

## The Absorption Spectrum of Acetone Vapor in the Far Ultraviolet

A. B. F. Duncan

Citation: [The Journal of Chemical Physics](#) **3**, 131 (1935); doi: 10.1063/1.1749617

View online: <http://dx.doi.org/10.1063/1.1749617>

View Table of Contents: <http://scitation.aip.org/content/aip/journal/jcp/3/3?ver=pdfcov>

Published by the [AIP Publishing](#)

---

### Articles you may be interested in

[Ultraviolet Absorption Spectrum of Pyrrole Vapor Including the Observation of LowEnergy Transitions in the Far Ultraviolet](#)

J. Chem. Phys. **51**, 2276 (1969); 10.1063/1.1672329

[FarUltraviolet Photolysis of Acetone](#)

J. Chem. Phys. **41**, 1247 (1964); 10.1063/1.1726056

[The Microwave Absorption Spectrum of Acetone Vapor](#)

J. Chem. Phys. **20**, 755 (1952); 10.1063/1.1700546

[The Ultraviolet Absorption Spectrum of Benzonitrile Vapor](#)

J. Chem. Phys. **16**, 480 (1948); 10.1063/1.1746920

[Photochemical Studies. XIX The Ultraviolet Absorption Spectrum of Acetone Vapor](#)

J. Chem. Phys. **2**, 717 (1934); 10.1063/1.1749385

---



# THE JOURNAL OF CHEMICAL PHYSICS

VOLUME 3

MARCH, 1935

NUMBER 3

## The Absorption Spectrum of Acetone Vapor in the Far Ultraviolet

A. B. F. DUNCAN, *Department of Chemistry, Brown University*

(Received December 10, 1934)

The absorption spectrum of acetone has been photographed down to 850Å. Discrete bands were found above 1300Å but only continuous absorption between 1300 and 850Å. The bands are described and a qualitative interpretation is given of the complete spectrum. One Rydberg series was found, converging to an ionization potential of 10.20 volts.

THERE are few molecules whose spectra are known in frequency ranges which are wide enough to include all electronic states giving discrete absorption. The absorption spectrum of acetone down to 1800Å was recently reported,<sup>1</sup> and a detailed description of the first two stable excited states given. The spectrum of this molecule has now been extended down to 850Å. Since only continuous absorption exists from about 1300Å down to this lower limit, it is quite possible that no discrete absorption will appear at shorter wavelengths, and that all the stable states are indicated in the data presented here.

The spectra were taken from a one meter focus glass grating used at normal incidence, with a theoretical resolving power of 120,000. The spectrograph was evacuated with a high speed diffusion pump using Apiezon Oil B, backed by a Cenco Hypervac pump. Eastman III-0 plates, sensitized with Nujol oil were used. The light source was a condensed discharge in hydrogen, described previously. The spectrograph, giving an absorbing column of about two meters, was

filled with acetone at pressures from 0.0025 to 0.15. It was necessary to take plates at frequent pressure intervals over this range. No new bands appeared, however above 0.035 mm pressure. The highly purified acetone was that used in the previous work.

The following lines were used as wavelength standards: 1066.555 (Si IV), 1215.68 (H, in absorption), 1388.66 (O IV), 1548.189 (C), and 1550.774 (C). The dispersion, 8.532 Å/mm, was effectively constant over the range used.

The bands with sharp edges could be measured to 0.05–0.08Å. The moderately diffuse bands could be measured with about half the above accuracy. A few were too diffuse to measure at all, and so cannot be reported. Five final plates showing twenty independent spectra were measured. The majority of the bands were measured independently five to ten times. The average deviation from the mean in measurement, expressed in wave numbers is 5 or less for the sharp bands and 5 to 15 for the diffuse bands. The bands observed are listed in Table I. All bands not labeled *s* are more or less diffuse. The intensities were estimated visually and checked by two other observers.

<sup>1</sup> Noyes, Duncan and Manning, *J. Chem. Phys.* 2, 717 (1934).

TABLE I. *Acetone bands 1800-850A.*

FREQUENCY (cm <sup>-1</sup> )	INTENSITY	LOWEST PRESSURE OBS. (mm Hg)	FREQUENCY (cm <sup>-1</sup> )	INTENSITY	LOWEST PRESSURE OBS. (mm Hg)
60086 s	2	0.0125	69316 s	3	0.0125
60361	0	0.035	70000	4	0.0125
60644	0	0.028	71096	2	0.0125
61122	1	0.02	71308 s	6	0.0125
61361	1	0.0125	71485 s	6	0.0125
61548	0	0.035	71634	1	0.0125
62201 s	3	0.0125	72529	4	0.0025
62406	0	0.028	73834 s	8	0.005
62529	3	0.0125	74150	4	0.0125
63019	2	0.0125	75376 s	8	0.005
63255	3	0.0125	75575	1	0.005
63576	2	0.005	75872	1	0.005
63847	2	0.0125	76030 s	8	0.0125
65213 s	10	0.0025	76563 s	4	0.0125
65563	7	0.0125	76629 s	3	0.0125
65817	6	0.0125	77360	4	0.005
66217	7	0.0125	77483 s	4	0.005
66833	5	0.0125	77646	0	0.005

## DESCRIPTION OF THE BANDS

A complete classification of bands in electron states and the assignment of vibrational transitions to each state could not be made on the basis of the available data. However the lack of sufficient data is not considered to be due to limitations in the experimental procedures. The resolution was probably much greater than necessary, and the accuracy in measurement adequate. The scarcity of data is due rather to the strong continuous absorption of acetone in this region, which occurs at the pressures necessary to bring out the weak bands, and thus prevents their observation. A more complete interpretation of the data may, however, occur to others, and for this reason it seems worth while to give a brief description of the bands.

At the end of the state with origin 51,171, previously described, there is a transmission extending to 60,086. The bands between 60,086 and 63,847 are all weak, those at the high frequency end being stronger. Relatively little continuous absorption is present in this region. Then a narrow transmission region extends to 65,213. At this point the strongest absorption region in the entire spectrum begins and extends to 67,000. Five bands are in this region. Another transmission region extends from 67,000 to 69,300. After this the continuous absorption

seems to become stronger, although at the lowest pressures the strong bands can be easily observed. Beyond 78,000, however, the continuous absorption becomes so strong that no bands could be observed at the pressures used.

Bands in the first region show differences which are thought to be modifications of the fundamental frequencies 376 and 1066. Both frequencies are lowered but not more than in the 51,171 state. It is possible that two electron states are present in this region with origins 60,086 and 62,201.

The band at 65,213 is the strongest in the whole region, being clearly developed at less than 0.0025 mm pressure. This is considered as the origin of another electron state, which includes the four following bands. The same differences as above seem to be present and lowered to about the same extent.

It is difficult to be sure of the meaning of differences in the third region beginning at 69,316. There is a possibility that the fundamental frequencies are lowered so greatly in the high energy states that they cannot be recognized.

Originally it was thought that three Rydberg series were present in these bands and that the 51,171 state fitted into a series. After a more careful study of intensities, it now appears necessary to eliminate two of these series, on the basis of irregularities in intensities within the series. The series presented contains the strongest band, 65,213, as its first member, the second most intense, 73,834, as the second, and one of moderate intensity as the third, 77,360. The other members, if they exist, would be lost in the continuous absorption. The series converges at 82,767 cm<sup>-1</sup> (10.20 volts). The formula is

$$\bar{\nu} = 82,767 - R/(n - 0.495)^2 \quad (n = 3, 4, 5, \dots).$$

After a thorough search no other series containing more than two members could be found in the bands in this region, which was convincing from the standpoint of intensities.