Bibliography on The Analyses of Optical Atomic Spectra Section 4

^{57}La–^{71}Lu

^{89}Ac–^{99}Es

United States Department of Commerce

National Bureau of Standards

Special Publication 306–4

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.
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Bibliography on The Analyses of Optical Atomic Spectra Section 4

The Spectra of Lanthanum, Cerium, Praseodymium, Neodymium, Promethium, Samarium, Europium, Gadolinium, Terbium, Dysprosium, Holmium, Erbium, Thulium, Ytterbium, Lutetium—Actinium, Thorium, Protactinium, Uranium, Neptunium, Plutonium, Americium, Curium, Berkelium, Californium, and Einsteinium

Charlotte E. Moore

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Preface

The program on "Atomic Energy Levels" (AEL) initiated at this Bureau in 1946 calls for complete coverage of the Periodic Table. Three Volumes have been published as NBS Circular 467. The fourth volume deals with rare-earth spectra and is in course of preparation.

The references to individual spectra have been extended from the respective dates of publication of the AEL Volumes, 1949, 1952, and 1958, in the first three corresponding Sections of this bibliography.

The present and last Section contains references to the two groups of rare-earth spectra, the lanthanides and the actinides. It is arranged to correspond to AEL Volume IV, but it differs from the first three Sections in that it does not continue references from a published volume.

Upon the retirement of the author, Charlotte E. Moore, who has been directing this program, the responsibility for continuing it was assigned to William C. Martin, Chief of the Spectroscopy Section of the Bureau, assisted by Lucy Hagan. He is in charge of the preparation of AEL Volume IV. Publication is being delayed because many of the spectra to be included are still under active investigation.

David R. Lide, Jr., *Chief*
Office of Standard Reference Data.

Abstract

There is a steady demand for information on rare-earth spectra. In an attempt to satisfy this need the present bibliography has been prepared. It comprises Section 4, concludes this publication, and completes the coverage of the Periodic Table. The references listed have been selected on a general basis as those needed for the preparation of Volume 4 of "Atomic Energy Levels."

Since rare-earth structure is revealed in the neighboring spectra, ^{57}La and ^{89}Ac, the references for these elements are repeated in the present Section, which contains the two groups of elements:

^{57}La to ^{71}Lu and ^{89}Ac to ^{99}Es

A selected list of general literature references is also included.

Nearly all of the quoted references have been checked from the original papers.

Key words: Analyses of rare-earth spectra; atomic spectra, La through Lu, Ac through Es; references to atomic spectra; rare-earth spectra; spectra, atomic: elements, spectra of rare-earths.

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Bibliography on The Analyses of Optical Atomic Spectra

Charlotte E. Moore

The present bibliography concludes the series of which three Sections have been published; Section 1 in September 1968, Section 2 in February 1969, and Section 3 in May 1969. Each of these three Sections covers the same elements as are contained in the respective three Volumes of "Atomic Energy Levels" [1]:[1]

Section 1	^{1}H through ^{23}V
Section 2	^{24}Cr through ^{41}Nb
Section 3	^{42}Mo through ^{57}La
	^{72}Hf through ^{89}Ac

The earlier references to the spectra of these elements are contained in "Atomic Energy Levels," and the various Sections of this publication provide references on individual spectra from the respective dates of publication of the three Volumes to the present.

The fourth Volume of the Atomic Energy Levels Series will contain the rare-earth elements, and thus complete the coverage of the Periodic Table. Many of the very complex spectra to be included are still under active investigation. Pending further progress toward the preparation of this Volume, the present bibliography has been prepared with the hope that it will satisfy to some extent the continuing demand for information on rare-earth spectra.

As in the preceding Sections the content of the individual papers is briefly described by key letters or words. The letters have the following meanings:

C L	Classified lines
E D	Energy level diagram
G D	Grotrian diagram
I P	Ionization potential
I S	Isotope shift
T	Terms (and/or energy levels)
W L	Wavelength
Z E	Zeeman effect
[ ]	Forbidden transitions
hfs	Hyperfine structure

If the paper is an Abstract or a Letter to the Editor, the respective letters "A" and "L" are entered in parentheses before the date of the reference.

The author has published partial reference lists for rare-earth spectra, most of which are embodied in the present Section [2, 3, 4]. The list of references has been greatly extended, but is selective. In general, an effort has been made to include all references to date that are needed to compile tables of atomic energy levels, classified lines and Zeeman data for rare-earth spectra [5]. The selection is essentially similar to that of the former Sections, but differs in that it is not a continuation from those included in a Volume of "Atomic Energy Levels" already published.

A number of criteria contribute to the interpretation of these complex spectra. In preparing the bibliography the writer has attempted to recognize the importance of references to theoretical papers and to work on hyperfine structure, isotope shift and other related subjects. Here the listing is not complete, but it is hoped that enough is given to serve as a guide to further references in the various fields.

Many rare-earth spectra are being observed in crystals and solutions, as absorption or fluorescence spectra. A number of lists of energy levels derived from these spectra have been published for individual spectra. This is a separate subject in itself, however; it is not covered in the present work, which is limited essentially to work on "the analyses of optical spectra."

The characteristic that distinguishes rare-earth spectra is the presence of *f*-electrons in the outer structure of the atoms, namely 4*f*-electrons for the lanthanon group ^{58}Ce to ^{71}Lu, and 5*f*-electrons for the actinon group ^{90}Th to ^{103}Lw. The elements preceding each of these groups, ^{57}La and ^{89}Ac, begin to reveal in their spectra some rare-earth characteristics, and thus provide a useful introduction to the study of rare-earth spectra. Consequently, the references to spectra of these two elements as given in Section 3 are repeated in Section 4.

The references are arranged similarly to those in the earlier Sections. They are with few exceptions, arranged in alphabetical order by author and by year for a given spectrum, starting with the earlier papers. A list of general references precedes the main Bibliography.

[1] Figures in brackets indicate the literature references on page VIII.

Nearly all of the references quoted here have been verified by the author. Only a very few which were not available have been copied from abstracts found in the literature.

The author appreciates the generosity of all who have contributed material for inclusion here. A number of colleagues have made special effort to furnish current references and reprints. W. C. Martin and his staff in the Spectroscopy Section have carefully examined the manuscript and given her the benefit of their experience with references to rare-earth spectra.

This Special Publication could not have been prepared without the continuing and efficient cooperation of Elizabeth L. Tate and her competent staff in the splendid Library of the National Bureau of Standards. Their help has been invaluable. Similarly, the preparation of the press copy of the manuscript with extreme care has been carried out by Isabel D. Murray. The author is most grateful for this splendid assistance.

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