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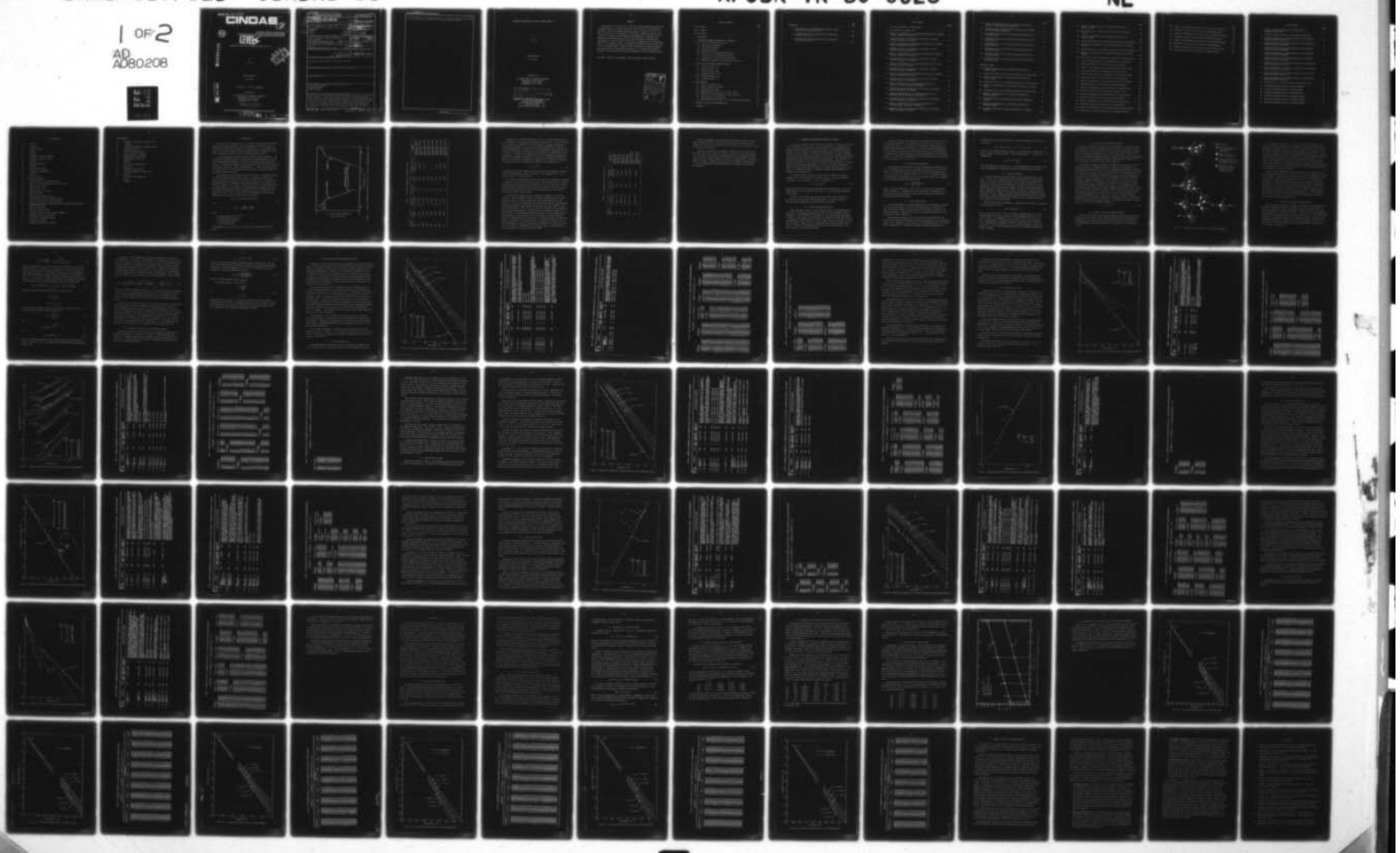

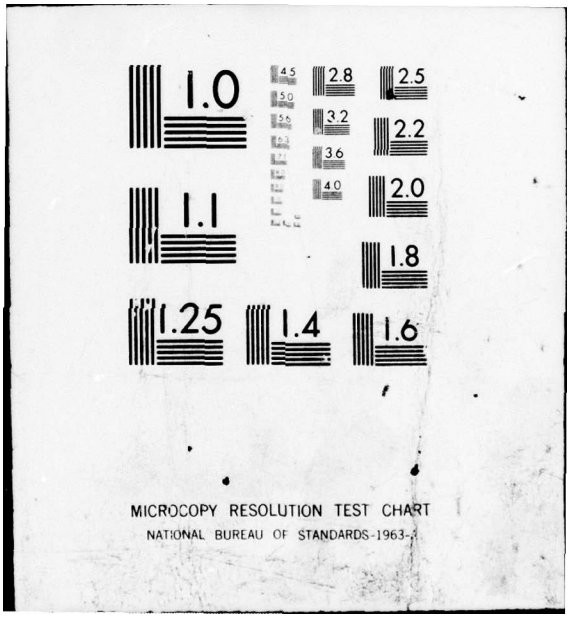
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ABSORPTION COEFFICIENT OF ALKALI HALIDES (PART II)

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By

H. H. LI

CINDAS REPORT 55

July 1979

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Prepared for

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH
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This report is the second part of the report entitled "Absorption Coefficient of Alkali Halides." In this second report, data analysis on the absorption coefficient in the multiphonon absorption region is carried out for LiF, NaF, NaCl, KCl, KBr and KI. An equation is formulated to describe absorption coefficient as a function of both frequency and temperature. Constants in the equation were determined based on data fitting calculations and empirical correlations. The Urbach rule has been found to be applicable to the UV

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absorption edge of the transparent region; the equation derived in this study is considered to be its matching rule in the IR absorption edge.

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ABSTRACT

This report is the second part of the report entitled "Absorption Coefficient of Alkali Halides." In this second report, data analysis on the absorption coefficient in the multiphonon absorption region is carried out for LiF, NaF, NaCl, KCl, KBr and KI. An equation is formulated to describe absorption coefficient as a function of both frequency and temperature. Constants in the equation were determined based on data fitting calculations and empirical correlations. In view of that the Urbach Rule is applied to the uv absorption edge of the transparent region, our equation is considered as its matching rule in the ir absorption edge. Comparing with the Deutsch's exponential equation, the proposed equation includes the temperature as an additional independent variable. The calculated values are in concordance with the experimental data.

Key Words: absorption coefficient, optical constants, alkali halides.

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LIST OF SYMBOLS

Λ	constant
a	constant
a_o	lattice constant
B	constant
b	constant
C	constant; calorimetric method
c	constant; velocity of light
D	constant
E	energy in units of eV
E_o	constant
e*	Born effective charge
f	f number of transition $\sim$1
f_o	constant
h	Plank constant
k	Boltzmann constant
M	molecular weight, coordination number
M_i	number of i-th type imperfection per unit area
m_r	reduced mass per cell
N	number of unit cells
N_i	number density of i-th mode
n	refractive index
$\bar{n}$	Bose-Einstein occupancy factor
Q_j	a phonon mode with vector $\bar{q}_j$ and branch b_j
R	apparent reflectivity; reflection method
R_∞	reflectivity at normal incidence without contribution from multiple internal reflection
$\bar{R}$	complex reflectivity
r_e	classical electron radius
r_o	equilibrium spacing between nearest neighbors
S_i	strengths of the i-th oscillator
T	temperature; transmission method
t	thickness of specimen
Z	transmission and reflection method

Greek Symbols

α	absorption coefficient in units of cm^{-1}
α_o	constant
Γn	relaxation frequency of fundamental mode
Δ	modified Kronecker δ
ε_o	static dielectric constant
ε_∞	optical dielectric constant
μ_D	dimensionless reduced mass
ν	wavenumber in unit of cm^{-1}
ν_o	constant
ξ_n	the vertex correction factor
ρ	resistivity
σ_i	absorption cross section
σ_s	steepness parameter in Urbach rule
σ_{so}	constant
τ	collision time, transmission
Ω	volume
ω	frequency

1. INTRODUCTION

This report is the second part of the technical report entitled "Absorption Coefficients of Alkali Halides." Material presented in the first report is essentially the up-to-date knowledge of available data. In this second report, results on the data analysis are given, particularly for the temperature dependence of absorption coefficient in the infrared wavelength region.

A typical absorption spectrum of alkali halides is shown in Figure 1. The fundamental transparent region of alkali halides is defined between the Urbach tail and multiphonon absorption. In the high transparent region, the transparency of the material is limited by many factors, notably the crystal vacancies, dislocations, impurities, surface contamination, etc. Extrinsic absorption due to these origins can be reduced through appropriate crystal growing, annealing, and surface cleaning processes.

Investigation of the Urbach tail region may serve as an indicator to show the extent of impurity and/or defect contents. As generally observed, the purer the sample is, the greater the validity of Urbach rule is extended to the transparent region. By comparing the absorption spectrum at the Urbach tail, the purer sample is self-revealed. Studies on the Urbach rule have been carried out by many workers, notably Haupt [1], Martienssen [2], Kobayashi and Tomiki [3], Miyata and Tomiki [4], Tomiki and Miyata [5], Sano [6], Tomiki [7], and Tomiki et al. [8]. Result of these works is an expression for the intrinsic absorption coefficient in the tail region, of the form:

$$\alpha(E,T) = \alpha_o \exp[-\sigma_s(T)(E_o - E)/kT], \tag{1}$$

and

$$\sigma_s(T) = \sigma_{so} \frac{2kT}{hf_o} \tanh \frac{hf_o}{2kT},$$

where

E = photon energy in units of eV

T = temperature in units of K

k = the Boltzmann constant

h = the Plank constant.

The parameters α_o, σ_{so}, E_o, and f_o for various alkali halides are given in Table 1.

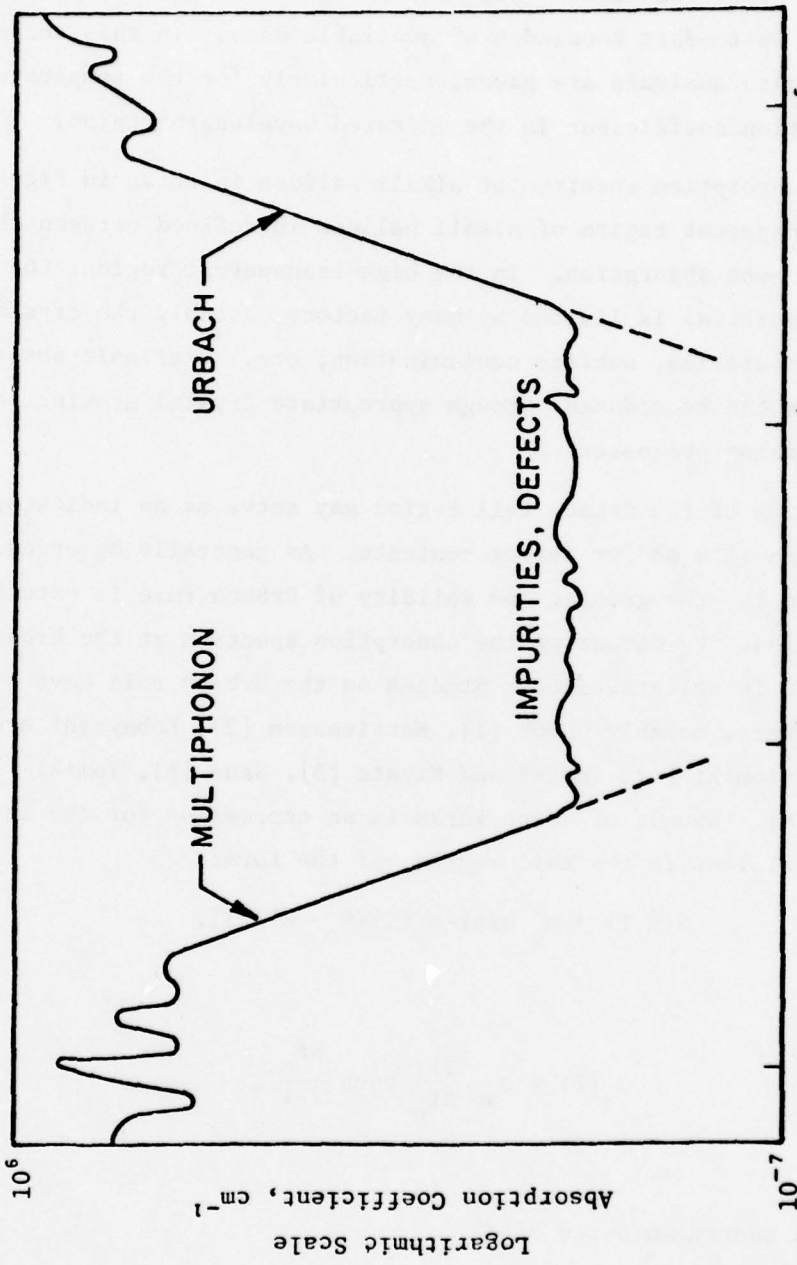

Figure 1. Schematic Absorption Spectrum of an Alkali Halide in Semilogarithismic Scale

Table 1. The Urbach Parameters of Alkali Halides

Crystal	E_o, eV	α_o, cm^{-1}	hf_o, meV	σ_{so}	Range of E, eV	Remarks
LiF	13.00	1.0×10^{10}	0.23	0.70	10.6-12.9	Reported by Tomiki and Miyata [5]
NaF	10.70	1.0×10^{10}	16.5	0.69	9.8-10.5	Reported by Tomiki, et al. [8]
NaCl	8.025	1.2×10^{10}	9.5	0.741	6.4-7.9	Reported by Tomiki, et al. [8]
NaBr	6.770	6×10^{9}	10.7	0.765	---	Reported by Tomiki, et al. [8]
NaI	5.666	6×10^{9}	8.5	0.845	---	Reported by Tomiki, et al. [8]
KCl	7.834	1.26×10^{10}	13.5	0.745	6.4-7.2	Reported by Tomiki, et al. [8]
KBr	6.840	6×10^{9}	10.5	0.774	5.3-6.8	Reported by Tomiki, et al. [8]
KI	5.890	6×10^{9}	4.5	0.830	4.4-5.8	Reported by Tomiki, et al. [8]

Absorption in the multiphonon region has been of current interest because of its application in windows for high-power infrared lasers. At the frequencies in this region, the absorption can be attributed to "intrinsic" processes involving several phonons or to defect modes involving impurities, vacancies, or surface contaminations. Available data in the multiphonon region indicate that the intrinsic absorption coefficient can be expressed as an exponential function of frequency. A number of investigations have been conducted to calculate the frequency and temperature dependence of the intrinsic multiphonon absorption. Deutsch [9] found that the exponential dependence of the absorption coefficient on frequency holds for LiF, NaCl, KCl, and KBr at room temperature, i.e.,

$$\alpha = \alpha_o e^{-\nu/\nu_o} \tag{2}$$

As discussed in the first report, we have found that this exponential relation is also applicable in the cases of NaF and KI. The parameters α_o and ν_o of various crystals are given in Table 2.

With regard to the theoretical works that consider the temperature dependence of absorption coefficient, the results are not quite satisfactory. As a theoretical approach to solve the problems is beyond the scope of this work, Section 2 briefly discusses the absorption mechanisms and theoretical works in the interpretation of the absorption spectrum. The interested reader is referred to the references given in that section.

All the theories dealing with the temperature dependence of absorption coefficient have attempted to resolve the problems encountered over the entire temperature range, from helium temperature up to the melting point of the crystals. In the area of high-power laser applications, however, the absorption coefficient measured at high temperatures are actually used. Therefore, from the practical point of view, our data analysis was performed in the temperature region above room temperature. Toward this end, we present in Section 3 the available data in the multiphonon-absorption region at various temperatures in both graphical and tabular forms, so that the reader can quickly grasp the essence of absorption behavior with respect to frequency as well as temperature. Section 4 is dedicated to discussions for data analysis and details of how the final expressions of frequency and temperature dependences of absorption coefficient were obtained. Recommended and provisional values, calculated based on these expressions, are also given in this section.

Table 2. The Parameters of Equation (2).

Crystal	α_o, cm^{-1}	ν_o, cm^{-1}	Range of ν, cm^{-1}	Remarks
LiF	2.1317×10^4	153.2	1450-2500	Reported by Deutsch [9]
NaCl	2.4273×10^4	56.0	356-945	Reported by Deutsch [9]
KCl	0.8696×10^4	50.8	317-750	Reported by Deutsch [9]
KBr	0.6077×10^4	39.1	250-600	Reported by Deutsch [9]
NaF	6.1053×10^4	79.5	700-1400	Established in Part I of this report
KI	0.4294×10^4	35.1	250-500	Established in Part I of this report

Section 5 summarizes this investigation and recommends further research to resolve unsolved problems. Sources from which either experimental data or theoretical results were obtained are given in Section 6, the reference section of this part of the report.

It should be noted that the substances reported in Part I were for LiF, NaF, NaCl, KCl, KBr, KI, and CsI. However, collection of data on the absorption coefficient, reflectivity, and transmission for the remaining 13 alkali halides was also conducted during the course of the present work. In order to provide the reader a complete profile of optical constants of alkali halides as a whole, available data on these materials are reported in the tables of the Appendices.

2. FUNDAMENTAL ABSORPTION MECHANISMS AND THEORIES

This section contains a review of what is known about the physical mechanisms that are responsible for the small residual absorption in the transparent infrared wavelength regions and a brief discussion on the multiphonon absorption theories. It is convenient to separate the origins that give rise to residual absorption into two classes, the extrinsic and intrinsic. Extrinsic absorptions are those associated with unwanted impurity atoms and molecules, deviations from stoichiometry, lattice defects and surface contaminations. The intrinsic absorption are those due to the electronic and vibrational absorptions in an ideal crystal of some specified composition. In practice, extrinsic absorptions appear to be more troublesome in the best of currently available materials and there are no appropriate means to completely eliminate the objectionable absorptions in optical materials.

In a given crystal, the total absorption can be considered as simply a superposition of the absorption from various origins. The total absorption coefficient, $\alpha(\nu)$, at frequency ν is well approximated by

$$\alpha(\nu) = \sum_i N_i \sigma_i(\nu), \tag{3}$$

where the sum is over the various modes and types of imperfection. N_i is the number density of the i-th mode or type and σ_i is the corresponding absorption cross-section.

In both of the extrinsic and intrinsic absorptions, the processes that give rise to $\sigma_i(\nu)$ may be of three general types: (1) lattice vibration, (2) free-carrier absorption, and (3) electronic excitation.

2.1. Lattice Vibration Absorption

There have been a number of recent studies on how the infrared absorption drops off as the frequency becomes much greater than the fundamental lattice frequencies. These studies have been mainly on the alkali halides and alkaline fluorides. In the highly purified samples, the absorption coefficient exhibits an exponential fall-off over two to four decades to the lowest values of α that can be measured. Equation (2) was established based on data obtained on pure crystals. Whether this exponential absorption tail is characteristic of all other classes of materials is not known.

Presence of impurities can complicate the exponential tail, particularly at low absorption levels. The impurities may enter the lattice singly or multiply in a number of various types of configurations. Unfortunately, the impurity atoms or molecules, which appear to produce troublesome absorptions near 10.6 and 2-5 μm, have not yet been studied adequately. These impurities are primarily the oxygen and hydroxyl radicals whose absorptions are centered at about 3, 9 and 13 μm. The absorption cross sections due to these impurities are in the range of 10^{-18} to 10^{-20} cm^2.

2.2. Free-Carrier Absorption

Free carriers either intrinsic or caused by impurities contribute a term, α_e, to the absorption which can be correlated roughly with the dc resistivity. Except in the very pure nonpolar crystals, the free-carrier collision time, τ, is on the order of an infrared period (i.e., $\nu\tau \leq 1$). Under this condition, the resistivity at that frequency is not much different from the dc resistivity and can be approximated by the Drude formula

$$\alpha_e(\nu) = \frac{[30/\rho\ n(\nu)]}{(1 + \nu^2\tau^2)}\ cm^{-1}, \tag{4}$$

where ρ is the dc resistivity in units of ohm-cm and $n(\nu)$ is the refractive index at frequency ν. Although free-carrier absorption is negligible for alkali halides, high intensities of laser beam may increase the free-carrier concentration by photo-excitation.

2.3. Electronic Absorption

In the consideration of infrared transparency of the materials, only those with band gap much higher than the infrared frequencies are considered. In the case of alkali halides, electronic excitation contributes little to the infrared absorption. Those which do affect the infrared absorption have their origins due to heavy impurities.

Heavy impurities generally have so low vibration frequencies that the wing of their vibrational absorption contributes negligibly at laser wavelengths. However, heavy impurities may contribute to infrared absorption via their electronic absorption tail. Assuming the impurity electronic absorption is a

Lorentzian line at ν_o and of half width $\Delta\nu$, then the absorption cross section is given by

$$\sigma_e(\nu) = \frac{1}{2} f r_e c \Delta\nu[(\nu - \nu_e)^{-2} - (\nu + \nu_e)^{-2}]\text{cm}^2 \tag{5}$$

where r_e is the classical electron radius, c is the velocity of light and $f \sim 1$ is the f-number of the transition. In the infrared where $\nu << \nu_e$ eq. (5) is simplified to

$$\sigma_e(\nu) = 2fr_e c \frac{\nu\Delta\nu}{\nu_e^3} . \tag{6}$$

It is well known that the half width, $\Delta\nu$, of heavy impurities is generally very large and consequently contributes noticably to absorption in the infrared.

2.4. Surface Absorption

Surface absorption can affect high-power laser window materials in many ways. The heat due to absorption can cause distortions of the optical phase front. In the case of fragile surfaces, such as of the alkali halides, the surface may develop cracks which subsequently propagate or enlarge, or become hygroscopic. When anti-reflection coatings are used, surface absorption may tend to dislodge or evaporate the coatings. The theory of surface absorption may be thought of in terms of the same mechanisms that were discussed for bulk absorption. The most commonly observed surface absorptions are those associated with oxygen and hydroxyl radicals whose absorptions are centered respectively at 2.8 and 9.3 μm in various crystals.

The fractional power of radiation, α_s, absorbed at the surface, is expressed in the same form as eq. (3):

$$\alpha_s(\nu) = \sum_i M_i \sigma_i(\nu), \tag{7}$$

where α_s is in units of cm^{-2}, M_i is the number of imperfections of i-th type per unit surface area, and σ_i carries the same meaning as those in eq. (3). In many cases, α_s is estimated to be in the order of 10^{-3} per unit surface area. Although this is a significant figure in high-power laser operations, it is very difficult to eliminate with the existing technology. Moderate reduction of α_s can be achieved through improved crystal growing techniques and surface polishing.

2.5. Processes in Multiphonon Absorption

Ever since the advent of high-power infrared lasers, the numerical values of absorption coefficient of window materials attracted much attention and have been receiving serious consideration in the wavelength regions where absorption is low. Because the wavelength regions of laser interest are located at the tails of the fundamental absorption bands, a number of theoretical and experimental investigations in the multiphonon absorption region have been carried out in order to define the intrinsic limits on the absorption.

The exponential frequency dependence of absorption coefficient on the high frequency side of the fundamental absorption band has been interpreted by a multiphonon absorption theory, in which the fundamental process which contributes to the absorption is that a photon is absorbed by the crystal through the virtual excitation of the fundamental (TO mode) phonon which in turn emits n phonons. The various processes involved in such a transformation are best demonstrated through a schematic representation. Shown in Figure 2 are typical processes of n-phonon creation: (a) absorption of a photon and creation of a TO phonon through the dipole moment interaction (open circle), and subsequent decay of the TO phonon into other phonons through anharmonic interactions (closed circles), (b) direct creation of phonons by a photon through higher order electric moment interactions (open square), (c) same process as in (b) with subsequent decay of the created phonons, (d) the sum of all processes of n-phonon creation equivalent to the creation of n phonons by a single process with a "renormalized" nth order interaction vertex (open hexagon). The anharmonic absorption coefficient, α_A, is the sum of n-phonon absorption, α_n,

$$\alpha_A = \sum_n \alpha_n . \tag{8}$$

2.6. Theories on the Multiphonon Absorption

The bulk of the theories concerning multiphonon absorption were developed during the years of 1972 to 1974. Essential simplification, modification and improvement of these theories were also made during these years. Currently, our understanding of multiphonon absorption is basically at the same level as in 1974.

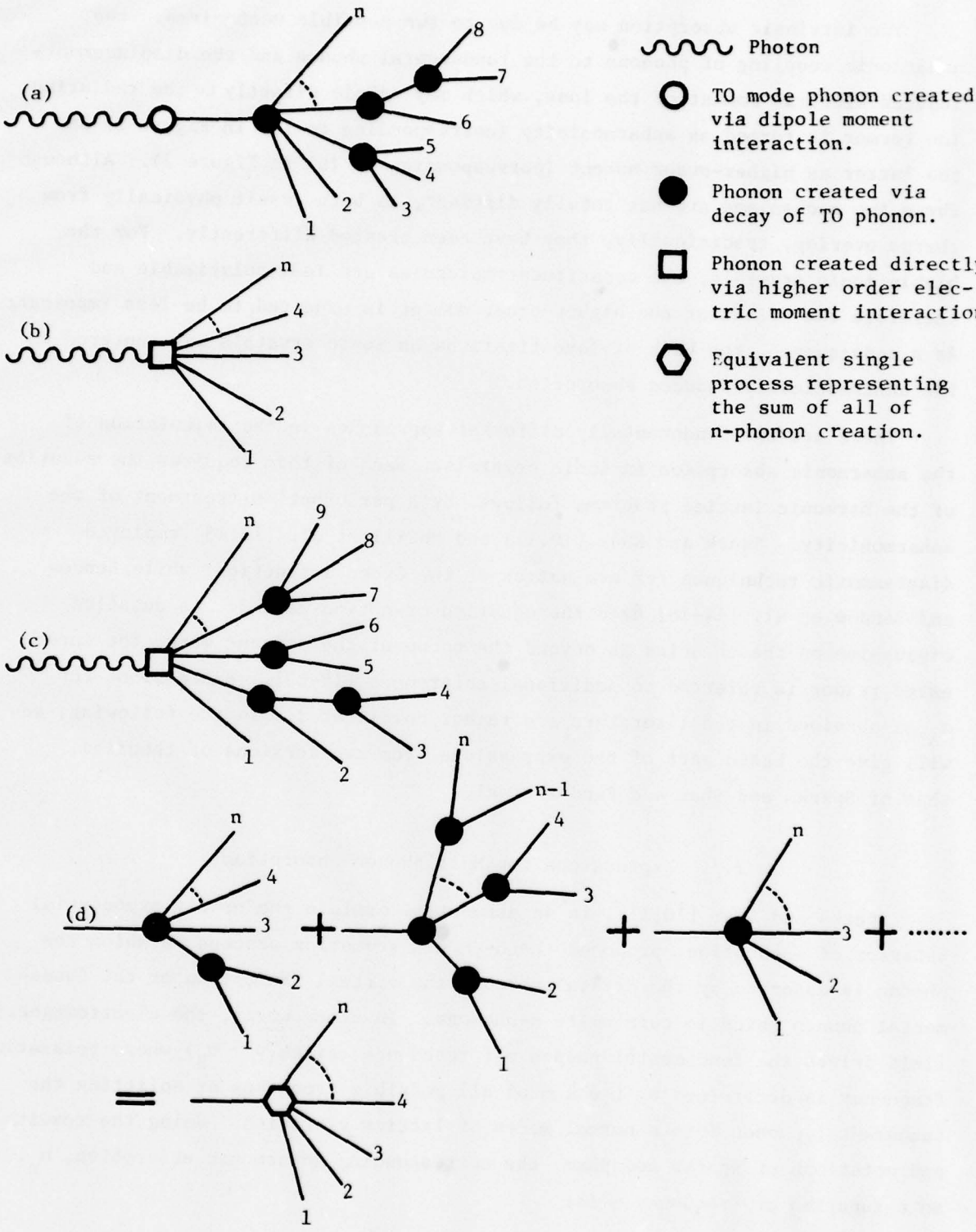

Figure 2. n-Phonon Creation Processes in Multiphonon Absorption.

The intrinsic absorption may be due to two possible mechanisms: the anharmonic coupling of phonons to the fundamental phonon and the displacement-induced electric moment of the ions, which may couple directly to the radiation. The former is termed as anharmonicity (corresponding to (a) in Figure 2) and the latter as higher-order moment (corresponding to (b) in Figure 2). Although these two mechanisms are not totally distinct, as both result physically from charge overlap, traditionally, they have been treated differently. For the highly ionic crystals, the constituent molecules are less polarizable and therefore the effect of the higher-order moment is expected to be less important. As a consequence, the bulk of investigations on ionic crystals was centered on the anharmonically induced absorption.

There are two fundamentally different approaches in the calculation of the anharmonic absorption in ionic crystals. Each of them requires the solution of the harmonic lattice problems followed by a perturbation treatment of the anharmonicity. Spark and Sham [10,11] and McGill et al. [12,13] employed diagrammatic techniques for evaluation of the Green's function, while Bendow and Bendow et al. [14-18] used the equation-of-motion method. As detailed discussion on the theories is beyond the scope of the present work, the interested reader is referred to additional references [19-23]. Expressions for α_A as obtained in the literature are rather complicated. In the following, we will give the basic part of the expressions from two versions of theories, that of Sparks and Sham and Bendow et al.

2.7. Expressions for Multiphonon Absorption

Sparks and Sham [10,11], in an attempt to explain the nearly exponential behavior of absorption, proposed the n-phonon summation process in which the photon is absorbed by the crystal through the virtual excitation of the fundamental phonon which in turn emits n-phonons. In other words, the electromagnetic field drives the fundamental phonon off resonance (since $\nu > \nu_R$) whose relaxation frequency is determined by the sum of all possible processes of splitting the fundamental phonon into n normal modes of lattice vibration. Using the results and notations of Sparks and Sham, the corresponding anharmonic absorption, α_n, as a function of frequency ω is:

$$\alpha_n(\omega) = \frac{4\pi Ne^{*2}}{cm_r n_r \Omega} \cdot \frac{\omega\omega_f \Gamma_n(\omega)}{(\omega^2 - \omega_f^2)^2 + [\omega_f \Gamma_n(\omega)]^2} , \tag{9}$$

where N is the number of unit cells in a sample of volume Ω; e* is the Born effective charge; c is the velocity of light; m_r the reduced mass of the two ions in a unit cell; n_r is the refractive index at ω; ω_f is the frequency of the fundamental mode and Γ_n is the relaxation frequency of the fundamental mode. It is clear that the central attention of the theory is in the calculation of Γ_n. The value of Γ_n can be calculated from the standard perturbation-theory expression for the n-Boson-summation relazation frequency [29]

$$\Gamma_n(\omega) = \frac{2\pi}{\hbar^2} (n+1)^2 n! \sum_{Q_1 \ldots Q_n} |\Lambda(fQ_1 \ldots Q_n)|^2 \, \Delta(\bar{q}) \delta(\bar{\omega}) \bar{n}_n \tag{10}$$

where Q_j is the phonon mode with wave vector $\bar{q}_j$ and branch b_j;

$$\bar{q} \text{ is } \sum_{j=1}^{n} \bar{q}_j ;$$

$$\bar{\omega} \text{ is } (\omega - \sum_{j=1}^{n} \omega_{Q_j}) ;$$

Δ is the modified Kronecker δ which is unity when the argument is zero or a reciprocal-lattice vector and zero otherwise, and

$$\bar{n}_n = \prod_{j=1}^{n} \frac{\bar{n}_j + 1}{\bar{n}_\omega + 1} \tag{11}$$

with

$$\bar{n}_j = n(Q_j) = (e^{\hbar\omega_{Q_j}/kT} - 1)^{-1} \tag{12}$$

and

$$\bar{n}_\omega = (e^{h\omega/kT} - 1)^{-1} \tag{13}$$

where k is the Boltzman constant and $\bar{n}_j$ and $\bar{n}_\omega$ are Bose-Einstein population factors. The factor, $\Lambda(fQ_1 \ldots Q_n)$ denotes the renormalized vertex corresponding to Figure 2(d).

Bendow et al. [15] introduced an anharmonic perturbative potential into the Hamiltonian of the phonon. This potential is considered as a portion of the full lattice-interaction potential in the form of a sum of interactions between pairs of atoms in the crystal under the assumption that the electronic motion is completely separated from the ionic motion (i.e., adiabaticity) and that the point-ion model is valid. As the lattice is set in vibration, the perturbing potential contains cubic or higher order terms of displacement. Their results, when all lengths are scaled in units of the lattice constant a_o, can be written as:

$$\alpha_n(\omega) = \frac{\varepsilon_o - \varepsilon_\infty}{6\pi c \sqrt{\varepsilon_\infty}} \left(\frac{\omega_f}{\omega}\right)^3 \frac{1}{n!} \left(\frac{3}{2}\frac{1}{\mu_D}\right)^{n+1} \left(\frac{\partial^{n+1} V(r)}{\partial \gamma^{n+1}}\right)^2_{r=r_o} \cdot \frac{(\bar{n}(\omega_f) + 1)^2}{\bar{n}(\omega) + 1} M^2 \xi_n, \qquad (14)$$

where ε_o is the static dielectric constant, ε_∞ is the optical dielectric constant; $\mu_D = \hbar/(\mu\omega_f a_o^2)$ is the dimensionless reduced mass; c is the velocity of light; r_o is the nearest neighbor equilibrium spacing; M is the coordination number, ξ_n is the vertex correction factor [11]; and $\bar{n}$ is the Bose-Einstein population factor.

Reviewed above are typical theories in the interpretation for the multiphonon absorption. Modifications and simplifications have been made by a number of later investigators, notably by Boyer et al. [28] and Harrington et al. [27]. All of the theories indicate that corresponding to a given n there is an n-phonon absorption centered at the frequency $n\omega_f$ and that the observed absorption spectrum actually corresponds to the convolution of all possible n's. It is therefore expected to see structure features in the spectrum. In practice, however, the structure is observable only at low temperatures. At room temperature, the spectrum is well represented by an exponential law of the form of eq. (2).

2.8. Temperature Dependence of Multiphonon Absorption

Although the existing theories do predict the exponential dependence of the absorption coefficient as a function of frequency at room temperature, with regard to the temperature dependence of absorption, theories have not been very successful. In these theories, the phonons are considered as bosons and thus lead to the following expression:

$$\alpha_n \sim (\bar{n} + 1)^n - (\bar{n})^n \tag{15}$$

where $\bar{n}$ is the usual Bose-Eistein population factor as given in eqs. (12) and (13). The transition matrix elements are assumed to be essentially temperature independent. After rearrangement of eq. (15), the coefficient α_A can be expressed as a function of temperature given by

$$\alpha_A \sim \frac{1 - \exp(-n\hbar\bar{\omega}/kT)}{[1 - \exp(-n\hbar\bar{\omega}/kT)]^n} . \tag{16}$$

where $\bar{\omega}$ is phonon frequency and $n\bar{\omega} = \omega_{photon}$.

In the limit where $kT >> \hbar\bar{\omega}$, we have

$$\alpha_A \sim n\left(\frac{kT}{\hbar\bar{\omega}}\right)^{n-1}$$

or

$$\alpha_A \sim T^{n-1} \tag{17}$$

Disagreement in the value of n is indicated, however, by the best available experimental data [28,30,31]. Subsequent modification of the theory, by taking into consideration the temperature dependence of the physical parameters used in the theory [32], some qualitative improvement is noted.

3. DATA IN THE MULTIPHONON ABSORPTION REGION

Although the bulk of available data on the absorption coefficient was given in Part I, data sets belonging to the multiphonon absorption and laser wavelength region are intermingled with those of other regions with the consequence that it becomes inconvenient for comparison. It is therefore desirable to collect the appropriate data sets and to tabulate them in a condensed version for ease of comparison. Furthermore, the collected data sets are appropriately ordered chronologically and replotted in enlarged scales for better resolution so that the behaviors of the absorption coefficient with respect to frequency and temperature can be easily observed.

Errors in observed data on the absorption coefficient usually amount to ±5-10% for high absorption levels, inaccuracies progressively increasing with decreasing absorption level, a natural consequence of decreasing in instrumental sensitivity. There is no clear cut demarcation separating the high and low absorption levels. A reasonable criterion may be based on the type of measuring technique used. In general, absorption coefficients, which can be measured with high degree of reliability by directly observing the decay of light through the crystal or indirectly deduced from reflectivity and/or transmission measurements, are considered as high absorption with the lower limit approaching 0.1 cm^{-1} or higher. Lower absorption has to be determined by a high sensitivity method, such as laser calorimetry.

Non-experimental errors are added to the data when these are reported only graphically with no accompanying tabulation reporting all relevant significant figures. Additionally, inadequate scales used in graphic data presentation further contribute significantly to data uncertainties to point which may make the data unacceptable.

As the order of magnitude of absorption coefficient varies over a wide range, from $10^{-6}cm^{-1}$ to $10^{6}cm^{-1}$. It is convenient to present the data in powers of ten. In the tables of absorption coefficient, the numerical value 1.259E ± n stands for $1.259 \times 10^{\pm n}$.

3.1. Lithium Fluoride, LiF

Available absorption coefficient data of LiF are plotted in Figure 3 and given in Tables 3 and 4. Each data set appears as nearly straight line in the

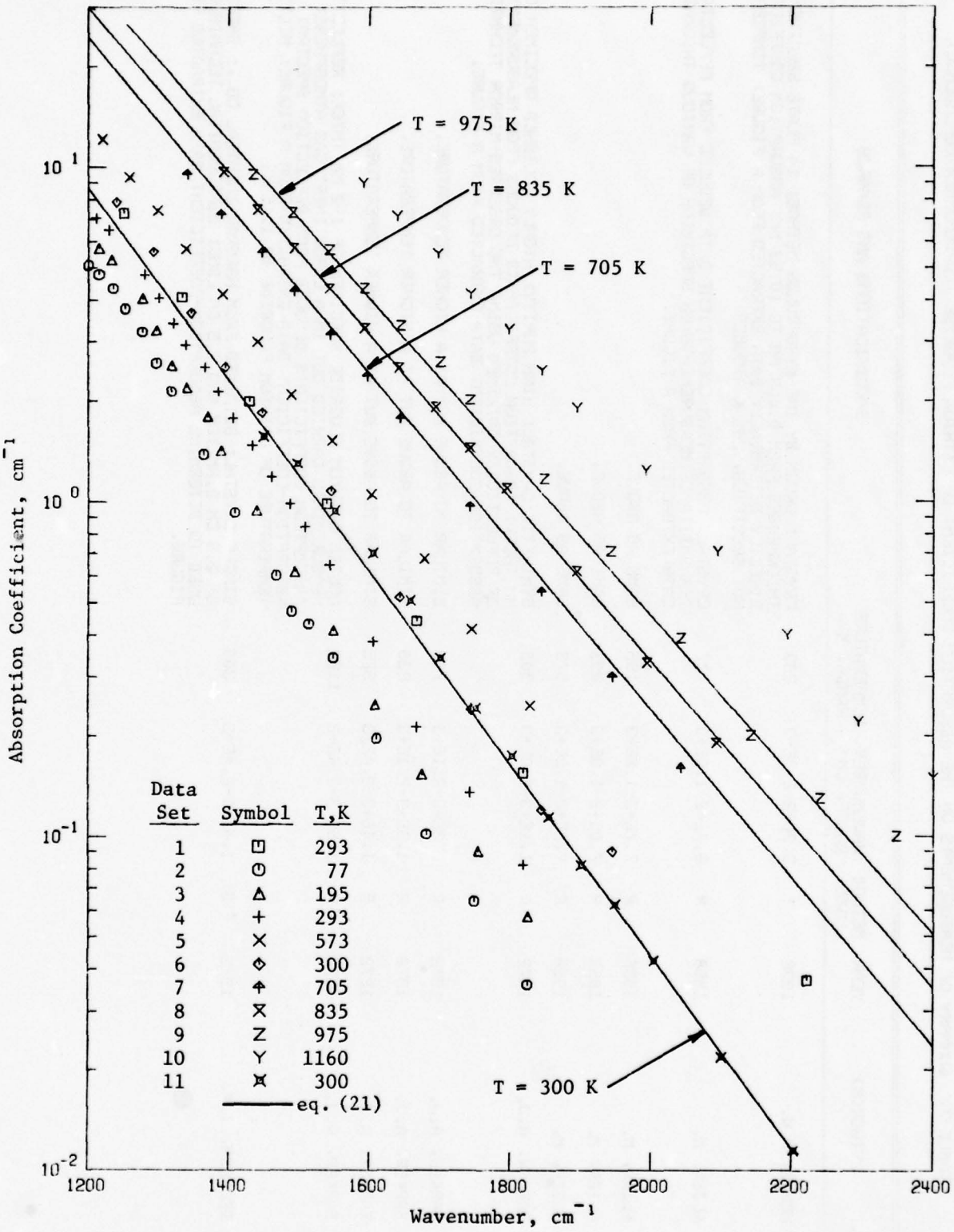

Figure 3. Absorption Coefficient of Lithium Fluoride in the Multiphonon Region

TABLE 3. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF LITHIUM FLUORIDE (WAVENUMBER DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	33	HOHLS, H.W.	1936	T	6.3E+2-2.3E+3	293	CRYSTAL: GROWN BY THE KYROPOULOS METHOD: 14 PLATE SPECIMENS OF THICKNESSES FROM 0.008 MM TO 10.53 MM: ABSORPTION COEFFICIENTS DIRECTLY DETERMINED: DATA EXTRACTED FROM A FIGURE: TEMPERATURE NOT SPECIFIED, 293 K ASSUMED.
2	34	KLIER, M.	1958	R	6.7E+2-1.9E+3	77	CRYSTAL: ABSORPTION-COEFFICIENT DATA DEDUCED FROM REFLECTANCE AND TRANSMITTANCE MEASUREMENTS ON SPECIMENS OF VARIOUS THICKNESSES: DATA EXTRACTED FROM A FIGURE.
3	34	KLIER, M.	1958	R	7.7E+2-1.9E+3	195	SAME AS ABOVE.
4	34	KLIER, M.	1958	R	7.0E+2-1.9E+3	293	SAME AS ABOVE.
5	34	KLIER, M.	1958	R	7.2E+2-1.9E+3	573	SAME AS ABOVE.
6	35	BARKER, A.J.	1972	R	1.1E+3-2.0E+3	300	SYNTHETIC CRYSTAL: HIGH PURITY: HIGHLY POLISHED SPECIMEN OF 1-2 MM THICK: ABSORPTION COEFFICIENTS DEDUCED FROM MEASUREMENTS OF OF REFLECTIVITY OBTAINED USING THE OBSCURED-MIRROR TECHNIQUE: ABSORPTION-COEFFICIENT DATA EXTRACTED FROM A FIGURE.
7	35	BARKER, A.J.	1972	R	1.3E+3-2.1E+3	705	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE.
8	35	BARKER, A.J.	1972	R	1.3E+3-2.1E+3	835	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE.
9	35	BARKER, A.J.	1972	R	1.4E+3-2.4E+3	975	SIMILAR TO ABOVE BUT AT A HIGHER TEMPERATURE.
10	35	BARKER, A.J.	1972	R	1.5E+3-2.4E+3	1160	MOLTEN LITHIUM FLUORIDE SPECIMEN OF 1-2 MM THICK: REFLECTIVITY MEASUREMENTS CARRIED OUT IN A LARGE INERT GAS ATMOSPHERE: ABSORPTION COEFFICIENTS DEDUCED FROM REFLECTION SPECTRA: ABSORPTION-COEFFICIENT DATA EXTRACTED FROM A FIGURE: MELTING TEMPERATURE OF LITHIUM FLUORIDE IS 1115 K.
11	9	DEUTSCH, T.F.	1973	D	1.4E+3-2.4E+3	300	SINGLE CRYSTAL: OBTAINED FROM HARSHAW CHEMICAL CO.,: SPECIMEN OF OF 2.5 CM DIAMETER AND 2.5 CM LONG: DIFFERENTIAL TECHNIQUE USED TO DETERMINE ABSORPTION-COEFFICIENT DATA EXTRACTED FROM A FIGURE.

TABLE 3. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF LITHIUMFLUORIDE (WAVENUMBER DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
12	36	KACHARE, A., SORIAGA, M., ANDERMANN, G.	1974	R	7.7E+2-1.2E+3	300	SINGLE CRYSTAL; POLISHED AND ANNEALED; NEAR NORMAL REFLECTION SPECTRUM OBTAINED; ABSORPTION COEFFICIENT DEDUCED FROM REFLECTION SPECTRUM BY THE KRAMERS-KRONIG ANALYSIS; DATA EXTRACTED FROM A FIGURE.
13	36	KACHARE, A., ET AL.	1974	R	7.1E+2-1.2E+3	80	SIMILAR TO ABOVE BUT AT A LOWER TEMPERATURE.
14	36	KACHARE, A., ET AL.	1974	R	7.1E+2-1.2E+3	20	SIMILAR TO ABOVE BUT AT A LOWER TEMPERATURE.

TABLE 4. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF LITHIUM FLUORIDE (WAVENUMBER DEPENDENCE)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α	ν	α	ν	α	ν	α	ν	α	ν	α
DATA SET 1		DATA SET 2		DATA SET 2(CONT.)		DATA SET 4		DATA SET 5		DATA SET 7	
T = 293.0		T = 77.0				T = 293.0		T = 573.0		T = 705.0	
				7.027E+2	1.770E+2						
2.222E+3	3.700E-2	1.825E+3	3.600E-2	6.906E+2	2.016E+2	1.818E+3	8.225E-2	1.828E+3	2.458E-1	2.042E+3	1.600E-1
1.818E+3	1.550E-1	1.748E+3	6.393E-2	6.793E+2	2.417E+2	1.742E+3	1.355E-1	1.745E+3	4.167E-1	1.945E+3	3.000E-1
1.667E+3	4.400E-1	1.681E+3	1.016E-1			1.667E+3	2.124E-1	1.678E+3	6.768E-1	1.844E+3	5.400E-1
1.538E+3	9.900E-1	1.610E+3	1.959E-1	DATA SET 3		1.605E+3	3.826E-1	1.603E+3	1.051E+0	1.742E+3	9.700E-1
1.429E+3	2.000E+0	1.548E+3	3.428E-1	T = 195.0		1.543E+3	6.481E-1	1.546E+3	1.529E+0	1.644E+3	1.780E+0
1.333E+3	4.100E+0	1.513E+3	4.316E-1			1.508E+3	8.427E-1	1.488E+3	2.098E+0	1.597E+3	2.380E+0
1.250E+3	7.300E+0	1.488E+3	4.718E-1	1.825E+3	5.756E-2	1.486E+3	9.889E-1	1.441E+3	3.018E+0	1.544E+3	3.170E+0
1.176E+3	9.500E+0	1.466E+3	6.045E-1	1.754E+3	9.017E-2	1.460E+3	1.190E+0	1.391E+3	4.193E+0	1.492E+3	4.280E+0
1.111E+3	1.200E+1	1.408E+3	9.288E-1	1.675E+3	1.532E-1	1.433E+3	1.477E+0	1.339E+3	5.726E+0	1.446E+3	5.590E+0
1.053E+3	1.950E+1	1.364E+3	1.387E+0	1.608E+3	2.475E-1	1.406E+3	1.784E+0	1.299E+3	7.426E+0	1.389E+3	7.270E+0
1.000E+3	3.300E+1	1.318E+3	2.143E+0	1.548E+3	4.140E-1	1.385E+3	2.141E+0	1.259E+3	9.319E+0	1.341E+3	9.580E+0
9.524E+2	4.450E+1	1.297E+3	2.595E+0	1.493E+3	6.210E-1	1.366E+3	2.528E+0	1.220E+3	1.212E+1		
9.091E+2	6.200E+1	1.277E+3	3.217E+0	1.439E+3	9.446E-1	1.339E+3	2.950E+0	1.148E+3	1.767E+1	DATA SET 8	
8.696E+2	9.000E+1	1.252E+3	3.773E+0	1.389E+3	1.425E+0	1.321E+3	3.421E+0	1.086E+3	2.415E+1	T = 835.0	
8.432E+2	1.292E+2	1.235E+3	4.352E+0	1.370E+3	1.802E+0	1.300E+3	4.067E+0	1.031E+3	3.471E+1		
8.333E+2	1.450E+2	1.215E+3	4.784E+0	1.340E+3	2.200E+0	1.280E+3	4.770E+0	9.785E+2	5.294E+1	2.093E+3	1.900E-1
8.299E+2	1.565E+2	1.200E+3	5.088E+0	1.319E+3	2.556E+0	1.229E+3	6.495E+0	9.320E+2	7.632E+1	1.994E+3	3.300E-1
8.183E+2	1.824E+2	1.179E+3	5.258E+0	1.297E+3	3.252E+0	1.211E+3	7.051E+0	8.921E+2	1.137E+2	1.894E+3	6.200E-1
8.000E+2	2.100E+2	1.144E+3	5.492E+0	1.277E+3	4.050E+0	1.190E+3	7.779E+0	8.726E+2	1.374E+2	1.795E+3	1.100E+0
7.962E+2	2.256E+2	1.131E+3	5.738E+0	1.233E+3	5.299E+0	1.156E+3	8.754E+0	8.354E+2	1.893E+2	1.743E+3	1.450E+0
7.899E+2	2.261E+2	1.112E+3	5.747E+0	1.215E+3	5.725E+0	1.144E+3	9.198E+0	8.019E+2	2.567E+2	1.694E+3	1.920E+0
7.868E+2	2.323E+2	1.099E+3	6.112E+0	1.179E+3	6.499E+0	1.126E+3	9.927E+0	7.716E+2	3.425E+2	1.642E+3	2.520E+0
7.800E+2	2.332E+2	1.071E+3	7.428E+0	1.147E+3	7.255E+0	1.093E+3	1.132E+1	7.559E+2	3.887E+2	1.593E+3	3.310E+0
7.746E+2	2.351E+2	1.029E+3	1.147E+1	1.126E+3	7.495E+0	9.990E+2	2.392E+1	7.283E+2	4.737E+2	1.542E+3	4.350E+0
7.698E+2	2.326E+2	9.785E+2	1.967E+1	1.093E+3	8.589E+0	9.533E+2	4.022E+1			1.492E+3	5.750E+0
7.692E+2	2.300E+2	9.542E+2	2.306E+1	1.056E+3	1.104E+1	9.320E+2	4.749E+1	DATA SET 6		1.440E+3	7.510E+0
7.539E+2	2.280E+2	9.320E+2	2.447E+1	1.030E+3	1.426E+1	9.091E+2	5.673E+1	T = 300.0		1.393E+3	9.720E+0
7.593E+2	2.154E+2	9.132E+2	2.856E+1	1.003E+3	1.899E+1	8.905E+2	6.996E+1				
7.547E+2	2.097E+2	8.921E+2	3.627E+1	9.786E+2	2.523E+1	8.696E+2	8.327E+1	1.945E+3	9.000E-2	DATA SET 9	
7.508E+2	2.075E+2	8.718E+2	4.362E+1	9.560E+2	3.046E+1	8.525E+2	1.004E+2	1.844E+3	1.200E-1	T = 975.0	
7.463E+2	2.075E+2	8.532E+2	5.627E+1	9.116E+2	4.236E+1	8.340E+2	1.198E+2	1.744E+3	2.400E-1		
7.407E+2	2.087E+2	8.347E+2	7.460E+1	8.718E+2	6.304E+1	8.183E+2	1.528E+2	1.643E+3	5.200E-1	2.348E+3	1.000E-1
7.364E+2	2.147E+2	8.190E+2	9.784E+1	8.354E+2	9.888E+1	8.019E+2	1.842E+2	1.545E+3	1.080E+0	2.240E+3	1.300E-1
7.241E+2	2.409E+2	8.032E+2	1.236E+2	8.183E+2	1.248E+2	7.862E+2	2.083E+2	1.447E+3	1.850E+0	2.142E+3	2.000E-1
7.143E+2	3.000E+2	7.862E+2	1.395E+2	8.019E+2	1.511E+2	7.564E+2	2.399E+2	1.395E+3	2.530E+0	2.042E+3	3.900E-1
6.897E+2	9.500E+2	7.710E+2	1.453E+2	7.874E+2	1.751E+2	7.418E+2	2.385E+2	1.346E+3	3.680E+0	1.943E+3	7.100E-1
6.667E+2	1.760E+3	7.407E+2	1.396E+2	7.710E+2	1.863E+2	7.289E+2	2.387E+2	1.292E+3	5.600E+0	1.848E+3	1.170E+0
6.452E+2	3.500E+3	7.289E+2	1.432E+2			7.148E+2	2.474E+2	1.240E+3	7.890E+0	1.743E+3	2.020E+0
6.349E+2	4.200E+3	7.148E+2	1.575E+2			7.032E+2	2.681E+2	1.191E+3	9.960E+0	1.701E+3	2.620E+0

TABLE 4. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF LITHIUM FLUORIDE (WAVENUMBER DEPENDENCE) (CONTINUED)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α	ν	α	ν	α
DATA SET 9(CONT.)		DATA SET 12		DATA SET 14	
		T = 300.0		T = 20.0	
1.644E+3	3.370E+0				
1.592E+3	4.370E+0	1.160E+3	8.746E+0	1.150E+3	5.781E+0
1.543E+3	5.680E+0	1.139E+3	8.586E+0	1.082E+3	5.439E+0
1.490E+3	7.360E+0	1.101E+3	4.151E+0	1.073E+3	6.742E+0
1.434E+3	9.560E+0	1.061E+3	9.333E+0	1.044E+3	1.050E+1
		1.040E+3	9.148E+0	1.036E+3	1.042E+1
DATA SET 10		9.910E+2	2.491E+1	1.022E+3	1.798E+1
T = 1160.0		9.610E+2	4.227E+1	1.007E+3	2.278E+1
		9.410E+2	4.966E+1	1.002E+3	2.392E+1
2.400E+3	1.500E-1	9.210E+2	5.324E+1	9.890E+2	2.113E+1
2.294E+3	2.200E-1	9.010E+2	6.907E+1	9.820E+2	2.098E+1
2.193E+3	4.000E-1	8.800E+2	8.847E+1	9.700E+2	2.316E+1
2.094E+3	7.100E-1	8.390E+2	1.529E+2	9.190E+2	3.465E+1
1.992E+3	1.240E+0	8.300E+2	1.700E+2	8.890E+2	4.580E+1
1.895E+3	1.910E+0	8.200E+2	1.917E+2	8.750E+2	5.498E+1
1.845E+3	2.470E+0	8.100E+2	2.117E+2	8.610E+2	6.600E+1
1.798E+3	3.290E+0	8.010E+2	2.023E+2	7.960E+2	1.420E+2
1.743E+3	4.200E+0	7.900E+2	2.085E+2	7.890E+2	1.457E+2
1.697E+3	5.540E+0	7.810E+2	2.051E+2	7.830E+2	1.486E+2
1.639E+3	7.180E+0	7.710E+2	2.170E+2	7.760E+2	1.433E+2
1.591E+3	9.020E+0	7.710E+2	2.316E+2	7.680E+2	1.303E+2
				7.590E+2	1.183E+2
DATA SET 11		DATA SET 13		7.530E+2	1.164E+2
T = 300.0		T = 80.0		7.410E+2	1.238E+2
				7.320E+2	1.371E+2
2.304E+3	5.900E-3	1.152E+3	1.882E+1	7.240E+2	1.492E+2
2.203E+3	1.150E-2	1.130E+3	1.278E+1	7.190E+2	1.590E+2
2.101E+3	2.180E-2	1.070E+3	1.748E+1		
2.004E+3	4.230E-2	1.029E+3	1.810E+1		
1.949E+3	6.240E-2	9.190E+2	2.656E+1		
1.901E+3	8.200E-2	8.800E+2	5.308E+1		
1.855E+3	1.143E-1	8.390E+2	8.435E+1		
1.802E+3	1.746E-1	8.280E+2	1.176E+2		
1.751E+3	2.416E-1	7.980E+2	1.454E+2		
1.701E+3	3.420E-1	7.780E+2	1.574E+2		
1.658E+3	5.070E-1	7.590E+2	1.364E+2		
1.605E+3	7.031E-1	7.390E+2	1.328E+2		
1.550E+3	9.397E-1	7.290E+2	1.475E+2		
1.497E+3	1.306E+0	7.100E+2	1.954E+2		
1.449E+3	1.574E+0				

semilogarithmic scale. Hohls [33] obtained room temperature absorption coefficients by observing the decay of light through plane-parallel plates of various thicknesses. The results were claimed to be accurate within ±5%. His data points define fairly well a straight line except the point at low absorption. Causes of this deviation might be due to low sensitivity of the experimental apparatus and impurities of the samples, which were quite common in early measurements. Trace of $LiNO_3$ impurity was detected which contributed to absorption in the spectral region centered at 2000 cm^{-1}.

Klier's [34] data were obtained by using a similar method with consideration of the effect due to internal multiple reflection. The investigation was made at four distinct temperatures and the errors of his results amounted to ±5 to 10%. His room temperature values are systematically lower than those of Hohls. A possible cause of such discrepancies may be attributed to the thinness, in the order of tens of micrometer, of the samples that Klier used, in which surface absorption may predominate the bulk absorption.

In the investigation on the effect of melting on the multiphonon absorption spectra, Barker [35] made a systematic observation in the temperature range from 300 to 1160 K on samples of high purity. The random error in his results varied between about 0.03 cm^{-1} at low α ($\alpha \to 0$) and 0.3 cm^{-1} at high α ($\alpha \to 10$ cm^{-1}). As shown in Figure 3, the plots of Barker's data are straight lines except at low α's. These deviations owe their origins to possible graph reading errors. Barker published his results in a graphical form where α values were plotted on a linear scale, hence the large uncertainties in the read-out of low values. The observed absorption spectrum for LiF melt indicate a 10% increase in absorption as the melting point is traversed.

Using the differential technique, Deutsch [9] was able to determine the absorption coefficient of LiF crystal with better accuracy and to identify bulk and surface contributions to the total absorption. Errors in his results were estimated based on the transmission values, τ. At $\tau \sim 0.9$ the error is ±10% while at $\tau \sim 0.5$ it is about 3%.

Kachare et al. [36] obtained absorption coefficients from a Kramers-Kronig analysis on the reflection spectrum. Large uncertainties in the results are expected.

Among the data from various authors, comparison can be made only for room temperature results as data at other temperatures are scarce. As indicated in Figure 3, agreement between the results of Holhs, Barker and Deutsch is well within their experimental errors. It is therefore reasonable to believe that Barker's results at other temperatures are reliable to the quoted limits of error.

Based on the above considerations, data by Barker, Deutsch and Holhs are used as the basis for the generation of recommended values of the absorption coefficient of LiF in the corresponding frequency region. The recommended values are given by the solid curves in Figure 3.

3.2. Sodium Fluoride, NaF

Absorption coefficients of NaF observed as a function of frequency in the multiphonon region are scanty as shown in Figure 4 and tabulated in Tables 5 and 6. In the present work we have collected the results of Holhs [33], Klier [34] and Beck and Pohl [37]. Holhs determined the absorption coefficient directly by observing the decrease in light intensity through plate specimens. Fourteen plates of thickness ranging from 0.024 to 10.62 mm were used in the experiment and absorption data were obtained based on the equation of decay. The claimed uncertainty of these data is ±5%. However, a trace of Na_2CO_3 impurity was found, the corresponding absorption being located near 900 cm^{-1}. As a result, the observed absorption coefficients at frequencies higher than 800 cm^{-1} are considerably higher than that for the pure sample.

Klier [34] obtained absorption coefficients for NaF at three temperatures, 77, 293 and 573 K. Results were derived from reflectivity and transmission measurements for thin NaF plates of unspecified purity. The claimed uncertainties are 5 to 10%. Comparing his room-temperature results with those of Holhs', it can be reasonably suspected that Klier investigated impure samples.

Beck and Pohl [37], in their theoretical studies of multiphonon absorption, reported a data set measured at 100 K by McNelly and Pohl [38] for specimens of extreme purity.

The temperature dependence for given frequencies is shown in Figure 5 and in Tables 7 and 8. It is seen that the curves obey a power law, $\alpha = T^a$, at temperatures higher than 300 K.

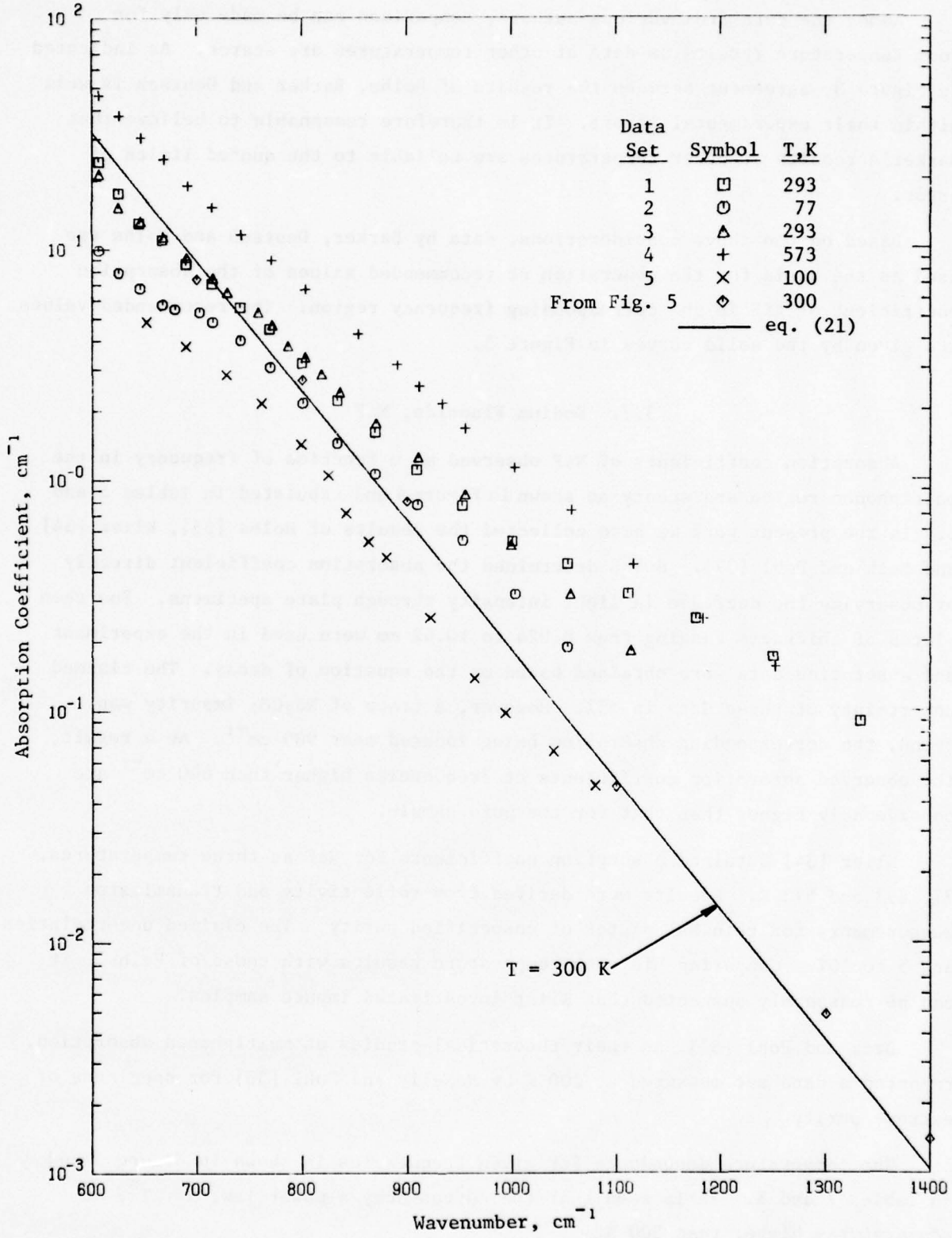

Figure 4. Absorption Coefficient of Sodium Fluoride in the Multiphonon Region

TABLE 5. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF SODIUM FLUORIDE (WAVENUMBER DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	33	HOHLS, H. W.	1936	T	4.1E+2-1.4E+3	293	CRYSTAL: GROWN BY THE KYROPOULOS METHOD; 14 PLATE SPECIMENS OF THICKNESSES FROM 0.024 TO 10.62 MM; ABSORPTION COEFFICIENTS DETERMINED FROM TRANSMISSION MEASUREMENTS; DATA EXTRACTED FROM A FIGURE; TEMPERATURE NOT SPECIFIED, 293 K ASSUMED.
2	34	KLIER, M.	1958	R	5.2E+2-1.1E+3	77	CRYSTAL: ABSORPTION-COEFFICIENT DATA DEDUCED FROM REFLECTIVITY AND TRANSMITTANCE MEASUREMENTS ON SPECIMENS OF VARIOUS THICKNESSES; DATA EXTRACTED FROM A FIGURE.
3	34	KLIER, M.	1958	R	5.7E+2-1.2E+3	293	SAME AS ABOVE.
4	34	KLIER, M.	1958	R	6.0E+2-1.3E+3	573	SAME AS ABOVE.
5	37	BECK, H., POHL, D.W.	1975	T	6.5E+2-1.1E+3	100	SINGLE CRYSTAL OF EXTREME PURITY; NO INDICATION OF ANY EXTRINSIC ABSORPTION; SPECIMENS OF 54.98 MM AND 3.82 MM THICK; ABSORPTION MEASURED BY MEANS OF INFRARED SPECTROPHOTOMETER; DATA EXTRACTED FROM A FIGURE.

TABLE 6. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF SODIUM FLUORIDE (WAVENUMBER DEPENDENCE)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α
DATA SET 1	
T = 293.0	
1.333E+3	9.000E-2
1.250E+3	1.700E-1
1.176E+3	2.500E-1
1.111E+3	3.200E-1
1.053E+3	4.300E-1
1.000E+3	5.400E-1
9.524E+2	7.700E-1
9.091E+2	1.100E+0
8.696E+2	1.600E+0
8.333E+2	2.200E+0
8.000E+2	3.200E+0
7.692E+2	4.500E+0
7.407E+2	5.600E+0
7.143E+2	7.100E+0
6.897E+2	8.600E+0
6.667E+2	1.100E+1
6.452E+2	1.300E+1
6.250E+2	1.750E+1
6.061E+2	2.400E+1
5.882E+2	3.500E+1
5.858E+2	3.700E+1
5.797E+2	4.260E+1
5.737E+2	4.950E+1
5.714E+2	4.700E+1
5.675E+2	5.670E+1
5.618E+2	6.080E+1
5.559E+2	6.260E+1
5.556E+2	6.100E+1
5.513E+2	6.140E+1
5.453E+2	6.080E+1
5.405E+2	5.900E+1
5.394E+2	6.050E+1
5.359E+2	6.370E+1
5.313E+2	7.250E+1
5.263E+2	8.500E+1
5.222E+2	9.280E+1
5.181E+2	1.108E+2
5.128E+2	1.250E+2
5.000E+2	1.750E+2

ν	α
DATA SET 1(CONT.)	
4.878E+2	2.200E+2
4.762E+2	2.800E+2
4.651E+2	3.500E+2
4.545E+2	4.300E+2
4.444E+2	6.400E+2
4.348E+2	7.700E+2
4.255E+2	1.050E+3
4.167E+2	1.350E+3
DATA SET 2	
T = 77.0	
1.053E+3	1.886E-1
1.003E+3	3.180E-1
9.524E+2	5.445E-1
9.099E+2	7.766E-1
8.696E+2	1.053E+0
8.333E+2	1.432E+0
8.006E+2	2.141E+0
7.698E+2	3.073E+0
7.413E+2	4.011E+0
7.153E+2	4.827E+0
7.027E+2	5.321E+0
6.793E+2	5.487E+0
6.671E+2	5.747E+0
6.460E+2	6.783E+0
6.254E+2	7.932E+0
6.061E+2	9.902E+0
5.875E+2	1.375E+1
5.718E+2	2.368E+1
5.546E+2	3.113E+1
5.394E+2	2.932E+1
5.249E+2	3.478E+1
DATA SET 3	
T = 293.0	
1.114E+3	1.811E-1
1.056E+3	3.198E-1
9.990E+2	5.210E-1

ν	α
DATA SET 3(CONT.)	
9.551E+2	8.576E-1
9.107E+2	1.243E+0
8.703E+2	1.749E+0
8.361E+2	2.385E+0
8.183E+2	2.845E+0
8.032E+2	3.373E+0
7.868E+2	3.794E+0
7.716E+2	4.684E+0
7.582E+2	5.308E+0
7.289E+2	6.514E+0
7.153E+2	7.477E+0
6.901E+2	9.208E+0
6.680E+2	1.132E+1
6.464E+2	1.330E+1
6.254E+2	1.525E+1
6.064E+2	2.118E+1
5.886E+2	2.812E+1
5.718E+2	3.946E+1
DATA SET 4	
T = 573.0	
1.252E+3	1.537E-1
1.183E+3	2.491E-1
1.116E+3	4.275E-1
1.057E+3	7.367E-1
1.003E+3	1.123E+0
9.551E+2	1.664E+0
9.337E+2	2.116E+0
9.116E+2	2.529E+0
8.913E+2	3.129E+0
8.540E+2	4.253E+0
8.032E+2	6.669E+0
7.710E+2	8.959E+0
7.418E+2	1.157E+1
7.148E+2	1.518E+1
6.911E+2	1.883E+1
6.684E+2	2.456E+1
6.468E+2	3.048E+1
6.258E+2	3.799E+1

ν	α
DATA SET 4(CONT.)	
6.068E+2	4.659E+1
DATA SET 5	
T = 100.0	
6.520E+2	4.860E+0
6.900E+2	3.780E+0
7.280E+2	2.850E+0
7.610E+2	2.140E+0
7.990E+2	1.420E+0
8.250E+2	1.040E+0
8.420E+2	7.110E-1
8.630E+2	5.360E-1
8.800E+2	4.580E-1
9.220E+2	2.510E-1
9.640E+2	1.380E-1
9.940E+2	9.770E-2
1.040E+3	6.700E-2
1.080E+3	4.740E-2
DATA SET 6	
T = 300.0	
7.000E+2	7.400E+0
8.000E+2	2.700E+0
9.000E+2	8.000E-1
1.100E+3	4.690E-2
1.300E+3	4.880E-3
1.400E+3	1.400E-3

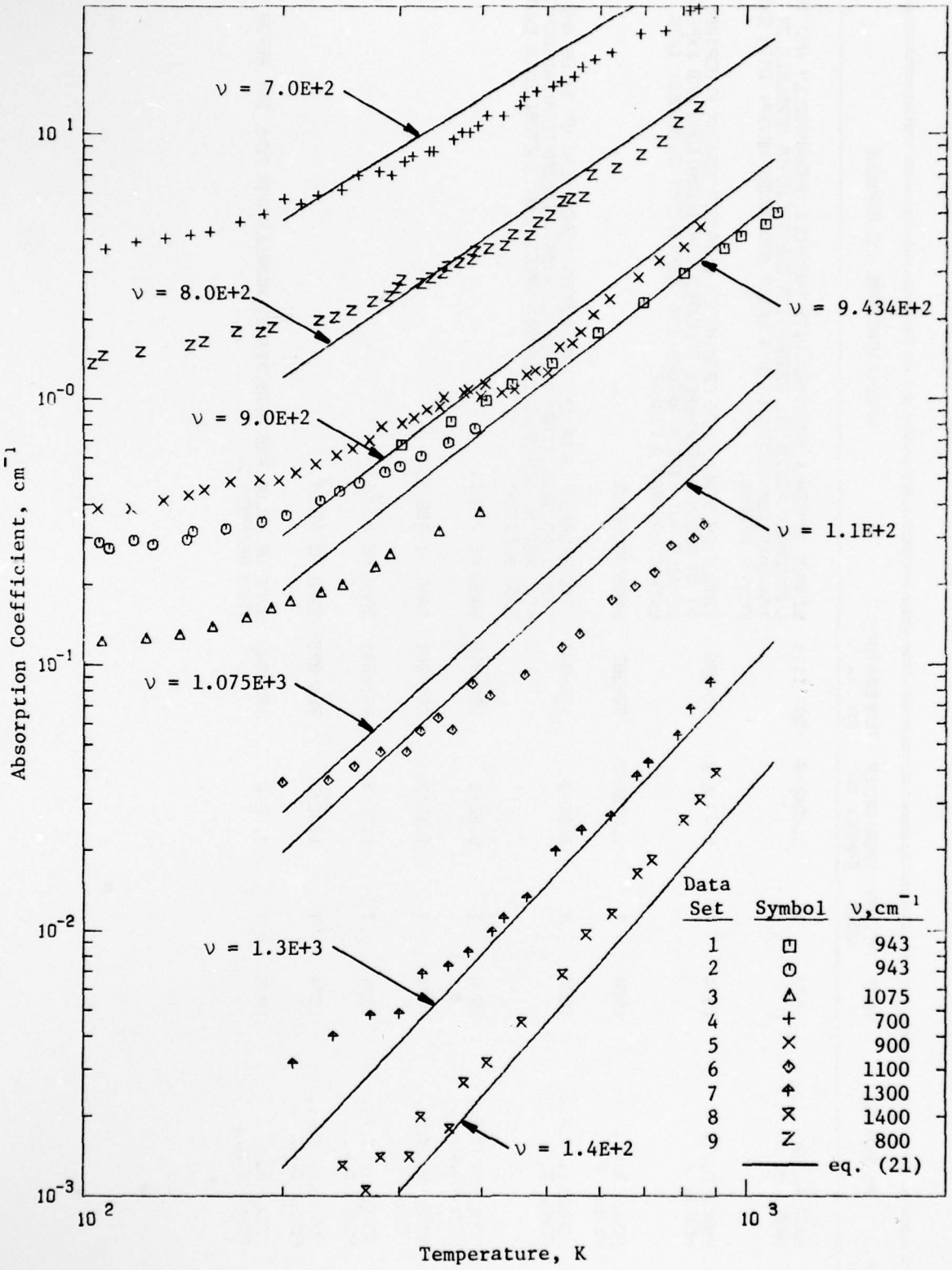

Figure 5. Absorption Coefficient of Sodium Fluoride (Temperature Dependence)

TABLE 7. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF SODIUM FLUORIDE (TEMPERATURE DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	31	HARRINGTON, J.A., HASS, M.	1973	T	9.434E+2	300-1110	SINGLE CRYSTAL; SPECIMEN WITH SURFACES MECHANICALLY AND THEN CHEMICALLY POLISHED; ABSORPTION COEFFICIENTS MEASURED BY TRANSMISSION METHOD WITH A LASER AND POWER METER; DATA EXTRACTED FROM A FIGURE.
2	39	POHL, D.W., MEIER, P.F.	1974	T	9.434E+2	31-390	SINGLE CRYSTAL; MADE FROM MERCK SUPRAPUR SODIUM FLUORIDE; GROWN IN AN ARGON ATMOSPHERE; SPECIMEN CONFIGURATIONS AND EXPERIMENTAL DETAILS NOT GIVEN; ABSORPTION COEFFICIENT OBTAINED; DATA EXTRACTED FROM A FIGURE.
3	39	POHL, D.W., MEIER, P.F.	1974	T	1.075E+3	32-397	SAME AS ABOVE.
4	38	MCNELLY, T.F., POHL, D.W.	1974	T	7.0E+2	103-843	SINGLE CRYSTALS OF EXTREME PURITY; SPECIMENS OF 54.98 AND 3.82 MM THICK; NO INDICATION OF ANY EXTRINSIC ABSORPTION; ABSORPTION MEASURED BY MEANS OF INFRARED SPECTROPHOTOMETER; DATA EXTRACTED FROM A FIGURE.
5	38	MCNELLY, T.F., POHL, D.W.	1974	T	9.0E+2	105-849	SAME AS ABOVE.
6	38	MCNELLY, T.F., POHL, D.W.	1974	T	1.1E+3	200-861	SAME AS ABOVE.
7	38	MCNELLY, T.F., POHL, D.W.	1974	T	1.3E+3	207-881	SAME AS ABOVE.
8	38	MCNELLY, T.F., POHL, D.W.	1974	T	1.4E+3	221-899	SAME AS ABOVE.
9	37	BECK, H., POHL, D.W.	1975	T	8.0E+2	103-845	SAME AS ABOVE AND MEASURED BY MCNELLY AND POHL BUT REPORTED IN THIS REFERENCE.

TABLE 8. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF SODIUM FLUORIDE (TEMPERATURE DEPENDENCE)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

T	α
DATA SET 1	
ν = 9.434E+2	
301.9	6.682E-1
358.9	8.165E-1
405.5	9.794E-1
443.6	1.132E+0
508.1	1.358E+0
595.6	1.766E+0
696.6	2.291E+0
803.5	2.965E+0
922.5	3.664E+0
977.2	4.073E+0
1064.1	4.529E+0
1109.1	5.012E+0
DATA SET 2	
ν = 9.434E+2	
31.4	2.700E-1
36.8	2.821E-1
42.7	2.700E-1
46.7	2.821E-1
54.3	2.663E-1
62.0	2.700E-1
69.6	2.700E-1
79.6	2.700E-1
86.4	2.700E-1
99.5	2.700E-1
105.6	2.886E-1
109.3	2.738E-1
119.1	2.940E-1
127.3	2.827E-1
143.2	2.960E-1
146.2	3.165E-1
164.0	3.246E-1
185.7	3.430E-1
202.2	3.634E-1
228.0	4.124E-1
243.7	4.460E-1
260.5	4.823E-1
285.0	5.277E-1

T	α
DATA SET 2(CONT.)	
300.5	5.564E-1
322.8	6.072E-1
354.7	6.829E-1
389.9	7.733E-1
DATA SET 3	
ν = 1.075E+3	
32.8	1.242E-1
40.2	1.208E-1
49.6	1.206E-1
56.4	1.225E-1
60.2	1.239E-1
72.6	1.242E-1
85.5	1.236E-1
95.0	1.265E-1
106.6	1.228E-1
124.4	1.262E-1
139.9	1.304E-1
156.6	1.394E-1
176.5	1.514E-1
192.2	1.630E-1
205.5	1.738E-1
228.5	1.867E-1
246.5	1.996E-1
276.0	2.329E-1
290.3	2.613E-1
344.3	3.186E-1
396.2	3.777E-1
DATA SET 4	
ν = 7.000E+2	
108.0	3.690E+0
120.0	3.910E+0
133.0	4.030E+0
145.0	4.150E+0
155.0	4.280E+0
172.0	4.670E+0
187.0	4.960E+0

T	α
DATA SET 4(CONT.)	
201.0	5.660E+0
213.0	5.420E+0
226.0	5.830E+0
246.0	6.100E+0
260.0	6.960E+0
280.0	7.170E+0
292.0	6.960E+0
305.0	7.830E+0
314.0	8.180E+0
332.0	8.550E+0
337.0	8.550E+0
362.0	9.480E+0
373.0	1.010E+1
383.0	1.010E+1
394.0	1.070E+1
406.0	1.160E+1
430.0	1.160E+1
455.0	1.270E+1
462.0	1.370E+1
482.0	1.430E+1
510.0	1.500E+1
525.0	1.560E+1
548.0	1.630E+1
564.0	1.780E+1
589.0	1.890E+1
624.0	2.010E+1
689.0	2.360E+1
751.0	2.430E+1
819.0	2.900E+1
843.0	2.940E+1
DATA SET 5	
ν = 9.000E+2	
105.0	3.860E-1
118.0	3.860E-1
132.0	4.150E-1
144.0	4.340E-1
152.0	4.540E-1
166.0	4.880E-1

T	α
DATA SET 5(CONT.)	
184.0	4.960E-1
197.0	4.890E-1
209.0	5.260E-1
224.0	5.660E-1
241.0	6.090E-1
255.0	6.460E-1
270.0	6.960E-1
282.0	7.830E-1
303.0	8.060E-1
316.0	8.430E-1
330.0	9.070E-1
345.0	9.340E-1
350.0	1.010E+0
376.0	1.050E+0
381.0	1.080E+0
398.0	1.020E+0
404.0	1.130E+0
428.0	1.050E+0
447.0	1.080E+0
466.0	1.220E+0
480.0	1.270E+0
501.0	1.250E+0
522.0	1.560E+0
545.0	1.610E+0
561.0	1.780E+0
586.0	2.070E+0
620.0	2.360E+0
685.0	2.850E+0
736.0	3.310E+0
802.0	3.720E+0
849.0	4.440E+0
DATA SET 6	
ν = 1.100E+3	
199.8	3.590E-2
234.5	3.660E-2
256.6	4.130E-2
280.8	4.670E-2
307.2	4.710E-2

T	α
DATA SET 6(CONT.)	
323.0	5.600E-2
342.9	6.310E-2
360.5	5.670E-2
386.7	8.470E-2
410.6	7.610E-2
462.9	9.130E-2
527.2	1.160E-1
559.8	1.300E-1
625.5	1.750E-1
677.6	1.970E-1
725.3	2.220E-1
767.8	2.800E-1
831.8	2.990E-1
860.5	3.360E-1
DATA SET 7	
ν = 1.300E+3	
207.4	3.170E-3
238.6	4.020E-3
271.7	4.830E-3
300.2	4.880E-3
325.3	6.890E-3
355.9	7.360E-3
381.7	8.300E-3
413.5	9.900E-3
430.6	1.110E-2
466.2	1.330E-2
515.2	1.990E-2
563.7	2.380E-2
623.0	2.690E-2
681.7	3.800E-2
710.2	4.270E-2
786.5	5.410E-2
822.7	6.810E-2
880.6	8.580E-2

T	α
DATA SET 8	
ν = 1.400E+3	
221.1	9.730E-4
246.8	1.300E-3
267.4	1.050E-3
281.1	1.400E-3
310.7	1.410E-3
323.3	1.990E-3
357.4	1.800E-3
375.7	2.670E-3
407.0	3.190E-3
458.8	4.530E-3
527.8	6.810E-3
571.8	9.620E-3
625.6	1.150E-2
684.5	1.630E-2
719.6	1.830E-2
802.5	2.590E-2
849.6	3.090E-2
898.5	3.890E-2
DATA SET 9	
ν = 8.000E+2	
103.0	1.360E+0
107.0	1.460E+0
122.0	1.510E+0
145.0	1.600E+0
152.0	1.650E+0
170.0	1.800E+0
185.0	1.780E+0
193.0	1.960E+0
227.0	1.970E+0
240.0	2.030E+0
254.0	2.150E+0
273.0	2.320E+0
289.0	2.420E+0
297.0	2.610E+0
302.0	2.800E+0
324.0	2.720E+0
334.0	2.850E+0

TABLE 8. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF SODIUM FLUORIDE (TEMPERATURE DEPENDENCE) (CONTINUED)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

T	α
DATA SET 9(CONT.)	
348.0	2.980E+0
353.0	3.160E+0
369.0	3.250E+0
385.0	3.350E+0
390.0	3.600E+0
408.0	3.660E+0
432.0	3.770E+0
444.0	4.170E+0
471.0	4.110E+0
484.0	4.630E+0
505.0	4.910E+0
527.0	5.520E+0
543.0	5.680E+0
567.0	5.770E+0
583.0	6.980E+0
635.0	7.400E+0
692.0	8.330E+0
743.0	9.370E+0
787.0	1.100E+1
845.0	1.260E+1

Harrington and Hass [31], in an attempt to test the applicability of the $\alpha = T^{n-1}$ law at high temperatures, carefully measured the absorption coefficients at 10.6 μm from 300 K to within 50 K of the melting points for several selected single crystals. The sample was investigated by a simple transmission method. The results are believed to represent largely intrinsic absorption. No uncertainty figures were reported. However, since values listed in Table 8 of this work were read from a graphical presentation, the uncertainty is significantly larger.

Pohl and Meiter [39] investigated the absorption coefficient of NaF crystals obtained from two sources. One was grown by standard techniques in air and the other in an argon atmosphere. The major difference between the crystals is the amount of oxygen-containing impurities. The absorption coefficients were measured between 4.2 and 400 K at wavelength 9.3 and 10.6 μm. Effects of impurity are reflected in the results of the two samples which differ by 0.25 cm^{-1} at 10.6 μm and 0.30 cm^{-1} at 9.3 μm. These values are of the same order of magnitude as the total absorption of the pure sample and therefore can significantly mask the intrinsic temperature dependence. The uncertainty of their results at low absorptions is ±0.02 cm^{-1}.

McNelly and Pohl [38] made a systematic observation of the absorption of NaF between 600 and 1500 cm^{-1} and from 100 to 850 K. Samples of extreme purity and sufficient thickness were employed. There were no indications of any extrinsic absorption. Although there was no uncertainty reported, the estimated uncertainty of their results can be as high as ±10% or more because they reported their results graphically in logarithmic scales of very low resolution.

A temperature dependent data set measured at 800 cm^{-1} by McNelly and Pohl was reported by Beck and Pohl [37]. The same situations discussed above also apply to this set of data. After reviewing each of the available data sets, the data by McNelly and Pohl, Harrington and Hass were selected for data analysis. It should be noted that the diamond-shaped symbol data points in Figure 4 were read from Figure 5 at 300 K.

3.3. Sodium Chloride, NaCl

Absorption coefficient of NaCl in the multiphonon region has been measured by a number of investigators. The majority of the observations were made at

room temperature, except for Barker [35], whose work was performed at several temperatures from room temperature up to past the melting point. One set of data was measured at liquid nitrogen by Harrington et al. [27]. Available data are shown in Figure 6 and tabulated in Tables 9 and 10.

Califano and Czerny [40] measured absorption on the short wavelength side of the reststrahlen region by a simple transmission method. In order to increase the accuracy of their results, they used long specimens. No estimate of error was reported.

Barker [35], in the investigation of the change of absorption at the melting point of NaCl, measured absorption coefficients at five temperatures, 300, 615, 775, 935 and 1105 K. The melting temperature of NaCl is 1074 K. The random error shown by successive determination of α varied between 0.03 cm^{-1} at low absorption and 0.3 cm^{-1} at higher levels. By taking into account the experimental errors, the results show that the transparency of the crystal to infrared radiation is hardly affected when the samples are melted.

Deutsch [9] measured room temperature absorption coefficients using a differential technique. Accuracies of the results vary from 10% at low absorption ($\alpha < 0.1$ cm^{-1}) to 3% at higher absorption ($\alpha \sim 0.5$ cm^{-1}). Sample purity was not given, but his results are believed to be largely intrinsic.

Allen and Harrington [41] observed absorption coefficients for high purity NaCl specimens cut from various sections of a given boule. Laser calorimetry was used at a number of laser wavelengths and the total absorption coefficient determined. Uncertainties in results vary from 3 to 20%. Contributions of surface and bulk origins were identified. Owing to the limit of instrument sensitivity, the lowest value of bulk absorption coefficient they could attain is $5 \pm 5 \times 10^{-7}$ cm^{-1}.

Harrington et al. [27] reported the absorption coefficient at temperatures of 300 and 80 K from two laboratories. No experimental details nor errors in results were given. However uncertainties of 10% or more may be expected as the data sets were read from a graph with scales of low resolution.

Temperature dependence of the absorption coefficient of NaCl is rarely investigated. Available data shown in Figure 7 and Tables 11 and 12 were obtained for the CO_2 laser wavelength of 10.6 μm. Harrington and Hass [31] reported absorption data for the temperature range from 304-1035 K. Those in

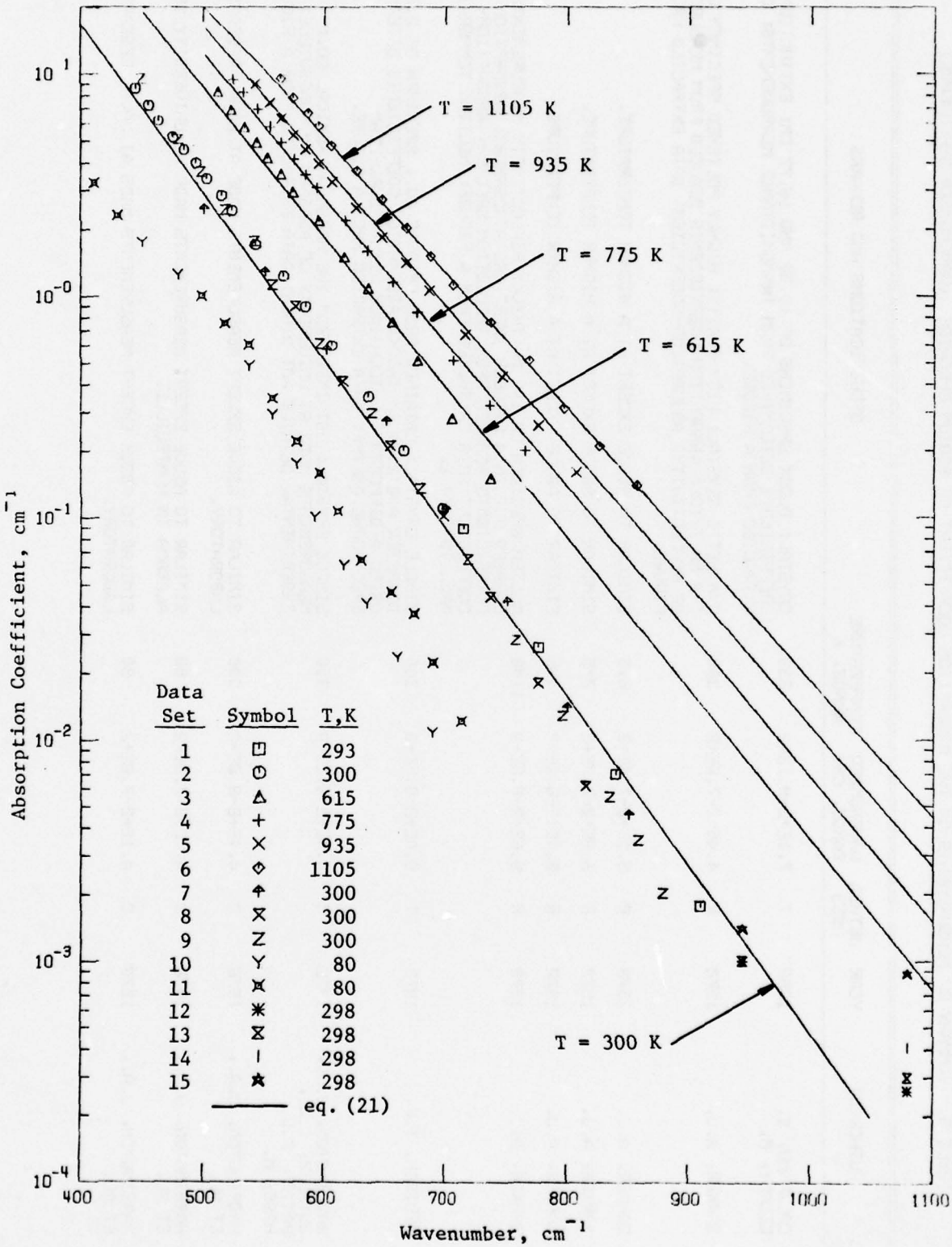

Figure 6. Absorption Coefficient of Sodium Chloride in the Multiphonon Region

TABLE 9. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF SODIUM CHLORIDE (WAVENUMBER DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	40	CALIFANO, S. CZERNY, M.	1958	T	7.1E+2-9.1E+2	293	CRYSTAL; BLOCK SPECIMENS OF 10.52 AND 16.77 CM; EXTINCTION COEFFICIENTS DETERMINED FROM TRANSMITTANCE MEASUREMENTS; DATA EXTRACTED FROM A FIGURE.
2	35	BARKER, A.J.	1972	R	4.4E+2-7.0E+2	300	SYNTHETIC CRYSTAL; HIGH PURITY; HIGHLY POLISHED SPECIMEN OF 1-2 MM THICK; ABSORPTION COEFFICIENTS DEDUCED FROM MEASUREMENTS OF REFLECTIVITY; ABSORPTION-COEFFICIENT DATA EXTRACTED FROM A FIGURE.
3	35	BARKER, A.J.	1972	R	5.1E+2-7.4E+2	615	SIMILAR TO ABOVE EXCEPT AT A HIGHER TEMPERATURE.
4	35	BARKER, A.J.	1972	R	5.2E+2-7.7E+2	775	SIMILAR TO ABOVE EXCEPT AT A HIGHER TEMPERATURE.
5	35	BARKER, A.J.	1972	R	5.4E+2-8.1E+2	935	SIMILAR TO ABOVE EXCEPT AT A HIGHER TEMPERATURE.
6	35	BARKER, A.J.	1972	R	5.6E+2-8.6E+2	1105	MOLTEN SPECIMEN OF 1-2 MM THICK; REFLECTIVITY MEASUREMENTS CARRIED OUT IN A LARGELY INERT GAS ATMOSPHERE; ABSORPTION COEFFICIENTS DEDUCED FROM REFLECTION SPECTRA; ABSORPTION-COEFFICIENT DATA EXTRACTED FROM A FIGURE; MELTING TEMPERATURE OF NACL IS 1074 K.
7	9	DEUTSCH, T.F.	1973	T	5.0E+2-8.5E+2	300	SINGLE CRYSTAL; OBTAINED FROM OPTOVAC CO.; SPECIMEN OF 2.54 CM DIAMETER AND 2.54 CM THICK; ABSORPTION COEFFICIENTS DETERMINED USING A DIFFERENTIAL TECHNIQUE WITH A DUAL-BEAM SPECTROPHOTOMETER; DATA EXTRACTED FROM A FIGURE.
8	27	HARRINGTON, J.A., DUTHLER, C.J., PATTEN, F.W. HASS, M.	1976	C	4.4E+2-8.8E+2	300	SINGLE CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; MEASUREMENTS MADE AT UNIVERSITY OF ALABAMA IN HUNTSVILLE; EXPERIMENTAL DETAILS NOT GIVEN; DATA EXTRACTED FROM A FIGURE.
9	27	HARRINGTON, J.A., ET AL.	1976	C	4.4E+2-8.8E+2	300	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT NAVAL RESEARCH LABORATORY.
10	27	HARRINGTON, J.A., ET AL.	1976	C	4.1E+2-7.2E+2	80	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT UNIVERSITY OF ALABAMA IN HUNTSVILLE.
11	27	HARRINGTON, J.A., ET AL.	1976	C	4.1E+2-7.2E+2	80	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT NAVAL RESEARCH LABORATORY.

TABLE 9. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF SODIUM CHLORIDE (WAVENUMBER DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
12	41	ALLEN, S.D., HARRINGTON, J.A.	1978	C	9.4E+2,1.1E+3	298	SINGLE CRYSTAL; PRODUCED BY REACTIVE-ATMOSPHERE-PROCESS; SAMPLES SECTIONED FROM A GIVEN BOULE; CALORIMETRIC METHOD USED AND TOTAL ABSORPTION DETERMINED; DATA EXTRACTED FROM A TABLE.
13	41	ALLEN, S. D., HARRINGTON, J. A.	1978	C	9.4E+2-3.6E+3	298	SAME AS ABOVE BUT FOR A SAMPLE FROM OTHER SECTION OF THE BOULE.
14	41	ALLEN, S.D., HARRINGTON, J.A.	1978	C	9.4E+2,1.1E+3	298	SAME AS ABOVE.
15	41	ALLEN, S.D., HARRINGTON, J.A.	1978	C	9.4E+2-3.6E+3	298	SAME AS ABOVE.

TABLE 10. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF SODIUM CHLORIDE (WAVENUMBER DEPENDENCE)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α
DATA SET 1	
T = 293.0	
9.091E+2	1.771E-3
8.396E+2	6.995E-3
7.758E+2	2.600E-2
7.143E+2	8.908E-2
DATA SET 2	
T = 300.0	
6.970E+2	1.100E-1
6.650E+2	2.000E-1
6.360E+2	3.500E-1
6.060E+2	6.000E-1
5.840E+2	9.000E-1
5.660E+2	1.230E+0
5.430E+2	1.710E+0
5.240E+2	2.440E+0
5.150E+2	2.870E+0
5.030E+2	3.410E+0
4.940E+2	4.010E+0
4.840E+2	4.600E+0
4.750E+2	5.240E+0
4.630E+2	6.210E+0
4.550E+2	7.240E+0
4.440E+2	8.630E+0
DATA SET 3	
T = 615.0	
7.370E+2	1.500E-1
7.050E+2	2.800E-1
6.760E+2	5.100E-1
6.560E+2	7.600E-1
6.360E+2	1.080E+0
6.160E+2	1.500E+0
5.950E+2	2.190E+0
5.740E+2	2.960E+0
5.640E+2	3.560E+0
5.530E+2	4.200E+0
5.440E+2	4.940E+0

ν	α
DATA SET 3(CONT.)	
5.340E+2	5.790E+0
5.230E+2	6.890E+0
5.120E+2	8.390E+0
DATA SET 4	
T = 775.0	
7.650E+2	2.000E-1
7.360E+2	3.200E-1
7.060E+2	5.100E-1
6.760E+2	8.400E-1
6.560E+2	1.150E+0
6.350E+2	1.600E+0
6.170E+2	2.200E+0
5.940E+2	3.090E+0
5.840E+2	3.540E+0
5.750E+2	4.160E+0
5.640E+2	4.930E+0
5.550E+2	5.820E+0
5.450E+2	6.950E+0
5.330E+2	8.280E+0
5.250E+2	9.420E+0
DATA SET 5	
T = 935.0	
8.070E+2	1.600E-1
7.760E+2	2.600E-1
7.460E+2	4.300E-1
7.160E+2	6.700E-1
6.860E+2	1.060E+0
6.670E+2	1.410E+0
6.470E+2	1.840E+0
6.260E+2	2.510E+0
6.060E+2	3.280E+0
5.950E+2	3.960E+0
5.840E+2	4.590E+0
5.740E+2	5.330E+0
5.640E+2	6.320E+0
5.550E+2	7.450E+0

ν	α
DATA SET 5(CONT.)	
5.430E+2	9.060E+0
DATA SET 6	
T = 1105.0	
8.570E+2	1.400E-1
8.260E+2	2.100E-1
7.970E+2	3.100E-1
7.680E+2	5.100E-1
7.370E+2	7.600E-1
7.060E+2	1.120E+0
6.870E+2	1.510E+0
6.670E+2	2.030E+0
6.470E+2	2.730E+0
6.260E+2	3.690E+0
6.050E+2	4.790E+0
5.950E+2	5.850E+0
5.860E+2	6.680E+0
5.740E+2	7.830E+0
5.640E+2	9.510E+0
DATA SET 7	
T = 300.0	
8.511E+2	4.600E-3
8.000E+2	1.400E-2
7.508E+2	4.190E-2
6.998E+2	1.091E-1
6.510E+2	2.741E-1
6.020E+2	5.768E-1
5.510E+2	1.294E+0
5.010E+2	2.500E+0
DATA SET 8	
T = 300.0	
5.760E+2	9.030E-1
6.150E+2	4.120E-1
6.540E+2	2.110E-1
6.980E+2	1.020E-1

ν	α
DATA SET 8(CONT.)	
7.370E+2	4.390E-2
7.760E+2	1.790E-2
8.150E+2	6.180E-3
DATA SET 9	
T = 300.0	
4.490E+2	9.480E+0
4.790E+2	5.120E+0
4.980E+2	3.660E+0
5.180E+2	2.470E+0
5.420E+2	1.770E+0
5.570E+2	1.130E+0
5.960E+2	6.100E-1
6.390E+2	2.950E-1
6.790E+2	1.350E-1
7.180E+2	6.500E-2
7.570E+2	2.810E-2
7.960E+2	1.280E-2
8.350E+2	5.530E-3
8.590E+2	3.530E-3
8.790E+2	2.020E-3
DATA SET 10	
T = 80.0	
4.500E+2	1.760E+0
4.790E+2	1.260E+0
5.380E+2	4.860E-1
5.570E+2	2.930E-1
5.770E+2	1.770E-1
5.920E+2	1.010E-1
6.160E+2	6.110E-2
6.350E+2	4.130E-2
6.600E+2	2.360E-2
6.890E+2	1.080E-2

ν	α
DATA SET 11	
T = 80.0	
4.110E+2	3.250E+0
4.300E+2	2.330E+0
4.990E+2	1.010E+0
5.180E+2	7.600E-1
5.380E+2	6.080E-1
5.570E+2	3.470E-1
5.770E+2	2.220E-1
5.960E+2	1.590E-1
6.110E+2	1.070E-1
6.300E+2	6.470E-2
6.550E+2	4.620E-2
6.740E+2	3.700E-2
6.890E+2	2.230E-2
7.130E+2	1.210E-2
DATA SET 12	
T = 298.0	
1.079E+3	2.600E-4
9.434E+2	1.000E-3
DATA SET 13	
T = 298.0	
3.571E+3	5.800E-5
2.632E+3	5.300E-5
1.887E+3	5.100E-5
1.079E+3	3.000E-4
9.434E+2	1.000E-3
DATA SET 14	
T = 298.0	
1.079E+3	4.100E-4
9.434E+2	1.000E-3

ν	α
DATA SET 15	
T = 298.0	
3.571E+3	6.900E-5
2.632E+3	6.500E-5
1.887E+3	3.400E-5
1.079E+3	8.800E-4
9.434E+2	1.400E-3

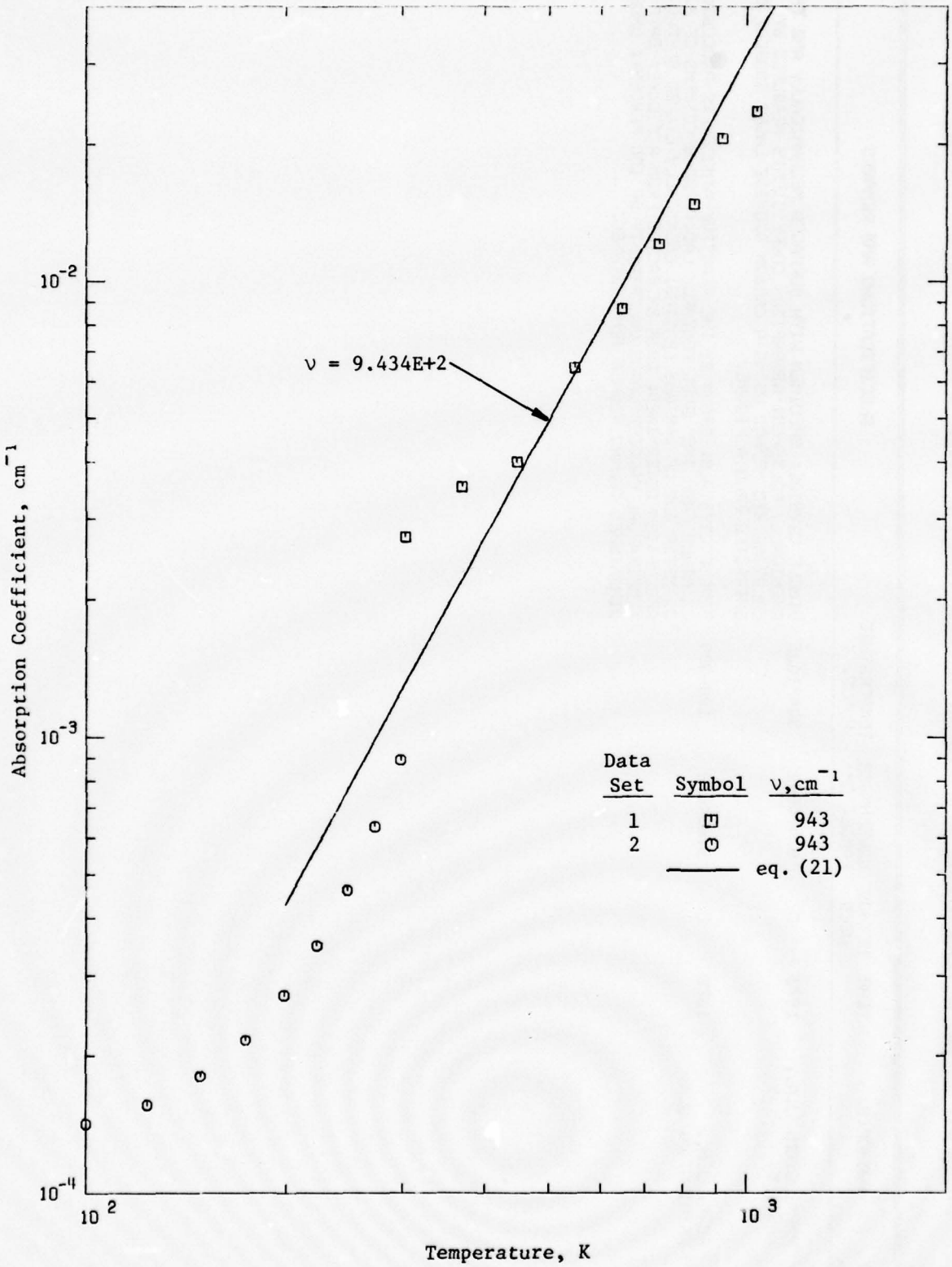

Figure 7. Absorption Coefficient of Sodium Chloride (Temperature Dependence)

TABLE 11. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF SODIUM CHLORIDE (TEMPERATURE DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	31	HARRINGTON, J.A., HASS, M.	1973	C	9.434E+2	304-1035	SINGLE CRYSTAL; SPECIMEN WITH SURFACES MECHANICALLY AND THEN CHEMICALLY POLISHED; ABSORPTION COEFFICIENTS MEASURED BY CALORIMETRIC METHOD USING A CARBON DIOXIDE LASER SOURCE; DATA EXTRACTED FROM A FIGURE.
2	30	ROWE, J.M., HARRINGTON, J.A.	1976	C	9.434E+2	100-300	SINGLE CRYSTALS; GROWN BY THE REACTIVE-ATMOSPHERE-PROCESS; OBTAINED FROM THE NAVAL RESEARCH LAB.; ROD SPECIMENS OF 2.5 CM DIAMETER AND OF VARIOUS LENGTHS; CHEMICALLY ETCHED SURFACE; BULK ABSORPTION DETERMINED; DATA EXTRACTED FROM A FIGURE; DATA AT LOW TEMPERATURE CARRIED LARGE UNCERTAINTY OF 100 PERCENT; UNCERTAINTY DIMINISHED TOWARD HIGHER TEMPERATURES.

TABLE 12. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF SODIUM CHLORIDE (TEMPERATURE DEPENDENCE)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

T	α
DATA SET 1	
ν = 9.434E+2	
304.0	2.740E-3
370.6	3.530E-3
448.7	4.010E-3
548.2	6.450E-3
647.1	8.690E-3
734.5	1.207E-2
829.8	1.475E-2
916.2	2.056E-2
1035.1	2.360E-2
DATA SET 2	
ν = 9.434E+2	
100.0	1.420E-4
124.0	1.560E-4
149.0	1.800E-4
174.0	2.160E-4
199.0	2.710E-4
223.0	3.480E-4
248.0	4.610E-4
273.0	6.360E-4
299.0	8.910E-4

the temperature region between 100-300 K were measured by Rowe and Harrington [30] with an estimated error of about $\pm 6 \times 10^{-5}$ cm^{-1}.

Comparison of room temperature data from various sources can be seen in Figure 6. Close agreement is observed. Based on this, Barker's data at higher temperatures are believed to be intrinsic in nature and can be used for data analysis, even though they are the only choices which are currently available.

3.4. Potassium Chloride, KCl

Plotted in Figure 8 are the absorption coefficient data of potassium chloride in the infrared region which have been reported by a number of investigators, particularly in the vicinity of CO_2 laser wavelength 10.6 μm for defining the intrinsic absorption of the crystal. Unfortunately, absorption at or near this wavelength is complicated by many factors, notably the surface absorption, impurity, and other unknown causes. As a consequence, absorptions due to these origins, at nearby wavelengths, contribute to the total absorption at 10.6 μm, thus masking its intrinsic property. Given below are discussions for each of the available data sets listed in Tables 13 and 14.

Hass et al. [42] measured absorption coefficient of KCl crystals between 9.2 and 10.86 μm using laser calorimetric techniques. In order to minimize the extrinsic absorptions, the sample crystal was grown in a reactive CCl_4 atmosphere with surfaces carefully prepared by chemical polishing. However, an absorption band near 9.8 μm was always presented in all samples examined. Although it was possible to identify the bulk absorption at 10.6 μm, which approached the estimated intrinsic limit of 8×10^{-5} cm^{-1}, the average total absorption was about 2×10^{-4} cm^{-1}. Due to surface absorption variations, the errors at 10.6 μm were large, ranging from 50% to several hundred percent. Most errors in calorimetry tend to increase the observed absorption coefficient. Among the samples investigated, optical inspection of those with higher absorptions indicated some bubbles or other imperfections in the ingots.

Deutsch [9] measured the absorption coefficient in the multiphonon region for both single crystal and polyscrystalline KCl provided by different suppliers. For regions of low absorption ($\alpha < 0.1$ cm^{-1}), the error is 10%, for high absorption ($\alpha > 0.5$ cm^{-1}), the error is 3%. To within the accuracy of the experiment, the long wavelength absorption coefficients of the polycrystalline material are

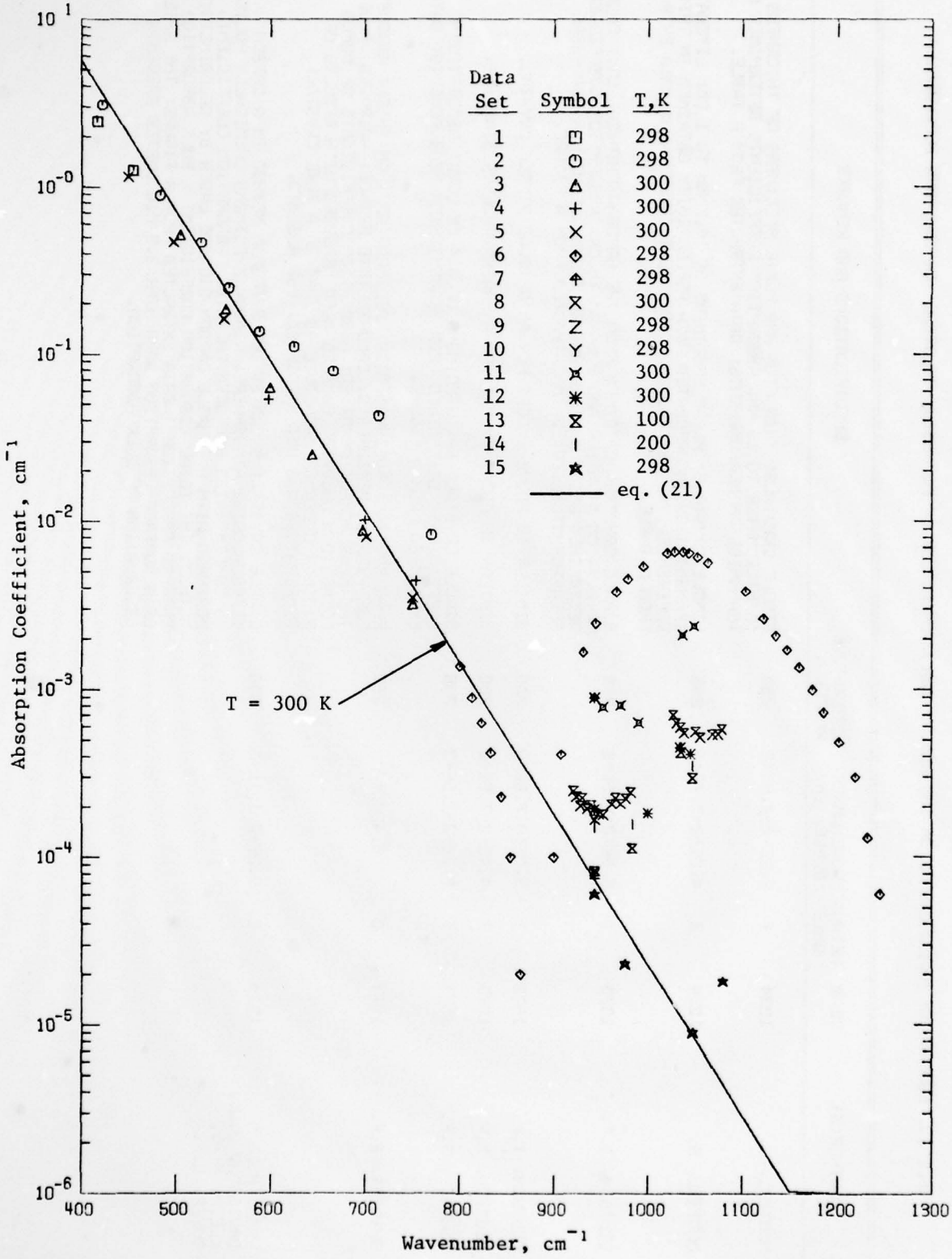

Figure 8. Absorption Coefficient of Potassium Chloride in the Multiphonon Region

TABLE 13. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF POTASSIUM CHLORIDE (WAVENUMBER DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	48	MENTZEL, A.	1934	T	2.2E+2-4.6E+2	298	SINGLE CRYSTALS; THIN FILM AND PLATE SPECIMENS OF THICKNESS FROM 16 MICROMETER TO 10 MM; ABSORPTION COEFFICIENTS DETERMINED FROM TRANSMISSION MEASUREMENTS; DATA EXTRACTED FROM A TABLE.
2	48	MENTZEL, A.	1934	Z	4.2E+2-7.7E+2	298	SINGLE CRYSTALS; PLATE SPECIMENS OF 10.7 MM TO 1 CM; LITERATURE TRANSMISSION INCORPORATED WITH REFLECTIVITY OBTAINED IN THIS REFERENCE, THE ABSORPTION COEFFICIENT DETERMINED; DATA EXTRACTED FROM A TABLE.
3	9	DEUTSCH, T.F.	1973	T	5.0E+2-7.5E+2	300	SINGLE CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; SPECIMEN OF 2.54 CM DIAMETER AND 2.54 CM THICK; ABSORPTION COEFFICIENTS DETERMINED USING A DIFFERENTIAL TECHNIQUE WITH A DUAL-BEAM SPECTROPHOTOMETER; DATA EXTRACTED FROM A FIGURE.
4	9	DEUTSCH, T.F.	1973	T	5.9E+2-7.6E+2	300	SIMILAR TO ABOVE EXCEPT FOR AN OPTOVAC SINGLE CRYSTAL.
5	9	DEUTSCH, T.F.	1973	T	4.4E+2-7.5E+2	300	SIMILAR TO ABOVE EXCEPT FOR A HARSHAW POLYCRYSTALLINE.
6	43	DEUTSCH, T.F.	1974	T	8.0E+2-1.3E+3	298	SINGLE CRYSTAL; BAR SPECIMENS OF 6.4 CM LONG; ABSORPTION COEFFICIENTS DETERMINED FROM TRANSMISSION MEASUREMENTS; DATA EXTRACTED FROM A FIGURE.
7	44	SHRADER, E.F.	1974	C	9.434E+2	298	PURE CRYSTAL; POLISHED DISC SPECIMENS OF 1 CM THICK; ABSORPTION COEFFICIENT MEASURED BY CALORIMETRIC METHOD; AVERAGED VALUE OF THE MEASUREMENT REPORTED; ABSORPTION COEFFICIENTS OF DOPED POTASSIOUM CHLORIDE SAMPLES ALSO MEASURED WITH RESULTS OF SIMILAR ORDER OF MAGNITUDE AS THAT OF A PURE CRYSTAL; TEMPERATURE WAS NOT SPECIFIED, 298 ASSUMED.
8	42	HASS, M., DAVISSON, J.W., KLEIN, P.H., BOYER, L.L.	1974	C	9.2E+2-1.1E+3	300	SINGLE CRYSTAL; GROWN BY THE BRIDGMAN METHOD IN A CARBON TETRACHLORIDE ATMOSPHERE; WINDOW SPECIMENS CHEMICALLY POLISHED IN CONCENTRATED HYDROGEN CHLORIDE, ABSORPTION COEFFICIENTS MEASURED WITH A TUNABLE CARBON DIOXIDE LASER BY CALORIMETRIC METHOD; THE TOTAL ABSORPTION COEFFICIENT (BULK ABSORPTION + SURFACE ABSORPTION) DATA EXTRACTED FROM A FIGURE; THE APPEARANCE OF A SURFACE ABSORPTION BAND NEAR 9.8 MICROMETER PREVENTS OBSERVATION OF BULK ABSORPTION.

TABLE 13. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF POTASSIUM CHLORIDE (WAVENUMBER DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
9	45	HASS, M., DAVISON, J.W., ROSENSTOCK, H. B., BABISKIN, J.	1975	C	9.434E+2	298	SINGLE CRYSTAL; GROWN IN REACTIVE ATMOSPHERE; RECTANGULAR PARALLELEPIPED SPECIMEN OF LENGTH 6.9 CM; ALL SIX SIDES CHEMICALLY POLISHED; LASER CALORIMETRIC METHOD USED AND THE THERMAL RISE CURVE OBTAINED; BULK ABSORPTION COEFFICIENT DETERMINED BASED ON THE INITIAL SLOPE OF THE CURVE.
10	46	ROSENSTOCK, H.B., GREGORY, D.A., HARRINGTON, J.A.	1976	C	9.434E+2	298	SINGLE CRYSTALS; OBTAINED FROM THE NAVAL RESEARCH LAB., THE HARSHAW CHEMICAL CO., AND THE RAYTHEON CORP.; MECHANICALLY POLISHED AND CHEMICALLY CLEANED WITH SPECTROGRADE CARBON TETRACHLORIDE; LASER CALORIMETRIC METHOD USED; DATA TAKEN FROM A TABLE; IT WAS FOUND THAT THE SURFACE ABSORPTION WAS ABOUT 45 TIMES HIGHER THAN THE BULK ABSORPTION.
11	47	ROWE, J.M., HARRINGTON, J.A.	1976	C	9.4E+2-1.1E+3	300	SINGLE CRYSTAL; GROWN BY THE EARLY REACTIVE-ATMOSPHERE-PROCESS; CHEMICALLY ETCHED SURFACES; TOTAL ABSORPTION COEFFICIENT DETERMINED WITH LASER CALORIMETRIC METHOD; HIGHER ABSORPTION NEAR 9.6 MICROMETER DUE TO EXTRINSIC SOURCES; DATA TAKEN FROM A FIGURE.
12	47	ROWE, J.M., HARRINGTON, J.A.	1976	C	9.4E+2-1.1E+3	300	SIMILAR TO ABOVE EXCEPT FOR SAMPLES GROWN BY IMPROVED REACTIVE-ATMOSPHERE-PROCESS AND ABSORPTION NEAR 9.6 MICROMETER DECREASED.
13	47	ROWE, J.M. HARRINGTON, J.A.	1976	C	9.4E+2-1.1E+3	100	SAME AS ABOVE.
14	47	ROWE, J.M. HARRINGTON, J.A.	1976	C	9.4E+2-1.1E+3	200	SAME AS ABOVE.
15	41	ALLEN, S.D., HARRINGTON, J.A.	1978	C	9.4E+2-3.6E+3	298	SINGLE CRYSTAL; GROWN BY A REACTIVE ATMOSPHERE PROCESS; ROD SPECIMEN OF 1 CM X 1 CM X 13.97 CM; CALORIMETRIC METHOD USED; BULK ABSORPTION COEFFICIENT; DATA EXTRACTED FROM A FIGURE.

TABLE 14. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF POTASSIUM CHLORIDE (WAVENUMBER DEPENDENCE)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α
DATA SET 1	
T = 298.0	
4.545E+2	1.257E+0
4.167E+2	2.461E+0
3.846E+2	4.398E+0
3.571E+2	6.732E+0
3.333E+2	1.257E+1
3.125E+2	2.003E+1
2.941E+2	3.696E+1
2.778E+2	6.981E+1
2.632E+2	1.224E+2
2.500E+2	2.325E+2
2.381E+2	3.890E+2
2.273E+2	6.283E+2
2.222E+2	8.936E+2
DATA SET 2	
T = 298.0	
7.692E+2	8.265E-3
7.143E+2	4.246E-2
6.667E+2	7.858E-2
6.250E+2	1.100E-1
5.882E+2	1.360E-1
5.556E+2	2.478E-1
5.263E+2	4.663E-1
4.831E+2	8.924E-1
4.219E+2	3.102E+0
DATA SET 3	
T = 300.0	
[illegible]	
6.969E+2	8.800E-3
6.439E+2	2.480E-2
5.992E+2	6.220E-2
5.531E+2	1.845E-1
5.040E+2	5.152E-1

ν	α
DATA SET 4	
T = 300.0	
7.530E+2	4.400E-3
6.998E+2	1.010E-2
5.981E+2	5.320E-2
DATA SET 5	
T = 300.0	
7.502E+2	3.500E-3
7.008E+2	8.000E-3
5.510E+2	1.614E-1
4.970E+2	4.677E-1
4.490E+2	1.153E+0
DATA SET 6	
T = 298.0	
1.245E+3	6.000E-5
1.232E+3	1.300E-4
1.219E+3	3.000E-4
1.202E+3	4.800E-4
1.186E+3	7.200E-4
1.174E+3	9.800E-4
1.160E+3	1.340E-3
1.147E+3	1.710E-3
1.135E+3	2.070E-3
1.122E+3	2.620E-3
1.103E+3	3.800E-3
1.063E+3	5.660E-3
1.052E+3	6.100E-3
1.043E+3	6.420E-3
[illegible]	
1.028E+3	6.540E-3
1.020E+3	6.390E-3
9.950E+2	5.380E-3
9.780E+2	4.500E-3
9.660E+2	3.780E-3
9.440E+2	2.470E-3
9.310E+2	1.660E-3
9.080E+2	4.100E-4

ν	α
DATA SET 6(CONT.)	
9.000E+2	1.000E-4
8.640E+2	2.000E-5
8.540E+2	1.000E-4
8.440E+2	2.300E-4
8.330E+2	4.200E-4
8.230E+2	6.300E-4
8.130E+2	8.900E-4
8.000E+2	1.370E-3
DATA SET 7	
T = 298.0	
9.434E+2	8.900E-4
DATA SET 8	
T = 300.0	
1.078E+3	5.750E-4
1.074E+3	5.370E-4
1.068E+3	5.370E-4
1.055E+3	5.170E-4
1.050E+3	5.590E-4
1.038E+3	5.490E-4
1.034E+3	5.910E-4
1.030E+3	6.280E-4
1.027E+3	7.010E-4
9.814E+2	2.430E-4
9.766E+2	2.220E-4
9.709E+2	2.070E-4
9.653E+2	2.250E-4
9.615E+2	2.070E-4
9.524E+2	1.790E-4
9.479E+2	1.810E-4
9.434E+2	1.680E-4
9.398E+2	2.050E-4
9.355E+2	1.950E-4
9.302E+2	2.260E-4
9.285E+2	2.020E-4
9.242E+2	2.290E-4
9.208E+2	2.480E-4

ν	α
DATA SET 9	
T = 298.0	
9.434E+2	8.000E-5
DATA SET 10	
T = 298.0	
9.434E+2	8.000E-5
DATA SET 11	
T = 300.0	
9.434E+2	8.930E-4
9.524E+2	7.850E-4
9.709E+2	8.020E-4
9.901E+2	6.330E-4
1.036E+3	2.100E-3
1.048E+3	2.380E-3
DATA SET 12	
T = 300.0	
9.434E+2	1.950E-4
1.000E+3	1.830E-4
1.034E+3	4.490E-4
1.045E+3	4.120E-4
DATA SET 13	
T = 100.0	
9.434E+2	8.280E-5
9.832E+2	1.132E-4
1.035E+3	4.219E-4
1.047E+3	2.961E-4
DATA SET 14	
T = 200.0	
9.434E+2	1.502E-4
9.832E+2	1.572E-4
1.035E+3	4.485E-4

ν	α
DATA SET 14(CONT.)	
1.047E+3	3.493E-4
DATA SET 15	
T = 298.0	
3.571E+3	5.500E-6
2.632E+3	6.500E-6
1.887E+3	5.000E-7
1.079E+3	1.800E-5
1.047E+3	9.000E-6
9.756E+2	2.300E-5
9.434E+2	6.000E-5

the same as those of the single crystal. At 10.6 μm, Deutsch [43] found that absorption in all KCl samples is dominated by a broad absorption band near 9.7 μm. The presence of this band appeared to be due to the oxygen-containing compounds in the bulk. The integrated absorption of this band decreases with increasing temperature, which is expected from the dissociation of absorbing pairs.

Shrader [44] measured the 10.6 μm absorption coefficient on a large number of specimens using a calorimetric method. Absorption coefficients of both doped and pure samples are about the same order of magnitude. His averaged result is about ten times higher than the intrinsic, largely contributed by surface absorption.

The low bulk absorption coefficient at 10.6 μm was remeasured by Hass et al. [45] using an improved laser calorimetric technique, the thermal rise procedure. The result is 8×10^{-5} cm^{-1}, which is close to the intrinsic value at this wavelength. Very low absorption at 1.06 μm was also measured by this technique, the result being 7×10^{-6} cm^{-1}.

Allen and Harrington [41] measured absorption coefficients of a reactive-atmosphere-grown single-crystal rod of KCl at selected laser wavelengths. The long-rod technique was used with the vacuum calorimeter to separate surface and bulk effects from the total absorption. Again, the extrinsic absorption observed near 9.6 μm is predominately due to surface absorption.

Rosenstock et al. [46], in an effort to separate the surface and bulk absorption of KCl crystal, observed that the surface absorption is about 10 times higher than the bulk absorption. The method involved the use of a long rod geometry combined with an analytical solution of the heat conduction equation for the temperature distribution in a sample that is heated both internally and on the surfaces. Rowe and Harrington [47] studied in detail the extrinsic absorption band near 9.6 μm and arrived at the conclusion that the extrinsic absorption may take place in the bulk or on the surface. The data discussed above indicate the state-of-the-art of KCl window material. It is seen that the extrinsic absorption band near 9.6 μm contributes to the absorption at 10.6 μm thus reducing its potential as window material at this specific wavelength.

Absorption measurement in the wavelength region longer than 10.6 μm was made available by Mentzel [48]. A simple transmission method was used with thin

plate specimens of various thicknesses. Although the experimental errors were not reported, it is believed that Mentzel used impure samples, as the samples in his studies apparently were obtained from natural sources and the results show considerable disagreement with those of the synthetic specimens shown in Figure 8.

Temperature dependence of the absorption coefficient of KCl has been measured only at the 10.6 μm CO_2 laser wavelength as shown in Figure 9 and given in Tables 15 and 16. These are reported mainly by Harrington and Hass [31], Boyer et al. [28] and Rowe and Harrington [30]. Again, absorption at 10.6 μm is generally predominated by the extrinsic absorption that is contributed from the absorption band near 9.6 μm. As a result, error assignment to the results is meaningless. However, as shown in Figure 9, the lowest available α values at various temperatures represent the bulk absorption of KCl and can be considered as the typical trend of the intrinsic absorption.

3.5. Potassium Bromide, KBr

Available absorption coefficient data of KBr in the multiphonon region are given in Tables 17 and 18 and Figure 10. Early measurements of absorption coefficient of KBr was made by Mentzel [48] using a simple transmission method on a number of thin specimens. As he probably used the natural single crystal, presence of impurities and surface contamination of the specimens is expected. This is reflected in the high absorption in the higher frequency region shown in the figure.

Califano and Czerny [40], used the simple transmission method and measured the absorption of two long block samples. Although their samples were obtained from natural sources, their results are in good agreement with the recent measurements as revealed in the figure. It is therefore reasonable to suspect that Mentzel's results are dominated by surface absorption.

Barker [35] reported absorption coefficients of KBr at temperatures 300, 590, 740, 885 and 1035 K. The samples were prepared from high quality synthetic single crystals and the surfaces were appropriately finished. The reported random error showed by successive determinations of α varied between about 0.03 cm^{-1} at low absorption and 0.3 cm^{-1} at higher absorption ($\alpha \sim 10$ cm^{-1}). It is difficult to say with assurance whether his results represent the intrinsic or extrinsic property, since there is no other evidence to rely upon in the

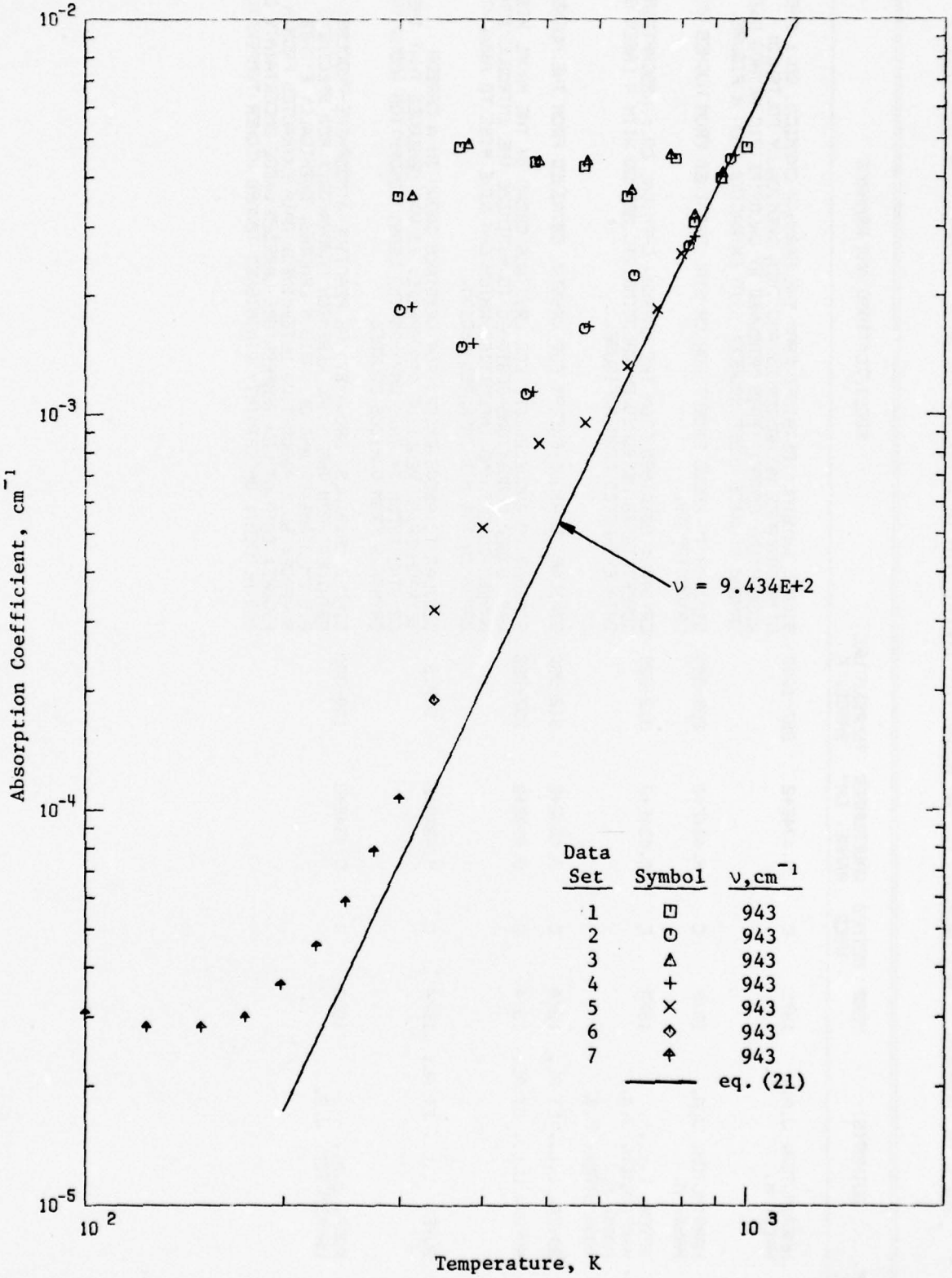

Figure 9. Absorption Coefficient of Potassium Chloride (Temperature Dependence)

TABLE 15. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF POTASSIUM CHLORIDE (TEMPERATURE DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	31	HARRINGTON, J.A., HASS, M.	1973	C	9.434E+2	297-1000	SINGLE CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; SPECIMEN WITH SURFACES MECHANICALLY AND THEN CHEMICALLY POLISHED; ABSORPTION COEFFICIENTS MEASURED BY CALORIMETRIC METHOD USING A CARBON DIOXIDE LASER SOURCE; DATA EXTRACTED FROM A FIGURE.
2	31	HARRINGTON, J.A. HASS, M.	1973	C	9.434E+2	299-944	SIMILAR TO ABOVE EXCEPT FOR CRYSTAL OBTAINED FROM HUGHES RESEARCH LABORATORIES.
3	28	BOYER, L.L., HARRINGTON, J.A., HASS, M., ROSENSTOCK, H.B.	1974	C	9.434E+2	312-920	CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; ABSORPTION COEFFICIENTS MEASURED BY CALORIMETRIC METHOD WITH A LASER SOURCE; DATA EXTRACTED FROM A FIGURE.
4	28	BOYER, L.L., ET AL.	1974	C	9.434E+2	312-960	SIMILAR TO ABOVE EXCEPT FOR CRYSTAL OBTAINED FROM THE HUGHES CO.
5	28	BOYER, L.L., ET AL.	1974	C	9.434E+2	337-796	SIMILAR TO ABOVE EXCEPT FOR CRYSTALS GROWN BY THE NAVAL RESEARCH LAB. UNDER CONDITIONS DESIGNED TO MINIMIZE THE INTRODUCTION OF OXYGEN-CONTAINING IMPURITIES WHICH CAN GIVE RISE TO ABSORPTION BANDS IN THE MID-INFRARED REGION.
6	28	BOYER, L.L., ET AL.	1974	C	9.434E+2	337.3	SIMILAR TO ABOVE EXCEPT FOR CRYSTALS GROWN IN A CARBON TETRACHLORIDE REACTIVE ATMOSPHERE; IT WAS OBSERVED THAT THE CRYSTAL GROWN IN THIS WAY HAS THE LEAST ABSORPTION AMONG THE CRYSTALS FROM VARIOUS SOURCES.
7	30	ROWE, J.M., HARRINGTON, J.A.	1976	C	9.434E+2	100-300	SINGLE CRYSTALS; GROWN BY THE REACTIVE-ATMOSPHERE-PROCESS; OBTAINED FROM THE NAVAL RESEARCH LABORATORY; ROD SPECIMENS OF 2.5 CM DIAMETER AND OF VARIOUS LENGTHS; CHEMICALLY ETCHED SURFACE; BULK ABSORPTION DETERMINED; DATA EXTRACTED FROM A FIGURE; DATA AT LOW TEMPERATURE CARRIED LARGE UNCERTAINTY OF 100 PERCENT; UNCERTAINTY DIMINISHED TOWARD HIGHER TEMPERATURES.

TABLE 16. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF POTASSIUM CHLORIDE (TEMPERATURE DEPENDENCE)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

T	α
DATA SET 1	
ν = 9.434E+2	
297.1	3.570E-3
368.9	4.760E-3
479.7	4.360E-3
568.8	4.240E-3
659.1	3.560E-3
781.6	4.440E-3
833.6	3.060E-3
916.2	3.960E-3
1000.0	4.740E-3
DATA SET 2	
ν = 9.434E+2	
299.2	1.840E-3
371.5	1.480E-3
464.5	1.120E-3
568.8	1.650E-3
676.0	2.250E-3
816.5	2.670E-3
944.0	4.430E-3
DATA SET 3	
ν = 9.434E+2	
312.6	3.600E-3
380.2	4.850E-3
486.4	4.400E-3
575.4	4.400E-3
669.9	3.720E-3
767.4	4.570E-3
833.7	3.210E-3
920.4	4.110E-3
DATA SET 4	
ν = 9.434E+2	
312.6	1.870E-3
385.4	1.510E-3
476.4	1.140E-3
578.1	1.670E-3
833.7	2.810E-3
959.4	4.540E-3
DATA SET 5	
ν = 9.434E+2	
337.3	3.200E-4
399.0	5.160E-4
486.4	8.430E-4
570.2	9.520E-4
660.7	1.320E-3
732.8	1.850E-3
796.2	2.550E-3
DATA SET 6	
ν = 9.434E+2	
337.3	1.900E-4
DATA SET 7	
ν = 9.434E+2	
100.0	3.070E-5
124.0	2.830E-5
150.0	2.830E-5
175.0	3.000E-5
198.0	3.630E-5
224.0	4.550E-5
248.0	5.870E-5
274.0	7.870E-5
299.0	1.070E-4

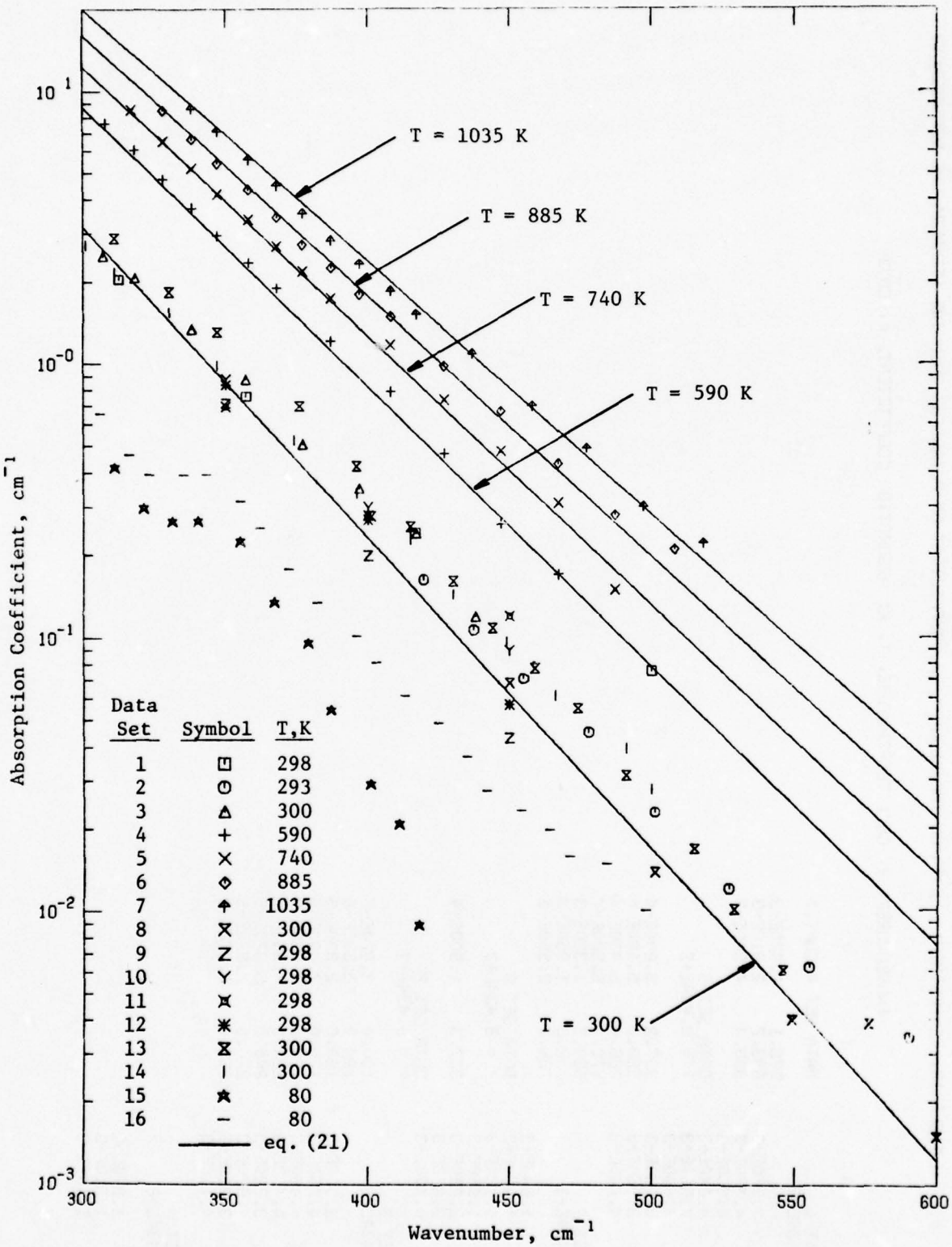

Figure 10. Absorption Coefficient of Potassium Bromide in the Multiphonon Region

TABLE 17. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF POTASSIUM BROMIDE (WAVENUMBER DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	48	MENTZEL, A.	1934	T	1.9E+2-6.3E+2	298	SINGLE CRYSTALS; THIN FILM AND PLATE SPECIMENS OF THICKNESS FROM 43 MICROMETER TO 13 MM; ABSORPTION COEFFICIENTS DETERMINED FROM TRANSMISSION MEASUREMENTS; DATA EXTRACTED FROM A TABLE.
2	40	CALIFANO, S., CZERNY, M.	1958	T	4.1E+2-5.9E+2	293	CRYSTAL; BLOCK SPECIMENS OF 15.15 AND 16.80 CM; ABSORPTION COEFFICIENTS DETERMINED FROM TRANSMITTANCE MEASUREMENTS; DATA EXTRACTED FROM A FIGURE.
3	35	BARKER, A.J.	1972	R	2.5E+2-4.4E+2	300	SYNTHETIC CRYSTAL; HIGH PURITY; HIGHLY POLISHED SPECIMEN OF 1-2 MM THICK; ABSORPTION COEFFICIENTS DEDUCED FROM REFLECTIVITY; DATA EXTRACTED FROM A FIGURE.
4	35	BARKER, A.J.	1972	R	2.9E+2-4.7E+2	590	SIMILAR TO ABOVE EXCEPT AT A HIGHER TEMPERATURE.
5	35	BARKER, A.J.	1972	R	3.1E+2-4.9E+2	740	SIMILAR TO ABOVE EXCEPT AT A HIGHER TEMPERATURE.
6	35	BARKER, A.J.	1972	R	3.2E+2-5.1E+2	885	SIMILAR TO ABOVE EXCEPT AT A HIGHER TEMPERATURE.
7	35	BARKER, A.J.	1972	R	3.3E+2-5.2E+2	1035	MOLTEN POTASSIUM BROMIDE SPECIMEN OF 1-2 MM THICK; REFLECTIVITY MEASUREMENTS CARRIED OUT IN A LARGELY INERT GAS ATMOSPHERE; ABSORPTION COEFFICIENTS DEDUCED FROM REFLECTION SPECTRA; ABSORPTION-COEFFICIENT DATA EXTRACTED FROM A FIGURE; MELTING TEMPERATURE OF POTASSIUM BROMIDE IS 1003 K.
8	9	DEUTSCH, T.F.	1973	T	2.9E+2-6.0E+2	300	SINGLE CRYSTAL; OBTAINED FROM OPTOVAC CO.; SPECIMEN OF 2.54 CM DIAMETER AND 2.54 CM THICK; ABSORPTION COEFFICIENTS DETERMINED USING A DIFFERENTIAL TECHNIQUE WITH A DUAL-BEAM SPECTROPHOTOMETER; DATA EXTRACTED FROM A FIGURE.
9	49	KLEIN, P.H., DAVISON, J.W., HARRINGTON, J.A.	1976	C	3.5E+2-4.5E+2	298	HIGH PURITY CRYSTAL; PURIFIED WITH REAGENT IODINE BROMIDE; BAR SPECIMENS; WATER GROUND FOLLOWED BY POLISHING WITH HYDROGEN BROMIDE SOLUTION; MEASURED WITH LASER CALORIMETRY; DATA EXTRACTED FROM A TABLE.
10	49	KLEIN, P.H. ET AL.	1976	C	3.5E+2-4.5E+2	298	SIMILAR TO ABOVE EXCEPT PURIFIED WITH HEXABROMOETHANE IN THE HALIDE PROCESS.
11	49	KLEIN, P.H. ET AL.	1976	C	3.5E+2-4.5E+2	298	SIMILAR TO ABOVE EXCEPT PURIFIED WITH HEXABROMOBENZENE IN THE HALIDE PROCESS.

TABLE 17. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF POTASSIUM BROMIDE (WAVENUMBER DEPENDENCE) (CONTINUED)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
12	49	KLEIN, P.H. ET AL.	1976	C	3.5E+2-4.5E+2	298	SIMILAR TO ABOVE EXCEPT PURIFIED WITH REAGENT CARBON TETRACHLORIDE IN THE HALIDE PROCESS.
13	27	HARRINGTON, J.A., DUTCHLER, C.J. PATTEN, F.W. HASS, M.	1976	C	2.7E+2-5.8E+2	300	SINGLE CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; MEASUREMENTS MADE AT UNIVERSITY OF ALABAMA IN HUNTSVILLE; EXPERIMENTAL DETAILS NOT GIVEN; DATA EXTRACTED FROM A FIGURE.
14	27	HARRINGTON, J.A., ET AL.	1976	C	2.7E+2-5.8E+2	300	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT NAVAL RESEARCH LABORATORY.
15	27	HARRINGTON, J.A. ET AL.	1976	C	2.8E+2-5.0E+2	80	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT UNIVERSITY OF ALABAMA IN HUNTSVILLE.
16	27	HARRINGTON, J.A., ET AL.	1976	C	2.8E+2-5.0E+2	80	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT NAVAL RESEARCH LABORATORY.

TABLE 18. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF POTASSIUM BROMIDE (WAVENUMBER DEPENDENCE)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α	ν	α	ν	α	ν	α	ν	α	ν	α
DATA SET 1		DATA SET 4		DATA SET 6(CONT.)		DATA SET 9		DATA SET 13(CONT.)		DATA SET 16	
T = 298.0		T = 590.0				T = 298.0				T = 80.0	
				4.080E+2	1.490E+0			4.740E+2	5.510E-2		
6.250E+2	1.021E-2	4.670E+2	1.700E-1	3.970E+2	1.800E+0	4.500E+2	4.300E-2	4.910E+2	3.130E-2	2.850E+2	1.300E+0
5.000E+2	7.540E-2	4.470E+2	2.600E-1	3.870E+2	2.250E+0	4.000E+2	2.000E-1	5.150E+2	1.680E-2	2.970E+2	8.730E-1
4.167E+2	2.409E-1	4.270E+2	4.700E-1	3.770E+2	2.740E+0	3.500E+2	7.200E-1	5.290E+2	1.010E-2	3.060E+2	6.580E-1
3.571E+2	7.630E-1	4.080E+2	7.900E-1	3.680E+2	3.450E+0			5.460E+2	6.060E-3	3.160E+2	4.680E-1
3.125E+2	2.042E+0	3.870E+2	1.210E+0	3.580E+2	4.370E+0	DATA SET 10		5.760E+2	3.860E-3	3.230E+2	3.950E-1
2.778E+2	4.538E+0	3.680E+2	1.900E+0	3.470E+2	5.430E+0	T = 298.0				3.350E+2	3.960E-1
2.500E+2	1.257E+1	3.580E+2	2.360E+0	3.380E+2	6.670E+0			DATA SET 14		3.430E+2	3.960E-1
2.273E+2	3.427E+1	3.470E+2	2.960E+0	3.280E+2	8.500E+0	4.500E+2	9.000E-2	T = 300.0		3.550E+2	3.160E-1
2.083E+2	9.687E+1	3.380E+2	3.730E+0			4.000E+2	3.000E-1			3.620E+2	2.520E-1
1.923E+2	2.344E+2	3.280E+2	4.760E+0	DATA SET 7		3.500E+2	8.800E-1	2.920E+2	3.610E+0	3.720E+2	1.790E-1
		3.180E+2	6.090E+0	T = 1035.0				3.010E+2	2.720E+0	3.820E+2	1.350E-1
DATA SET 2		3.080E+2	7.610E+0			DATA SET 11		3.110E+2	2.170E+0	3.960E+2	1.020E-1
T = 293.0		2.980E+2	9.320E+0	5.180E+2	2.200E-1	T = 298.0		3.300E+2	1.550E+0	4.030E+2	8.130E-2
				4.970E+2	3.000E-1			3.470E+2	9.850E-1	4.130E+2	6.120E-2
5.900E+2	3.462E-3	DATA SET 5		4.770E+2	4.900E-1	4.500E+2	1.200E-1	3.740E+2	5.290E-1	4.250E+2	4.890E-2
5.552E+2	6.189E-3	T = 740.0		4.580E+2	7.000E-1	4.000E+2	2.800E-1	3.960E+2	3.350E-1	4.350E+2	3.680E-2
5.259E+2	1.205E-2			4.370E+2	1.090E+0	3.500E+2	7.000E-1	4.150E+2	2.270E-1	4.420E+2	2.770E-2
5.010E+2	2.292E-2	4.870E+2	1.500E-1	4.170E+2	1.520E+0			4.300E+2	1.440E-1	4.540E+2	2.340E-2
4.778E+2	4.509E-2	4.670E+2	3.100E-1	4.080E+2	1.850E+0	DATA SET 12		4.490E+2	9.700E-2	4.640E+2	1.980E-2
4.548E+2	7.086E-2	4.470E+2	4.800E-1	3.970E+2	2.330E+0	T = 298.0		4.660E+2	6.170E-2	4.710E+2	1.580E-2
4.373E+2	1.071E-1	4.270E+2	7.400E-1	3.870E+2	2.830E+0			4.910E+2	3.930E-2	4.840E+2	1.490E-2
4.195E+2	1.629E-1	4.080E+2	1.170E+0	3.770E+2	3.580E+0	4.500E+2	5.700E-2	5.000E+2	2.790E-2	4.980E+2	1.000E-2
		3.870E+2	1.740E+0	3.680E+2	4.500E+0	4.000E+2	2.700E-1				
DATA SET 3		3.770E+2	2.190E+0	3.580E+2	5.630E+0	3.500E+2	8.400E-1	DATA SET 15			
T = 300.0		3.680E+2	2.700E+0	3.470E+2	7.110E+0			T = 80.0			
		3.580E+2	3.400E+0	3.380E+2	8.650E+0	DATA SET 13					
4.380E+2	1.200E-1	3.470E+2	4.190E+0			T = 300.0		2.890E+2	6.950E-1		
4.170E+2	2.400E-1	3.380E+2	5.210E+0	DATA SET 8				3.110E+2	4.180E-1		
3.970E+2	3.500E-1	3.280E+2	6.560E+0	T = 300.0		2.720E+2	8.950E+0	3.210E+2	2.970E-1		
3.770E+2	5.100E-1	3.170E+2	8.540E+0			2.910E+2	5.080E+0	3.310E+2	2.660E-1		
3.570E+2	8.800E-1			5.999E+2	1.500E-3	3.110E+2	2.890E+0	3.400E+2	2.660E-1		
3.380E+2	1.350E+0	DATA SET 6		5.491E+2	4.000E-3	3.300E+2	1.840E+0	3.550E+2	2.250E-1		
3.180E+2	2.070E+0	T = 885.0		5.010E+2	1.380E-2	3.470E+2	1.310E+0	3.670E+2	1.350E-1		
3.070E+2	2.480E+0			4.500E+2	6.820E-2	3.760E+2	7.030E-1	3.790E+2	9.610E-2		
2.970E+2	3.130E+0	5.080E+2	2.100E-1	4.010E+2	2.773E-1	3.960E+2	4.220E-1	3.870E+2	5.450E-2		
2.870E+2	3.980E+0	4.870E+2	2.800E-1	2.990E+2	2.009E+0	4.150E+2	2.540E-1	4.010E+2	2.920E-2		
2.780E+2	5.250E+0	4.670E+2	4.300E-1			4.300E+2	1.610E-1	4.110E+2	2.080E-2		
2.670E+2	7.560E+0	4.470E+2	6.700E-1			4.440E+2	1.090E-1	4.180E+2	8.870E-3		
2.580E+2	9.970E+0	4.270E+2	9.800E-1			4.590E+2	7.730E-2				

absence of other high temperature measurements for comparison. However, his room temperature values closely agree with recent measurements which were performed on well purified and finished samples and the results are believed to be intrinsic. Therefore, it is reasonable to consider Barker's results to be intrinsic at least in the frequency region where the data were obtained. It should be noted that the melting point of KBr is 1003 K. Barker's data at 1035 K is for the molten phase of KBr. However, he observed only a small change in the absorption spectra as the melting point was traversed.

Deutsch [9] studied the absorption of KBr using a differential technique with a dual beam spectrophotometer. Errors varied from 10% at low absorption level to 3% at higher level. His results are believed to be largely intrinsic.

As KBr single crystals have been occasionally observed to have a lower absorption coefficient than KCl at 10.6 μm, it attracted new interest. Klein et al. [49] studied the crystal growing and surface polishing processes to seek the most effective procedure for decreasing infrared absorption. Using KBr single crystals, various halogen producing reagents were studied in the reactive-atmosphere-crystal-growing process and the multiphonon absorption coefficients in each case were measured at frequencies of 350 cm^{-1}, 400 cm^{-1} and 450 cm^{-1}. It was found that the reagent CCl_4 is the most effective one in reducing infrared absorption.

Harrington et al. [27] reported data obtained from the University of Alabama and the Naval Research Laboratory. Although neither details of measurement procedure nor experimental errors were given, an estimated error of 10% or more should be assigned as data were presented in graphs with scales at low resolution.

As seen in Figure 10, the room temperature data from various investigations are in reasonable agreement. Minute traces of impurities do not affect the absorption at high temperatures. At low temperatures, however, distinguishable features in the absorption spectrum of different samples are seen.

3.6. Potassium Iodide, KI

Absorption data of KI in the multiphonon region is scanty. The existing data are those of [27,50 and 51] and are reported in Tables 19 and 20 and Figure 11.

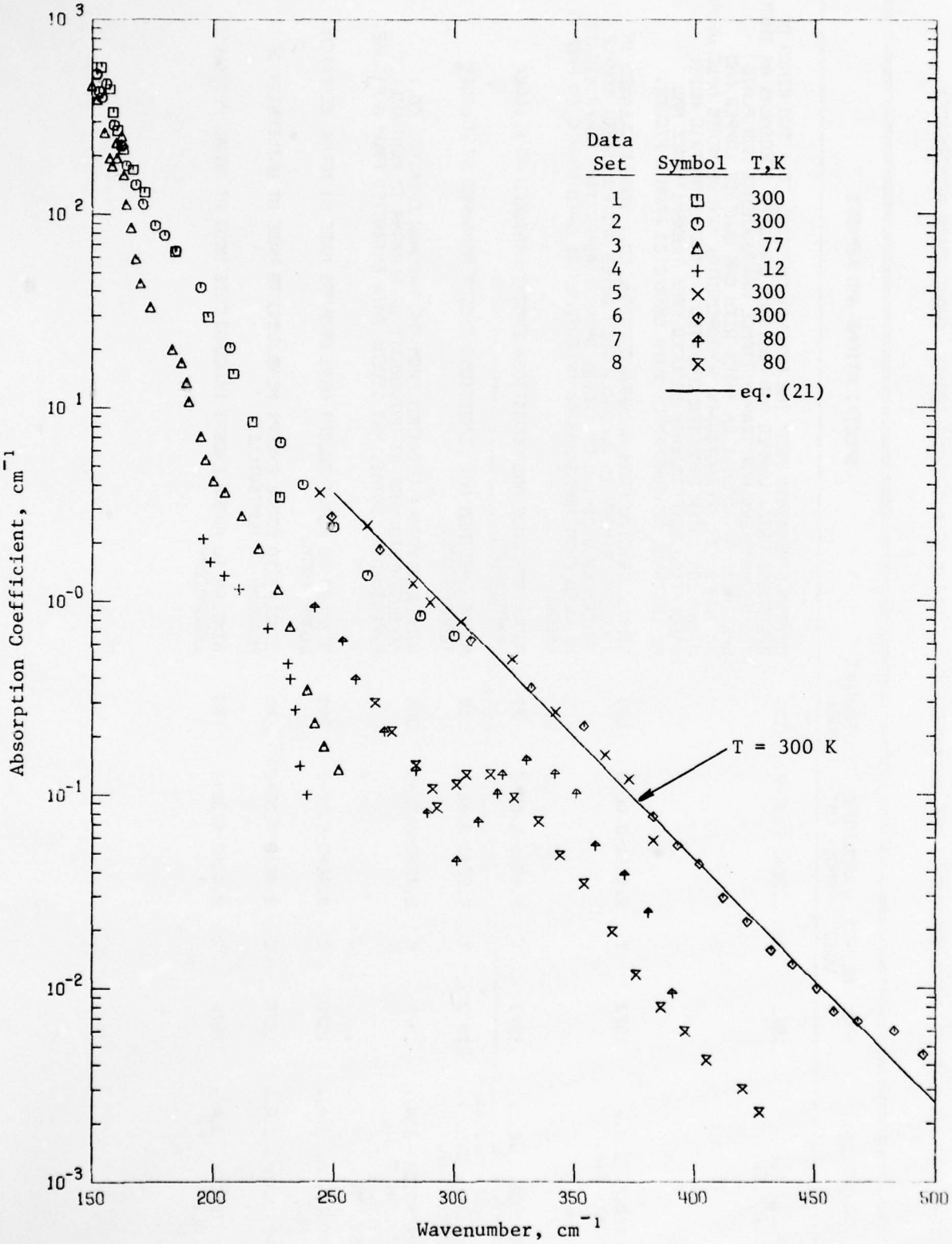

Figure 11. Absorption Coefficient of Potassium Iodide in the Multiphonon Region

TABLE 19. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF POTASSIUM IODIDE (WAVENUMBER DEPENDENCE)

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	50	BERG, J.I., BELL, E.E.	1971	Z	2.2E+1-2.3E+2	300	CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; TWO KINDS OF SPECIMENS USED, LAPPED AND POLISHED LAMELLAR SPECIMENS AS THIN AS 100 MICROMETERS FOR TRANSMITTANCE MEASUREMENTS AND PLATE SPECIMENS OF ABOUT 1 CM THICK WITH ONE SURFACE LAPPED AND POLISHED FOR REFRACTIVITY MEASUREMENTS; MEASUREMENTS MADE USING A MICHELSON INTERFEROMETER OPERATED IN THE ASYMMETRIC MODE; ABSORPTION COEFFICIENTS DEDUCED FROM TRANSMITTANCE AND REFLECTANCE MEASUREMENTS; DATA EXTRACTED FROM A FIGURE.
2	51	ELDRIDGE, J.E., KEMBRY, K.A.	1973	T	2.5E+1-3.0E+2	300	SINGLE CRYSTAL FROM HARSHAW CHEMICAL CO.; SAMPLE CLEANED IN TOLUENE, RINSED IN ALCOHOL, THEN DRIED AND POLISHED; SAMPLE THICKNESS 0.01-1.0 CM (WEDGE SHAPE); ABSORPTION COEFFICIENTS DEDUCED FROM TRANSMISSION MEASUREMENTS; DATA EXTRACTED FROM A FIGURE.
3	51	ELDRIDGE, J.E. , KEMBRY, K.A.	1973	T	2.8E+1-2.5E+2	77	ABOVE SPECIMEN AND CONDITIONS EXCEPT MEASURED AT A LOWER TEMPERATURE.
4	51	ELDRIDGE, J.E. , KEMBRY, K.A.	1973	T	6.9E+1-2.4E+2	12	ABOVE SPECIMEN AND CONDITIONS EXCEPT MEASURED AT A LOWER TEMPERATURE.
5	27	HARRINGTON, J.A., DUTHLER, C.J., PATTEN, F.W., HASS, M.	1976	C	2.4E+2-5.3E+2	300	SINGLE CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; MEASUREMENTS MADE AT UNIVERSITY OF ALABAMA IN HUNTSVILLE; EXPERIMENTAL DETAIL NOT GIVEN; DATA EXTRACTED FROM A FIGURE.
6	27	HARRINGTON, J.A., ET AL.	1976	C	2.4E+2-5.3E+2	300	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT NAVAL RESEARCH LABORATORY.
7	27	HARRINGTON, J.A., ET AL.	1976	C	2.4E+2-4.3E+2	80	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT UNIVERSITY OF ALABAMA IN HUNTSVILLE.
8	27	HARRINGTON, J.A., ET AL.	1976	C	2.4E+2-4.3E+2	80	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT NAVAL RESEARCH LABORATORY.

TABLE 20. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF POTASSIUM IODIDE (WAVENUMBER DEPENDENCE)

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α	ν	α	ν	α	ν	α	ν	α	ν	α
DATA SET 1		DATA SET 1(CONT.)		DATA SET 2(CONT.)		DATA SET 3(CONT.)		DATA SET 5		DATA SET 7(CONT.)	
T = 300.0								T = 300.0			
		4.850E+1	8.258E+1	4.700E+1	7.244E+1	1.500E+2	4.571E+2			2.840E+2	1.340E-1
2.276E+2	3.432E+0	4.410E+1	6.185E+1	4.100E+1	4.074E+1	1.490E+2	4.266E+2	2.440E+2	3.610E+0	2.890E+2	8.050E-2
2.165E+2	8.434E+0	4.120E+1	4.675E+1	3.500E+1	2.089E+1	1.460E+2	3.631E+2	2.640E+2	2.430E+0	3.010E+2	4.570E-2
2.085E+2	1.493E+1	3.890E+1	3.603E+1	3.000E+1	9.120E+0	1.010E+2	1.413E+2	2.830E+2	1.230E+0	3.100E+2	7.200E-2
1.980E+2	2.936E+1	3.500E+1	2.362E+1	2.800E+1	5.012E+0	9.400E+1	8.511E+1	2.900E+2	9.830E-1	3.180E+2	1.010E-1
1.845E+2	6.376E+1	3.190E+1	1.475E+1	2.500E+1	1.000E-1	8.800E+1	4.571E+1	3.030E+2	7.840E-1	3.200E+2	1.270E-1
1.717E+2	1.292E+2	2.850E+1	8.560E+0			8.200E+1	4.169E+1	3.240E+2	4.990E-1	3.300E+2	1.510E-1
1.667E+2	1.695E+2	2.580E+1	5.252E+0	DATA SET 3		7.600E+1	5.129E+1	3.420E+2	2.670E-1	3.420E+2	1.280E-1
1.626E+2	2.139E+2	2.210E+1	2.472E+0	T = 77.0		7.000E+1	4.571E+1	3.630E+2	1.610E-1	3.510E+2	1.020E-1
1.603E+2	2.703E+2					6.300E+1	3.388E+1	3.730E+2	1.210E-1	3.590E+2	5.450E-2
1.586E+2	3.352E+2	DATA SET 2		2.520E+2	1.349E-1	5.100E+1	1.778E+1	3.830E+2	5.730E-2	3.710E+2	3.880E-2
1.574E+2	4.407E+2	T = 300.0		2.460E+2	1.778E-1	4.600E+1	1.230E+1			3.810E+2	2.470E-2
1.537E+2	5.700E+2			2.420E+2	2.344E-1	4.200E+1	9.120E+0	DATA SET 6		3.910E+2	9.390E-3
1.488E+2	7.511E+2	3.000E+2	6.607E-1	2.390E+2	3.467E-1	3.800E+1	6.026E+0	T = 300.0			
1.463E+2	8.519E+2	2.860E+2	8.318E-1	2.320E+2	7.413E-1	3.400E+1	3.162E+0			DATA SET 8	
1.449E+2	9.510E+2	2.640E+2	1.349E+0	2.270E+2	1.148E+0	3.300E+1	2.089E+0	2.490E+2	2.720E+0	T = 80.0	
1.416E+2	9.778E+2	2.500E+2	2.399E+0	2.190E+2	1.862E+0	2.900E+1	2.630E-1	2.690E+2	1.830E+0		
1.367E+2	9.311E+2	2.370E+2	3.981E+0	2.120E+2	2.754E+0	2.800E+1	1.000E-1	3.070E+2	6.250E-1	2.670E+2	2.970E-1
1.330E+2	9.528E+2	2.280E+2	6.607E+0	2.050E+2	3.631E+0			3.320E+2	3.550E-1	2.740E+2	2.110E-1
1.294E+2	1.045E+3	2.070E+2	2.042E+1	2.000E+2	4.169E+0	DATA SET 4		3.540E+2	2.260E-1	2.840E+2	1.420E-1
1.268E+2	1.165E+3	1.950E+2	4.169E+1	1.970E+2	5.370E+0	T = 12.0		3.830E+2	7.690E-2	2.910E+2	1.070E-1
1.208E+2	1.833E+3	1.850E+2	6.457E+1	1.950E+2	7.079E+0			3.930E+2	5.470E-2	2.930E+2	8.530E-2
1.100E+2	3.537E+3	1.800E+2	7.762E+1	1.900E+2	1.072E+1	2.390E+2	1.000E-1	4.020E+2	4.370E-2	3.010E+2	1.130E-1
1.050E+2	5.063E+3	1.760E+2	8.710E+1	1.890E+2	1.349E+1	2.360E+2	1.413E-1	4.120E+2	2.940E-2	3.050E+2	1.270E-1
1.024E+2	5.936E+3	1.710E+2	1.122E+2	1.870E+2	1.698E+1	2.340E+2	2.754E-1	4.220E+2	2.210E-2	3.150E+2	1.270E-1
1.002E+2	5.297E+3	1.680E+2	1.413E+2	1.830E+2	1.995E+1	2.320E+2	3.981E-1	4.320E+2	1.570E-2	3.250E+2	3.590E-2
9.860E+1	3.759E+3	1.640E+2	1.778E+2	1.740E+2	3.311E+1	2.310E+2	4.786E-1	4.410E+2	1.330E-2	3.350E+2	7.220E-2
9.700E+1	2.570E+3	1.620E+2	2.239E+2	1.700E+2	4.365E+1	2.230E+2	7.244E-1	4.510E+2	1.000E-2	3.440E+2	4.860E-2
9.480E+1	1.361E+3	1.590E+2	2.884E+2	1.680E+2	5.888E+1	2.110E+2	1.148E+0	4.580E+2	7.540E-3	3.540E+2	3.460E-2
9.400E+1	9.469E+2	1.560E+2	4.677E+2	1.660E+2	8.511E+1	2.050E+2	1.349E+0	4.680E+2	6.740E-3	3.660E+2	1.960E-2
9.230E+1	7.218E+2	1.540E+2	3.981E+2	1.640E+2	1.122E+2	1.990E+2	1.585E+0	4.830E+2	6.030E-3	3.760E+2	1.180E-2
9.030E+1	5.609E+2	1.530E+2	4.266E+2	1.630E+2	1.585E+2	1.960E+2	2.089E+0	4.950E+2	4.540E-3	3.860E+2	7.920E-3
8.710E+1	3.760E+2	1.520E+2	5.248E+2	1.620E+2	2.291E+2	1.010E+2	2.692E+1			3.960E+2	5.960E-3
8.410E+1	2.883E+2	8.900E+1	3.631E+2	1.620E+2	2.512E+2	9.300E+1	3.388E+0	DATA SET 7		4.050E+2	4.240E-3
8.180E+1	2.398E+2	8.600E+1	2.754E+2	1.600E+2	2.344E+2	8.700E+1	1.413E+0	T = 80.0		4.200E+2	3.020E-3
7.730E+1	1.974E+2	8.300E+1	2.188E+2	1.600E+2	1.950E+2	8.100E+1	7.244E-1			4.270E+2	2.280E-3
6.530E+1	1.667E+2	7.500E+1	1.738E+2	1.580E+2	1.778E+2	7.700E+1	5.495E-1	2.420E+2	9.230E-1		
6.070E+1	1.439E+2	6.600E+1	1.738E+2	1.570E+2	1.950E+2	7.400E+1	4.677E-1	2.540E+2	6.210E-1		
5.650E+1	1.216E+2	6.000E+1	1.479E+2	1.550E+2	2.630E+2	6.900E+1	4.074E-1	2.590E+2	3.940E-1		
5.250E+1	1.031E+2	5.400E+1	1.072E+2	1.520E+2	3.890E+2			2.710E+2	2.110E-1		

Berg and Bell's [50] results were derived from reflectivity and transmission measurements. Although no error was reported with the results, large errors are expected and are estimated to be 10% or more.

Eldridge and Kembry [51] determined the absorption coefficient of a natural KI single crystal also using reflectivity and transmission method. As they used natural samples, large errors due to impurities are expected in their results. An effective estimate of error is about 10% at high absorption ($\alpha \sim 100$ cm^{-1}) to as high as 100% or more at low absorption ($\alpha < 1$ cm^{-1}). It is clear that data from the above mentioned sources are not suitable for a basis of data analysis.

Multiphonon absorption data of pure KI samples were reported by Harrington et al. [27]. Data were measured at the University of Alabama and the Naval Research Laboratory. No errors were reported with the data, but a 5% error should be assigned for $\alpha > 1$ cm^{-1} and 10% or higher for $\alpha < 0.1$ cm^{-1} as a result of uncertainty in graph reading. Effects of impurities were revealed only at low temperatures as shown in Figure 11.

4. DATA ANALYSIS

Absorption in the multiphonon region is of current interest because of its application in windows for high-power infrared lasers. At the frequencies encountered in this region, the total absorption can be attributed to processes involving several phonons, defect modes due to impurities, vacancies, and surface contaminations. A number of observations have been made to investigate the frequency and temperature dependence of the intrinsic multiphonon absorption. It has been found that the exponential dependence of the absorption coefficient on frequency holds for LiF, NaF, NaCl, KCl, KBr and KI at room temperature.

This exponential relation attracted considerable attention in the theoretical interpretation of such behavior. Theoretical results indeed predict the exponential dependence of the room temperature absorption coefficient on the frequency. With regard to the temperature dependence, however, the results are not satisfactory. Discrepancies between experimental results and theoretical predictions are of several orders of magnitude. In the case of NaF, NaCl and KCl, for example, theory predicts that at high temperatures the absorption coefficient varies with temperature according to eq. (17), where the values of (n-1) are predicted to be 3, 5, and 6 for NaF, NaCl and KCl, respectively, while the corresponding experimental values are 2.6, 3.3 and 2.8. As a consequence, many investigators have questioned the validity of the basic assumptions in the transition matrix of Bose-Einstein statistics. It is therefore conceivable that an empirical formula that closely fits the available data should be established until such time when an improved theory becomes available.

4.1. Status of Available Data

Absorption coefficient data in the multiphonon region, as a whole, are scanty. The available data are given and discussed in Section 3. It is well known that impurities are the major factors that contribute to the total observed absorption. However, these very important pieces of information are generally missing, partly due to unawareness on the part of investigators and partly due to the inadequacy of the facilities used. As a result, errors are inevitable.

Surface contamination is known to contribute to absorption and is usually in the order of $10^{-3}cm^{-1}$ per unit surface area. At high absorption levels, the

effect of surface absorption is negligible. At low absorption levels, say $\alpha < 10^{-3} cm^{-1}$, surface absorption may predominate the bulk absorption, resulting in difficulties in the determination of the intrinsics, examples are NaCl and KCl. Additional errors are introduced in the data available to the end-user, when they must be read off from graphs. The latter errors are unnecessarily contributed in the process of data presentation.

As a result of the combination of the above considerations, the errors in data are estimated in general at 3 to 10% in the high absorption range for $\alpha > 0.1\ cm^{-1}$. At low absorptions, errors increase with decreased absorption. At very low absorption, errors can be in excess of 100%. As a consequence, intrinsic behavior is only revealed in the high absorption range, while at low levels, the extrinsics can predominate and mask the intrinsics.

In the special applications, particularly in the area of lasers, high temperature (>300) absorption coefficients are usually needed. It is unfortunate that absorption coefficients are seldom measured at elevated temperatures. The only known systematic measurement of absorption coefficient as a function of frequency and temperature was made by Barker [35] for LiF, NaCl and KBr. As Barker's values are mostly in the high absorption range (see Figures 3, 6 and 10) and are well behaved, it is highly probable that his results represent the intrinsic absorptions of the corresponding crystals.

4.2. Typical Trends in Data

Typical trends in experimental data (room temperature or higher) can be clearly seen in the figures of Section 3 where frequency-dependent absorption coefficients are plotted in semi-log scale (i.e., log α vs. ν) and temperature dependent absorption coefficients are plotted in log-log scale (i.e., log α vs. log T). Both appear as straight lines in corresponding plots. The implication of this straight line behavior is that the absorption coefficient is related to frequency and temperature, respectively, in the form $\alpha(\nu) \sim e^{-A\nu}$ and $\alpha(T) \sim T^{A'}$ where A and A' are constants for each of the given lines.

The exponential behavior is not only observed in the multiphonon region, but is also observed in the Urbach tail region as shown in Figure 1. The power law is not only obeyed at the frequencies in the multiphonon region, the same is also observed in the frequency region on the other side of the fundamental

reststrahlen band. This can be seen in the figures labeled with temperature dependence in Part I of this report.

4.3. Formulation of an Empirical Model

A straight line in a semi-log plot of log α vs. ν indicates an exponential relation of the form

$$\log \alpha = \log \alpha_o - 0.43429A(\nu + B) \tag{18}$$

where A is the slope of the line at a given temperature, α_o and B are arbitrary constants corresponding to the coordinates of a point on the line. Therefore three parameters are required to define a straight line in the semi-log presentation.

Review of Figures 3, 6 and 10, we can see that the slopes are varying with temperatures. This means that α_o and B are also varying with temperature unless there exists a pair of values that is common to all of the lines for a given material. This requirement sets a restriction that all the lines must converge to the point (α_o, B). To see whether this point could be found, a graphical extrapolation was made by drawing straight lines through corresponding data sets and extending to a region where they tend to meet. Indeed, one does find a definite point of convergence for each of the materials, LiF, NaCl and KBr. Since adequate data are available at various temperatures, the existence of such a point of convergence provides a reliable clue that α_o and B are constants for a given material and that only the slope, A, varies with temperature, i.e.,

$$\log \alpha = \log \alpha_o - 0.43429(\nu + B)\ A(T). \tag{19}$$

To find the functional variation of A with T, we have made use of the fact that the plot of α versus T is a straight line in the log-log scale. To meet this condition we are limited to consider the expression

$$A(T) = C(D - \log T), \tag{20}$$

where C and D are constants for a given material. Combining eqs. (18) to (20) leads to the following empirical equation to represent the absorption coefficient as a function of frequency and temperature:

$$\alpha(\nu,T) = \alpha_o\ e^{-a(\nu + b)(c - \log T)} \tag{21}$$

where α_o, a, b and c are constants for a given material. At a given temperature this equation is reduced to the form of $\alpha(\nu) \sim e^{-a'\nu}$ while at a given frequency, $\alpha(T) \sim T^{b'}$, where a' and b' are constants.

It is interesting to point out that eq. (21) is analogous to the Urbach rule in the ultraviolet absorption edge. The pair of constants, α_o and b, defines the "cross over point" where the curves of α versus ν converge and the factor $a(c - \log T)$ is defined as the "steepness" of the lines. The physical meaning of these parameters remains to be ascertained.

4.4. Numerical Data Fitting for LiF, NaCl and KBr

Numerical values of the constants, α_o, a, b and c can be defined through least-squares fitting of the experimental data to eq. (21). Needless to say that reliability of the values depends upon the availability of experimental data and their accuracies. Review of the existing data as discussed in Section 3 indicated that adequate data fitting can be made for LiF, NaCl and KBr. As the errors in the data are in the range of 10%, therefore the uncertainty in the results of such fitting are at best 10%.

The least-square calculation was performed on the equation:

$$\log \alpha = \log \alpha_o - 0.43429a(\nu + b)(c - \log T) \qquad (22)$$

The first approximate values of a and c were evaluated by holding α_o and b fixed at their graphically determined values. The final values of the constants were then determined by allowing free adjustment of all four constants. The results of the best fit are:

	α_o	a, cm	b, cm^{-1}	c
LiF	$10^{4.4591}$	0.002237	49.1557	5.39574
NaCl	$10^{5.0505}$	0.005909	83.8511	5.50982
KBr	$10^{4.9073}$	0.008862	93.7115	5.39708

It was found that, except for LiF, the resulting equation also predicts α values for the molten phase of the materials as if there is no significant change at the phase transition point. This is inconsistent with Barker's observation.

4.5. Prediction of Key Parameters for NaF, KCl and KI

As it was stated in Section 3, data for NaF, KCl and KI are not adequate for least-squares calculations in which both frequency and temperature are treated as independent variables. In order to utilize the existing data of these materials and yet give some meaning to the calculations, we have to reduce the number of unknown parameters in eq. (22). Clues have been observed which enable us to define the parameters a and c for these materials thus reducing the number of unknown parameters to 2.

A careful examination of the list of parameters in the last subsection, we can see that the values of the parameter c merges as almost a constant for LiF, NaCl and KBr. The small differences among them can very well be accounted for by errors in the data. Hence it is assumed that an average value of 5.434, may be used as the value of c in eq. (21) for alkali halides.

Comparing eq. (21) with Deutsch's representation, eq. (2), we can see that $1/\nu_o \sim a(c - \log T)$. At a given temperature, say room temperature, the factor $(c - \log T)$ is a constant and therefore $1/\nu_o \sim a$. Indeed, we have found that this is the case for LiF, NaCl and KBr for which the values of a are obtained from fitting the data. It was noted that the parameter ν_o is related to the molecular weight, M, of the corresponding material as discussed in Part I. This implies that 1/a is related to M in a similar fashion. Listed below are the values of ν_o, a, 1/a, M and 1/M and ν_{To} of various materials, where ν_{To} represents the frequency of the transverse mode fundamental phonon. The inclusion of ν_{To} here is based on the fact that it was found that ν_{To} is proportional to ν_o and 1/a as well, except for LiF as shown in the list.

	ν_o cm^{-1}	a cm	1/a cm^{-1}	M g $mole^{-1}$	1/M mole g^{-1}	ν_{To} cm^{-1}
LiF	153.2	0.002237	447.03	26	0.0385	305
NaF	(78)	(0.00437)	(228.83)	42	0.0238	246.5
NaCl	56.0	0.00591	169.20	58.5	0.0171	164
KCl	50.8	(0.00700)	(142.86)	74.5	0.0134	142
KBr	39.1	0.00886	112.87	120	0.0083	114
KI	(36)	(0.0098)	(102.04)	166	0.0060	102

In the above table, the values in parentheses are those predicted graphically as discussed below.

Figure 12 shows a plot of 1/M versus 1/a and ν_o. It is seen that the lines of 1/a vs. 1/M and ν_o vs. 1/M are parallel to each other and the points for LiF, NaCl and KBr on the 1/a vs. 1/M plot precisely define a straight line. Values of a for NaF, KCl and KI are thus predicted.

Based on the above discussion, one now has only two unknowns in eq. (21) for NaF, KCl and KI. What remains to be done is the evaluation of the parameters α_o and b.

4.6. Final Results of Data Analysis

Although there are significant amount of data available for NaF, measured in a wide range of temperature at a number of discrete frequencies, large uncertainties are inevitably introduced through the rough graphical presentations. Examination of Figure 5 will show that data sets measured at 900 cm^{-1} and 1075 cm^{-1} are inconsistent with the rest of the data sets. Hence, these two data sets are not included in the data fitting calculations.

In the case of KCl, frequency dependence data are only available at room temperature. Although there are temperature-dependent data obtained at 10.6 μm, it is difficult to define the intrinsic bulk absorption because of the extrinsic absorption band at 9.7 μm. As a result, the existing temperature dependence data can not be used in the determination of α_o and b and one has to rely on the room-temperature frequency-dependent data to define the values of α_o and b. In the case of KI, only the room-temperature frequency-dependent data are available.

Least-squares data fitting was carried out for NaF, KCl and KI. For LiF, NaCl and KBr, the values of α_o and b were redefined by the least-square fitting. The final results of data fitting yielding the constants α_o, a, b, and c used in eq. (21) are given below:

	α_o, cm^{-1}	a, cm	b, cm^{-1}	c
LiF	$10^{4.512}$	0.002237	44.1	5.434
NaF	$10^{5.480}$	0.00437	108.4	5.434
NaCl	$10^{4.978}$	0.00591	94.5	5.434
KCl	$10^{6.419}$	0.00700	230.2	5.434
KBr	$10^{4.941}$	0.00886	90.2	5.434
KI	$10^{6.311}$	0.0098	207.3	5.434

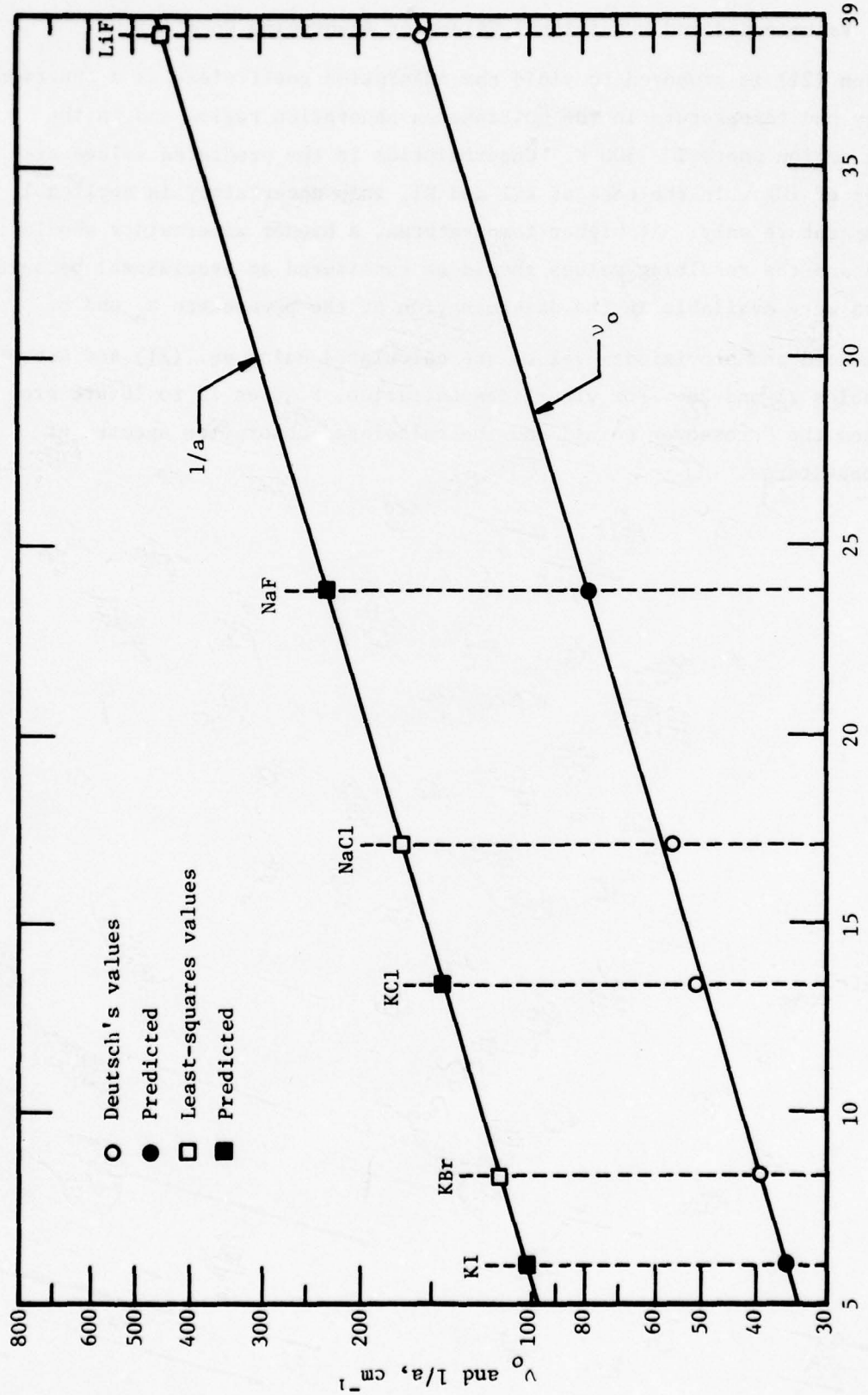

Figure 12. Semi-Log Plot of ν_o and 1/a of Alkali Halides as a Function of 1/M

4.7. Recommended and Provisional Values of Absorption Coefficient

Equation (21) is proposed to yield the absorption coefficient as a function of frequency and temperature in the multiphonon absorption region and in the temperature region where $T \geq 300$ K. Uncertainties in the predicted values are in the range of 10%. In the case of KCl and KI, this uncertainty is applicable to room temperature only. At higher temperatures, a higher uncertainty should be assigned and the resulting values should be considered as provisional because limited data were available in the determination of the parameters α_o and b.

Recommended and provisional values are calculated using eq. (21) and are given in Tables 21 and 26. For visual demonstration, Figures 13 to 18 are provided to show the "crossover point" and the calculated absorption spectra at various temperatures.

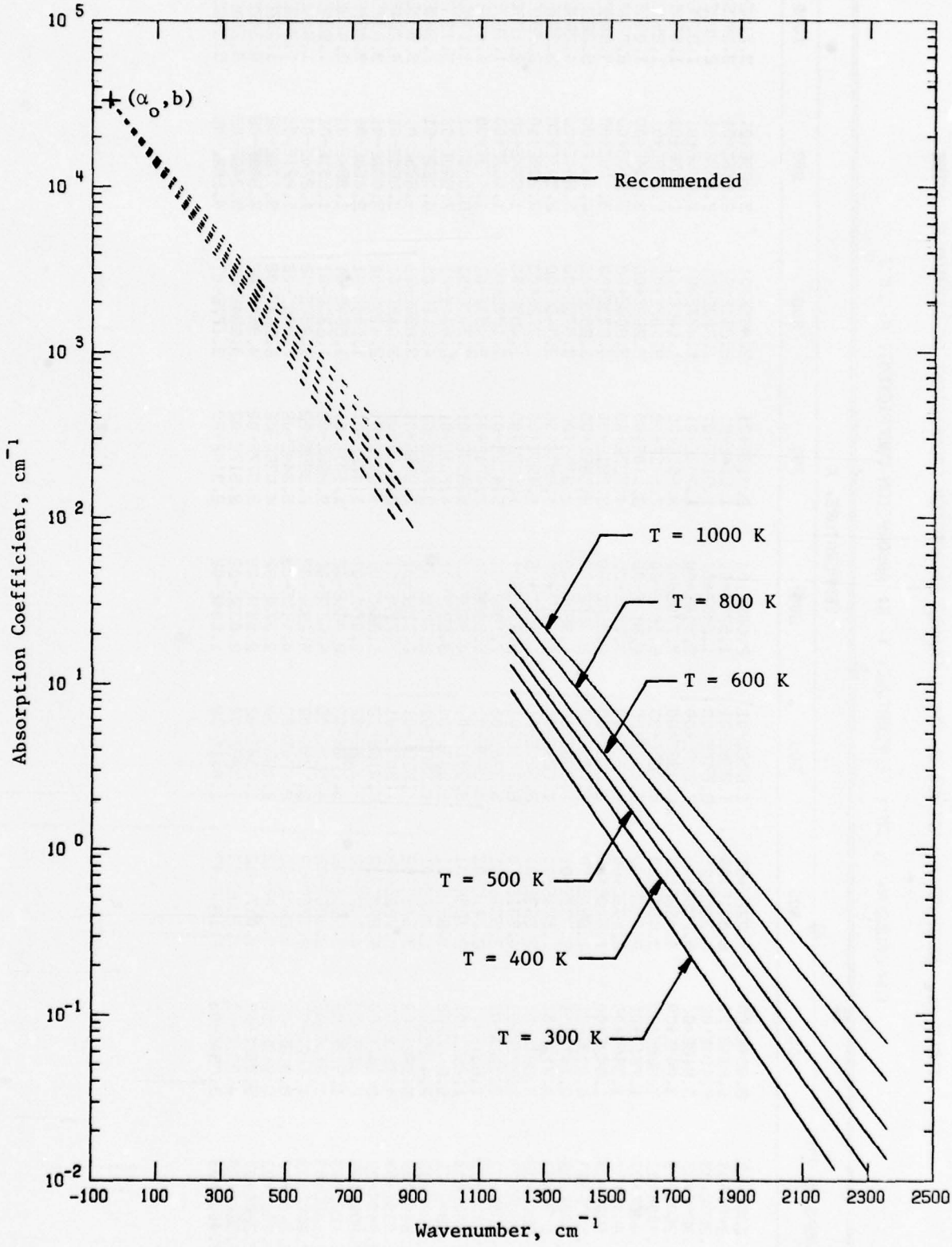

Figure 13. Calculated Absorption Spectra of Lithium Fluoride

TABLE 21. RECOMMENDED VALUES ON THE INFRARED ABSORPTION COEFFICIENT OF LITHIUM FLUORIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

WAVENUMBER, CM^{-1}	TEMPERATURE, K							
	300	400	500	600	700	800	900	1000
1.200E+03	8.664E+00	1.227E+01	1.606E+01	2.002E+01	2.413E+01	2.835E+01	3.269E+01	3.713E+01
1.240E+03	6.650E+00	9.521E+00	1.258E+01	1.579E+01	1.914E+01	2.261E+01	2.618E+01	2.986E+01
1.280E+03	5.104E+00	7.390E+00	9.847E+00	1.245E+01	1.518E+01	1.802E+01	2.097E+01	2.402E+01
1.320E+03	3.918E+00	5.736E+00	7.709E+00	9.816E+00	1.204E+01	1.437E+01	1.680E+01	1.932E+01
1.360E+03	3.007E+00	4.452E+00	6.036E+00	7.740E+00	9.551E+00	1.146E+01	1.346E+01	1.554E+01
1.400E+03	2.308E+00	3.455E+00	4.725E+00	6.103E+00	7.576E+00	9.137E+00	1.078E+01	1.250E+01
1.440E+03	1.771E+00	2.682E+00	3.700E+00	4.812E+00	6.010E+00	7.286E+00	8.634E+00	1.005E+01
1.480E+03	1.360E+00	2.082E+00	2.897E+00	3.794E+00	4.767E+00	5.809E+00	6.916E+00	8.084E+00
1.520E+03	1.043E+00	1.616E+00	2.268E+00	2.992E+00	3.781E+00	4.632E+00	5.540E+00	6.502E+00
1.560E+03	8.009E-01	1.254E+00	1.775E+00	2.359E+00	2.999E+00	3.693E+00	4.437E+00	5.229E+00
1.600E+03	6.147E-01	9.733E-01	1.390E+00	1.860E+00	2.379E+00	2.945E+00	3.554E+00	4.206E+00
1.640E+03	4.718E-01	7.554E-01	1.088E+00	1.467E+00	1.887E+00	2.348E+00	2.847E+00	3.383E+00
1.680E+03	3.621E-01	5.863E-01	8.520E-01	1.156E+00	1.497E+00	1.872E+00	2.280E+00	2.721E+00
1.720E+03	2.779E-01	4.551E-01	6.671E-01	9.117E-01	1.187E+00	1.493E+00	1.827E+00	2.188E+00
1.760E+03	2.133E-01	3.532E-01	5.223E-01	7.189E-01	9.419E-01	1.190E+00	1.463E+00	1.760E+00
1.800E+03	1.637E-01	2.741E-01	4.089E-01	5.668E-01	7.471E-01	9.490E-01	1.172E+00	1.415E+00
1.840E+03	1.257E-01	2.128E-01	3.201E-01	4.469E-01	5.926E-01	7.567E-01	9.388E-01	1.138E+00
1.880E+03	9.646E-02	1.651E-01	2.506E-01	3.524E-01	4.701E-01	6.034E-01	7.520E-01	9.157E-01
1.920E+03	7.403E-02	1.282E-01	1.962E-01	2.779E-01	3.729E-01	4.811E-01	6.023E-01	7.365E-01
1.960E+03	5.682E-02	9.949E-02	1.536E-01	2.191E-01	2.958E-01	3.836E-01	4.825E-01	5.923E-01
2.000E+03	4.361E-02	7.722E-02	1.203E-01	1.727E-01	2.346E-01	3.059E-01	3.865E-01	4.764E-01
2.040E+03	3.347E-02	5.993E-02	9.416E-02	1.362E-01	1.861E-01	2.439E-01	3.096E-01	3.832E-01
2.080E+03	2.569E-02	4.652E-02	7.372E-02	1.074E-01	1.476E-01	1.945E-01	2.480E-01	3.082E-01
2.120E+03	1.972E-02	3.610E-02	5.772E-02	8.468E-02	1.171E-01	1.550E-01	1.986E-01	2.479E-01
2.160E+03	1.513E-02	2.802E-02	4.519E-02	6.677E-02	9.288E-02	1.236E-01	1.591E-01	1.994E-01
2.200E+03	1.162E-02	2.175E-02	3.538E-02	5.265E-02	7.368E-02	9.857E-02	1.274E-01	1.603E-01
2.240E+03	8.916E-03	1.688E-02	2.770E-02	4.151E-02	5.844E-02	7.860E-02	1.021E-01	1.290E-01
2.280E+03	6.843E-03	1.310E-02	2.169E-02	3.273E-02	4.636E-02	6.267E-02	8.176E-02	1.037E-01
2.320E+03	5.252E-03	1.017E-02	1.698E-02	2.581E-02	3.677E-02	4.997E-02	6.549E-02	8.342E-02
2.360E+03	4.031E-03	7.893E-03	1.329E-02	2.035E-02	2.917E-02	3.984E-02	5.246E-02	6.710E-02
2.400E+03	3.094E-03	6.126E-03	1.041E-02	1.604E-02	2.314E-02	3.177E-02	4.202E-02	5.396E-02

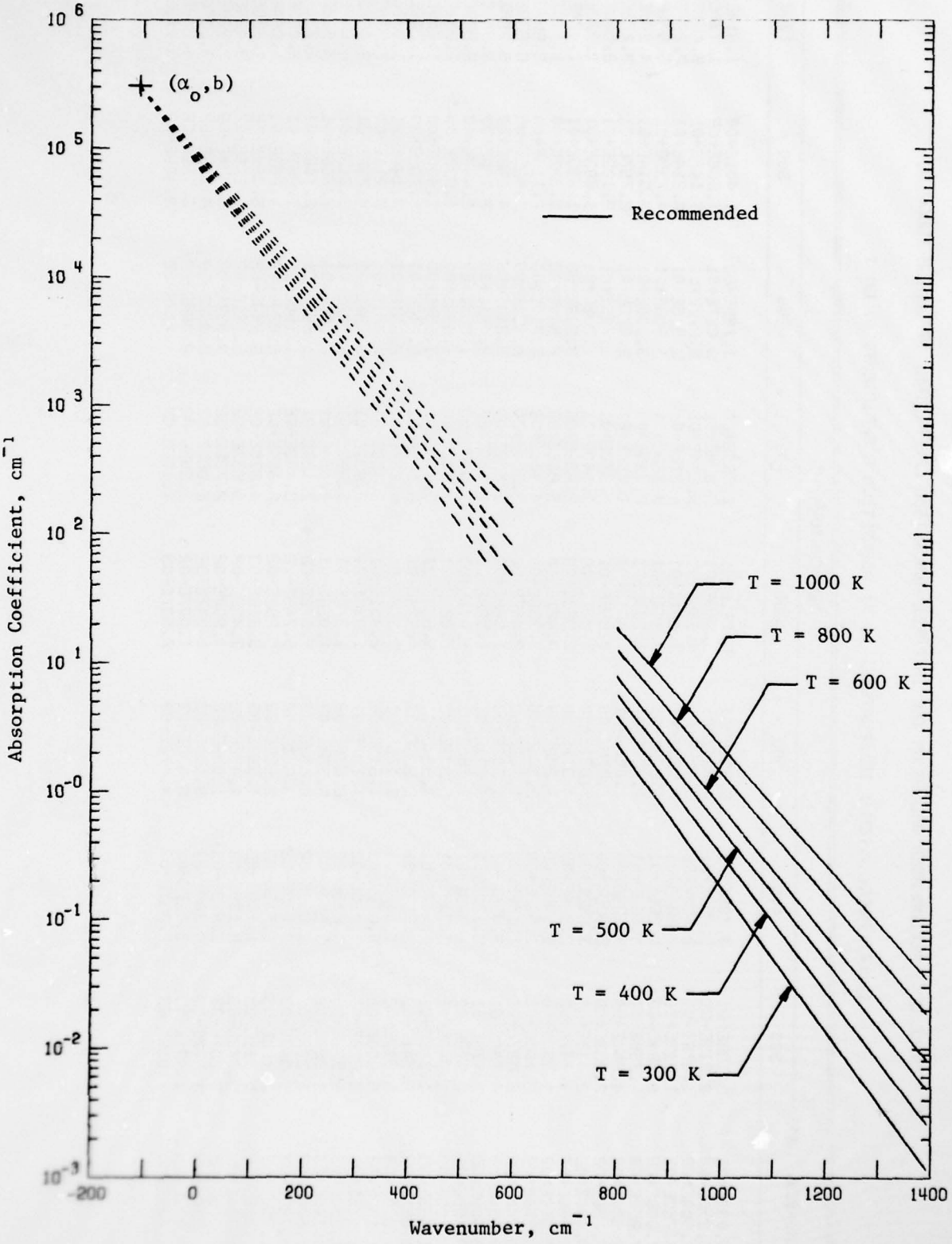

Figure 14. Calculated Absorption Spectra of Sodium Fluoride

TABLE 22. RECOMMENDED VALUES ON THE INFRARED ABSORPTION COEFFICIENT OF SODIUM FLUORIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

WAVENUMBER, CM^{-1}	TEMPERATURE, K							
	300	400	500	600	700	800	900	1000
6.000E+02	3.198E+01	4.708E+01	6.355E+01	8.120E+01	9.990E+01	1.195E+02	1.401E+02	1.614E+02
6.250E+02	2.315E+01	3.455E+01	4.714E+01	6.075E+01	7.529E+01	9.067E+01	1.068E+02	1.237E+02
6.500E+02	1.676E+01	2.536E+01	3.496E+01	4.545E+01	5.674E+01	6.877E+01	8.147E+01	9.481E+01
6.750E+02	1.213E+01	1.861E+01	2.593E+01	3.401E+01	4.276E+01	5.215E+01	6.214E+01	7.267E+01
7.000E+02	8.784E+00	1.366E+01	1.923E+01	2.544E+01	3.223E+01	3.956E+01	4.739E+01	5.570E+01
7.250E+02	6.359E+00	1.002E+01	1.427E+01	1.903E+01	2.429E+01	3.000E+01	3.614E+01	4.270E+01
7.500E+02	4.604E+00	7.356E+00	1.058E+01	1.424E+01	1.831E+01	2.275E+01	2.757E+01	3.273E+01
7.750E+02	3.333E+00	5.399E+00	7.848E+00	1.065E+01	1.380E+01	1.726E+01	2.102E+01	2.509E+01
8.000E+02	2.413E+00	3.962E+00	5.821E+00	7.971E+00	1.040E+01	1.309E+01	1.603E+01	1.923E+01
8.250E+02	1.747E+00	2.908E+00	4.317E+00	5.963E+00	7.836E+00	9.926E+00	1.223E+01	1.474E+01
8.500E+02	1.265E+00	2.134E+00	3.202E+00	4.461E+00	5.905E+00	7.529E+00	9.327E+00	1.130E+01
8.750E+02	9.155E-01	1.566E+00	2.375E+00	3.338E+00	4.450E+00	5.710E+00	7.114E+00	8.659E+00
9.000E+02	6.627E-01	1.149E+00	1.762E+00	2.497E+00	3.354E+00	4.331E+00	5.425E+00	6.638E+00
9.250E+02	4.798E-01	8.435E-01	1.307E+00	1.868E+00	2.528E+00	3.284E+00	4.138E+00	5.088E+00
9.500E+02	3.473E-01	6.190E-01	9.691E-01	1.398E+00	1.905E+00	2.491E+00	3.156E+00	3.900E+00
9.750E+02	2.515E-01	4.543E-01	7.188E-01	1.046E+00	1.436E+00	1.889E+00	2.407E+00	2.989E+00
1.000E+03	1.820E-01	3.334E-01	5.331E-01	7.823E-01	1.082E+00	1.433E+00	1.836E+00	2.291E+00
1.025E+03	1.318E-01	2.447E-01	3.954E-01	5.853E-01	8.154E-01	1.087E+00	1.400E+00	1.756E+00
1.050E+03	9.541E-02	1.796E-01	2.933E-01	4.379E-01	6.145E-01	8.242E-01	1.068E+00	1.346E+00
1.075E+03	6.907E-02	1.318E-01	2.175E-01	3.276E-01	4.631E-01	6.251E-01	8.144E-01	1.032E+00
1.100E+03	5.000E-02	9.672E-02	1.613E-01	2.451E-01	3.490E-01	4.741E-01	6.211E-01	7.909E-01
1.125E+03	3.620E-02	7.098E-02	1.197E-01	1.834E-01	2.631E-01	3.596E-01	4.737E-01	6.062E-01
1.150E+03	2.621E-02	5.209E-02	8.876E-02	1.372E-01	1.983E-01	2.727E-01	3.613E-01	4.647E-01
1.175E+03	1.897E-02	3.823E-02	6.584E-02	1.026E-01	1.494E-01	2.068E-01	2.756E-01	3.562E-01
1.200E+03	1.373E-02	2.806E-02	4.883E-02	7.679E-02	1.126E-01	1.569E-01	2.102E-01	2.730E-01
1.225E+03	9.943E-03	2.059E-02	3.622E-02	5.745E-02	8.486E-02	1.190E-01	1.603E-01	2.093E-01
1.250E+03	7.198E-03	1.511E-02	2.686E-02	4.298E-02	6.396E-02	9.024E-02	1.223E-01	1.604E-01
1.275E+03	5.211E-03	1.109E-02	1.992E-02	3.216E-02	4.820E-02	6.844E-02	9.324E-02	1.230E-01
1.300E+03	3.773E-03	8.139E-03	1.478E-02	2.406E-02	3.633E-02	5.191E-02	7.111E-02	9.424E-02
1.325E+03	2.731E-03	5.973E-03	1.096E-02	1.800E-02	2.738E-02	3.937E-02	5.424E-02	7.224E-02
1.350E+03	1.977E-03	4.384E-03	8.130E-03	1.347E-02	2.063E-02	2.986E-02	4.136E-02	5.537E-02
1.375E+03	1.431E-03	3.217E-03	6.030E-03	1.007E-02	1.555E-02	2.264E-02	3.155E-02	4.244E-02
1.400E+03	1.036E-03	2.361E-03	4.472E-03	7.537E-03	1.172E-02	1.717E-02	2.406E-02	3.253E-02

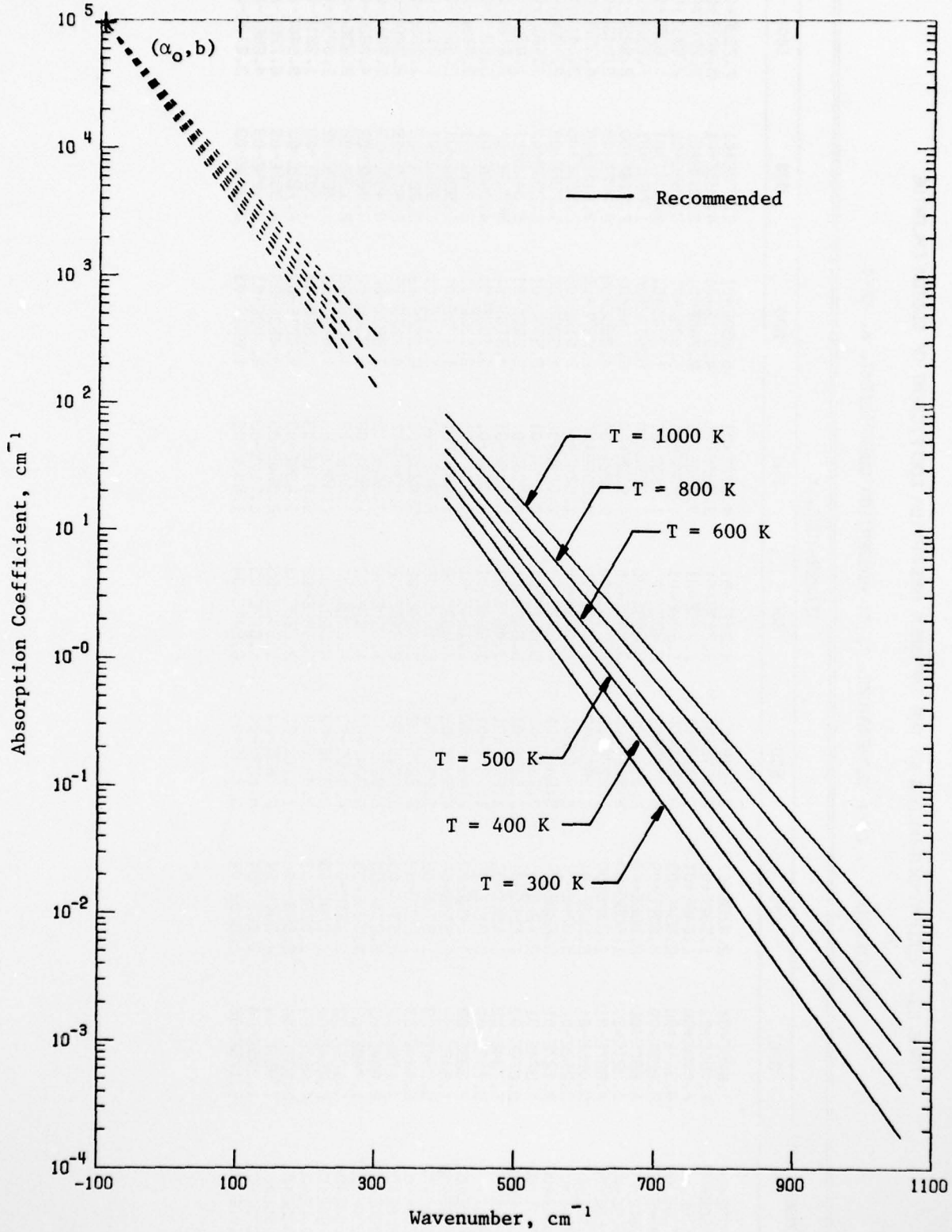

Figure 15. Calculated Absorption Spectra of Sodium Chloride

TABLE 23. RECOMMENDED VALUES ON THE INFRARED ABSORPTION COEFFICIENT OF SODIUM CHLORIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

WAVENUMBER, CM^{-1}	TEMPERATURE, K							
	300	400	500	600	700	800	900	1000
4.000E+02	1.679E+01	2.419E+01	3.211E+01	4.047E+01	4.921E+01	5.830E+01	6.770E+01	7.739E+01
4.250E+02	1.085E+01	1.592E+01	2.143E+01	2.733E+01	3.357E+01	4.011E+01	4.693E+01	5.401E+01
4.500E+02	7.008E+00	1.048E+01	1.431E+01	1.846E+01	2.290E+01	2.760E+01	3.253E+01	3.770E+01
4.750E+02	4.527E+00	6.894E+00	9.552E+00	1.247E+01	1.562E+01	1.899E+01	2.255E+01	2.631E+01
5.000E+02	2.925E+00	4.537E+00	6.377E+00	8.422E+00	1.066E+01	1.306E+01	1.564E+01	1.836E+01
5.250E+02	1.890E+00	2.986E+00	4.257E+00	5.689E+00	7.269E+00	8.988E+00	1.084E+01	1.282E+01
5.500E+02	1.221E+00	1.965E+00	2.842E+00	3.842E+00	4.958E+00	6.184E+00	7.514E+00	8.945E+00
5.750E+02	7.887E-01	1.293E+00	1.897E+00	2.595E+00	3.382E+00	4.255E+00	5.209E+00	6.243E+00
6.000E+02	5.095E-01	8.509E-01	1.267E+00	1.753E+00	2.307E+00	2.927E+00	3.611E+00	4.357E+00
6.250E+02	3.292E-01	5.600E-01	8.455E-01	1.184E+00	1.574E+00	2.014E+00	2.503E+00	3.041E+00
6.500E+02	2.127E-01	3.685E-01	5.644E-01	7.997E-01	1.074E+00	1.386E+00	1.735E+00	2.122E+00
6.750E+02	1.374E-01	2.425E-01	3.768E-01	5.401E-01	7.323E-01	9.533E-01	1.203E+00	1.481E+00
7.000E+02	8.876E-02	1.596E-01	2.515E-01	3.648E-01	4.996E-01	6.559E-01	8.340E-01	1.034E+00
7.250E+02	5.734E-02	1.050E-01	1.679E-01	2.464E-01	3.408E-01	4.513E-01	5.782E-01	7.216E-01
7.500E+02	3.705E-02	6.911E-02	1.121E-01	1.664E-01	2.325E-01	3.105E-01	4.008E-01	5.036E-01
7.750E+02	2.393E-02	4.548E-02	7.484E-02	1.124E-01	1.586E-01	2.136E-01	2.778E-01	3.515E-01
8.000E+02	1.546E-02	2.993E-02	4.996E-02	7.593E-02	1.082E-01	1.470E-01	1.926E-01	2.453E-01
8.250E+02	9.990E-03	1.970E-02	3.335E-02	5.129E-02	7.379E-02	1.011E-01	1.335E-01	1.712E-01
8.500E+02	6.454E-03	1.296E-02	2.227E-02	3.464E-02	5.033E-02	6.957E-02	9.257E-02	1.195E-01
8.750E+02	4.170E-03	8.531E-03	1.486E-02	2.340E-02	3.434E-02	4.787E-02	6.417E-02	8.340E-02
9.000E+02	2.694E-03	5.614E-03	9.923E-03	1.580E-02	2.342E-02	3.293E-02	4.448E-02	5.821E-02
9.250E+02	1.740E-03	3.694E-03	6.624E-03	1.067E-02	1.598E-02	2.266E-02	3.084E-02	4.063E-02
9.500E+02	1.124E-03	2.431E-03	4.422E-03	7.209E-03	1.090E-02	1.559E-02	2.138E-02	2.836E-02
9.750E+02	7.264E-04	1.600E-03	2.952E-03	4.869E-03	7.435E-03	1.073E-02	1.482E-02	1.979E-02
1.000E+03	4.693E-04	1.053E-03	1.971E-03	3.289E-03	5.071E-03	7.380E-03	1.027E-02	1.381E-02
1.025E+03	3.032E-04	6.929E-04	1.316E-03	2.222E-03	3.459E-03	5.077E-03	7.122E-03	9.640E-03
1.050E+03	1.959E-04	4.560E-04	8.783E-04	1.500E-03	2.360E-03	3.493E-03	4.937E-03	6.728E-03
1.075E+03	1.265E-04	3.001E-04	5.863E-04	1.013E-03	1.610E-03	2.403E-03	3.423E-03	4.696E-03
1.100E+03	8.175E-05	1.975E-04	3.914E-04	6.845E-04	1.098E-03	1.654E-03	2.373E-03	3.278E-03

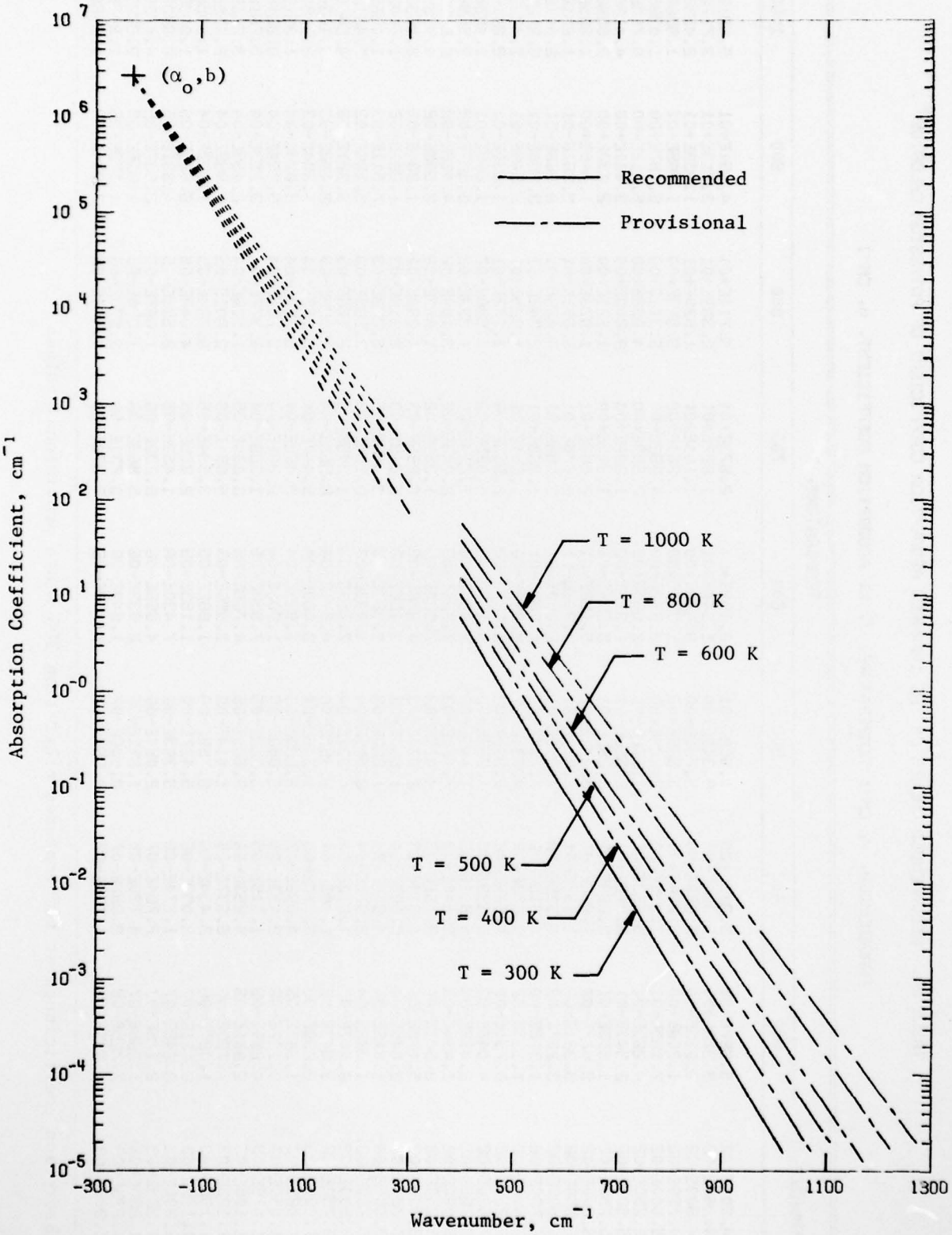

Figure 16. Calculated Absorption Spectra of Potassium Chloride

TABLE 24. RECOMMENDED VALUES ON THE INFRARED ABSORPTION COEFFICIENT OF POTASSIUM CHLORIDE*

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

WAVENUMBER, CM^{-1}	TEMPERATURE, K							
	300	400	500	600	700	800	900	1000
4.000E+02	5.667E+00	9.835E+00	1.508E+01	2.139E+01	2.873E+01	3.711E+01	4.651E+01	5.691E+01
4.250E+02	3.378E+00	5.991E+00	9.345E+00	1.344E+01	1.827E+01	2.383E+01	3.013E+01	3.717E+01
4.500E+02	2.013E+00	3.650E+00	5.790E+00	8.442E+00	1.161E+01	1.530E+01	1.953E+01	2.428E+01
4.750E+02	1.200E+00	2.224E+00	3.588E+00	5.304E+00	7.381E+00	9.828E+00	1.265E+01	1.586E+01
5.000E+02	7.153E-01	1.355E+00	2.223E+00	3.332E+00	4.692E+00	6.311E+00	8.197E+00	1.036E+01
5.250E+02	4.263E-01	8.253E-01	1.378E+00	2.094E+00	2.983E+00	4.053E+00	5.311E+00	6.765E+00
5.500E+02	2.541E-01	5.028E-01	8.536E-01	1.315E+00	1.896E+00	2.603E+00	3.441E+00	4.418E+00
5.750E+02	1.515E-01	3.063E-01	5.289E-01	8.264E-01	1.205E+00	1.671E+00	2.230E+00	2.886E+00
6.000E+02	9.027E-02	1.866E-01	3.277E-01	5.192E-01	7.662E-01	1.073E+00	1.445E+00	1.885E+00
6.250E+02	5.381E-02	1.137E-01	2.031E-01	3.262E-01	4.870E-01	6.892E-01	9.361E-01	1.231E+00
6.500E+02	3.207E-02	6.925E-02	1.258E-01	2.050E-01	3.096E-01	4.426E-01	6.066E-01	8.041E-01
6.750E+02	1.912E-02	4.219E-02	7.797E-02	1.288E-01	1.968E-01	2.842E-01	3.930E-01	5.252E-01
7.000E+02	1.139E-02	2.570E-02	4.831E-02	8.090E-02	1.251E-01	1.825E-01	2.546E-01	3.430E-01
7.250E+02	6.791E-03	1.566E-02	2.993E-02	5.083E-02	7.953E-02	1.172E-01	1.650E-01	2.241E-01
7.500E+02	4.048E-03	9.539E-03	1.855E-02	3.193E-02	5.055E-02	7.526E-02	1.069E-01	1.463E-01
7.750E+02	2.412E-03	5.811E-03	1.149E-02	2.006E-02	3.214E-02	4.833E-02	6.927E-02	9.558E-02
8.000E+02	1.438E-03	3.540E-03	7.121E-03	1.261E-02	2.043E-02	3.104E-02	4.488E-02	6.243E-02
8.250E+02	8.571E-04	2.157E-03	4.413E-03	7.920E-03	1.299E-02	1.993E-02	2.908E-02	4.078E-02
8.500E+02	5.108E-04	1.314E-03	2.734E-03	4.976E-03	8.255E-03	1.280E-02	1.884E-02	2.663E-02
8.750E+02	3.045E-04	8.005E-04	1.694E-03	3.126E-03	5.248E-03	8.219E-03	1.221E-02	1.740E-02
9.000E+02	1.815E-04	4.877E-04	1.050E-03	1.964E-03	3.336E-03	5.278E-03	7.911E-03	1.136E-02
9.250E+02	1.082E-04	2.971E-04	6.505E-04	1.234E-03	2.120E-03	3.389E-03	5.126E-03	7.421E-03
9.500E+02	6.447E-05	1.810E-04	4.031E-04	7.753E-04	1.348E-03	2.176E-03	3.321E-03	4.847E-03
9.750E+02	3.843E-05	1.103E-04	2.497E-04	4.871E-04	8.569E-04	1.398E-03	2.152E-03	3.166E-03
1.000E+03	2.290E-05	6.717E-05	1.548E-04	3.060E-04	5.447E-04	8.975E-04	1.394E-03	2.068E-03
1.025E+03	1.365E-05	4.092E-05	9.589E-05	1.923E-04	3.463E-04	5.764E-04	9.034E-04	1.351E-03
1.050E+03	8.137E-06	2.493E-05	5.942E-05	1.208E-04	2.201E-04	3.701E-04	5.854E-04	8.821E-04
1.075E+03	4.850E-06	1.519E-05	3.682E-05	7.590E-05	1.399E-04	2.377E-04	3.793E-04	5.761E-04
1.100E+03	2.891E-06	9.253E-06	2.281E-05	4.768E-05	8.894E-05	1.526E-04	2.458E-04	3.763E-04
1.125E+03	1.723E-06	5.637E-06	1.414E-05	2.996E-05	5.654E-05	9.801E-05	1.592E-04	2.458E-04
1.150E+03	1.027E-06	3.434E-06	8.759E-06	1.882E-05	3.594E-05	6.294E-05	1.032E-04	1.605E-04
1.175E+03	6.121E-07	2.092E-06	5.427E-06	1.183E-05	2.285E-05	4.042E-05	6.685E-05	1.049E-04
1.200E+03	3.648E-07	1.274E-06	3.363E-06	7.430E-06	1.452E-05	2.596E-05	4.331E-05	6.848E-05
1.225E+03	2.175E-07	7.764E-07	2.084E-06	4.668E-06	9.232E-06	1.667E-05	2.807E-05	4.473E-05
1.250E+03	1.296E-07	4.730E-07	1.291E-06	2.933E-06	5.869E-06	1.070E-05	1.818E-05	2.922E-05
1.275E+03	7.725E-08	2.882E-07	8.000E-07	1.843E-06	3.731E-06	6.873E-06	1.178E-05	1.908E-05
1.300E+03	4.605E-08	1.756E-07	4.957E-07	1.158E-06	2.372E-06	4.414E-06	7.634E-06	1.246E-05

* Absorption coefficients at temperatures other than 300 K are provisional values.

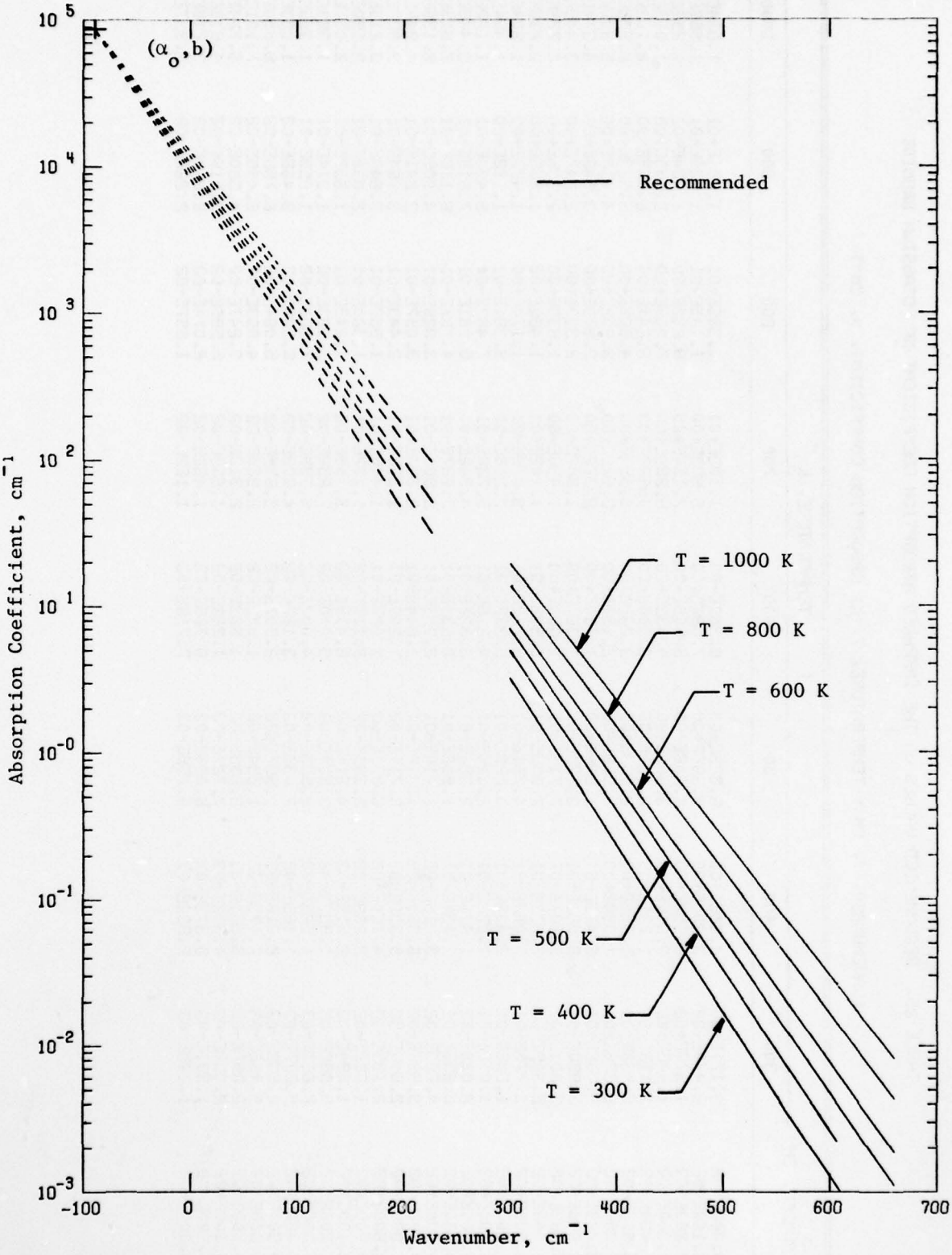

Figure 17. Calculated Absorption Coefficient of Potassium Bromide

TABLE 25. RECOMMENDED VALUES ON THE INFRARED ABSORPTION COEFFICIENT OF POTASSIUM BROMIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

WAVENUMBER, CM^{-1}	TEMPERATURE, K							
	300	400	500	600	700	800	900	1000
3.000E+02	3.171E+00	4.885E+00	6.829E+00	8.980E+00	1.132E+01	1.383E+01	1.651E+01	1.934E+01
3.100E+02	2.440E+00	3.801E+00	5.360E+00	7.097E+00	8.999E+00	1.105E+01	1.325E+01	1.559E+01
3.200E+02	1.878E+00	2.957E+00	4.206E+00	5.609E+00	7.154E+00	8.833E+00	1.064E+01	1.256E+01
3.300E+02	1.445E+00	2.301E+00	3.301E+00	4.433E+00	5.688E+00	7.059E+00	8.540E+00	1.013E+01
3.400E+02	1.112E+00	1.791E+00	2.591E+00	3.504E+00	4.522E+00	5.641E+00	6.855E+00	8.162E+00
3.500E+02	8.558E-01	1.393E+00	2.033E+00	2.769E+00	3.595E+00	4.508E+00	5.503E+00	6.578E+00
3.600E+02	6.586E-01	1.084E+00	1.596E+00	2.188E+00	2.850E+00	3.602E+00	4.418E+00	5.302E+00
3.700E+02	5.068E-01	8.435E-01	1.252E+00	1.730E+00	2.272E+00	2.879E+00	3.546E+00	4.274E+00
3.800E+02	3.900E-01	6.563E-01	9.828E-01	1.367E+00	1.807E+00	2.300E+00	2.847E+00	3.445E+00
3.900E+02	3.001E-01	5.107E-01	7.713E-01	1.080E+00	1.436E+00	1.838E+00	2.285E+00	2.776E+00
4.000E+02	2.309E-01	3.973E-01	6.053E-01	8.538E-01	1.142E+00	1.469E+00	1.835E+00	2.238E+00
4.100E+02	1.777E-01	3.092E-01	4.751E-01	6.748E-01	9.079E-01	1.174E+00	1.473E+00	1.804E+00
4.200E+02	1.368E-01	2.406E-01	3.728E-01	5.333E-01	7.218E-01	9.381E-01	1.182E+00	1.454E+00
4.300E+02	1.052E-01	1.872E-01	2.926E-01	4.215E-01	5.738E-01	7.497E-01	9.490E-01	1.172E+00
4.400E+02	8.098E-02	1.456E-01	2.296E-01	3.331E-01	4.562E-01	5.991E-01	7.618E-01	9.445E-01
4.500E+02	6.232E-02	1.133E-01	1.802E-01	2.633E-01	3.627E-01	4.787E-01	6.116E-01	7.613E-01
4.600E+02	4.795E-02	8.818E-02	1.414E-01	2.081E-01	2.884E-01	3.826E-01	4.909E-01	6.136E-01
4.700E+02	3.690E-02	6.861E-02	1.110E-01	1.644E-01	2.293E-01	3.057E-01	3.941E-01	4.946E-01
4.800E+02	2.840E-02	5.339E-02	8.711E-02	1.300E-01	1.823E-01	2.443E-01	3.164E-01	3.986E-01
4.900E+02	2.185E-02	4.154E-02	6.836E-02	1.027E-01	1.449E-01	1.952E-01	2.540E-01	3.213E-01
5.000E+02	1.682E-02	3.232E-02	5.365E-02	8.117E-02	1.152E-01	1.560E-01	2.039E-01	2.590E-01
5.100E+02	1.294E-02	2.515E-02	4.211E-02	6.415E-02	9.159E-02	1.247E-01	1.637E-01	2.087E-01
5.200E+02	9.958E-03	1.957E-02	3.304E-02	5.070E-02	7.282E-02	9.963E-02	1.314E-01	1.683E-01
5.300E+02	7.663E-03	1.523E-02	2.593E-02	4.007E-02	5.789E-02	7.962E-02	1.055E-01	1.356E-01
5.400E+02	5.897E-03	1.185E-02	2.035E-02	3.167E-02	4.603E-02	6.363E-02	8.466E-02	1.093E-01
5.500E+02	4.538E-03	9.218E-03	1.597E-02	2.503E-02	3.659E-02	5.084E-02	6.796E-02	8.810E-02
5.600E+02	3.492E-03	7.173E-03	1.254E-02	1.978E-02	2.909E-02	4.063E-02	5.456E-02	7.101E-02
5.700E+02	2.687E-03	5.581E-03	9.838E-03	1.563E-02	2.313E-02	3.247E-02	4.380E-02	5.724E-02
5.800E+02	2.068E-03	4.342E-03	7.721E-03	1.236E-02	1.839E-02	2.595E-02	3.516E-02	4.613E-02
5.900E+02	1.591E-03	3.379E-03	6.059E-03	9.765E-03	1.462E-02	2.074E-02	2.822E-02	3.718E-02
6.000E+02	1.225E-03	2.629E-03	4.755E-03	7.718E-03	1.162E-02	1.657E-02	2.266E-02	2.997E-02

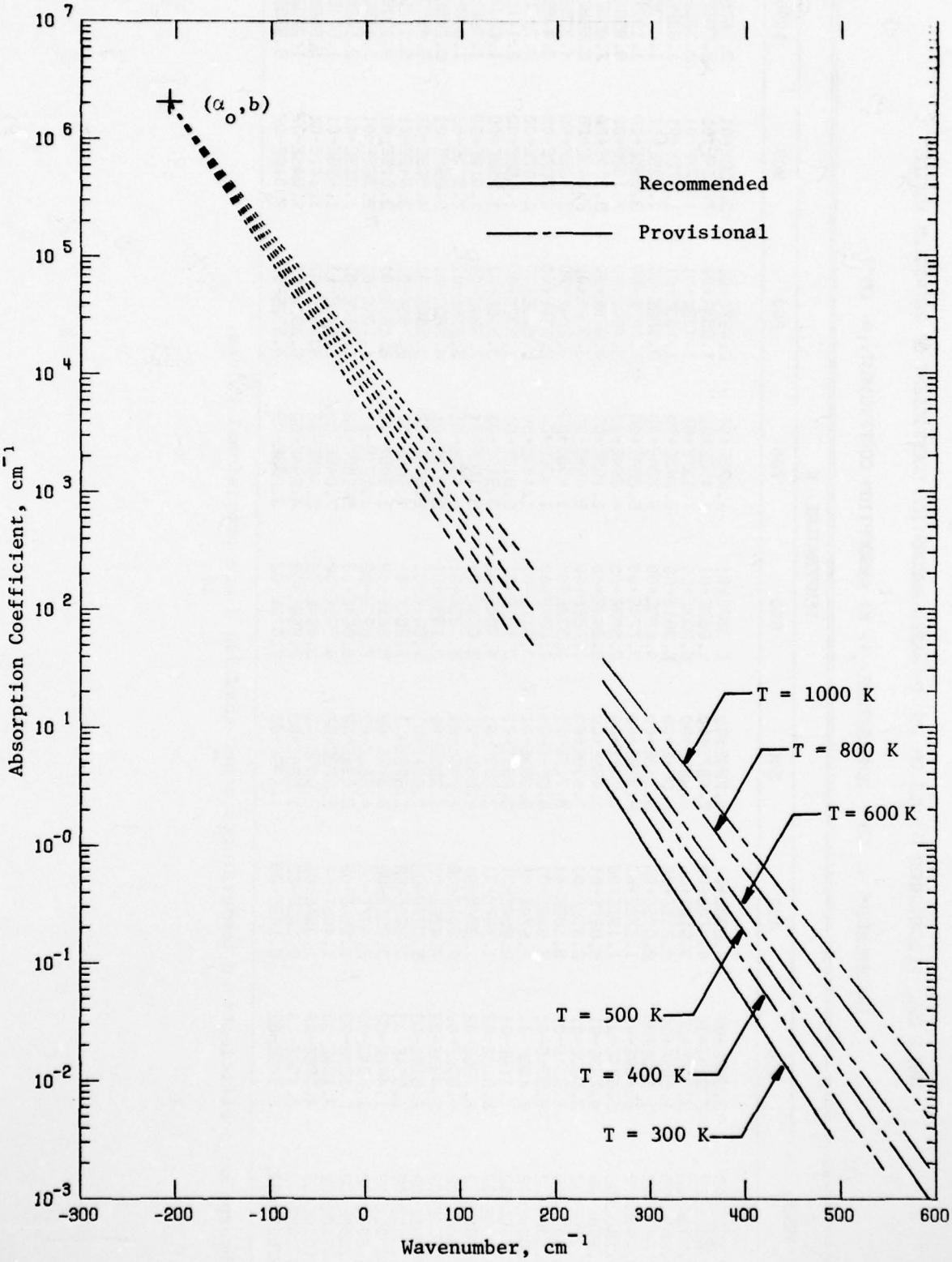

Figure 18. Calculated Absorption Spectra of Potassium Iodide

TABLE 26. RECOMMENDED VALUES ON THE INFRARED ABSORPTION COEFFICIENT OF POTASSIUM IODIDE*

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

WAVENUMBER, CM^{-1}	TEMPERATURE, K							
	300	400	500	600	700	800	900	1000
2.500E+02	3.598E+00	6.298E+00	9.724E+00	1.387E+01	1.872E+01	2.427E+01	3.052E+01	3.747E+01
2.600E+02	2.693E+00	4.772E+00	7.437E+00	1.069E+01	1.452E+01	1.894E+01	2.394E+01	2.952E+01
2.700E+02	2.016E+00	3.615E+00	5.689E+00	8.239E+00	1.127E+01	1.478E+01	1.877E+01	2.325E+01
2.800E+02	1.509E+00	2.739E+00	4.351E+00	6.351E+00	8.743E+00	1.153E+01	1.472E+01	1.832E+01
2.900E+02	1.129E+00	2.075E+00	3.328E+00	4.895E+00	6.784E+00	8.999E+00	1.155E+01	1.443E+01
3.000E+02	8.450E-01	1.572E+00	2.546E+00	3.774E+00	5.264E+00	7.022E+00	9.055E+00	1.137E+01
3.100E+02	6.324E-01	1.191E+00	1.947E+00	2.909E+00	4.084E+00	5.480E+00	7.102E+00	8.956E+00
3.200E+02	4.733E-01	9.027E-01	1.489E+00	2.242E+00	3.169E+00	4.276E+00	5.570E+00	7.055E+00
3.300E+02	3.543E-01	6.839E-01	1.139E+00	1.728E+00	2.459E+00	3.337E+00	4.368E+00	5.558E+00
3.400E+02	2.651E-01	5.182E-01	8.713E-01	1.332E+00	1.908E+00	2.604E+00	3.426E+00	4.379E+00
3.500E+02	1.984E-01	3.926E-01	6.665E-01	1.027E+00	1.480E+00	2.032E+00	2.687E+00	3.449E+00
3.600E+02	1.485E-01	2.974E-01	5.098E-01	7.917E-01	1.149E+00	1.586E+00	2.107E+00	2.717E+00
3.700E+02	1.112E-01	2.254E-01	3.899E-01	6.102E-01	8.912E-01	1.237E+00	1.652E+00	2.141E+00
3.800E+02	8.319E-02	1.707E-01	2.982E-01	4.704E-01	6.915E-01	9.655E-01	1.296E+00	1.686E+00
3.900E+02	6.226E-02	1.294E-01	2.281E-01	3.626E-01	5.365E-01	7.534E-01	1.016E+00	1.328E+00
4.000E+02	4.660E-02	9.801E-02	1.745E-01	2.795E-01	4.163E-01	5.879E-01	7.971E-01	1.047E+00
4.100E+02	3.488E-02	7.426E-02	1.335E-01	2.155E-01	3.230E-01	4.588E-01	6.251E-01	8.245E-01
4.200E+02	2.610E-02	5.626E-02	1.021E-01	1.661E-01	2.506E-01	3.580E-01	4.903E-01	6.495E-01
4.300E+02	1.954E-02	4.263E-02	7.808E-02	1.280E-01	1.945E-01	2.793E-01	3.845E-01	5.117E-01
4.400E+02	1.462E-02	3.230E-02	5.972E-02	9.869E-02	1.509E-01	2.180E-01	3.015E-01	4.031E-01
4.500E+02	1.094E-02	2.447E-02	4.568E-02	7.607E-02	1.171E-01	1.701E-01	2.365E-01	3.175E-01
4.600E+02	8.190E-03	1.854E-02	3.494E-02	5.864E-02	9.085E-02	1.327E-01	1.855E-01	2.502E-01
4.700E+02	6.130E-03	1.405E-02	2.672E-02	4.520E-02	7.049E-02	1.036E-01	1.455E-01	1.971E-01
4.800E+02	4.588E-03	1.064E-02	2.044E-02	3.484E-02	5.469E-02	8.083E-02	1.141E-01	1.552E-01
4.900E+02	3.434E-03	8.063E-03	1.564E-02	2.686E-02	4.244E-02	6.307E-02	8.946E-02	1.223E-01
5.000E+02	2.570E-03	6.109E-03	1.196E-02	2.070E-02	3.293E-02	4.922E-02	7.016E-02	9.635E-02

* Absorption coefficients at temperatures other than 300 K are provisional values.

5. SUMMARY OF RESULTS AND RECOMMENDATIONS

The purpose of the present work is to survey and compile the available data on the absorption coefficient of alkali halides and to generate recommended values on the absorption coefficient in the infrared region through data evaluation and analysis.

Results of this investigation are reported in two separate reports, Part I and Part II. The first report (Part I) contains essentially the current status of available data. Material was comprehensively compiled and displayed so that one can see at a glance the distribution of the available data with respect to frequency and temperature. The second report (Part II) is devoted to the analysis of data and the generation of recommended values of absorption coefficients. In addition, theories currently available are briefly reviewed to enable the reader to grasp the essence of the theoretical aspects in dealing with the absorption phenomena.

Available data can be classified into three categories: those in the Urbach tail region, the high transparent region, and the multiphonon absorption region. The Urbach tail is located in the uv absorption edge of the transparent region. The Urbach rule appears to be valid in this region. Measurements of absorption coefficients as a function of frequency at various temperatures enable the formulation of the expressions for the Urbach rule, eq. (1). These equations are useful in predicting the intrinsic absorption coefficients for alkali halides. Comparing the predicted results with the experimental data in the tail region, the extent of impurity and/or defect in the samples is revealed. It is not known how far the Urbach rule can be extrapolated into the transparent region. Experimental data on ultrapure samples are required to ascertain this, however, the existing data are less than adequate to provide such evidence.

The absorption coefficient in the high transparency region is low in general. Factors that contribute to absorption are sometimes uncontrolable or inevitable. Predominant ones are impurities, defects, and surface contamination. The effects of these factors are reflected in the absorption spectrum by the existence of color centers and high absorption coefficients as discussed in Part I.

Low absorption coefficients at laser wavelengths are of particular interest in laser applications. Unfortunately laser wavelengths are located near the

multiphonon absorption region. Factors that introduce extrinsic absorptions into this region will therefore increase the absorption at laser wavelengths. For this reason, while numerous investigations were conducted in this region, the results are still less than satisfactory, particularly in the theoretical understanding of the temperature dependence of the absorption coefficient.

Based on the considerations given above, the present work is naturally focused in the multiphonon absorption region. We have developed an equation that describes the absorption coefficient as a function of both frequency and temperature. In contrast with the Urbach rule for the uv absorption edge, we have established an expression for the infrared absorption edge. These expressions are of the same form and the parameters in the corresponding equations are similar. Compared with Deutsch's expression, we have extended the dependence of the absorption coefficient to include the temperature in addition to frequency.

Unless one is satisfied with the meager available data having uncertainties of 10% or more, serious consideration should be given to conducting improved measurements. A systematic measurement program on the absorption coefficient should be carried out keeping in mind the following considerations:

1. Experimental method: Needless to say, surface absorption is objectionable in the determination of bulk absorption coefficient. Particularly at low bulk absorption, surface absorption may predominate. As in most cases, the surface absorption is persistent even though the sample is laboriously and carefully polished and treated. In order to reduce or minimize the interference of surface absorption, measurements should be made on long specimens, so that the contribution from the surface is negligible. This can be done since the absorption per unit surface is usually low and there are only two surfaces to be considered for each specimen. Long specimens should be exclusively used whether the method is a laser calorimetry or a simple transmission.

2. Sample characterization: As the impurity content of the sample strongly affects the results, the impurities in the sample should be ascertained and reported. Merely characterizing the sample as "ultrapure" or "high purity" is not adequate. The nature and amount of impurities should specifically be reported. In order to see the effects of impurities on the results, measurement should be carried out on a series of specimens with systematically controlled impurities.

3. Environmental conditions: Among the controlling parameters for absorption measurement, temperature appears to play the key role in the accuracy of the results. As the radiation travels through the sample, it looses its power along the way through the absorption process in the sample. The lost radiation energy is then transformed into thermal energy within the sample. As a result, the local temperature may be considerably higher than that obtained from the thermocouple devices. It is therefore strongly recommended that a pulsed radiation source be used to minimize such errors.

4. Broad wavelength coverage: Some materials have relatively high intrinsic absorption at certain wavelengths. However, it has been made clear by the advances of laser technology that laser wavelengths are no longer limited to the 2-6 μm or to 10.6 μm. New developments have shown that laser action can be produced at other wavelengths in the near infrared, visible, near ultraviolet, and ultraviolet regions. There is little doubt that thorough investigation on the absorption coefficient in accessible wavelength regions should be made.

In conclusion, it should be emphasized that the present work does not resolve the discrepancies between the available data sets, it simply establishes the most probable values of the absorption coefficient that a pure crystal alkali halide may have with the quoted uncertainties. Also, it should be remembered that, as in any statistical study of this type, eq. (21) is valid only to the reported accuracy and within the region of experimental data it is based on. In general, extrapolation of the equation for use outside of this region is invalid for quantitative results. Finally, the type of analysis presented here assumes the model is an absolutely correct representation of the data at hand, which is not generally true since the model is an oversimplification of the true behavior of matter. However, for predictive purposes, based upon the experimental data from several sources, and within the usable region of the data, we believe that eq. (21) is valid for calculation of the absorption coefficient in the given wavelength and temperature regions. It is important to point out that the rule established in the present work is for the temperature region where $T \geq 300$ K.

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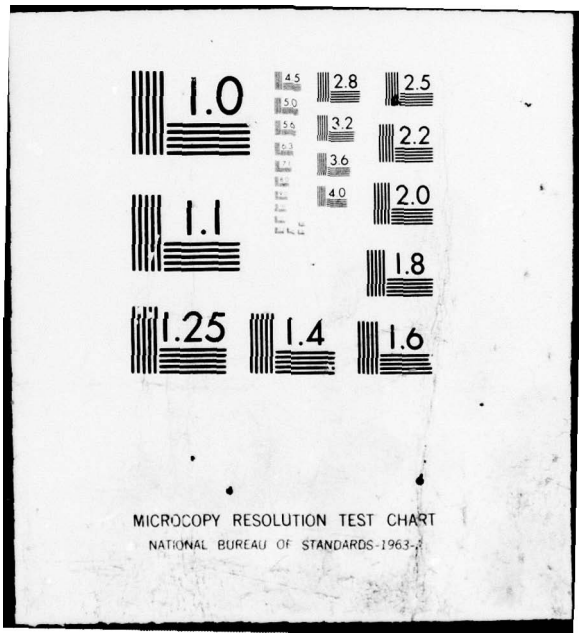
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APPENDICES

Materials covered in Part I of the report are for LiF, NaF, NaCl, KCl, KBr, KI and CsI. However, data compilation for the other members of alkali halide group was also conducted during the course of this work. In order to provide the reader a complete source of references, available data on these materials are given in the Appendices. Presented in Appendices A, B and C are, respectively, the data on the absorption coefficient, transmission and reflectivity. Data are not necessarily available for every member of the family nor adequate for data evaluation and analysis. As a consequence, only raw experimental data are reported in the form of tables. These tables are of the same format as those of Tables 3 to 20, and are designated by the prefix letters A, B and C in the corresponding Appendices.

APPENDIX A

TABLE A1. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF LITHIUM IODIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	52	HASHIMOTO, S., KANZAKI, H.	1974	T	4.0E+4-4.7E+4	4.2	SINGLE CRYSTAL; ZONE REFINED; CLEAVED SPECIMENS OF ABOUT 2 MM THICK; AS THE MATERIAL IS EXTREMELY DELIQUESCENCE THE ABSORPTION MEASUREMENTS WERE CARRIED OUT WITH THE SPECIMENS IMMERSED IN LIQUID HELIUM TO AVOID SURFACE DETERIORATION; ABSORPTION COEFFICIENT EXTRACTED FROM A FIGURE.

TABLE A2. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF LITHIUM IODIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α
DATA SET 1	
T = 4.2	
4.702E+4	1.454E+1
4.669E+4	1.176E+1
4.629E+4	9.710E+0
4.573E+4	7.670E+0
4.540E+4	6.690E+0
4.508E+4	6.100E+0
4.476E+4	5.500E+0
4.435E+4	5.030E+0
4.363E+4	4.350E+0
4.242E+4	3.590E+0
4.032E+4	2.500E+0

TABLE A3. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF SODIUM BROMIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	53	BAUER, G.	1934	T	5.0E+4-5.4E+4	293	CRYSTAL: THIN FILM SPECIMENS OF VARIOUS THICKNESSES; ABSORPTION COEFFICIENTS OF BULK CRYSTAL DEDUCED FROM TRANSMITTANCE AND SPECIMEN THICKNESS MEASUREMENTS; DATA EXTRACTED FROM A TABLE.
2	8	TOMIKI, T. MIYATA, T. TSUKAMOTO, H.	1974	R	5.3E+4-5.5E+4	27	SINGLE CRYSTAL: OBTAINED FROM HARSHAW CHEMICAL CO.: ABSORPTION COEFFICIENT DEDUCED FROM REFLECTION SPECTRUM; DATA EXTRACTED FROM A FIGURE.

TABLE A4. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF SODIUM BROMIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α
DATA SET 1	
T = 293.0	
5.382E+4	3.710E+5
5.277E+4	7.570E+5
5.260E+4	7.000E+5
5.226E+4	9.740E+5
5.165E+4	4.460E+5
5.123E+4	1.910E+5
5.028E+4	3.400E+4
DATA SET 2	
T = 27.0	
5.440E+4	1.445E+6
5.436E+4	1.656E+6
5.434E+4	1.919E+6
5.431E+4	2.239E+6
5.427E+4	2.710E+6
5.425E+4	3.342E+6
5.422E+4	4.018E+6
5.419E+4	4.613E+6
5.415E+4	4.667E+6
5.413E+4	3.524E+6
5.410E+4	1.910E+6
5.407E+4	8.318E+5
5.404E+4	4.955E+5
5.402E+4	3.606E+5
5.398E+4	2.606E+5
5.393E+4	1.125E+5

TABLE A5. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF SODIUM IODIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	8	TOMIKI, T. MIYATA, T. TSUKAMOTO, H.	1973	R	4.5E+4-4.6E+4	26	SINGLE CRYSTAL; OBTAINED FROM HARSHAW CHEMICAL CO.; ABSORPTION COEFFICIENTS DEDUCED FROM REFLECTION MEASUREMENTS; DATA EXTRACTED FROM A FIGURE.
2	27	HARRINGTON, J.A., DUTHLER, C.J., PATTEN, F.W. HASS, M.	1976	C	2.7E+2-5.8E+2	300	SINGLE CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; MEASUREMENTS MADE AT UNIVERSITY OF ALABAMA IN HUNTSVILLE; EXPERIMENTAL DETAILS NOT GIVEN; DATA EXTRACTED FROM A FIGURE.
3	27	HARRINGTON, J.A., ET AL.	1976	C	2.9E+2-5.0E+2	300	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT NAVAL RESEARCH LABORATORY.
4	27	HARRINGTON, J.A., ET AL.	1976	C	2.9E+2-4.3E+2	80	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT UNIVERSITY OF ALABAMA IN HUNTSVILLE.
5	27	HARRINGTON, J.A., ET AL.	1976	C	2.8E+2-5.0E+2	80	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT NAVAL RESEARCH LABORATORY.

TABLE A6. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF SODIUM IODIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α
DATA SET 1	
T = 26.0	
4.555E+4	8.492E+5
4.553E+4	8.630E+5
4.551E+4	9.931E+5
4.549E+4	1.146E+6
4.547E+4	1.297E+6
4.545E+4	1.563E+6
4.543E+4	1.841E+6
4.541E+4	2.153E+6
4.539E+4	2.477E+6
4.536E+4	2.924E+6
4.535E+4	3.508E+6
4.532E+4	4.102E+6
4.530E+4	4.345E+6
4.528E+4	3.846E+6
4.526E+4	2.223E+6
4.524E+4	1.057E+6
4.522E+4	5.284E+5
4.520E+4	8.810E+4
4.520E+4	9.120E+3
4.516E+4	4.487E+4
4.514E+4	4.603E+4
4.512E+4	1.578E+4
DATA SET 2	
T = 300.0	
0.272E+3	0.948E+1
0.292E+3	0.509E+1
0.314E+3	0.289E+1
0.331E+3	0.184E+1
0.350E+3	0.131E+1
0.377E+3	0.665E+0
0.397E+3	0.423E+0
0.416E+3	0.254E+0
0.431E+3	0.162E+0
0.448E+3	0.109E+0
0.460E+3	0.776E-1
0.477E+3	0.522E-1
0.492E+3	0.332E-1

ν	α
DATA SET 2(CONT.)	
0.517E+3	0.159E-1
0.531E+3	0.107E-1
0.551E+3	0.644E-2
0.575E+3	0.388E-2
DATA SET 3	
T = 300.0	
0.292E+3	0.383E+1
0.301E+3	0.288E+1
0.309E+3	0.217E+1
0.333E+3	0.146E+1
0.350E+3	0.986E+0
0.375E+3	0.500E+0
0.394E+3	0.337E+0
0.416E+3	0.215E+0
0.431E+3	0.144E+0
0.453E+3	0.973E-1
0.468E+3	0.619E-1
0.490E+3	0.384E-1
0.499E+3	0.297E-1
DATA SET 4	
T = 80.0	
0.292E+3	0.695E+0
0.302E+3	0.524E+0
0.312E+3	0.418E+0
0.321E+3	0.298E+0
0.331E+3	0.251E+0
0.338E+3	0.266E+0
0.353E+3	0.213E+0
0.373E+3	0.135E+0
0.382E+3	0.910E-1
0.392E+3	0.546E-1
0.402E+3	0.276E-1
0.412E+3	0.197E-1
0.422E+3	0.941E-2

ν	α
DATA SET 5	
T = 80.0	
0.285E+3	0.130E+1
0.297E+3	0.873E+0
0.307E+3	0.658E+0
0.316E+3	0.469E+0
0.326E+3	0.396E+0
0.336E+3	0.396E+0
0.346E+3	0.375E+0
0.358E+3	0.317E+0
0.368E+3	0.239E+0
0.375E+3	0.170E+0
0.385E+3	0.135E+0
0.397E+3	0.108E+0
0.407E+3	0.770E-1
0.417E+3	0.614E-1
0.426E+3	0.463E-1
0.436E+3	0.369E-1
0.446E+3	0.278E-1
0.458E+3	0.235E-1
0.466E+3	0.198E-1
0.475E+3	0.167E-1
0.485E+3	0.150E-1
0.500E+3	0.107E-1

TABLE A7. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF RUBIDIUM FLUORIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	54	PEIMANN, C.J. SKIBOWSKI, M.	1971	R	4.0E+4-2.5E+5	293	THIN FILM SPECIMEN; EVAPORATED IN SITU FROM A TUNGSTEN BOAT ONTO A GLASS SLIDE; NEAR NORMAL REFLECTIVITY MEASURED; ABSORPTION COEFFICIENT OBTAINED BY A KRAMERS-KRONIG ANALYSIS OF THE REFLECTIVITY SPECTRUM; DATA EXTRACTED FROM A FIGURE.

TABLE A8. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF RUBIDIUM FLUORIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α
DATA SET 1	
T = 293.0	
2.419E+5	4.760E+5
2.231E+5	7.940E+5
2.198E+5	8.740E+5
2.173E+5	1.014E+6
2.149E+5	1.076E+6
2.120E+5	1.093E+6
2.090E+5	1.093E+6
2.055E+5	1.081E+6
2.027E+5	1.047E+6
2.001E+5	9.970E+5
1.882E+5	1.032E+6
1.825E+5	1.173E+6
1.789E+5	1.216E+6
1.765E+5	1.202E+6
1.731E+5	1.143E+6
1.695E+5	1.107E+6
1.665E+5	1.051E+6
1.642E+5	9.560E+5
1.626E+5	8.870E+5
1.601E+5	8.540E+5
1.569E+5	8.870E+5
1.547E+5	9.790E+5
1.503E+5	1.389E+6
1.485E+5	1.420E+6
1.480E+5	1.393E+6
1.465E+5	1.164E+6
1.440E+5	1.360E+6
1.420E+5	1.130E+6
1.390E+5	1.007E+6
1.356E+5	1.114E+6
1.324E+5	8.860E+5
1.289E+5	1.201E+6
1.279E+5	1.113E+6
1.265E+5	8.580E+5
1.244E+5	7.450E+5
1.215E+5	5.280E+5
1.196E+5	4.220E+5
1.159E+5	3.360E+5
1.095E+5	3.720E+5

ν	α
DATA SET 1(CONT.)	
1.052E+5	4.150E+5
1.023E+5	4.030E+5
9.573E+4	4.220E+5
9.323E+4	4.540E+5
9.097E+4	5.010E+5
8.952E+4	5.570E+5
8.831E+4	6.270E+5
8.548E+4	4.400E+5
8.323E+4	4.210E+5
8.081E+4	3.110E+5
7.935E+4	3.960E+5
7.774E+4	5.610E+5
7.476E+4	1.080E+6
7.355E+4	1.095E+6
7.250E+4	1.082E+6
7.065E+4	2.250E+5
6.976E+4	1.610E+5
6.879E+4	1.140E+5
6.581E+4	8.300E+4
6.185E+4	5.600E+4
5.379E+4	3.000E+4

TABLE A9. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF RUBIDIUM CHLORIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	54	PEIMANN, C.D., SKIBOWSKI, M.	1971	R	5.0E+4-2.1E+5	293	SINGLE CRYSTAL; FRESHLY CLEAVED SPECIMENS; NEAR NORMAL REFLECTIVITY MEASURED; ABSORPTION COEFFICIENTS DERIVED FROM REFLECTIVITY.
2	27	HARRINGTON, J.A., DUTHLER, C.J., PATTEN, F.W. HASS, M.	1976	C	2.9E+2-5.0E+2	300	SINGLE CRYSTAL; OBTAINED FROM THE HARSHAW CHEMICAL CO.; MEASUREMENTS MADE AT UNIVERSITY OF ALABAMA IN HUNTSVILLE; EXPERIMENTAL DETAILS NOT GIVEN; DATA EXTRACTED FROM A FIGURE.
3	27	HARRINGTON, J.A., ET AL.	1976	C	3.1E+2-5.5E+2	300	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT NAVAL RESEARCH LABORATORY.
4	27	HARRINGTON, J.A., ET AL.	1976	C	3.1E+2-4.5E+2	80	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT UNIVERSITY OF ALABAMA IN HUNTSVILLE.
5	27	HARRINGTON, J.A., ET AL.	1976	C	2.7E+2-5.3E+2	80	SIMILAR TO ABOVE EXCEPT MEASUREMENTS MADE AT NAVAL RESEARCH LABORATORY.

TABLE A10. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF RUBIDIUM CHLORIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α	ν	α	ν	α	ν	α
DATA SET 1		DATA SET 1(CONT.)		DATA SET 3(CONT.)		DATA SET 5(CONT.)	
T = 293.0							
		8.919E+4	7.160E+5	0.471E+3	0.168E+0	0.391E+3	0.328E+0
2.029E+5	1.210E+5	8.508E+4	6.640E+5	0.491E+3	0.923E-1	0.411E+3	0.256E+0
1.945E+5	3.370E+5	7.863E+4	6.230E+5	0.511E+3	0.456E-1	0.431E+3	0.157E+0
1.923E+5	3.550E+5	7.524E+4	5.230E+5	0.520E+3	0.383E-1	0.451E+3	0.922E-1
1.901E+5	3.330E+5	7.194E+4	1.297E+6	0.532E+3	0.344E-1	0.474E+3	0.583E-1
1.871E+5	3.330E+5	6.935E+4	7.900E+5	0.541E+3	0.310E-1	0.491E+3	0.259E-1
1.822E+5	3.740E+5	6.516E+4	6.320E+5	0.550E+3	0.269E-1	0.511E+3	0.137E-1
1.752E+5	7.410E+5	6.355E+4	2.950E+5			0.530E+3	0.115E-1
1.738E+5	7.690E+5	6.081E+4	1.298E+6	DATA SET 4			
1.699E+5	7.690E+5	5.833E+4	4.390E+5	T = 80.0			
1.660E+5	7.310E+5	5.677E+4	2.280E+5				
1.631E+5	6.560E+5	5.508E+4	9.700E+4	0.313E+3	0.144E+1		
1.593E+5	5.770E+5			0.324E+3	0.944E+0		
1.562E+5	6.390E+5	DATA SET 2		0.331E+3	0.663E+0		
1.527E+5	8.020E+5	T = 300.0		0.342E+3	0.466E+0		
1.506E+5	9.550E+5			0.347E+3	0.419E+0		
1.475E+5	9.860E+5	0.293E+3	0.680E+1	0.351E+3	0.483E+0		
1.456E+5	1.049E+6	0.304E+3	0.513E+1	0.360E+3	0.518E+0		
1.431E+5	7.349E+5	0.333E+3	0.313E+1	0.371E+3	0.467E+0		
1.402E+5	9.230E+5	0.351E+3	0.228E+1	0.380E+3	0.306E+0		
1.375E+5	8.160E+5	0.371E+3	0.155E+1	0.391E+3	0.230E+0		
1.355E+5	8.650E+5	0.391E+3	0.101E+1	0.399E+3	0.162E+0		
1.345E+5	7.630E+5	0.411E+3	0.342E+0	0.411E+3	0.122E+0		
1.328E+5	7.410E+5	0.429E+3	0.365E+0	0.420E+3	0.800E-1		
1.319E+5	6.250E+5	0.451E+3	0.223E+0	0.431E+3	0.543E-1		
1.289E+5	8.660E+5	0.460E+3	0.157E+0	0.451E+3	0.225E-1		
1.275E+5	6.070E+5	0.481E+3	0.103E+0				
1.260E+5	5.280E+5	0.501E+3	0.605E-1	DATA SET 5			
1.241E+5	4.650E+5			T = 80.0			
1.210E+5	3.930E+5	DATA SET 3					
1.159E+5	3.930E+5	T = 300.0		0.275E+3	0.360E+1		
1.132E+5	4.110E+5			0.284E+3	0.253E+1		
1.102E+5	5.420E+5	0.313E+3	0.401E+1	0.293E+3	0.191E+1		
1.069E+5	5.910E+5	0.322E+3	0.292E+1	0.304E+3	0.134E+1		
1.045E+5	7.220E+5	0.342E+3	0.228E+1	0.313E+3	0.879E+0		
9.968E+4	1.128E+6	0.363E+3	0.155E+1	0.322E+3	0.618E+0		
9.823E+4	1.174E+6	0.382E+3	0.109E+1	0.330E+3	0.483E+0		
9.637E+4	1.148E+6	0.402E+3	0.793E+0	0.351E+3	0.641E+0		
9.419E+4	9.210E+5	0.420E+3	0.484E+0	0.363E+3	0.712E+0		
9.177E+4	7.880E+5	0.451E+3	0.266E+0	0.371E+3	0.519E+0		

TABLE A11. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF RUBIDIUM BROMIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	54	PEIMANN, C.D., SKIBOWSKI, M.	1971	R	3.8E+4-2.5E+5	293	SINGLE CRYSTAL; FRESHLY CLEAVED SPECIMEN; NEAR NORMAL REFLECTIVITY MEASURED; ABSORPTION COEFFICIENTS DERIVED FROM REFLECTIVITY BY A KRAMERS-KRONIG ANALYSIS; DATA EXTRACTED FROM A FIGURE.

TABLE A12. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF RUBIDIUM BROMIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α
DATA SET 1	
T = 293.0	
2.419E+5	1.470E+5
2.269E+5	1.610E+5
2.225E+5	1.800E+5
2.183E+5	2.200E+5
2.071E+5	3.690E+5
1.896E+5	6.360E+5
1.859E+5	6.540E+5
1.834E+5	6.470E+5
1.814E+5	6.280E+5
1.773E+5	6.540E+5
1.711E+5	7.950E+5
1.680E+5	8.140E+5
1.654E+5	8.030E+5
1.619E+5	7.310E+5
1.598E+5	6.730E+5
1.571E+5	6.570E+5
1.531E+5	6.900E+5
1.489E+5	8.830E+5
1.465E+5	1.027E+6
1.427E+5	8.760E+5
1.399E+5	1.089E+6
1.379E+5	9.060E+5
1.359E+5	9.260E+5
1.342E+5	6.690E+5
1.331E+5	6.540E+5
1.319E+5	5.790E+5
1.293E+5	7.620E+5
1.277E+5	6.140E+5
1.264E+5	4.420E+5
1.248E+5	3.930E+5
1.228E+5	3.490E+5
1.204E+5	3.250E+5
1.167E+5	3.250E+5
1.116E+5	3.630E+5
1.056E+5	4.530E+5
1.016E+5	6.100E+5
9.903E+4	6.430E+5
9.685E+4	6.470E+5
9.532E+4	8.050E+5

ν	α
DATA SET 1(CONT.)	
9.024E+4	1.021E+6
8.879E+4	9.960E+5
8.694E+4	1.008E+6
8.605E+4	9.710E+5
8.476E+4	6.750E+5
8.258E+4	5.470E+5
7.444E+4	4.230E+5
7.016E+4	5.070E+5
6.806E+4	4.950E+5
6.677E+4	7.600E+5
6.500E+4	8.480E+5
6.500E+4	7.190E+5
6.347E+4	7.260E+5
6.226E+4	5.220E+5
5.895E+4	3.770E+5
5.758E+4	7.020E+5
5.613E+4	3.230E+5
5.444E+4	3.350E+5
5.258E+4	8.340E+5
5.113E+4	1.730E+5
4.952E+4	1.260E+5
4.718E+4	8.900E+4
4.355E+4	6.200E+4
3.806E+4	3.800E+4

TABLE A13. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF RUBIDIUM IODIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	55	BALDINI, G., RIGALDI, L.	1969	Z	4.0E+4-5.4E+4	293	SINGLE CRYSTAL; THIN FILM SPECIMEN OF RUBIDIUM IODIDE; VACUUM DEPOSITED ON A FUSED SILICA PLATE; ABSORPTION COEFFICIENTS DEDUCED FROM TRANSMITTANCE AND REFLECTANCE MEASUREMENTS; DATA EXTRACTED FROM A FIGURE; ESTIMATED UNCERTAINTY ABOUT 5 PERCENT.
2	54	PEIMANN, C.J., SKIBOWSKI, M.	1971	R	3.8E+4-2.5E+5	293	SINGLE CRYSTAL; FRESHLY CLEAVED SPECIMEN; NEAR NORMAL REFLECTIVITY MEASURED; ABSORPTION COEFFICIENTS DERIVED FROM REFLECTIVITY BY A KRAMERS-KRONIG ANALYSIS; DATA EXTRACTED FROM A FIGURE.

TABLE A14. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF RUBIDIUM IODIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α	ν	α	ν	α
DATA SET 1		DATA SET 2(CONT.)		DATA SET 2(CONT.)	
T = 293.0					
		1.585E+5	5.010E+5	4.137E+4	5.600E+4
5.405E+4	6.426E+5	1.547E+5	4.940E+5	3.815E+4	3.800E+4
5.319E+4	6.992E+5	1.511E+5	4.710E+5		
5.263E+4	6.918E+5	1.459E+5	6.920E+5		
5.236E+4	7.231E+5	1.421E+5	5.340E+5		
5.208E+4	7.193E+5	1.384E+5	8.040E+5		
5.155E+4	6.452E+5	1.359E+5	5.630E+5		
5.051E+4	1.879E+5	1.344E+5	5.540E+5		
5.000E+4	1.860E+5	1.333E+5	5.170E+5		
4.950E+4	1.841E+5	1.306E+5	6.010E+5		
4.926E+4	1.832E+5	1.276E+5	5.220E+5		
4.878E+4	1.508E+5	1.253E+5	5.160E+5		
4.808E+4	1.782E+5	1.230E+5	4.980E+5		
4.762E+4	1.777E+5	1.197E+5	5.070E+5		
4.651E+4	1.736E+5	1.183E+5	4.770E+5		
4.630E+4	2.304E+5	1.158E+5	4.210E+5		
4.545E+4	3.690E+5	1.127E+5	4.270E+5		
4.525E+4	4.816E+5	1.089E+5	3.880E+5		
4.484E+4	5.911E+5	1.060E+5	3.960E+5		
4.464E+4	6.165E+5	1.021E+5	3.400E+5		
4.444E+4	5.836E+5	9.798E+4	3.160E+5		
4.405E+4	3.023E+5	8.911E+4	5.170E+5		
4.348E+4	5.354E+4	8.734E+4	5.170E+5		
		8.347E+4	6.660E+5		
DATA SET 2		7.815E+4	7.790E+5		
T = 293.0		7.597E+4	7.740E+5		
		7.315E+4	9.210E+5		
2.347E+5	3.900E+4	6.621E+4	6.320E+5		
2.281E+5	6.200E+4	6.468E+4	6.950E+5		
2.221E+5	6.200E+4	6.210E+4	7.120E+5		
2.142E+5	1.140E+5	6.040E+4	5.980E+5		
2.077E+5	1.310E+5	5.790E+4	5.490E+5		
2.007E+5	1.650E+5	5.556E+4	8.470E+5		
1.967E+5	2.040E+5	5.444E+4	8.210E+5		
1.922E+5	2.620E+5	5.234E+4	1.030E+6		
1.880E+5	3.460E+5	5.065E+4	5.010E+5		
1.837E+5	3.960E+5	4.782E+4	3.730E+5		
1.795E+5	3.790E+5	4.669E+4	3.160E+5		
1.760E+5	3.880E+5	4.460E+4	8.920E+5		
1.637E+5	5.290E+5	4.266E+4	8.700E+4		

TABLE A15. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF CESIUM CHLORIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	56	AVAKIAN, P. SMAKULA, A.	1960	R	4.0E+4-5.7E+4	83	SINGLE CRYSTAL; GROWN FROM THE MELT BY A DOUBLE-RUN BRIDGMAN METHOD; NO DETAILS WERE GIVEN FOR SPECIMEN CONFIGURATION AND MEASUREMENT TECHNIQUE; ABSORPTION COEFFICIENT DATA OBTAINED; DATA EXTRACTED FROM A FIGURE.
2	56	AVAKIAN, P., ET AL.	1960	R	3.7E+4-5.7E+4	195	SAME AS ABOVE.
3	56	AVAKIAN, P. ET AL.	1960	R	3.7E+4-5.7E+4	298	SAME AS ABOVE.

TABLE A16. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF CESIUM CHLORIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α
DATA SET 1	
T = 83.0	
5.714E+4	5.420E+0
5.650E+4	4.820E+0
5.618E+4	4.360E+0
5.556E+4	5.710E+0
5.525E+4	7.000E+0
5.495E+4	8.600E+0
5.464E+4	9.880E+0
5.464E+4	1.139E+1
5.435E+4	1.168E+1
5.405E+4	9.230E+0
5.376E+4	6.840E+0
5.348E+4	4.700E+0
5.291E+4	3.490E+0
5.236E+4	2.960E+0
5.155E+4	2.960E+0
5.051E+4	2.600E+0
4.975E+4	2.310E+0
4.831E+4	2.110E+0
4.630E+4	1.980E+0
4.525E+4	1.930E+0
4.425E+4	1.810E+0
4.329E+4	1.660E+0
4.274E+4	1.520E+0
4.237E+4	1.560E+0
4.149E+4	1.600E+0
4.082E+4	1.430E+0
4.016E+4	1.320E+0
DATA SET 2	
T = 195.0	
5.714E+4	8.410E+0
5.714E+4	7.280E+0
5.618E+4	6.000E+0
5.587E+4	5.840E+0
5.495E+4	7.310E+0
5.435E+4	8.460E+0
5.376E+4	8.940E+0
5.348E+4	8.060E+0

ν	α
DATA SET 2(CONT.)	
5.291E+4	6.060E+0
5.263E+4	5.780E+0
5.076E+4	3.370E+0
5.025E+4	2.800E+0
4.975E+4	2.620E+0
4.739E+4	2.200E+0
4.444E+4	1.930E+0
4.237E+4	1.610E+0
4.132E+4	1.590E+0
4.049E+4	1.440E+0
3.937E+4	1.290E+0
3.717E+4	1.100E+0
DATA SET 3	
T = 298.0	
5.682E+4	1.087E+1
5.650E+4	8.670E+0
5.556E+4	7.120E+0
5.525E+4	6.830E+0
5.348E+4	7.320E+0
5.319E+4	7.110E+0
5.236E+4	5.920E+0
5.155E+4	4.310E+0
5.102E+4	3.880E+0
4.505E+4	2.070E+0
4.386E+4	1.850E+0
4.184E+4	1.730E+0
4.098E+4	1.730E+0
3.984E+4	1.430E+0
3.891E+4	1.300E+0
3.717E+4	1.150E+0

TABLE A17. SUMMARY OF MEASUREMENTS ON THE ABSORPTION COEFFICIENT OF CESIUM BROMIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	57	DIANOV, E.M.	1966	T	8.8E+0-2.7E+1	293	SINGLE CRYSTAL; PLANE-PARALLEL PLATE OR DISK SPECIMENS OF 50-80 MM DIAMETER AND VARIOUS THICKNESSES; AVERAGE ABSORPTION COEFFICIENTS DETERMINED FROM THE MEASURED VALUES OF TRANSMISSION IN THE ABSENCE OF INTERNAL INTERFERENCE; DATA EXTRACTED FROM A FIGURE.

TABLE A18. EXPERIMENTAL DATA ON THE ABSORPTION COEFFICIENT OF CESIUM BROMIDE

[WAVENUMBER, ν, CM^{-1}; TEMPERATURE, T, K; ABSORPTION COEFFICIENT, α, CM^{-1}]

ν	α
DATA SET 1	
T = 293.0	
2.660E+1	1.598E+1
2.639E+1	1.651E+1
2.551E+1	1.452E+1
2.506E+1	1.471E+1
2.445E+1	1.294E+1
2.410E+1	1.387E+1
2.232E+1	1.229E+1
2.227E+1	1.167E+1
2.088E+1	1.031E+1
2.070E+1	1.043E+1
1.980E+1	1.038E+1
1.931E+1	1.041E+1
1.890E+1	8.956E+0
1.838E+1	8.709E+0
1.815E+1	8.507E+0
1.684E+1	6.833E+0
1.565E+1	4.287E+0
1.406E+1	3.535E+0
1.220E+1	2.161E+0
1.214E+1	2.013E+0
1.145E+1	1.756E+0
1.087E+1	1.543E+0
1.083E+1	1.389E+0
1.032E+1	1.219E+0
9.901E+0	1.045E+0
9.443E+0	9.493E-1
8.889E+0	8.042E-1

APPENDIX B

TABLE B1. SUMMARY OF MEASUREMENTS ON THE TRANSMISSION OF LITHIUM IODIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	58	MACK, S.A., VONSCIVER, W.J.	1970	T	0.23-0.33	300	CRYSTAL; OBTAINED FROM HARSHAW CHEMICAL CO.; SPECIMENS CLEAVED FROM A SINGLE INGOT; DATA EXTRACTED FROM A CURVE; THICKNESS OF SPECIMEN NOT GIVEN.

TABLE B2. EXPERIMENTAL DATA ON THE TRANSMISSION OF LITHIUM IODIDE

[WAVELENGTH, λ, μM; TEMPERATURE, T, K; TRANSMISSION, τ]

λ	τ
DATA SET 1	
T = 300.0	
0.231	0.170
0.232	0.262
0.232	0.315
0.233	0.409
0.234	0.456
0.234	0.499
0.236	0.548
0.247	0.670
0.252	0.716
0.255	0.732
0.259	0.746
0.261	0.759
0.263	0.778
0.270	0.808
0.278	0.839
0.284	0.864
0.288	0.878
0.295	0.899
0.326	0.982

TABLE B3. SUMMARY OF MEASUREMENTS ON THE TRANSMISSION OF RUBIDIUM IODIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	59	MC CARTHY, D.E.	1968	T	2.5-50.0	313	SYNTHETIC SINGLE CRYSTAL; PLATE SPECIMEN OF 3.91 MM THICK; POLISHED FLAT TO 10 FRINGES OR BETTER OF VISIBLE LIGHT; NORMAL INCIDENT TRANSMISSION MEASURED; DATA EXTRACTED FROM A CURVE.
2	60	MC CARTHY, D.E.	1968	T	0.241-3.0	298	HIGH PURITY SYNTHETIC SINGLE CRYSTAL; OBTAINED FROM ISOMET CORP.; PLATE SPECIMEN OF 1.36 MM THICK; NORMAL INCIDENT TRANSMISSION OBSERVED; DATA EXTRACTED FROM A CURVE.
3	61	JONES, G.O., MARTIN, D.H, MOWER, P.A. PEVY, C.H.	1961	T	84.3-15.9	300	POLYCRYSTALLINE; THIN FILM SPECIMEN VACUUM EVAPORATED ON POLYETHLENE SUBSTRATE; NORMAL INCIDENT TRANSMISSION MEASURED; DATA EXTRACTED FROM A CURVE.
4	61	JONES, G.O. ET AL.	1961	T	89.8-139	100	SAME AS ABOVE.
5	61	JONES, G.O. ET AL.	1961	T	98.2-145	4.2	SAME AS ABOVE.
6	61	JONES, G.O. ET AL.	1961	T	76.9-160	293	SIMILAR TO ABOVE WITH FILM OF 0.25 MM THICK.
7	61	JONES, G.O. ET AL.	1961	T	76.5-161	298	SIMILAR TO ABOVE WITH FILM OF 0.77 MM THICK.
8	61	JONES, G.O. ET AL.	1961	T	76.5-159	300	SIMILAR TO ABOVE SPECIMEN WITH FILM OF 0.87 MM THICK.
9	61	JONES, G.O. ET AL.	1961	T	76.4-161	300	SIMILAR TO ABOVE SPECIMEN WITH FILM OF 2.36 MM THICK.
10	61	JONES, G.O. ET AL.	1961	T	76.6-160	300	SIMILAR TO ABOVE SPECIMEN WITH FILM OF 3.54 MM THICK.

TABLE B4. EXPERIMENTAL DATA ON THE TRANSMISSION OF RUBIDIUM IODIDE

[WAVELENGTH, λ, μM; TEMPERATURE, T, K; TRANSMISSION, τ]

λ	τ
DATA SET 1	
T = 313.0	
2.50	0.731
2.70	0.776
3.50	0.815
4.50	0.851
5.60	0.880
6.80	0.897
8.10	0.912
9.40	0.922
39.7	0.922
41.2	0.908
42.7	0.882
43.9	0.856
45.0	0.824
46.0	0.793
47.6	0.736
49.0	0.682
50.0	0.633
DATA SET 2	
T = 298.0	
0.241	0.000
0.261	0.439
0.264	0.487
0.283	0.536
0.326	0.581
0.388	0.607
0.836	0.676
1.82	0.728
3.03	0.753
DATA SET 3	
T = 300.0	
84.3	0.983
87.4	0.995
92.7	0.970
95.4	0.968
98.2	0.964

λ	τ
DATA SET 3(CONT.)	
101.0	0.949
104.0	0.925
106.0	0.926
109.0	0.924
112.0	0.892
114.0	0.916
117.0	0.869
120.0	0.803
123.0	0.730
126.0	0.630
127.0	0.575
129.0	0.482
130.0	0.425
131.0	0.376
132.0	0.326
133.0	0.332
135.0	0.371
137.0	0.447
138.0	0.532
140.0	0.612
142.0	0.740
145.0	0.845
148.0	0.883
151.0	0.905
154.0	0.905
156.0	0.968
159.0	0.995
DATA SET 4	
T = 100.0	
89.8	0.920
92.7	0.900
98.3	0.892
103.0	0.894
109.0	0.851
112.0	0.792
117.0	0.516
120.0	0.339
123.0	0.250

λ	τ
DATA SET 4(CONT.)	
125.0	0.322
128.0	0.526
131.0	0.751
134.0	0.830
137.0	0.911
139.0	0.943
DATA SET 5	
T = 4.2	
98.2	0.989
101.0	0.993
103.0	0.957
106.0	0.891
106.0	0.933
109.0	0.896
112.0	0.811
114.0	0.706
117.0	0.473
120.0	0.256
122.0	0.232
126.0	0.399
129.0	0.642
131.0	0.795
134.0	0.936
137.0	0.947
145.0	0.980
DATA SET 6	
T = 293.0	
76.9	0.988
77.8	0.982
79.3	0.979
80.6	0.976
82.1	0.973
83.5	0.962
85.0	0.952
86.1	0.958
87.5	0.970

λ	τ
DATA SET 6(CONT.)	
89.0	0.953
90.3	0.958
91.7	0.966
93.3	0.956
94.9	0.959
96.2	0.980
97.5	0.976
98.6	0.980
100.0	0.979
101.0	0.976
103.0	0.967
104.0	0.960
105.0	0.963
107.0	0.967
108.0	0.963
110.0	0.951
111.0	0.949
113.0	0.942
114.0	0.941
116.0	0.938
117.0	0.918
119.0	0.911
120.0	0.908
122.0	0.907
123.0	0.890
125.0	0.879
126.0	0.838
127.0	0.826
129.0	0.790
130.0	0.762
131.0	0.678
133.0	0.678
134.0	0.753
135.0	0.789
136.0	0.837
138.0	0.859
140.0	0.885
141.0	0.895
142.0	0.882
143.0	0.898

λ	τ
DATA SET 6(CONT.)	
145.0	0.893
148.0	0.886
153.0	0.889
155.0	0.901
157.0	0.903
160.0	0.899
DATA SET 7	
T = 298.0	
76.5	0.938
77.5	0.939
79.1	0.926
80.3	0.922
81.7	0.929
83.1	0.920
84.8	0.917
85.8	0.930
87.3	0.930
88.6	0.922
89.9	0.922
91.2	0.920
93.0	0.922
94.3	0.919
95.4	0.929
97.3	0.919
98.3	0.929
99.6	0.919
101.0	0.918
102.0	0.913
104.0	0.916
105.0	0.902
106.0	0.906
108.0	0.900
109.0	0.881
111.0	0.869
112.0	0.864
114.0	0.861
115.0	0.842
116.0	0.822

λ	τ
DATA SET 7(CONT.)	
118.0	0.812
120.0	0.807
121.0	0.777
123.0	0.767
125.0	0.704
127.0	0.655
128.0	0.603
129.0	0.524
130.0	0.495
134.0	0.518
135.0	0.579
136.0	0.648
138.0	0.732
140.0	0.783
141.0	0.817
143.0	0.820
144.0	0.851
145.0	0.861
147.0	0.864
148.0	0.846
149.0	0.840
153.0	0.869
156.0	0.889
158.0	0.895
159.0	0.869
161.0	0.878
DATA SET 8	
T = 298.0	
76.5	0.923
77.6	0.926
79.2	0.917
80.3	0.930
81.7	0.917
83.3	0.906
84.8	0.899
86.1	0.905
87.5	0.896
88.7	0.907

TABLE B4. EXPERIMENTAL DATA ON THE TRANSMISSION OF RUBIDIUM IODIDE (CONTINUED)

[WAVELENGTH, λ, μM; TEMPERATURE, T, K; TRANSMISSION, τ]

λ	τ	λ	τ	λ	τ	λ	τ	λ	τ
DATA SET 8(CONT.)		DATA SET 8(CONT.)		DATA SET 9(CONT.)		DATA SET 10(CONT.)		DATA SET 10(CONT.)	
90.2	0.890	147.0	0.830	107.0	0.796	87.5	0.794	146.0	0.624
91.2	0.906	147.0	0.852	108.0	0.805	89.0	0.782	147.0	0.644
93.0	0.914	147.0	0.870	105.0	0.764	91.0	0.773	148.0	0.692
94.3	0.905	149.0	0.799	111.0	0.733	92.4	0.772	150.0	0.704
95.8	0.910	149.0	0.809	112.0	0.748	94.8	0.782	152.0	0.736
97.6	0.906	149.0	0.850	113.0	0.706	95.9	0.780	153.0	0.769
98.5	0.910	149.0	0.897	116.0	0.649	97.3	0.779	155.0	0.827
99.5	0.901	151.0	0.843	118.0	0.651	98.4	0.774	156.0	0.847
101.0	0.899	152.0	0.809	119.0	0.617	99.4	0.762	157.0	0.831
102.0	0.895	152.0	0.836	120.0	0.598	101.0	0.753	159.0	0.824
104.0	0.886	153.0	0.816	121.0	0.579	102.0	0.762	160.0	0.832
105.0	0.875	154.0	0.852	123.0	0.540	104.0	0.756		
106.0	0.875	159.0	0.855	125.0	0.492	106.0	0.747		
108.0	0.871			126.0	0.427	107.0	0.749		
109.0	0.869	DATA SET 9		127.0	0.388	108.0	0.736		
111.0	0.860	T = 298.0		129.0	0.314	109.0	0.725		
112.0	0.846			130.0	0.260	109.0	0.714		
113.0	0.847	76.4	0.897	131.0	0.237	110.	0.697		
114.0	0.827	77.8	0.883	133.0	0.237	112.0	0.682		
116.0	0.814	79.1	0.869	134.0	0.282	113.0	0.669		
118.0	0.789	80.7	0.884	136.0	0.336	116.0	0.586		
120.0	0.776	81.9	0.872	137.0	0.417	118.0	0.564		
121.0	0.765	83.0	0.855	139.0	0.522	119.0	0.518		
123.0	0.726	84.7	0.859	140.0	0.613	120.0	0.487		
124.0	0.688	85.9	0.857	141.0	0.682	122.0	0.437		
126.0	0.635	87.4	0.853	142.0	0.717	125.0	0.306		
127.0	0.580	89.0	0.829	143.0	0.761	126.0	0.242		
130.0	0.458	90.3	0.836	161.0	0.868	127.0	0.210		
131.0	0.422	90.7	0.822			129.0	0.163		
135.0	0.476	91.8	0.822	DATA SET 10		130.0	0.144		
136.0	0.556	93.5	0.819	T = 298.0		132.0	0.117		
137.0	0.633	94.7	0.823			133.0	0.124		
138.0	0.695	95.8	0.827	76.6	0.913	135.0	0.163		
140.0	0.757	97.1	0.828	77.6	0.865	135.0	0.188		
141.0	0.784	98.3	0.826	79.2	0.826	137.0	0.230		
142.0	0.800	99.6	0.817	80.8	0.824	138.0	0.291		
144.0	0.804	101.0	0.807	82.0	0.813	140.0	0.361		
144.0	0.886	103.0	0.806	83.3	0.812	141.0	0.426		
145.0	0.828	104.0	0.806	84.9	0.809	141.0	0.480		
145.0	0.844	106.0	0.792	86.0	0.800	144.0	0.599		

APPENDIX C

TABLE C1. SUMMARY OF MEASUREMENTS ON THE REFLECTIVITY OF LITHIUM CHLORIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	62	BALDINI, G., BOSACCHI, B.	1970	R	0.123-0.154	55	CRYSTAL: CLEAVED SPECIMEN; CLEAVAGE PERFORMED AT A TEMPERATURE OF 55 K IN A HIGH VACUUM TO REDUCE THE UNAVOIDABLE CONTAMINATION OF THE SURFACE AND TO PROVIDE EXCELLENT REPRODUCIBILITY FOR THE RESULTS; REFLECTIVITY (20 DEGREE ANGLE OF INCIDENCE) MEASURED; DATA EXTRACTED FROM A FIGURE.

TABLE C2. EXPERIMENTAL DATA ON THE REFLECTIVITY OF LITHIUM CHLORIDE

[WAVELENGTH, λ, μM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

λ	ρ
DATA SET 1	
T = 55.0	
0.123	0.142
0.124	0.242
0.125	0.271
0.126	0.299
0.128	0.299
0.130	0.289
0.131	0.270
0.132	0.238
0.133	0.207
0.134	0.193
0.135	0.283
0.136	0.350
0.137	0.399
0.138	0.435
0.139	0.386
0.141	0.395
0.142	0.328
0.143	0.271
0.144	0.229
0.145	0.214
0.146	0.198
0.148	0.181
0.149	0.170
0.152	0.158
0.153	0.152

TABLE C3. SUMMARY OF MEASUREMENTS ON THE REFLECTIVITY OF LITHIUM BROMIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	62	BALDINI, G., BOSACCHI, B.	1970	R	0.123-0.173	55	CRYSTAL; CLEAVED SPECIMEN; CLEAVAGE PERFORMED AT A TEMPERATURE OF 55 K IN A HIGH VACUUM TO REDUCE THE UNAVOIDABLE CONTAMINATION OF THE SURFACE AND TO PROVIDE EXCELLENT REPRODUCIBILITY FOR THE RESULTS; REFLECTIVITY (20 DEGREE ANGLE OF INCIDENCE) MEASURED; DATA EXTRACTED FROM A FIGURE.

TABLE C4. EXPERIMENTAL DATA ON THE REFLECTIVITY OF LITHIUM BROMIDE

[WAVELENGTH, λ, UM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

λ	ρ
DATA SET 1	
T = 55.0	
0.123	0.310
0.124	0.349
0.125	0.349
0.127	0.331
0.129	0.295
0.132	0.251
0.135	0.205
0.138	0.165
0.140	0.148
0.141	0.148
0.142	0.155
0.143	0.187
0.144	0.234
0.145	0.282
0.147	0.302
0.149	0.336
0.151	0.371
0.155	0.371
0.156	0.376
0.157	0.388
0.159	0.388
0.160	0.370
0.162	0.335
0.165	0.279
0.167	0.254
0.168	0.192
0.169	0.328
0.170	0.259
0.171	0.571
0.172	0.367

TABLE C5. SUMMARY OF MEASUREMENTS ON THE REFLECTIVITY OF LITHIUM IODIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	62	BALDINI, G., BOSACCHI, B.	1970	R	0.125-0.212	55	CRYSTAL: CLEAVED SPECIMEN; CLEAVAGE PERFORMED AT TEMPERATURE OF 55 K IN A HIGH VACUUM TO REDUCE THE UNAVOIDABLE CONTAMINATION OF THE SURFACE AND TO PROVIDE EXCELLENT REPRODUCIBILITY FOR THE RESULTS; REFLECTIVITY (20 DEGREE ANGLE OF INCIDENCE) MEASURED; DATA EXTRACTED FROM A FIGURE.
2	63	BALDINI, G., BOSACCHI, A. BOSACCHI, B.	1969	R	0.200-0.210	6	CLEAVED CRYSTAL, GEOMETRY AND ORIGIN NOT SPECIFIED; NORMAL REFLECTIVITY MEASURED; DATA TAKEN FROM A FIGURE.

TABLE C6. EXPERIMENTAL DATA ON THE REFLECTIVITY OF LITHIUM IODIDE

[WAVELENGTH, λ, μM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

λ	ρ
DATA SET 1	
T = 55.0	
0.125	0.399
0.126	0.418
0.127	0.434
0.128	0.412
0.129	0.383
0.130	0.368
0.132	0.360
0.133	0.355
0.135	0.349
0.137	0.341
0.138	0.332
0.139	0.322
0.140	0.315
0.141	0.309
0.144	0.297
0.146	0.286
0.149	0.239
0.151	0.228
0.153	0.228
0.154	0.235
0.155	0.295
0.156	0.314
0.157	0.325
0.158	0.338
0.159	0.357
0.160	0.357
0.161	0.345
0.162	0.350
0.163	0.365
0.164	0.374
0.165	0.374
0.166	0.367
0.168	0.338
0.169	0.339
0.170	0.354
0.173	0.435
0.174	0.445
0.175	0.428
0.176	0.410

λ	ρ
DATA SET 1(CONT.)	
0.177	0.400
0.178	0.407
0.180	0.464
0.181	0.477
0.182	0.469
0.184	0.420
0.187	0.324
0.188	0.250
0.189	0.243
0.190	0.247
0.192	0.341
0.194	0.353
0.196	0.353
0.197	0.346
0.199	0.336
0.200	0.331
0.202	0.314
0.203	0.300
0.204	0.276
0.205	0.266
0.206	0.246
0.207	0.408
0.208	0.445
0.209	0.371
0.210	0.335
0.211	0.326
DATA SET 2	
T = 6.0	
0.200	0.272
0.201	0.269
0.202	0.259
0.203	0.254
0.204	0.237
0.205	0.240
0.206	0.290
0.207	0.370
0.208	0.356
0.209	0.294

λ	ρ
DATA SET 2(CONT.)	
0.210	0.290

TABLE C7. SUMMARY OF MEASUREMENTS ON THE REFLECTIVITY OF SODIUM BROMIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	62	BALDINI, G., BOSACCHI, B.	1970	R	0.121-0.207	55	CRYSTAL; CLEAVED SPECIMEN; CLEAVAGE PERFORMED AT A TEMPERATURE OF 55 K IN A HIGH VACUUM TO REDUCE THE UNAVOIDABLE CONTAMINATION OF THE SURFACE AND TO PROVIDE EXCELLENT REPRODUCIBILITY FOR THE RESULTS; REFLECTIVITY (20 DEGREE ANGLE OF INCIDENCE) MEASURED; DATA EXTRACTED FROM A FIGURE.
2	63	BAIDINI, G., BOSACCHI, A., BOSACCHI, B.	1969	R	0.180-0.188	6	CLEAVED CRYSTAL; GEOMETRY AND SOURCE NOT SPECIFIED; NORMAL REFLECTIVITY MEASURED; DATA TAKEN FROM A FIGURE.
3	64	VISHNEVSKII, V.N., KULIK, Z.S., KULIK, L.N.	1973	R	0.142-0.216	296	SINGLE CRYSTAL; GEOMETRY AND SOURCE NOT SPECIFIED; REFLECTIVITY MEASURED FOR ANGLE OF INCIDENCE = 45 DEGREES; DATA TAKEN FROM A CURVE.
4	64	VISHNEVSKII, V.N. ET AL.	1973	R	0.126-0.46	296	SIMILAR TO ABOVE BUT ANGLE INCIDENCE = 70 DEGREES.

TABLE C8. EXPERIMENTAL DATA ON THE REFLECTIVITY OF SODIUM BROMIDE

[WAVELENGTH, λ, UM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

λ	ρ
DATA SET 1	
T = 55.0	
0.121	0.227
0.122	0.261
0.124	0.240
0.125	0.213
0.127	0.190
0.128	0.166
0.130	0.139
0.132	0.109
0.133	0.095
0.134	0.086
0.136	0.094
0.138	0.121
0.139	0.131
0.141	0.140
0.142	0.147
0.145	0.147
0.151	0.140
0.155	0.133
0.157	0.133
0.159	0.122
0.160	0.122
0.162	0.126
0.163	0.126
0.165	0.112
0.166	0.112
0.168	0.130
0.170	0.153
0.171	0.215
0.172	0.231
0.173	0.209
0.174	0.173
0.175	0.155
0.176	0.142
0.177	0.128
0.178	0.112
0.179	0.094
0.180	0.081
0.181	0.042
0.182	0.100

λ	ρ
DATA SET 1(CONT.)	
0.183	0.100
0.184	0.100
0.185	0.100
0.186	0.100
0.187	0.100
DATA SET 2	
T = 6.0	
0.180	0.081
0.181	0.053
0.182	0.248
0.183	0.417
0.184	0.769
0.185	0.379
0.186	0.308
0.187	0.206
DATA SET 3	
T = 296.0	
0.1428	0.137
0.1469	0.132
0.1481	0.122
0.1494	0.116
0.1506	0.112
0.1520	0.097
0.1533	0.104
0.1551	0.120
0.1565	0.128
0.1575	0.124
0.1590	0.111
0.1622	0.101
0.1635	0.089
0.1664	0.095
0.1688	0.111
0.1708	0.131
0.1725	0.135
0.1736	0.145
0.1746	0.148

λ	ρ
DATA SET 3(CONT.)	
0.1757	0.145
0.1776	0.120
0.1796	0.105
0.1812	0.086
0.1837	0.080
0.1851	0.085
0.1861	0.095
0.1871	0.116
0.1880	0.149
0.1886	0.161
0.1900	0.173
0.1914	0.226
0.1935	0.189
0.1950	0.181
0.1965	0.169
0.1965	0.134
0.1974	0.117
0.1988	0.105
0.2004	0.095
0.2027	0.089
0.2041	0.089
0.2065	0.094
0.2081	0.093
0.2097	0.090
0.2115	0.086
0.2127	0.080
0.2160	0.077
DATA SET 4	
T = 296.0	
0.1266	0.196
0.1285	0.197
0.1305	0.202
0.1348	0.217
0.1400	0.234
0.1421	0.251
0.1441	0.270
0.1453	0.294
0.1470	0.321

λ	ρ
DATA SET 4(CONT.)	
0.1480	0.330
0.1503	0.335
0.1524	0.332
0.1563	0.311
0.1572	0.292
0.1582	0.283
0.1595	0.286
0.1600	0.292
0.1616	0.296
0.1626	0.293
0.1642	0.277
0.1665	0.271
0.1682	0.266
0.1692	0.256
0.1702	0.248
0.1712	0.252
0.1723	0.263
0.1731	0.274
0.1752	0.277
0.1771	0.286
0.1790	0.295
0.1813	0.298
0.1827	0.294
0.1834	0.284
0.1843	0.280
0.1859	0.284
0.1879	0.292
0.1895	0.311
0.1902	0.329
0.1905	0.357
0.1916	0.361
0.1932	0.358
0.1945	0.346
0.1971	0.327
0.1988	0.327
0.2018	0.335
0.2062	0.341
0.2081	0.350
0.2106	0.357
0.2122	0.361

λ	ρ
DATA SET 4(CONT.)	
0.2160	0.365

TABLE C9. SUMMARY OF MEASUREMENTS ON THE REFLECTIVITY OF SODIUM IODIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	62	BALDINI, G., BOSACCHI, B.	1970	R	0.122-0.226	55	CRYSTAL: CLEAVED SPECIMEN: CLEAVAGE PERFORMED AT A TEMPERATURE OF 55 K IN A HIGH VACUUM TO REDUCE THE UNAVOIDABLE CONTAMINATION OF THE SURFACE AND TO PROVIDE EXCELLENT REPRODUCIBILITY FOR THE RESULTS: REFLECTIVITY (20 DEGREE ANGLE OF INCIDENCE) MEASURED: DATA EXTRACTED FROM A FIGURE.
2	65	PETROFF, Y., PINCHAUX, R., CHECKROUN, C., BALKANSKI, M., KAMIMURA, H.	1971	R	2.17-2.21	1.8	SINGLE CRYSTAL: SPECIMEN CLEAVED IN AIR 5 SECONDS BEFORE EXPERIMENT: NEAR NORMAL REFLECTION SPECTRUM OBTAINED: DATA EXTRACTED FROM A CURVE.
3	65	PETROFF, Y. ET AL.	1971	R	2.17-2.21	1.8	SIMILAR TO ABOVE EXCEPT SPECIMEN CLEAVED IN LIQUID HELIUM.
4	64	VISHNEVSKII, V.N., KULIK, Z.S., KULIK, L.N.	1973	R	0.161-0.260	296	SINGLE CRYSTAL: GEOMETRY AND ORIGIN NOT SPECIFIED: 45 SAME AS ABOVE BUT ANGLE OF INCIDENCE = 70 DEGREES: DATA TAKEN FROM A CURVE.
5	64	VISHNEVSKII, V.N. ET AL.	1973	R	0.161-0.260	296	SAME AS ABOVE BUT ANGLE OF INCIDENCE IS 70 DEGREES.

TABLE C10. EXPERIMENTAL DATA ON THE REFLECTIVITY OF SODIUM IODIDE

[WAVELENGTH, λ, μM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

λ	ρ
DATA SET 1	
T = 55.0	
0.122	0.363
0.125	0.316
0.126	0.293
0.127	0.280
0.135	0.280
0.136	0.266
0.139	0.232
0.142	0.202
0.144	0.187
0.144	0.187
0.150	0.239
0.155	0.239
0.157	0.224
0.159	0.214
0.160	0.220
0.162	0.261
0.163	0.283
0.165	0.314
0.166	0.101
0.167	0.379
0.169	0.355
0.171	0.338
0.172	0.326
0.175	0.319
0.176	0.310
0.178	0.273
0.180	0.254
0.181	0.269
0.183	0.325
0.184	0.351
0.185	0.334
0.187	0.283
0.189	0.250
0.192	0.227
0.195	0.211
0.198	0.202
0.201	0.196
0.202	0.187
0.205	0.181

λ	ρ
DATA SET 1(CONT.)	
0.208	0.177
0.214	0.176
0.216	0.161
DATA SET 2	
T = 1.8	
2.1700	0.135
2.1727	0.151
2.1745	0.169
2.1764	0.190
2.1778	0.212
2.1790	0.237
2.1803	0.269
2.1818	0.304
2.1837	0.354
2.1845	0.374
2.1855	0.391
2.1863	0.405
2.1876	0.419
2.1889	0.433
2.1898	0.450
2.1906	0.468
2.1915	0.502
2.1923	0.540
2.1931	0.571
2.1948	0.622
2.1960	0.650
2.1967	0.666
2.1971	0.672
2.1978	0.672
2.1911	0.659
2.2004	0.628
2.2019	0.599
2.2031	0.566
2.2042	0.541
2.2050	0.528

λ	ρ
DATA SET 3	
T = 1.8	
0.2204	0.483
0.2203	0.532
0.2202	0.573
0.2201	0.616
0.2200	0.657
0.2199	0.697
0.2197	0.722
0.2195	0.697
0.2194	0.664
0.2193	0.518
0.2191	0.463
0.2190	0.333
0.2189	0.311
0.2188	0.306
0.2187	0.314
0.2186	0.341
0.2185	0.349
0.2184	0.343
0.2183	0.311
0.2182	0.281
0.2180	0.175
0.2179	0.142
0.2177	0.117
0.2176	0.096
0.2175	0.087
0.2173	0.085
0.2172	0.071
0.2171	0.063
0.2169	0.060
DATA SET 4	
T = 296.0	
0.1612	0.209
0.1623	0.197
0.1629	0.193
0.1649	0.200
0.1659	0.211
0.1665	0.226

λ	ρ
DATA SET 4(CONT.)	
0.1672	0.239
0.1675	0.242
0.1688	0.246
0.1695	0.244
0.1709	0.240
0.1717	0.247
0.1723	0.258
0.1769	0.239
0.1785	0.226
0.1825	0.222
0.1839	0.218
0.1853	0.220
0.1866	0.236
0.1874	0.246
0.1886	0.251
0.1893	0.245
0.1906	0.242
0.1921	0.242
0.1941	0.239
0.1951	0.223
0.1961	0.217
0.1986	0.211
0.2002	0.200
0.2020	0.203
0.2037	0.202
0.2059	0.200
0.2072	0.192
0.2090	0.172
0.2106	0.178
0.2122	0.176
0.2134	0.165
0.2149	0.165
0.2159	0.169
0.2172	0.171
0.2193	0.171
0.2220	0.172
0.2230	0.165
0.2235	0.159
0.2246	0.159
0.2258	0.162

λ	ρ
DATA SET 4(CONT.)	
0.2281	0.157
0.2290	0.164
0.2310	0.189
0.2329	0.214
0.2346	0.221
0.2359	0.218
0.2382	0.193
0.2421	0.185
0.2447	0.175
0.2474	0.165
0.2508	0.159
0.2527	0.155
0.2538	0.141
0.2544	0.132
0.2555	0.130
0.2567	0.133
0.2574	0.141
0.2585	0.143
0.2600	0.146
DATA SET 5	
T = 296.0	
0.1630	0.522
0.1651	0.520
0.1659	0.515
0.1669	0.512
0.1689	0.515
0.1762	0.469
0.1794	0.442
0.1811	0.439
0.1830	0.440
0.1843	0.436
0.1860	0.432
0.1868	0.436
0.1872	0.440
0.1884	0.436
0.1893	0.428
0.1948	0.387
0.1975	0.354

λ	ρ
DATA SET 5(CONT.)	
0.1988	0.336
0.2003	0.329
0.2024	0.334
0.2043	0.334
0.2057	0.329
0.2075	0.310
0.2085	0.307
0.2096	0.310
0.2104	0.325
0.2123	0.339
0.2135	0.335
0.2158	0.332
0.2177	0.302
0.2190	0.298
0.2202	0.300
0.2218	0.307
0.2233	0.305
0.2243	0.311
0.2254	0.313
0.2267	0.310
0.2287	0.298
0.2303	0.312
0.2311	0.325
0.2317	0.332
0.2331	0.329
0.2357	0.296
0.2363	0.277
0.2388	0.265
0.2402	0.267
0.2412	0.282
0.2428	0.285
0.2443	0.281
0.2454	0.271
0.2467	0.266
0.2481	0.269
0.2492	0.290
0.2508	0.295
0.2522	0.291
0.2537	0.272
0.2546	0.263

TABLE C11. SUMMARY OF MEASUREMENTS ON THE REFLECTIVITY OF POTASSIUM FLUORIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	66	ROESSLER, D.M., LEMPKA, H.J.	1966	R	0.052-50.207	298	SINGLE CRYSTAL; FRESHLY CLEAVED; NORMAL REFLECTIVITY MEASURED; DATA EXTRACTED FROM A CURVE.
2	67	RAO, K.K., MORAVEC, T.J., RIFE, J.C., DEXTER, R.N.	1975	R	0.035-0.138	30	SINGLE CRYSTAL; OBTAINED FROM HARSHAW CHEMICAL CO.; CLEAVED SPECIMEN OF 1 CM DIAMETER AND 3 MM THICK; SPECIMEN KEPT IN VACUUM DURING REFLECTANCE MEASUREMENTS; NEAR NORMAL REFLECTIVITY OBTAINED; DATA EXTRACTED FROM A CURVE.

TABLE C12. EXPERIMENTAL DATA ON THE REFLECTIVITY OF POTASSIUM FLUORIDE

[WAVELENGTH, λ, μM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

λ	ρ
DATA SET 1	
T = 298.0	
0.052	0.035
0.053	0.046
0.055	0.053
0.059	0.029
0.062	0.060
0.065	0.038
0.067	0.042
0.069	0.036
0.071	0.045
0.073	0.043
0.074	0.044
0.075	0.030
0.080	0.014
0.086	0.062
0.089	0.069
0.093	0.085
0.095	0.077
0.097	0.075
0.100	0.056
0.104	0.166
0.105	0.125
0.108	0.102
0.117	0.083
0.121	0.058
0.124	0.023
0.127	0.071
0.130	0.240
0.132	0.189
0.135	0.118
0.140	0.092
0.159	0.055
0.207	0.035
DATA SET 2	
T = 30.0	
0.035	0.024
0.036	0.027
0.037	0.025
0.038	0.038
0.040	0.089
0.041	0.084
0.042	0.058
0.043	0.070
0.044	0.043
0.045	0.053
0.046	0.088
0.046	0.089
0.047	0.046
0.048	0.036
0.049	0.035
0.050	0.049
0.051	0.037
0.052	0.031
0.053	0.026
0.054	0.019
0.055	0.016
0.056	0.056
0.057	0.047
0.058	0.045
0.059	0.013
0.060	0.009
0.061	0.016
0.062	0.069
0.063	0.080
0.064	0.035
0.065	0.049
0.067	0.040
0.068	0.023
0.069	0.022
0.070	0.036
0.071	0.032
0.072	0.041
0.074	0.081
0.076	0.042
0.079	0.028
0.082	0.027
0.084	0.022
0.087	0.024
0.091	0.024
0.094	0.027
0.097	0.012
0.099	0.009
0.100	0.021
0.102	0.212
0.105	0.045
0.106	0.035
0.110	0.029
0.113	0.031
0.118	0.000
0.124	0.249
0.126	0.083
0.130	0.068
0.134	0.057
0.137	0.052

TABLE C13. SUMMARY OF MEASUREMENTS ON THE REFLECTIVITY OF RUBIDIUM FLUORIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	54	PEIMANN, C.J., SKIBOWSKI, M.	1971	R	0.041-0.151	298	SINGLE CRYSTAL; FRESHLY CLEAVED SPECIMENS; NEAR NORMAL REFLECTION SPECTRUM OBSERVED; DATA EXTRACTED FROM A FIGURE.

TABLE C14. EXPERIMENTAL DATA ON THE REFLECTIVITY OF RUBIDIUM FLUORIDE

[WAVELENGTH, λ, μM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

DATA SET 1
T = 298.0

λ	ρ
0.041	0.070
0.043	0.082
0.044	0.097
0.046	0.110
0.047	0.101
0.048	0.083
0.049	0.074
0.051	0.068
0.052	0.068
0.053	0.071
0.056	0.093
0.057	0.086
0.058	0.076
0.059	0.069
0.060	0.062
0.061	0.052
0.062	0.050
0.063	0.053
0.064	0.090
0.066	0.139
0.068	0.094
0.069	0.123
0.070	0.094
0.071	0.077
0.072	0.090
0.073	0.095
0.075	0.072
0.077	0.119
0.079	0.070
0.083	0.053
0.085	0.039
0.086	0.032
0.089	0.027
0.095	0.032
0.100	0.031
0.104	0.036
0.108	0.044
0.113	0.077
0.117	0.053

DATA SET 1(CONT.)

λ	ρ
0.120	0.047
0.123	0.031
0.126	0.046
0.129	0.169
0.130	0.201
0.134	0.222
0.136	0.210
0.141	0.097
0.143	0.086
0.145	0.077
0.150	0.067

TABLE C15. SUMMARY OF MEASUREMENTS ON THE REFLECTIVITY OF RUBIDIUM CHLORIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	68	BALDINI, G., BOSACCHI, B.	1968	R	0.126-0.184	300	SINGLE CRYSTAL; SPECIMEN WITH CLEAVED SURFACE; BACK SURFACE OF THE SPECIMEN TREATED WITH AN EMERY CLOTH TO REDUCE THE REFLECTION FROM THE BACK; NEAR NORMAL (20 DEGREE ANGLE OF INCIDENCE) REFLECTIVITY OBTAINED WITH SPECIMEN IN VACUUM; DATA EXTRACTED FROM A FIGURE.
2	68	BALDINI, G., ET AL.	1968	R	0.126-0.174	55	SIMILAR TO ABOVE BUT AT LOW TEMPERATURE.
3	54	PIEMANN, C.J., SKIBOWSKI, M.	1971	R	0.041-0.148	298	SINGLE CRYSTAL; FRESHLY CLEAVED SPECIMENS; NEAR NORMAL REFLECTION SPECTRUM OBSERVED; DATA EXTRACTED FROM A FIGURE.

TABLE C16. EXPERIMENTAL DATA ON THE REFLECTIVITY OF RUBIDIUM CHLORIDE

[WAVELENGTH, λ, UM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

λ	ρ
DATA SET 1 T = 300.0	
0.126	0.0928
0.127	0.0905
0.130	0.0916
0.132	0.0866
0.133	0.0690
0.134	0.0743
0.135	0.1538
0.136	0.2523
0.137	0.2924
0.138	0.3235
0.139	0.3235
0.140	0.2951
0.142	0.2500
0.143	0.2094
0.145	0.1803
0.146	0.1545
0.148	0.1393
0.149	0.1321
0.151	0.1216
0.153	0.1111
0.154	0.1018
0.155	0.0864
0.156	0.0645
0.157	0.0598
0.158	0.0547
0.160	0.1104
0.161	0.1588
0.162	0.2172
0.164	0.2831
0.165	0.3388
0.166	0.3622
0.167	0.3622
0.169	0.3280
0.171	0.2766
0.174	0.2301
0.176	0.1923
0.179	0.1651
0.181	0.1566
0.183	0.1462

λ	ρ
DATA SET 2 T = 55.0	
0.126	0.1044
0.127	0.1020
0.128	0.1035
0.129	0.1035
0.130	0.0995
0.131	0.0895
0.132	0.0707
0.133	0.0504
0.134	0.0687
0.135	0.1442
0.136	0.2454
0.137	0.3655
0.138	0.5116
0.139	0.4841
0.140	0.3326
0.141	0.2747
0.142	0.2523
0.143	0.2094
0.145	0.1803
0.146	0.1636
0.147	0.1555
0.148	0.1534
0.149	0.1455
0.150	0.1406
0.151	0.1442
0.152	0.1393
0.153	0.0950
0.154	0.0636
0.155	0.0220
0.156	0.0223
0.157	0.0584
0.159	0.2103
0.160	0.3357
0.161	0.5345
0.162	0.4775
0.164	0.3672
0.165	0.4405
0.166	0.3523
0.168	0.2818

λ	ρ
DATA SET 2(CONT.)	
0.170	0.2197
0.172	0.1819
0.174	0.1621
DATA SET 3 T = 298.0	
0.0413	0.017
0.0424	0.020
0.0434	0.027
0.0453	0.044
0.0473	0.056
0.0486	0.068
0.0499	0.080
0.0506	0.080
0.0517	0.067
0.0525	0.061
0.0532	0.064
0.0562	0.107
0.0568	0.110
0.0574	0.107
0.0593	0.086
0.0606	0.063
0.0617	0.059
0.0626	0.061
0.0642	0.093
0.0661	0.114
0.0671	0.116
0.0677	0.120
0.0685	0.085
0.0693	0.060
0.0707	0.100
0.0713	0.074
0.0718	0.072
0.0722	0.078
0.0728	0.057
0.0738	0.058
0.0744	0.041
0.0756	0.074
0.0761	0.077

λ	ρ
DATA SET 3(CONT.)	
0.0768	0.075
0.0774	0.042
0.0783	0.031
0.0787	0.026
0.0803	0.023
0.0830	0.024
0.0841	0.028
0.0863	0.038
0.0883	0.053
0.0893	0.065
0.0893	0.083
0.0919	0.093
0.0936	0.111
0.0983	0.229
0.1000	0.236
0.1018	0.223
0.1064	0.130
0.1081	0.113
0.1099	0.102
0.1117	0.095
0.1153	0.090
0.1179	0.088
0.1250	0.093
0.1306	0.079
0.1350	0.300
0.1374	0.311
0.1398	0.201
0.1415	0.181
0.1443	0.165
0.1481	0.147

TABLE C17. SUMMARY OF MEASUREMENTS ON THE REFLECTIVITY OF RUBIDIUM BROMIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	68	BALDINI, G., BOSACCHI, B.	1968	R	0.124-0.20	300	SINGLE CRYSTAL; SPECIMEN WITH CLEAVED SURFACE; BACK SURFACE OF THE SPECIMEN TREATED WITH AN EMERGY CLOTH TO REDUCE THE REFLECTION FROM THE BACK; NEAR NORMAL (20 DEGREE ANGLE OF INCIDENCE) REFLECTIVITY OBTAINED WITH SPECIMEN IN VACUUM; DATA EXTRACTED FROM A FIGURE.
2	68	BALDINI, G., ET AL.	1968	R	0.127-0.193	55	SIMILAR TO ABOVE BUT AT LOW TEMPERATURE.
3	54	PIEMANN, C.J., SKIBOWSKI, M.	1971	R	0.041-0.124	298	SINGLE CRYSTAL; FRESHLY CLEAVED SPECIMENS; NEAR NORMAL REFLECTION SPECTRUM OBSERVED; DATA EXTRACTED FROM A FIGURE.

TABLE C18. EXPERIMENTAL DATA ON THE REFLECTIVITY OF RUBIDIUM BROMIDE

[WAVELENGTH, λ, UM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

λ	ρ
DATA SET 1	
T = 300.0	
0.124	0.0713
0.127	0.0680
0.130	0.0606
0.133	0.0549
0.135	0.0524
0.138	0.0524
0.140	0.0549
0.141	0.0619
0.145	0.0792
0.146	0.0841
0.147	0.0750
0.148	0.0820
0.150	0.1124
0.151	0.1910
0.152	0.1982
0.154	0.1858
0.156	0.1660
0.158	0.1690
0.161	0.1406
0.166	0.0955
0.169	0.0813
0.171	0.0753
0.172	0.0753
0.174	0.0849
0.177	0.1746
0.179	0.2005
0.181	0.1730
0.183	0.1061
0.185	0.0912
0.187	0.0803
0.188	0.0885
0.191	0.2089
0.192	0.2512
0.194	0.2698
0.197	0.2118
0.199	0.1710

λ	ρ
DATA SET 2	
T = 55.0	
0.127	0.0597
0.129	0.0523
0.134	0.0379
0.135	0.0346
0.137	0.0328
0.138	0.0338
0.139	0.0355
0.141	0.0311
0.142	0.0344
0.143	0.0376
0.144	0.0393
0.145	0.0554
0.146	0.0605
0.147	0.0295
0.148	0.0182
0.149	0.0185
0.150	0.1349
0.151	0.2070
0.152	0.2382
0.153	0.1592
0.155	0.1057
0.156	0.1161
0.157	0.1592
0.158	0.1380
0.159	0.1239
0.161	0.1180
0.162	0.1205
0.164	0.0785
0.166	0.0557
0.168	0.0478
0.169	0.0401
0.170	0.0383
0.171	0.0428
0.172	0.0753
0.173	0.3159
0.174	0.4614
0.175	0.3185
0.176	0.2382
0.177	0.1702

λ	ρ
DATA SET 2(CONT.)	
0.180	0.0826
0.182	0.0376
0.183	0.0140
0.184	0.0801
0.185	0.2339
0.186	0.4499
0.187	0.7381
0.188	0.4257
0.189	0.2931
0.191	0.2302
0.193	0.2056
DATA SET 3	
T = 298.0	
0.0415	0.009
0.0431	0.011
0.0448	0.016
0.0457	0.022
0.0495	0.043
0.0510	0.051
0.0521	0.051
0.0526	0.049
0.0534	0.041
0.0542	0.039
0.0554	0.043
0.0565	0.050
0.0574	0.061
0.0579	0.063
0.0587	0.062
0.0606	0.039
0.0619	0.036
0.0635	0.039
0.0657	0.070
0.0672	0.094
0.0690	0.061
0.0709	0.101
0.0716	0.067
0.0723	0.069
0.0733	0.043

λ	ρ
DATA SET 3(CONT.)	
0.0742	0.041
0.0747	0.031
0.0760	0.051
0.0776	0.026
0.0801	0.024
0.0840	0.015
0.0871	0.015
0.0901	0.018
0.0921	0.027
0.0954	0.054
0.0977	0.074
0.0989	0.092
0.1019	0.100
0.1070	0.181
0.1090	0.185
0.1110	0.183
0.1134	0.165
0.1160	0.166
0.1177	0.162
0.1196	0.106
0.1214	0.087
0.1240	0.074

TABLE C19. SUMMARY OF MEASUREMENTS ON THE REFLECTIVITY OF RUBIDIUM IODIDE

DATA SET NO.	REF. NO.	AUTHOR(S)	YEAR	METHOD USED	WAVENUMBER RANGE, CM^{-1}	TEMPERATURE RANGE, K	SPECIFICATIONS AND REMARKS
1	68	BALDINI, G., BOSACCHI, B.	1968	R	0.129-0.239	300	SINGLE CRYSTAL; SPECIMEN WITH CLEAVED SURFACE; BACK SURFACE OF THE SPECIMEN TREATED WITH AN EMERGY CLOTH TO REDUCE THE REFLECTION FROM THE BACK; NEAR NORMAL (20 D ANGLE OF INCIDENCE) REFLECTIVITY OBTAINED WITH SPECIMEN IN VACUUM; DATA EXTRACTED FROM A FIGURE.
2	68	BALDINI, G., ET AL.	1968	R	0.129-0.226	55	SIMILAR TO ABOVE BUT AT LOW TEMPERATURE.
3	69	ROESSLER, D.M., WALKER, W.C.	1967	R	0.110-0.248	293	SINGLE CRYSTAL; CLEAVED IN AIR; EXPOSED TO ATMOSPHERE FOR 2 MINUTES; NEAR NORMAL REFLECTIVITY; MEASURED IN VACUUM; DATA EXTRACTED FROM A CURVE.
4	69	ROESSLER, D.M., WALKER, W.C.	1967	R	0.110-0.248	77	ABOVE SPECIMEN AND CONDITIONS.
5	70	KATO, R., WATANABE, M.	1968	R	0.174-0.248	273	SINGLE CRYSTAL; GROWN FROM THE MELT; 2 MM THICK; FRESHLY CLEAVED IN AIR; NEAR NORMAL REFLECTIVITY MEASURED IN VACUUM; DATA EXTRACTED FROM A CURVE.
6	59	MCCARTHY, D.E.	1968	R	2.6-43.8	313	SYNTHETIC SINGLE CRYSTAL; 3.91 MM THICK; FLAT TO 10 FRINGES OR BETTER; NEAR NORMAL REFLECTIVITY; MEASUREMENT MADE WITH AN ALUMINUM MIRROR REFERENCE STANDARD; DATA EXTRACTED FROM A CURVE.
7	54	PEIMANN, G.J., SKIBOWSKI, M.	1971	R	0.041-0.131	298	SINGLE CRYSTAL; FRESHLY CLEAVED SPECIMEN; NEAR NORMAL REFLECTION SPECTRUM OBSERVED; DATA EXTRACTED FROM A FIGURE.

TABLE C20. EXPERIMENTAL DATA ON THE REFLECTIVITY OF RUBIDIUM IODIDE

[WAVELENGTH, λ, μM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

λ	ρ
DATA SET 1 T = 300.0	
0.129	0.0755
0.131	0.1089
0.133	0.1259
0.134	0.1368
0.135	0.1396
0.140	0.1188
0.143	0.1079
0.145	0.0997
0.146	0.0975
0.147	0.0973
0.149	0.1011
0.151	0.1127
0.152	0.1183
0.155	0.1253
0.157	0.1349
0.160	0.1349
0.162	0.1210
0.164	0.1117
0.166	0.1040
0.168	0.0993
0.171	0.0993
0.172	0.1045
0.173	0.1172
0.175	0.1510
0.176	0.2028
0.177	0.2318
0.178	0.2518
0.179	0.2518
0.180	0.2449
0.182	0.2280
0.183	0.2188
0.184	0.2275
0.186	0.2673
0.188	0.3221
0.191	0.3221
0.194	0.3289
0.195	0.2891
0.198	0.2138
0.200	0.1730

λ	ρ
DATA SET 1(CONT.)	
0.203	0.1455
0.207	0.1303
0.210	0.1191
0.213	0.0993
0.216	0.0772
0.217	0.0830
0.221	0.1945
0.223	0.2871
0.225	0.3631
0.228	0.2600
0.231	0.2009
0.233	0.1687
0.238	0.1435
DATA SET 2 T = 55.0	
0.128	0.0762
0.131	0.1167
0.133	0.1364
0.134	0.1445
0.135	0.1445
0.136	0.1333
0.138	0.1177
0.139	0.1023
0.141	0.0887
0.144	0.0676
0.145	0.0639
0.147	0.0557
0.149	0.0708
0.150	0.0824
0.152	0.0824
0.154	0.0792
0.155	0.0767
0.156	0.0767
0.158	0.0807
0.159	0.0908
0.160	0.1018
0.161	0.0861
0.163	0.0727

λ	ρ
DATA SET 2(CONT.)	
0.164	0.0662
0.167	0.0623
0.168	0.0671
0.169	0.0736
0.171	0.0738
0.172	0.0586
0.173	0.0380
0.175	0.1538
0.177	0.4366
0.180	0.2512
0.181	0.2203
0.182	0.2158
0.183	0.1581
0.185	0.1778
0.186	0.3802
0.187	0.4437
0.188	0.2952
0.189	0.2524
0.190	0.2661
0.191	0.3304
0.193	0.2577
0.195	0.2009
0.198	0.1660
0.200	0.1517
0.201	0.1403
0.203	0.1496
0.204	0.1702
0.206	0.1172
0.209	0.0883
0.210	0.0533
0.212	0.0289
0.214	0.3855
0.215	0.6747
0.216	0.7587
0.217	0.5048
0.219	0.2924
0.221	0.2286
0.223	0.1854
0.225	0.1644

λ	ρ
DATA SET 3 T = 300.0	
0.110	0.090
0.114	0.114
0.118	0.154
0.120	0.177
0.121	0.172
0.123	0.191
0.129	0.179
0.133	0.224
0.135	0.224
0.138	0.193
0.140	0.152
0.144	0.143
0.146	0.126
0.148	0.120
0.150	0.130
0.153	0.153
0.158	0.163
0.160	0.165
0.164	0.135
0.169	0.111
0.174	0.135
0.175	0.197
0.178	0.271
0.181	0.235
0.184	0.238
0.188	0.307
0.193	0.322
0.195	0.236
0.199	0.187
0.204	0.155
0.210	0.144
0.216	0.099
0.219	0.114
0.222	0.241
0.224	0.336
0.230	0.210
0.233	0.178
0.234	0.184
0.240	0.159

λ	ρ
DATA SET 3(CONT.)	
0.248	0.143
DATA SET 4 T = 77.0	
0.110	0.110
0.112	0.121
0.114	0.144
0.116	0.161
0.118	0.159
0.119	0.176
0.121	0.201
0.123	0.234
0.124	0.232
0.125	0.205
0.127	0.144
0.129	0.203
0.131	0.278
0.132	0.294
0.134	0.271
0.138	0.196
0.141	0.146
0.145	0.109
0.147	0.109
0.150	0.155
0.152	0.160
0.156	0.143
0.159	0.180
0.162	0.124
0.165	0.111
0.167	0.115
0.170	0.124
0.171	0.110
0.173	0.067
0.174	0.128
0.175	0.194
0.177	0.525
0.179	0.322
0.180	0.272
0.182	0.283

λ	ρ
DATA SET 4(CONT.)	
0.183	0.224
0.184	0.249
0.186	0.500
0.189	0.310
0.191	0.418
0.192	0.322
0.194	0.261
0.196	0.211
0.203	0.169
0.205	0.192
0.207	0.134
0.211	0.074
0.212	0.025
0.216	0.839
0.220	0.322
0.222	0.244
0.226	0.191
0.232	0.179
0.235	0.186
0.240	0.159
0.248	0.143
DATA SET 5 T = 298.0	
0.174	0.122
0.176	0.164
0.178	0.244
0.179	0.252
0.183	0.218
0.184	0.215
0.185	0.227
0.189	0.289
0.191	0.280
0.193	0.292
0.195	0.286
0.198	0.205
0.201	0.165
0.205	0.142
0.211	0.126

TABLE C20. EXPERIMENTAL DATA ON THE REFLECTIVITY OF RUBIDIUM IODIDE (CONTINUED)

[WAVELENGTH, λ, μM; TEMPERATURE, T, K; REFLECTIVITY, ρ]

λ	ρ
DATA SET 5(CONT.)	
0.214	0.107
0.216	0.090
0.219	0.104
0.221	0.182
0.224	0.306
0.225	0.320
0.229	0.232
0.234	0.176
0.238	0.155
0.240	0.150
0.244	0.184
0.248	0.197
DATA SET 6	
T = 313.0	
2.60	0.045
3.10	0.057
4.20	0.069
38.1	0.069
39.4	0.062
40.7	0.053
41.8	0.039
42.8	0.024
43.4	0.014
43.8	0.000
DATA SET 7	
T = 298.0	
0.0412	0.012
0.0438	0.012
0.0455	0.013
0.0472	0.016
0.0491	0.020
0.0503	0.024
0.0514	0.029
0.0526	0.037
0.0534	0.038
0.0543	0.037
DATA SET 7(CONT.)	
0.0553	0.031
0.0564	0.032
0.0587	0.043
0.0596	0.044
0.0604	0.043
0.0620	0.036
0.0631	0.035
0.0643	0.036
0.0654	0.035
0.0666	0.037
0.0686	0.063
0.0699	0.041
0.0703	0.038
0.0711	0.040
0.0723	0.079
0.0734	0.033
0.0741	0.033
0.0748	0.031
0.0757	0.042
0.0765	0.044
0.0780	0.032
0.0792	0.032
0.0805	0.030
0.0825	0.034
0.0861	0.025
0.0886	0.029
0.0912	0.025
0.0937	0.029
0.0959	0.030
0.0990	0.025
0.1024	0.027
0.1059	0.066
0.1087	0.071
0.1110	0.106
0.1147	0.114
0.1199	0.185
0.1220	0.190
0.1277	0.189
0.1305	0.184