
5694.34	5	-----	I		-----	5802.88	40	3	I
5695.732	8	1	I		-----	5803.64	2	-----	I
5697.25	15	2	I		3	5804.84	1	-----	I
5699.46	4	-----	I		-----	5806.28	1	-----	I
5700.82	1	-----	I		-----	5808.428	30	2	I
5701.11	4	-----	I		-----	5809.27	5	-----	I
5702.10	20	2	I		1	5809.499	40	100	II
5703.95	2h	-----	I		-----	5810.26	2	-----	I
5706.64	5	-----	I		-----	5810.58	2	-----	I
5706.85	2	-----	I		-----	5811.275	15	2	I
5708.38	10	-----	I		-----	5813.14	1	-----	I
5713.267	100	10	I		7	5816.499	3	-----	I
5719.175	600	100	I		2	5817.475	80	6	I
5721.68	3	-----	I		-----	5817.920	6	-----	I
5723.880	8	1	I		-----	5818.194	4	-----	I
5724.80	6	-----	I		-----	5818.58	1	-----	I
5729.683	20	2	I		-----	5837.05	6	-----	I
5734.13	10	-----	I		-----	5838.896	40	4	I
5734.514	50	6	I		3?	5842.235	20	300	II
5735.61	2	-----	I		-----	5844.879	8	1	I
5735.986	9	1	I		-----	5845.866	100	10	I
5736.32	1	-----	I		-----	5847.12	3	-----	I
5736.92	7	-----	I		-----	5847.768	80	8	I
5737.37	1	4	II		-----	5849.688	60	8	I
5738.24	1	2	II		-----	5851.54	1	-----	I
5739.915	4	-----	I		-----	5853.44	1	-----	I
5740.93	1	-----	I		-----	5853.76	3	-----	I
5743.49	1	-----	I		-----	5856.55	1h	-----	I
5744.217	10	1	I		-----	5858.349	30	3	I
5744.37	1	-----	I		-----	5859.07	4	-----	I
5745.12	1	-----	I		-----	5859.34	3	-----	I

TABLE I. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
5860.42	4	----	I	----	5971.91	2	----	I	----
5862.07	2	----	I	----	5974.294	200	30	I	2
5864.32	1	----	I	----	5974.728	80	8	I	1
5868.195	8	----	I	----	5978.67	150	20	I	7
5868.39	2	----	I	----	5980.264	8	----	I	----
5868.50	1	----	I	----	5981.24	2	----	I	----
5868.97	2	----	I	----	5981.41	1	----	I	----
5869.106	7	----	I	----	5983.381	9	1	I	----
5871.84	1	----	I	----	5986.22	1	----	I	----
5872.93	3h	----	I	----	5986.62	20	2	I	1
5873.712	7	----	I	----	5989.76	2	----	I	----
5879.772	8	----	I	----	5991.567	4	----	I	----
5881.44	1	----	I	----	5991.806	5	----	I	----
5882.50	2	----	I	----	5991.97	4	----	I	----
5883.650	70	10	I	7	5992.08	3	----	I	----
5885.04	3	----	I	----	5992.97	50	6	I	7
5886.31	30	2	I	3	5993.07	5	----	I	----
5887.43	20	2	I	1	5994.58	10	----	I	2
5890.46	200	30	I	1	5996.70	1	----	I	----
5891.18	5	----	I	----	5996.99	1	----	I	----
5892.80	3	----	I	----	5998.05	3	----	I	----
5896.63	50	4	I	7	6000.56	1	----	I	----
5898.19	1	15H1	II	7	6002.30	1	----	I	----
5900.53	3	----	I	----	6002.51	1	----	I	----
5902.95	500	70	I	3	6002.64	2	----	I	----
5906.259	4	----	I	----	6004.18	30	2	I	3
5906.393	8	----	I	----	6006.375	2	6hl	II	4
5911.506	4	----	I	----	6007.03	3	----	I	----
5913.91	2	----	I	----	6011.843	4	----	I	----
5914.73	1	----	I	----	6014.90	2	----	I	----
5918.28	1	----	I	----	6015.360	10	----	I	----
5922.94	10	----	I	----	6016.78	100	20	I	1
5926.48	40	5	I	7	6017.83	2	----	I	----
5927.208	5	----	I	----	6018.46	2	----	I	----
5927.53	2	----	I	----	6019.34	3	----	I	----
5929.36	2	15hl	II	6	6021.77	20	2	I	2
5933.70	150	20	I	3	6022.54	1	----	I	----
5936.02	5	----	I	----	6024.93	2	----	I	----
5938.142	15	2	I	2	6026.14	7	----	I	----
5938.80	1	----	I	----	6027.559	5	200h	II	4
5942.41	3	----	I	----	6030.58	3	----	I	----
5944.10	1	----	I	----	6031.92	2	20hl	II	5
5945.12	2	----	I	----	6033.938	2	----	I	----
5945.78	1	----	I	----	6038.82	3	----	I	----
5946.524	7	----	I	----	6039.711	10	1	I	----
5949.390	6	----	I	----	6040.37	15	1	I	2
5949.60	1	----	I	----	6041.43	3	30hl	II	5
5949.80	2	----	I	----	6044.61	1	----	I	----
5950.26	1	----	I	----	6047.98	4	15hl	II	5
5951.24	1	----	I	----	6048.86	1	----	I	----
5952.86	2	----	I	----	6052.071	4	----	I	----
5953.13	1	----	I	----	6054.166	80	6	I	7
5954.20	1h	----	I	----	6059.067	4	----	I	----
5954.71	4	----	I	----	6059.62	1	----	I	----
5957.24	4	----	I	----	6063.75	2	----	I	----
5959.30	2	----	I	----	6064.257	10	1	I	----
5959.57	5	----	I	----	6064.712	4	----	I	----
5966.30	4	----	I	----	6069.20	3	----	I	----
5968.37	1	----	I	----	6070.16	1	----	I	----
5969.37	5	20hl	II	5	6070.591	8	1	I	----

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
6071.92	2	-----	I	-----	6168.66	20	2	I	2
6073.50	1	-----	I	-----	6172.74	1	-----	I	-----
6074.360	10	-----	I	-----	6173.89	-----	4hl	II	-----
6075.50	1	-----	I	-----	6176.55	3	-----	I	-----
6077.53	2h	-----	I	-----	6176.99	2	-----	I	-----
6079.59	1	-----	I	-----	6185.128	400	40	I	3
6084.67	1	-----	I	-----	6189.21	-----	8Hl	II	-----
6085.71	3	-----	I	-----	6191.33	1	-----	I	-----
6090.80	4	-----	I	-----	6191.784	10	-----	I	-----
6091.37	20	2	I	1	6192.475	50	5	I	2
6092.44	8	-----	I	-----	6193.806	4	-----	I	-----
6092.90	2	-----	I	-----	6198.460	20	2	I	2
6093.14	2	20hl	I	II	7	6200.890	4	I	-----
6094.88	4	-----	I	-----	6202.86	3	10	II	4
6097.47	-----	10Hl	I	II	4	6206.36	10	I	-----
6098.68	200	30	I	-----	6206.51	12	-----	I	-----
6104.58	20	3	I	-----	6206.926	1	30hl	II	4
6104.88	15	2	I	-----	6207.08	1	-----	I	-----
6105.07	3	-----	I	-----	6207.46	10	1	I	-----
6106.11	10	1	I	-----	6207.97	10	1	I	-----
6106.22	2	-----	I	-----	6209.43	40	4	I	2
6108.90	1	-----	I	-----	6210.680	150	20	I	2
6109.22	1	-----	I	-----	6211.21	1	10Hl	II	-----
6115.29	3	-----	I	-----	6211.60	4	-----	I	-----
6116.62	5	-----	I	-----	6211.70	3	-----	I	-----
6118.16	40	6	I	1	6212.00	20	2	I	2
6119.27	2	-----	I	-----	6212.71	1	-----	I	-----
6119.70	5	-----	I	-----	6216.800	80	10	I	7
6122.00	15	2	I	-----	6217.315	1	10	II	-----
6122.93	3	-----	I	-----	6219.83	1	-----	I	-----
6126.30	6	-----	I	-----	6222.81	10	40hl	II	6
6128.14	3	-----	I	-----	6223.74	1	-----	I	-----
6129.19	1	-----	I	-----	6224.35	2	-----	I	-----
6129.49	1	-----	I	-----	6227.03	2	-----	I	-----
6135.10	10	200hl	I	II	4	6228.20	-----	2	II
6135.40	10	-----	I	-----	6229.10	15	1	I	-----
6135.68	3	6	I	II	6229.63	1	20hl	II	-----
6138.51	2	-----	I	-----	6230.825	6	60hl	II	5
6138.73	1	-----	I	-----	6236.51	8	2	I	-----
6139.00	3	-----	I	-----	6237.34	3	-----	I	-----
6140.46	2	-----	I	-----	6238.59	100	10	I	3
6141.78	3	-----	I	-----	6241.81	10	1	I	7
6142.15	2	-----	I	-----	6242.27	7	-----	I	-----
6142.77	1	-----	I	-----	6243.83	1	-----	I	-----
6144.392	30	2	I	-----	6248.94	50	200	II	5
6144.58	20	-----	I	-----	6250.16	1	-----	I	-----
6146.54	5	-----	I	-----	6250.36	2	-----	I	-----
6146.99	3	-----	I	-----	6252.92	1	-----	I	-----
6147.24	3	-----	I	-----	6256.97	70	9	I	1
6148.68	7	1	I	-----	6258.79	40	4	I	2
6150.01	3	-----	I	-----	6262.71	1	-----	I	-----
6152.952	10	1	I	-----	6262.94	3	-----	I	-----
6156.264	3	20hl	I	II	5	6266.63	1	-----	I
6156.54	-----	4hl	I	II	-----	6270.44	2	-----	I
6158.76	-----	20hl	I	II	6	6271.06	3	15hl	II
6160.681	-----	30hl	I	II	6	6271.355	15	2	I
6164.70	2	-----	I	-----	6272.770	9	1	I	-----
6166.59	1	-----	I	-----	6273.25	1	-----	I	-----
6167.04	10	-----	I	-----	6275.49	15	-----	I	-----
6168.03	3	-----	I	-----	6276.41	3	-----	I	-----

TABLE I. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
6277. 197	10	1	I	7	6376. 19	20	2	I	3
6278. 40	1	---	I	---	6376. 88	1	---	I	---
6278. 804	4	---	I	---	6377. 53	3	---	I	---
6279. 834	15	60	II	6	63806. 19	80	7	I	3
6290. 10	1	---	I	---	6381. 564	10	---	I	---
6296. 27	5	---	I	---	6382. 232	10	---	I	---
6297. 903	4	---	I	---	6383. 69	20	1	I	---
6298. 12	3	---	I	---	6386. 229	300	40	I	2
6298. 63	1	---	I	---	6388. 914	20	2	I	3
6299. 52	50	6	I	1	6390. 22	10	---	I	---
6299. 99	8	---	I	---	6390. 40	2	---	I	---
6300. 128	20	---	I	---	6396. 67	1	---	I	---
6300. 72	8	---	I	---	6397. 91	1	---	I	---
6300. 94	2	---	I	---	6398. 94	1	---	I	---
6302. 63	1	---	I	---	6400. 24	2	---	I	---
6303. 16	2	---	I	---	6406. 53	15	---	I	---
6303. 90	1	---	I	---	6409. 50	70	7	I	4?
6304. 31	1	---	I	---	6418. 02	10	---	I	7
6306. 00	3	---	I	---	6420. 58	1	---	I	---
6306. 201	1	15H1	II	4	6420. 86	1	---	I	---
6306. 50	2	---	I	---	6421. 10	6	---	I	---
6307. 91	1	---	I	---	6421. 91	2	---	I	---
6309. 67	1	---	I	---	6422. 76	1	---	I	---
6310. 74	10	1	I	---	6423. 40	5	---	I	---
6311. 844	50	7	I	3	6429. 44	10	---	I	3
6312. 72	3	---	I	---	6430. 75	5	---	I	---
6313. 41	30	2	I	---	6431. 46	1	---	I	---
6315. 92	2	30hl	II	5	6434. 52	2	---	I	---
6318. 313	30	3	I	1	6434. 77	4	---	I	---
6323. 69	1	---	I	---	6435. 60	1	---	I	---
6328. 51	3	---	I	---	6436. 99	6	---	I	---
6328. 76	1	---	I	---	6438. 36	1	---	I	---
6330. 66	3	---	I	---	6439. 03	1	---	I	---
6337. 74	2	---	II	---	6442. 22	1	---	I	---
6338. 096	80	9	I	1	6443. 11	1	---	I	---
6340. 24	3	---	I	---	6444. 07	5	---	I	---
6340. 48	3	---	I	---	6447. 10	1	---	I	---
6340. 708	15	2	I	---	6449. 166	4	---	I	---
6343. 742	1	8hl	II	---	6449. 52	2	---	I	---
6343. 98	2	---	I	---	6451. 16	1	---	I	---
6345. 08	3	---	I	---	6454. 466	3	---	I	---
6347. 10	8	---	I	---	6455. 84	2	15hl	I	II
6347. 37	2	---	I	---	6456. 956	50	6	I	3
6347. 63	5	---	I	---	6461. 49	1	---	I	---
6349. 91	4	---	I	---	6462. 28	2	4	II	4
6353. 46	3	---	I	---	6466. 59	1	---	I	---
6354. 30	1	---	I	---	6467. 931	8	---	I	---
6355. 393	5	---	I	---	6468. 32	4	---	I	---
6355. 68	4	---	I	---	6469. 324	3	---	I	---
6355. 99	1	---	I	---	6472. 14	1	---	I	---
6357. 47	1	---	I	---	6472. 67	6	---	I	---
6359. 84	10	1	I	---	6473. 882	3	20hl	I	II
6363. 08	1	---	I	---	6474. 14	4	---	I	---
6366. 87	1	---	I	---	6475. 04	1	---	I	---
6367. 09	3	---	I	---	6477. 03	4	---	I	---
6370. 018	10	1	I	---	6478. 72	1	---	I	---
6371. 36	4	---	I	---	6479. 486	7	---	I	---
6372. 792	2	---	I	---	6481. 55	4	---	I	---
6373. 46	1	---	I	---	6482. 526	3	---	I	---
6375. 03	1	---	I	---	6483. 32	1	---	I	---

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
6485.43	3	-----	I	-----	6584.53	4	100hl	II	4
6486.32	1	-----	I	-----	6585.794	8	-----	I	3
6490.61	2	-----	I	-----	6587.23	150	15	I	-----
6492.54	5	-----	I	-----	6590.111	10	1	I	-----
6494.589	1	5	II	-----	6590.54	1	-----	I	-----
6495.64	1	-----	I	-----	6590.767	8	1	I	-----
6498.46	1	-----	I	-----	6591.80	30	1	I	-----
6500.49	4	-----	I	-----	6595.188	2	-----	I	-----
6501.85	1	-----	I	-----	6595.491	8	-----	I	-----
6505.12	1	-----	I	-----	6596.654	6	-----	I	-----
6505.22	1	-----	I	-----	6596.90	2	-----	I	-----
6507.12	4	-----	I	-----	6599.766	2	4	II	-----
6508.12	5	-----	I	-----	6605.91	-----	3	III	-----
6510.388	6	-----	I	-----	6609.20	1	8	II	6
6511.61	1	8hl	II	-----	6611.02	1	-----	I	-----
6511.81	3h	-----	I	-----	6612.68	2	-----	I	-----
6512.37	3	-----	I	-----	6616.18	5	-----	I	-----
6512.61	2	8	II	4	6616.66	4	-----	I	-----
6518.14	1	-----	I	-----	6621.13	1	-----	I	-----
6519.82	1	-----	I	-----	6622.76	2	-----	I	-----
6521.175	15	1	I	-----	6624.35	1	-----	I	-----
6521.82	2	-----	I	-----	6625.57	4	-----	I	-----
6523.92	30	2	I	3	6626.62	3	-----	I	-----
6525.13	2	-----	I	-----	6627.91	2	-----	I	-----
6525.330	2	-----	I	-----	6628.767	6	-----	I	-----
6525.66	1	-----	I	-----	6632.59	2	-----	I	-----
6526.03	3	-----	I	-----	6633.52	1	-----	I	-----
6526.183	1	8Hl	II	-----	6639.97	2	-----	I	-----
6526.77	9	-----	I	-----	6641.21	2	-----	I	-----
6527.05	1	-----	I	-----	6643.085	9	-----	I	-----
6530.23	3	-----	I	II	6644.609	100	300	II	7
6531.66	4	20	I	5	6646.15	1	-----	I	-----
6531.86	10	-----	I	-----	6647.04	40	200	II	7
6534.09	4	-----	I	-----	6649.05	2	-----	I	-----
6536.56	15	-----	I	1	6654.52	1	-----	I	-----
6540.24	2	-----	I	-----	6656.76	1	-----	I	-----
6541.58	2	-----	I	-----	6657.51	9	-----	I	-----
6542.82	2	40hl	II	7	6659.42	40	4	I	3
6546.02	-----	2	II	-----	6660.507	1	-----	I	-----
6548.24	2	20Hl	II	6	6663.90	2	-----	I	-----
6549.35	1	-----	I	-----	6664.64	1	-----	I	-----
6549.99	1	20hl	II	-----	6665.839	1	-----	I	-----
6550.68	9	-----	I	-----	6666.35	10	-----	I	-----
6552.91	20	2	I	2	6667.89	3hl	-----	I	-----
6556.48	70	6	I	1	6668.14	4h	-----	I	-----
6557.59	4	-----	I	-----	6669.34	15	2	I	1
6557.91	10	60hl	II	6	6669.49	2	-----	I	-----
6562.83	1	6	II	6	6669.97	2	-----	I	-----
6565.75	1	4	II	-----	6670.47	1	-----	I	-----
6567.39	4	60hl	II	4	6671.28	20	2	I	2
6567.67	20	-----	I	-----	6676.39	5	-----	I	-----
6568.02	3	-----	I	-----	6678.82	6	1	I	-----
6572.27	5	-----	I	-----	6684.50	30	2	I	3
6573.48	1	-----	I	-----	6691.66	20	2	I	-----
6573.78	2	-----	I	-----	6693.491	15	1	I	1
6576.964	4	-----	I	-----	6694.26	2	-----	I	-----
6578.138	4	-----	I	-----	6698.45	2	-----	I	-----
6582.14	1	-----	I	-----	6702.30	1	-----	I	-----
6583.26	3	-----	I	-----	6702.90	3	-----	I	-----
6584.42	2	-----	I	-----	6704.17	2	-----	I	-----

TABLE I. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
6704. 33	2	-----	I	-----	6839. 378	1	-----	I	-----
6704. 926	4	-----	I	-----	6841. 182	9	1	I	-----
6705. 23	4	-----	I	-----	6849. 22	10	-----	I	-----
6705. 740	1	-----	I	-----	6849. 57	1	-----	I	-----
6707. 032	1	-----	I	-----	6850. 06	60	8	I	1
6707. 200	4	-----	I	-----	6851. 314	9	-----	I	-----
6707. 662	2	-----	I	-----	6852. 24	3	-----	I	-----
6708. 33	20	3	I	II	6852. 906	10	1	I	-----
6709. 39	3	50hl			6853. 01	2	-----	I	-----
6713. 48	200	20	I		6855. 29	10	40	II	5
6716. 014	30	3	I		6857. 03	20	3	I	7
6717. 19	3	-----	I		6858. 56	60	10	I	-----
6718. 87	2	-----	I		6858. 76	200	40	I	1
6720. 95	2	-----	I		6860. 45	4	-----	I	-----
6723. 51	3	-----	I		6861. 26	1	-----	I	-----
6734. 65	2	-----	I		6862. 77	1	-----	I	-----
6736. 42	1	-----	I		6865. 96	1	-----	I	-----
6737. 15	1	-----	I		6869. 32	1	-----	I	-----
6739. 210	9	1	I		6874. 89	40	5	I	2
6742. 64	1	-----	I		6884. 53	10	1	I	-----
6744. 00	7	-----	I		6889. 81	10	1	I	-----
6745. 61	1	-----	I		6896. 52	15	2	I	-----
6747. 00	2	-----	I		6902. 78	12	1	I	-----
6747. 16	1	-----	I		6911. 40	300	80	I	1
6747. 56	1	-----	I		6914. 17	5	-----	I	-----
6749. 15	1	-----	I		6917. 48	4	-----	I	-----
6751. 47	1	3	II		6926. 21	70	10	I	0
6754. 624	70	200	II		6926. 780	15	-----	I	-----
6756. 16	2	-----	I		6928. 15	2	-----	I	-----
6762. 42	4	-----	I		6935. 16	8	30	II	-----
6763. 03	1	-----	I		6936. 57	3	-----	I	-----
6763. 705	9	1	I		6937. 456	7	1	I	-----
6767. 27	20	2	I		6938. 85	1	-----	I	-----
6767. 88	5	-----	I		6947. 53	20	2	I	-----
6769. 924	40	5	I		6949. 24	1	-----	I	-----
6770. 87	2h	-----	I		6952. 849	12	1	I	-----
6773. 06	30	3	I		6954. 17	20	2	I	-----
6773. 63	3h	-----	I		6956. 80	3	-----	I	-----
6774. 22	2	-----	I		6962. 46	1	-----	I	-----
6774. 36	4	-----	I		6965. 809	40	5	I	-----
6778. 24	1	-----	I		6967. 71	1	-----	I	-----
6782. 66	1	-----	I		6970. 42	50	6	I	-----
6786. 40	1	-----	I		6972. 03	4	-----	I	-----
6789. 28	1000	100	I		6972. 53	2	-----	I	-----
6793. 99	10	-----	I		6973. 03	1	-----	I	-----
6797. 56	2	-----	I		6976. 20	20	2	I	-----
6797. 810	3	-----	I		6978. 30	1	-----	I	-----
6798. 481	1	-----	I		6979. 61	100	20	I	3?
6801. 771	7	1	I		6980. 905	100	200	II	7
6805. 313	3	-----	I		6981. 61	50	8	I	-----
6814. 96	5	-----	I		6982. 75	1	-----	I	-----
6818. 95	2000	300	I		6997. 84	2	10	II	-----
6822. 06	4	-----	I		7002. 94	10	1	I	-----
6824. 34	3	-----	I		7007. 36	2	-----	I	-----
6826. 55	100	10	I		7010. 69	30	4	I	-----
6832. 62	3h	-----	I		7014. 29	20	2	I	-----
6833. 750	20	2	I		7016. 99	-----	6	II	-----
6834. 18	1	-----	I		7018. 22	3	-----	I	-----
6836. 83	1	-----	I		7019. 25	50	10	I	-----
6837. 95	4	-----	I		7021. 23	6	20	II	-----

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
7026.24	1	-----	I	-----	7163.58	1	-----	I	-----
7028.24	1	-----	I	-----	7164.52	4	10	II	-----
7028.52	1	-----	I	-----	7167.42	10	2	I	-----
7028.93	3	-----	I	-----	7175.94	1	-----	I	-----
7030.31	50	100	II	6	7177.12	8	1	I	-----
7032.55	12	1	I	-----	7179.20	3	-----	I	-----
7035.15	70	10	I	-----	7181.148	6	1	I	-----
7036.48	2	-----	I	-----	7182.94	3	-----	I	-----
7036.95	5	-----	I	-----	7185.985	40	6	I	-----
7038.07	2	-----	I	-----	7188.84	3	-----	I	-----
7039.16	12	1	I	-----	7189.31	5	10	II	-----
7040.54	1	-----	I	-----	7189.99	1	-----	I	-----
7042.69	3	-----	I	-----	7191.21	3	-----	I	-----
7046.35	2	-----	I	-----	7196.09	20	5	I	-----
7048.885	12	1	I	-----	7200.91	12	1	I	-----
7049.72	6	-----	I	-----	7204.684	4	-----	I	-----
7050.11	1	-----	I	-----	7205.08	30	5	I	-----
7052.65	50	6	I	-----	7206.31	1	-----	I	-----
7054.052	40	4	I	-----	7212.882	2	-----	I	-----
7054.515	4	-----	I	-----	7216.53	12	1	I	-----
7055.38	5	-----	I	-----	7220.76	7	-----	I	-----
7061.90	80	10	I	-----	7221.20	2	-----	I	-----
7062.85	150	20	I	-----	7221.86	8	1	I	-----
7063.852	3000	400	I	3	7222.64	20	3	I	-----
7064.34	15?	30?	I	II	7223.01	1	-----	I	-----
7065.83	12	2	I	-----	7225.15	1	-----	I	-----
7070.77	6	1	I	-----	7231.565	30	4	I	-----
7071.01	2	-----	I	-----	7233.10	15	2	I	-----
7074.76	2	-----	I	-----	7237.101	8000	1000	I	1
7075.34	1	-----	I	-----	7240.87	5000	600	I	1
7081.28	1	-----	I	-----	7244.11	40	5	I	-----
7083.016	6	-----	I	-----	7251.66	5	-----	I	-----
7084.61	4	-----	I	-----	7251.80	2	-----	I	-----
7085.02	2	-----	I	-----	7255.43	5	1	I	-----
7085.33	6	-----	I	-----	7257.99	5	-----	I	-----
7086.71	6	-----	I	-----	7261.82	4	-----	I	-----
7089.81	7	-----	I	-----	7262.587	80	10	I	3
7093.83	50	6	I	-----	7263.04	15	2	I	-----
7094.412	100	15	I	3?	7271.24	2	-----	I	-----
7096.15	5	-----	I	-----	7272.33	1	-----	I	-----
7096.36	15	2	I	-----	7272.93	1	-----	I	-----
7096.712	12	1	I	-----	7273.28	7	1	I	-----
7100.546	150	20	I	-----	7277.07	5	-----	I	II
7105.28	2	-----	I	-----	7277.64	20	50	I	-----
7114.46	2	-----	I	-----	7277.90	15	2	I	-----
7114.85	3	-----	I	-----	7278.74	1	4	II	-----
7115.685	40	7	I	-----	7280.006	10	2	I	-----
7118.37	30	5	I	-----	7281.52	30	5	I	-----
7119.520	700	100	I	1	7282.01	1	-----	I	-----
7120.80	30	5	I	-----	7282.29	3	-----	I	-----
7131.82	7000	1000	I	2	7283.43	1	-----	I	-----
7144.81	4	-----	I	-----	7285.12	2	-----	I	-----
7153.21	6	1	I	-----	7285.58	1	-----	I	-----
7156.31	10	2	I	-----	7287.79	1	-----	I	-----
7156.93	1	-----	I	-----	7288.31	1	-----	I	-----
7157.945	30	4	I	-----	7290.13	1	-----	I	II
7161.19	1	-----	I	-----	7292.29	2	5	I	-----
7161.64	2	-----	I	-----	7294.026	20	4	I	-----
7162.643	7	1	I	-----	7294.31	10	1	I	-----
7163.48	3	-----	I	-----	7294.98	3	-----	I	-----

TABLE I. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
7297. 06	1	-----	I	-----	7430. 09	4	-----	I	-----
7297. 33	2	-----	I	-----	7437. 600	500	100	I	3
7298. 79	3	-----	I	-----	7441. 16	6	-----	I	-----
7301. 03	5	1	I	-----	7444. 26	20	3?	I	-----
7303. 63	15	2	I	-----	7444. 81	12	1?	I	-----
7309. 38	5	-----	I	-----	7447. 19	3	-----	I	-----
7312. 68	1	2	II?	-----	7447. 39	1	-----	I	-----
7315. 25	10	1	I	-----	7447. 724	5	-----	I	-----
7315. 72	1	2	II?	-----	7448. 66	7	-----	I	-----
7316. 94	2	-----	I	-----	7450. 59	1	-----	I	-----
7320. 06	1000	200	I	7	7451. 94	6	-----	I	-----
7321. 79	150	30	I	1	7461. 30	10	1	I	-----
7322. 91	15	2	I	-----	7462. 51	3	-----	I	-----
7323. 43	3h	-----	I	-----	7463. 905	200	40	I	7
7324. 13	2	-----	I	-----	7473. 67	6	-----	I	-----
7327. 175	15	2	I	-----	7476. 53	2	-----	I	-----
7328. 63	15	30	II	-----	7476. 71	4	-----	I	-----
7334. 73	1	-----	I	-----	7479. 78	15	2	I	-----
7334. 88	2	3	I	II?	7480. 781	20	2	I	-----
7337. 93	12	2	I	-----	7483. 704	4	-----	I	-----
7339. 294	40	7	I	-----	7484. 603	50	10	I	-----
7342. 01	1	-----	I	-----	7488. 17	30	4	I	-----
7342. 80	1	-----	I	-----	7489. 02	15	2	I	-----
7344. 70	2	-----	I	-----	7492. 11	10	1	I	-----
7346. 14	3h	-----	I	-----	7501. 63	1	-----	I	-----
7352. 41	1	-----	I	-----	7506. 80	3	-----	I	-----
7356. 18	100	15	I	-----	7508. 77	2	-----	I	-----
7358. 78	3	-----	I	-----	7511. 00	10?	-----	I	-----
7359. 916	3	-----	I	-----	7511. 47	1	-----	I	-----
7365. 35	100	20	I	-----	7513. 36	2	-----	I	-----
7368. 160	30	6	I	-----	7514. 98	3	5	II	-----
7374. 389	15	2	I	-----	7515. 22	3	-----	I	-----
7375. 59	1	-----	I	-----	7516. 79	2	-----	I	-----
7376. 987	4	-----	I	-----	7517. 49	1	-----	I	-----
7377. 176	8	1	I	-----	7520. 38	3	-----	I	-----
7378. 91	2	-----	I	-----	7525. 09	2	-----	I	-----
7381. 77	1	-----	I	-----	7526. 82	15	2	I	-----
7384. 03	10	-----	I	-----	7529. 21	2	-----	I	-----
7384. 75	1	-----	I	-----	7530. 13	5h	-----	I	-----
7385. 35	3	-----	I	-----	7532. 42	1	-----	I	-----
7388. 86	4	-----	I	-----	7532. 88	5	-----	I	-----
7390. 729	400	60	I	3	7534. 81	1	-----	I	-----
7392. 86	4	-----	I	-----	7535. 11	2	-----	I	-----
7396. 99	15	2	I	-----	7537. 35	3	-----	I	-----
7398. 137	12	2	I	-----	7542. 39	10	1	I	-----
7398. 97	3	-----	I	-----	7543. 40	50	6	I	-----
7400. 72	12	2	I	-----	7544. 81	3	-----	I	-----
7402. 75	15	1	I	-----	7551. 64	7	1	I	-----
7408. 97	30	6	I	-----	7556. 37	200	40	I	2
7409. 505	70	12	I	-----	7557. 78	1	-----	I	-----
7412. 70	5	-----	I	-----	7558. 63	1	-----	I	-----
7414. 63	20	2	I	-----	7561. 12	1	10	II	-----
7417. 51	8	1	I	-----	7562. 93	1500	300	I	1
7420. 48	3	-----	I	-----	7564. 24	200	40	I	7
7420. 76	1	-----	I	-----	7565. 35	-----	2	II	-----
7422. 416	15	2	I	-----	7568. 85	2	-----	I	-----
7423. 628	120	20	I	3	7570. 90	1	2	II	-----
7424. 274	10	-----	I	-----	7576. 67	40	6	I	-----
7426. 67	3	-----	I	-----	7577. 02	300	40	I	1
7427. 77	1	-----	I	-----	7581. 18	4	-----	I	-----

TABLE 1. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
7582.462	70	12	I		7750.15	2	-----	I	II
7584.93	1	-----	I		7757.89	40	100		6
7586.26	8	1	I		7758.84	1	-----	I	-----
7586.80	1	-----	I		7762.38	15	2	I	-----
7589.67	3	-----	I		7773.09	10	1	I	-----
7592.977	150	30	I		7773.95	2	-----	I	-----
7599.56	40	8	I		7774.39	5	-----	I	-----
7605.27	3	-----	I		7776.65	3	-----	I	-----
7606.03	2	-----	I		7777.43	10	1	I	-----
7606.39	8	1	I		7782.56	1	-----	I	-----
7608.549	200	40	I		7783.88	6	1	I	-----
7612.60	50	8	I		7789.52	15	2	I	-----
7624.387	5000	1000	I		7790.90	500	100	I	2
7634.44	10?	20?	II		7796.82	60	10	I	-----
7645.655	400	80	I		7801.54	20	60	II	4
7646.34	20	-----	I		7803.97	4	-----	I	-----
7648.84	4	-----	I		7804.56	2	-----	I	-----
7650.39	2	-----	I		7813.50	10	1	I	-----
7653.88	4h	-----	I		7814.57	400	80	I	1
7654.99	1	-----	I		7826.62	4	-----	I	-----
7656.39	20	4	I		7830.08	1	-----	I	-----
7660.318	6	1	I		7830.60	5	-----	I	-----
7662.32	2	-----	I		7831.81	8	1	I	-----
7662.52	4	-----	I		7845.37	4000	800	I	2
7663.09	20	50	II		7846.57	50	8	I	-----
7663.51	5h	-----	I		7853.81	12	2	I	-----
7664.465	20	2	I		7857.78	3h	-----	I	-----
7664.749	8	1	I		7858.32	1	-----	I	-----
7666.09	6	-----	I		7858.52	3	-----	I	-----
7668.414	20	2	I		7861.23	30	60	II	-----
7670.76	1	-----	I		7862.78	60	15	I	-----
7670.93	3	-----	I		7866.58	5	-----	I	-----
7671.92	20	4	I		7867.26	20	4	I	-----
7676.53	1	-----	I		7870.84	1	-----	I	-----
7678.60	3	-----	I		7877.69	20	4	I	-----
7679.95	3	-----	I		7881.12	1	-----	I	-----
7682.16	2	-----	I		7884.58	3	-----	I	-----
7684.47	1	-----	I		7885.53	4	-----	I	-----
7685.38	2	-----	I		7888.01	7	1	I	-----
7685.91	1	-----	I		7888.54	20	2	I	-----
7693.40	4	-----	I		7893.03	4	-----	I	-----
7694.10	12	2	I		7893.75	30	5	I	-----
7697.38	1	-----	I	II?	7894.01	8?	1	I	-----
7699.37	2	3	I		7901.45	8	1	I	-----
7701.69	3	-----	I		7906.12	15	2	I	-----
7702.171	8	-----	I		7907.17	1	-----	I	-----
7704.530	30	2	I		7908.09	2	-----	I	-----
7706.90	5	-----	I		7908.58	1	-----	I	-----
7709.92	1	-----	I		7910.71	2	-----	I	-----
7710.25	1	-----	I		7911.94	1	-----	I	-----
7714.92	1	-----	I		7914.77	4	-----	I	-----
7717.84	2	-----	I		7917.36	5	-----	I	-----
7720.65	2	5	II		7920.75	2000	400	I	7
7723.68	2	-----	I		7924.08	5	-----	I	-----
7725.12	1	-----	I		7927.19	2	-----	I	-----
7736.89	10?	1	I		7929.10	1	-----	I	-----
7740.17	2000	400	I		7930.04	2	-----	I	-----
7741.59	50	10	I		7930.77	1	-----	I	-----
7743.57	150	20	I		7934.70	1	-----	I	-----
7749.62	4	-----	I		7938.06	500	100	I	2

TABLE I. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
A					A				
7940.57	2	-----	I	-----	8146.05	5	-----	I	-----
7940.96	3	-----	I	-----	8147.19	2	-----	I	-----
7948.63	20	2	I	-----	8151.54	1	-----	I	-----
7950.43	5	1	I	-----	8154.58	1	-----	I	-----
7951.00	20	4	I	-----	8157.59	6	-----	I	-----
7951.73	3	-----	I	-----	8162.04	3	-----	I	-----
7952.83	4	-----	I	-----	8163.60	20	2	I	-----
7954.27	15	2	I	-----	8164.96	1	-----	I	-----
7955.21	30	7	I	-----	8173.90	300	70	I	1
7957.56	4	-----	I	-----	8174.92	30	4	I	-----
7960.31	4	-----	I	-----	8176.39	1	-----	I	-----
7970.22	1	-----	I	-----	8177.25	1h	-----	I	-----
7971.57	20	4	I	-----	8182.02	1	-----	I	-----
7972.29	1	-----	I	-----	8182.28	1	-----	I	-----
7976.81	40	5	I	-----	8185.72	4	-----	I	-----
7976.95	10	1	I	-----	8193.82	100	10	I	-----
7979.17	2	-----	I	-----	8196.61	1	-----	I	-----
7980.01	8	1	I	-----	8202.05	6	-----	I	-----
7980.54	1	-----	I	-----	8204.57	2000	500	I	7
7983.64	6	15	II	-----	8210.70	1	2	II?	-----
7986.90	40	4	I	-----	8212.15	10	2	I	-----
7990.03	3	-----	I	-----	8217.36	15	-----	I	-----
7994.76	5000	800	I	1	8222.46	20	-----	I	-----
8002.44	15	1	I	-----	8224.31	1	-----	I	-----
8007.66	1	-----	I	-----	8224.59	1	-----	I	-----
8008.68	8	1	I	-----	8226.54	1	-----	I	-----
8010.58	100	15	I	-----	8236.12	40	80	I	II
8032.24	8	1	I	-----	8238.65	20	2	I	-----
8034.52	1	-----	I	-----	8244.40	40	5	I	-----
8047.26	8	1	I	-----	8248.81	100	10	I	-----
8048.82	4	-----	I	-----	8250.58	1	-----	I	-----
8056.47	400	80	I	-----	8251.15	8	-----	I	-----
8063.63	1	-----	I	-----	8251.73	10	-----	I	-----
8068.34	3	-----	I	-----	8254.57	2	-----	I	-----
8074.30	1	-----	I	-----	8257.75	1	-----	I	-----
8076.83	1	-----	I	-----	8264.53	1	-----	I	-----
8080.26	500	100	I	3	8267.38	1	-----	I	-----
8080.77	50	10	I	-----	8269.33	1	-----	I	-----
8080.96	100	20	I	-----	8274.29	5	-----	I	-----
8082.62	10	2	I	-----	8276.94	1000	200	I	2
8085.36	20?	-----	I	-----	8284.30	6h	4	I	II?
8085.73	15	2	I	-----	8284.93	7	1	I	-----
8087.51	1	-----	I	-----	8292.00	15	2	I	-----
8091.02	3	-----	I	-----	8293.41	20	3	I	-----
8092.58	1	-----	I	-----	8294.70	4	-----	I	-----
8092.91	20	4	I	-----	8297.37	1h	2	II?	-----
8094.14	8	1	I	-----	8301.85	4	-----	I	-----
8096.44	1	2	I	-----	8305.33	6	-----	I	-----
8103.67	20	4	I	-----	8311.32	1	-----	I	-----
8105.36	10	2	I	-----	8316.35	1	-----	I	-----
8106.04	2	-----	I	-----	8316.69	1	-----	I	-----
8107.66	4	-----	I	-----	8317.60	2	-----	I	-----
8118.20	10	1	I	-----	8318.34	1	-----	I	-----
8121.18	5	-----	I	-----	8321.35	2	-----	I	-----
8128.91	10	1	I	-----	8325.80	1	-----	I	-----
8136.01	1	-----	I	-----	8328.97	6?	-----	I	-----
8136.63	15	1	I	-----	8331.12	2	-----	I	-----
8139.10	30	2	I	-----	8333.19	2h	-----	I	-----
8140.90	2	-----	I	-----	8335.27	2	-----	I	-----
8143.62	60	7	I	-----	8338.07	60	8	I	-----

TABLE 1. Emission spectra of hafnium—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
8339.35	2	-----	I	-----	8558.22	1	-----	I	-----
8340.42	2	-----	I	-----	8560.59	1	-----	I	-----
8342.44	3	-----	I	-----	8561.04	1	-----	I	-----
8344.25	400	80	I	3	8563.66	3	-----	I	-----
8346.36	2	-----	I	-----	8563.83	2	-----	I	-----
8352.55	5	-----	I	-----	8564.10	1	-----	I	-----
8357.68	1	4	II	-----	8569.04	80	15	I	-----
8358.56	1	2	II?	-----	8572.34	1	-----	I	-----
8359.13	2	-----	I	-----	8575.06	1	2	II?	-----
8361.29	20	4	I	-----	8581.89	10	30	II	-----
8367.91	1	-----	I	-----	8586.54	8	1	I	-----
8375.38	1	-----	I	-----	8587.84	1	-----	I	-----
8376.00	1	-----	I	-----	8589.89	1	-----	I	-----
8380.05	80	8	I	-----	8592.06	20	2	I	-----
8382.98	100	10	I	-----	8597.83	5	-----	I	-----
8384.52	1	3?	II	-----	8599.87	10	1	I	-----
8385.03	40	5	I	-----	8603.32	60	8	I	-----
8391.63	10	2	I	-----	8609.98	50	6	I	-----
8394.99	20	2	I	-----	8610.86	7	1	I	-----
8399.12	3	-----	I	-----	8614.81	1	-----	I	-----
8399.98	40	3	I	-----	8624.83	20	2	I	-----
8402.58	2	-----	I	-----	8628.28	1	-----	I	-----
8403.23	1	-----	I	-----	8636.36	10	1?	I	-----
8404.57	3	-----	I	-----	8640.04	2500	500	I	3
8404.89	20	2	I	-----	8644.31	20	2	I	-----
8407.84	1	-----	I	-----	8653.35	2	-----	I	-----
8408.11	5	-----	I	-----	8655.40	5	-----	I	-----
8416.26	2	-----	I	-----	8656.12	7	1	I	-----
8425.76	10	2	I	-----	8657.60	1	-----	I	-----
8427.38	3	-----	I	-----	8658.23	20	2	I	-----
8434.98	1	-----	I	-----	8659.03	6	-----	I	-----
8435.65	1	-----	I	-----	8660.92	3	10	I	II
8439.31	8	1	I	-----	8661.68	40	4	I	-----
8440.51	1	-----	I	-----	8671.37	10	1	I	-----
8441.42	20	2	I	-----	8673.87	30	3	I	-----
8442.14	1	-----	I	-----	8683.60	2	-----	I	-----
8447.31	1	-----	I	-----	8689.58	1	-----	I	-----
8451.69	50	5	I	-----	8690.37	2	-----	I	II
8453.26	6	1	I	-----	8699.27	1	2	I	-----
8454.00	60	7	I	-----	8709.17	5	-----	I	-----
8460.00	500	120	I	2	8711.20	600	100	I	2
8465.36	2	-----	I	-----	8715.58	70	10	I	-----
8471.46	3	-----	I	-----	8716.70	10	-----	I	-----
8475.37	40	3	I	-----	8725.09	1	2h	I	II
8477.51	1	-----	I	-----	8728.66	1	-----	I	-----
8478.06	1	-----	I	-----	8737.03	4	-----	I	-----
8487.10	2	-----	I	-----	8749.15	40	4	I	-----
8493.16	3	-----	I	-----	8749.41	20	2	I	-----
8506.53	5	-----	I	-----	8763.88	10	1	I	-----
8508.15	50	5	I	-----	8764.71	1	-----	I	-----
8513.55	1	-----	I	-----	8765.17	6	-----	I	-----
8513.69	2	-----	I	-----	8765.43	1	-----	I	-----
8514.18	4	-----	I	-----	8767.04	1	-----	I	-----
8514.82	8	1	I	-----	8795.54	4	-----	I	-----
8516.03	1	-----	I	-----	8804.34	-----	2	II	-----
8521.37	1	-----	I	-----	8815.11	3	-----	I	-----
8527.70	1	-----	I	-----	8821.12	1	-----	I	-----
8527.91	3	-----	I	-----	8823.95	1	-----	II	-----
8532.47	1	-----	I	-----	8825.24	20	2	I	-----
8546.43	2500	500	I	7	8828.79	1	-----	I	-----

TABLE I. *Emission spectra of hafnium*—Continued

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
<i>A</i>									
8841. 99	20	2	I	----	9482. 83	10	1	I	----
8845. 95	5	-----	I	----	9483. 52	1	-----	I	----
8871. 65	1	-----	I	----	9493. 42	1	-----	I	----
8875. 92	10	-----	I	----	9498. 81	30	3	I	----
8876. 17	5	-----	I	----	9506. 10	2	-----	I	----
8886. 72	3	-----	I	----	9513. 14	600	100	I	----
8888. 43	1	-----	I	----	9514. 37	8	3	I	----
8902. 06	4	-----	I	----	9524. 87	1	-----	I	----
8906. 81	1	-----	I	----	9553. 63	1	-----	I	----
8918. 06	2	-----	I	----	9563. 26	200	50	I	----
8927. 24	3	-----	I	----	9566. 01	1	-----	I	----
8952. 14	5	-----	I	----	9581. 37	10	3	I	----
8958. 89	20	-----	I	----	9587. 35	5	-----	I	----
8967. 15	10	-----	I	----	9613. 15	3	-----	I	----
8976. 65	20	-----	I	----	9616. 05	5	2	I	----
8994. 77	30	2	I	----	9628. 91	1	-----	I	----
9004. 74	200	20	I	----	9652. 05	50	7	I	----
9031. 77	2	-----	I	----	9654. 41	3	-----	I	----
9035. 66	1	-----	I	----	9662. 40	1	-----	I	----
9052. 35	10	3	I	----	9673. 88	10	2	I	----
9093. 88	2	-----	I	----	9697. 66	15	3	I	----
9138. 20	30	3	I	----	9716. 80	3	-----	I	----
9145. 58	3	-----	I	----	9722. 30	4	1	I	----
9153. 00	2	-----	I	----	9737. 93	4	1	I	----
9158. 55	9	-----	I	----	9746. 45	2	-----	I	----
9177. 23	100	8	I	----	9752. 40	20	10	I	----
9179. 30	4	-----	I	----	9754. 43	1	-----	I	----
9182. 14	250	40	I	----	9791. 20	1	-----	I	----
9193. 30	300	30	I	----	9793. 40	1	-----	I	----
9216. 86	10	-----	I	----	9801. 09	10	4	I	----
9243. 18	1	-----	I	----	9805. 71	2	-----	I	----
9250. 25	1000	150	I	----	9828. 22	15	4	I	----
9282. 54	4	-----	I	----	9864. 37	1	-----	I	----
9295. 63	15	1	I	----	9877. 96	1	-----	I	----
9299. 95	60	5	I	----	10023. 30	2	-----	I	----
9306. 16	2	-----	I	----	10036. 53	150	40	I	----
9306. 79	1	-----	I	----	10088. 51	40	8	I	----
9308. 29	9	-----	I	----	10103. 88	15	3	I	----
9313. 65	2	-----	I	----	10112. 20	10	2	I	----
9314. 46	2	-----	I	----	10120. 15	3	-----	I	----
9325. 14	80	10	I	----	10135. 30	6	3	I	----
9341. 17	3	-----	I	----	10168. 81	20	4	I	----
9342. 00	2	-----	I	----	10181. 45	2	-----	I	----
9346. 32	150	20	I	----	10184. 18	1	-----	I	----
9359. 86	1	-----	I	----	10190. 70	2	-----	I	----
9365. 75	3	-----	I	----	10203. 90	2	-----	I	----
9372. 00	1	-----	I	----	10207. 78	8	1	I	----
9380. 14	50	7	I	----	10208. 74	2	-----	I	----
9387. 54	3	-----	I	----	10209. 56	1	-----	I	----
9387. 94	2	-----	I	----	10227. 18	20	6	I	----
9389. 91	1	-----	I	II	10259. 15	30	6	I	----
9402. 57	50	4	I	----	10259. 67	10	-----	I	----
9404. 14	4	2	I	----	10293. 33	1	-----	I	----
9405. 18	1	-----	I	----	10312. 19	1	-----	I	----
9412. 23	2	-----	I	----	10319. 65	2	-----	I	----
9453. 75	12	2	I	----	10342. 55	3	-----	I	----
9488. 25	12	2	I	----	10361. 40	2	-----	I	----
9469. 05	1	-----	I	----	10377. 83	2	-----	I	----
9472. 01	1	-----	I	----	10388. 31	8	-----	I	----
9474. 26	1	-----	I	----	10389. 01	1	-----	I	----

TABLE I. *Emission spectra of hafnium—Continued*

Wavelength in air	Intensity		Spectrum	Zeeman type	Wavelength in air	Intensity		Spectrum	Zeeman type
	Tube	Spark				Tube	Spark		
10397. 45	200	50	I	----	10859. 40	1	----	I	----
10405. 51	5	-----	I	----	10868. 44	20	2	I	----
10414. 09	3	-----	I	----	10876. 28	1	-----	I	----
10418. 99	6	1	I	----	10882. 85	1	-----	I	----
10423. 78	400	150	I	----	10900. 75	15	5	I	----
10438. 63	2	-----	I	----	10914. 47	50	10	I	----
10445. 17	7	-----	I	----	10923. 38	2	-----	I	----
10457. 92	1	-----	I	----	10933. 82	10	-----	I	----
10472. 68	1	-----	I	----	10938. 08	2	-----	I	----
10479. 20	1	-----	I	----	10953. 12	4	-----	I	----
10480. 21	200	30	I	----	10971. 61	50	5	I	----
10484. 44	3	-----	I	----	11000. 00	3	-----	I	----
10496. 77	3	-----	I	----	11030. 13	20	1	I	----
10499. 16	1	-----	I	----	11039. 01	4	-----	I	----
10517. 74	1	-----	I	----	11046. 97	40	4	I	----
10527. 28	25	3	I	----	11074. 42	5	-----	I	----
10529. 38	2	-----	I	----	11092. 58	1	-----	I	----
10545. 50	7	1	I	----	11139. 05	20	-----	I	----
10547. 44	1	-----	I	----	11190. 17	1	-----	I	----
10550. 85	100	7	I	----	11219. 28	1	-----	I	----
10588. 44	1	-----	I	----	11227. 70	10	-----	I	----
10594. 89	50	5	I	----	11229. 01	15	1	I	----
10622. 14	12	1	I	----	11242. 16	3	-----	I	----
10634. 81	5	-----	I	----	11296. 74	1	-----	I	----
10637. 93	150	30	I	----	11303. 44	10	-----	I	----
10642. 30	1	-----	I	----	11365. 02	25	7	I	----
10661. 35	2	-----	I	----	11393. 12	1	-----	I	----
10698. 21	1	-----	I	----	11480. 61	15	2	I	----
10755. 89	1	-----	I	----	11602. 16	4	-----	I	----
10756. 97	1	-----	I	----	11766. 95	10	-----	I	----
10762. 68	3	-----	I	----	11960. 80	2	-----	I	----
10772. 33	15	2	I	----	12043. 08	6	-----	I	----
10784. 36	10	3	I	----					
10815. 24	2	-----	I	----					
10851. 65	6	1	I	----					

WASHINGTON, June 23, 1958.