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Two Computer Programs to Produce Theoretical Absorption Spectra of Water Vapor and Carbon Dioxide

ELAINE M. DEUTSCHMAN
ROBERT F. CALFEE

APRIL, 1967
Boulder, Colorado

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ESSA TECHNICAL REPORT IER 31-ITSA 31

Two Computer Programs to Produce Theoretical Absorption Spectra of Water Vapor and Carbon Dioxide

ELAINE M. DEUTSCHMAN

ROBERT F. CALFEE

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Foreword

This research was supported by the Advanced Research Projects Agency of the Department of Defense and was monitored by Ralph Zirkind under ARPA Order No. 250.

Two Computer Programs to Produce Theoretical Absorption Spectra of Water Vapor and Carbon Dioxide

Elaine M. Deutschman and Robert F. Calfee

The theoretical basis and computational procedures for producing absorption spectra of water vapor and carbon dioxide under varying conditions of temperature and pressure are discussed. Such spectra are produced with a line-by-line analysis using theoretically calculated spectral parameters. Any experimentally practical degree of spectral resolution is possible.

Key Words: Absorption spectra, carbon dioxide, computer program, water vapor.

1. Introduction

In this report, the theory and methods of calculation used by two computer programs for producing theoretical absorption spectra are discussed. One of the programs, Spectrum, produces a spectrum of infinitely high resolution; the other, Degrade, applies an instrument factor to this infinitely high resolution spectrum to produce a spectrum of any desired resolution such as might be observed with an instrument. The instrument factor we used is a triangular function. The total absorptance, the area under the absorption curve, over a region of interest is also given by program Degrade.

The discussion will be composed of four parts: absorption coefficient, instrument factor, total absorptance, and program mechanics.

2. Absorption Coefficient

To produce the absorption spectrum for either absorber, the absorption, and hence the absorption coefficient, must be calculated at each frequency of interest. These calculations are based on the familiar extinction law of Lambert relating the observed intensity at frequency ν, I_ν, to the incident intensity at that frequency

$$I_\nu = I_{o_\nu} \exp(-k_\nu w), \tag{1}$$

where k_ν is the absorption coefficient at the frequency ν, and w is the absorber concentration. Thus, the fractional transmission of energy through w amount of absorber is

$$T_\nu (w) = I_\nu / I_{o_\nu} = \exp(-k_\nu w), \tag{2}$$

and the fractional absorption of energy by w is

$$A_\nu (w) = 1 - T_\nu (w). \tag{3}$$

In these programs, the Lorentz line shape is assumed; the expression for k_ν is then

$$k_\nu = \frac{S}{\pi} \frac{\alpha}{(\nu - \nu_o)^2 + \alpha^2}, \tag{4}$$

where S is the line intensity, α is the Lorentz half-width, and ν_o is the frequency at a line center. Figure 1 is a sketch of this line shape. A more detailed treatment of this and other line shapes is given by Goody (1964).

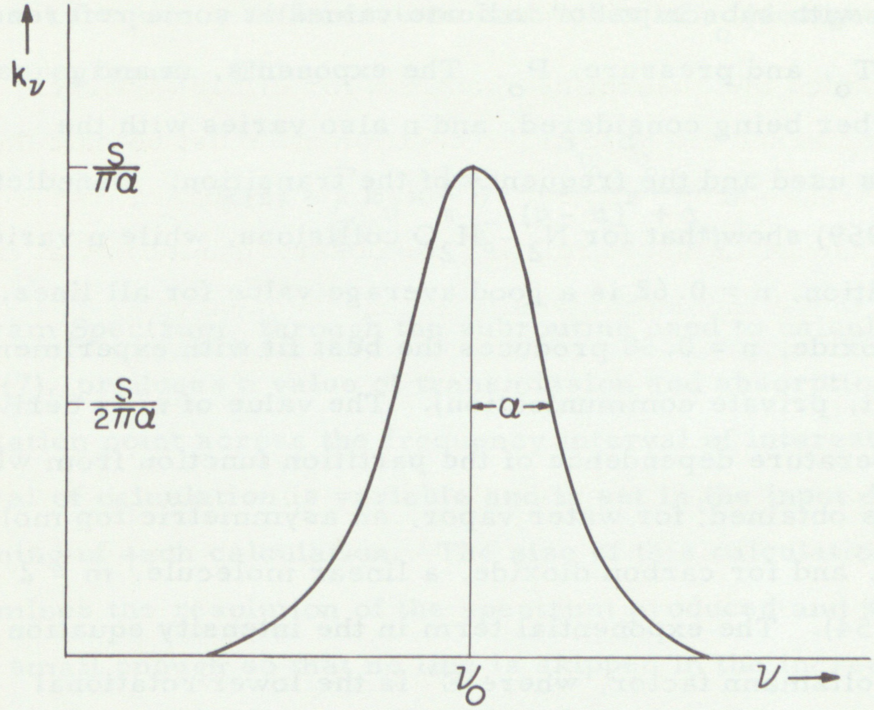

Figure 1. Lorentz line shape with $S = \int_{-\infty}^{\infty} k_\nu \, d\nu$.

Both the line intensity and the half-width are temperature dependent. In addition, the half-width is pressure dependent. These dependencies are

$$S = S_o \left(\frac{T_o}{T}\right)^m \exp\left[-\frac{E''}{k}\frac{(T_o - T)}{T_o T}\right] \tag{5}$$

and

$$\alpha = \alpha_o \left(\frac{P}{P_o}\right)\left(\frac{T_o}{T}\right)^n . \tag{6}$$

The quantities with subscript "o" indicate values at some reference temperature, T_o, and pressure, P_o. The exponents, m and n, vary with the absorber being considered, and n also varies with the broadening gas used and the frequency of the transition. Benedict and Kaplan (1959) show that for N_2 - H_2O collisions, while n varies with the transition, n = 0.62 is a good average value for all lines. For carbon dioxide, n = 0.58 produces the best fit with experimental work (Benedict, private communication). The value of m is derived from the temperature dependence of the partition function from which the intensity is obtained; for water vapor, an asymmetric top molecule, m = 1.5, and for carbon dioxide, a linear molecule, m = 2 (Herzberg, 1954). The exponential term in the intensity equation is the familiar Boltzmann factor, where E'' is the lower rotational energy level of the transition and k is Boltzmann's constant.

With (5) and (6), it is possible to account for pressure and temperature effects on the absorption coefficients. Comparison with experimental work shows these relations hold well over temperature and pressure ranges encountered in the atmosphere. With these relations, one can calculate absorption coefficients for almost any combination of temperature and pressure for which spectra are desired.

Because the absorption at any frequency results not only from lines near that frequency, but also from the wings of lines at some distance from that frequency, the contributions from all lines out to a reasonable distance must be considered. To do this, the absorption coefficient at frequency ν is calculated by summing over all k_ν out to some set frequency difference on both sides of υ_o (designated BOUND in the programs). Thus,

$$k(\upsilon) = \sum_{\upsilon_o} k_\upsilon = \frac{1}{\pi} \sum_{\upsilon_o} \frac{S_{\upsilon_o} \alpha_{\upsilon_o}}{(\upsilon - \upsilon_o)^2 + \alpha_{\upsilon_o}^2} . \qquad (7)$$

Program Spectrum, through the subroutine used to calculate k (υ) from (7), produces a value of transmission and absorption at every calculation point across the frequency interval of interest. The interval of calculation is variable and is set in the input data at the beginning of each calculation. The size of this calculation interval determines the resolution of the spectrum produced and should be made small enough so that no line is skipped in the incrementing process, i. e., the interval should be less than the pressure-corrected half-width. (Actually, the program calculates by two intervals depending on where the calculation point is with respect to a spectral line; see section 5 for details.)

Program Degrade, through the same subroutine, also gets a value for the transmission at each calculation point. This value, however, is an intermediate one that is stored until all transmission values for frequencies passed by the instrument slit function are obtained. These stored values are then combined to give what corresponds to an observed transmission at the center of the frequency interval passed by the slit function. This calculation is the subject of section 3.

3. Instrument Factor

The above method of calculating the absorption coefficient produces a spectrum of resolution equal to the calculating interval.

This calculation interval can be made as small as desired; it is generally much less than the line widths. An instrument with a finite resolving power would not produce such a spectrum. To compare experimentally observed spectra with those calculated theoretically, an instrument factor or slit function is applied to "degrade" the high-resolution results. The slit function, $\rho(\nu)$, is defined by its effect on the theoretical transmission, T_ν, to produce the observed transmission, $\overline{T}_{\nu_i}$. This relation is

$$\overline{T}_{\nu_i} = \frac{\int_{\nu_i - a}^{\nu_i + a} \rho(\nu) T_\nu \, d\nu}{\int_{\nu_i - a}^{\nu_i + a} \rho(\nu) \, d\nu}, \quad (8)$$

where ν_i is the central frequency of the interval being scanned by the instrument slit and a is the spectral slit width defined as the width of the slit function at half its peak.

Program Degrade applies a triangular slit function to the theoretical transmission. The triangular slit function represents the most common slit function shape for instruments that are not limited by diffraction. A discussion by von Planta (1957) shows that the Gaussian and triangular slit functions fit the measured Ebert spectrometer slit function well. We found, by comparison calculations, that the difference between application of a Gaussian function and a triangular function was insignificant for commonly used slit widths. More complex approximations to the actual slit function could be used if the exact shape of an instrument's slit function is known, and such close approximation is necessary.

The triangular function, as used here, is expressed as

$$\rho(\upsilon) = a - | \upsilon_i - \upsilon | . \tag{9}$$

This function is applied to the theoretical spectrum by superimposing it on the spectrum and finding the average transmission across the slit by (8). The slit function is then moved along the spectrum by a preset increment and the average transmission calculated at each frequency, again by (8). This preset increment is designated DELV in program Degrade. (Those transmission values common to two adjacent positionings of the slit function are stored each time, eliminating a lot of unnecessary recalculation.)

In the case of the triangular slit function, (8) can be rewritten as

$$\overline{T}_{\upsilon_i} = \frac{\int_{\upsilon_i - a}^{\upsilon_i + a} \left(a - | \upsilon_i - \upsilon | \right) T_\upsilon d\upsilon}{\int_{\upsilon_i - a}^{\upsilon_i + a} \left(a - | \upsilon_i - \upsilon | \right) d\upsilon} . \tag{8a}$$

For computing purposes, this is conveniently broken up and applied. The numerator can be rewritten as

$$\int_{\upsilon_i - a}^{\upsilon_i + a} \left(a - | \upsilon_i - \upsilon | \right) T_\upsilon d\upsilon \equiv \int_{\upsilon_i - a}^{\upsilon_i + a} \tau_\upsilon d\upsilon = \sum_{j=1}^{n} \left(\tau_{\upsilon_j} (\Delta\upsilon)_j \right) = \Delta\upsilon \sum_{j=1}^{n} \tau_{\upsilon_j} , \tag{10}$$

where τ_{υ} has replaced $T_{\upsilon}\rho(\upsilon)$ in (8) and twice the slit width, 2a, has been divided into n division of $\Delta\upsilon$ each. In program Degrade $\Delta\upsilon$ is called DV. The denominator of (8a) can be directly integrated to give

$$\int_{\upsilon_i - a}^{\upsilon_i + a} \left(a - \left| \upsilon_i - \upsilon \right| \right) d\upsilon = a^2 . \qquad (11)$$

Hence, the observed, average fractional transmission becomes

$$\overline{T}_{\upsilon_i} = \frac{\Delta\upsilon \sum_{j=1}^{n} \tau_{\upsilon_j}}{a^2} . \qquad (12)$$

Figure 2 shows these slit-width variables.

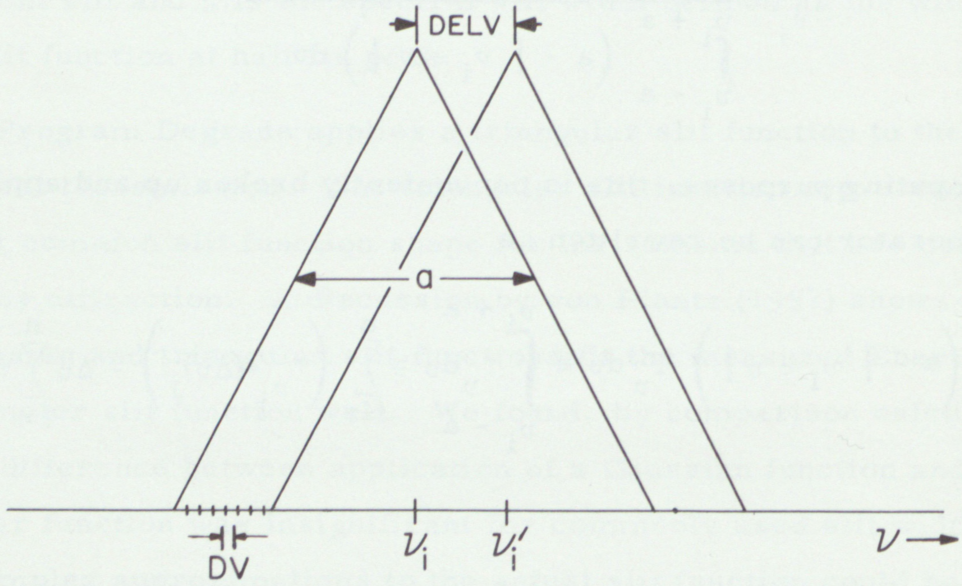

Figure 2. Two adjacent positionings of the slit function at υ_i and υ_i'.

This average transmission and its associated absorption at the center of the frequency interval spanned by the triangle are printed from Degrade. Because of the integration in (12), the absorption coefficient loses its direct meaning and hence is not printed from program Degrade as it is from program Spectrum.

4. Total Absorptance

In addition to the average fractional transmission and absorption, program Degrade integrates the absorption over the total frequency interval of interest to give the total absorptance

$$A = \int_{\nu_1}^{\nu_2} \left(1 - \overline{T}_\nu \right) d\nu . \qquad (13)$$

This merely represents the area under the absorption curve (a plot of $\overline{A}_\nu = 1 - \overline{T}_\nu$ vs frequency), which is a convenient quantity for comparing spectra of different resolutions or comparing theoretical and observed spectra over the same frequency range. Nielsen, Thornton, and Dale (1944) have shown that the area under the absorption curve for an entire region is invariant to changes in the slit width. For program Degrade, this principle has been extended so that the absorptance can be calculated for smaller frequency intervals between windows where absorption is very small. Good agreement with experimental work is obtained with this extension.

The total absorptance is calculated in program Degrade by using the simple trapezoidal rule for irregular areas. Simpson's rule could also be used, but comparison with actually measured areas shows the simpler trapezoidal rule to be very satisfactory. Note, however, that the calculation increment is usually small (of the order of a line half-width or so), thus reducing the error in such an approximation to the area. Calculations with all conditions held constant, but with the calculation interval set first at 0.05 wave number and then at 0.0125 wave number, showed no change in the calculated total absorptance out to five significant figures, indicating that a value near the line half-width is small enough. The calculated absorptance is printed at the end of the output with the temperature, pressure, and concentration conditions producing it.

5. Program Mechanics

The Fortran IV listings of the two programs, Spectrum and Degrade, and the subroutine used to calculate the absorption coefficient are found in the appendix. The comments preceding the computational section define the parameters used.

Complete samples of input data for both programs appear at the end of the listings. The needed data include the variable formats; the calculation counters and intervals, spectral slit width (for program Degrade), pressure, and BOUND values; temperature and correction constant values, and line parameters and absorber concentrations. The variable format feature of Fortran is used to provide flexibility in the form of the input data. The formats used with our data are included with the samples; the data cards shown fit these formats. The first variable format reflects the definite form of our line-data cards.

These line-data cards contain the line frequency, ν, in wave numbers (this frequency unit, represented by cm^{-1}, is the reciprocal of the wave length in cm); the line intensity, S, in $cm^{-1}/gm\ cm^{-2}$ for water vapor or cm^{-1}/atm cm for carbon dioxide; the half-width, α, in cm^{-1}/atm; and the ground-state energy, E'', in cm^{-1}. Examples of line cards for both water vapor and carbon dioxide are included in the appendix. There are fields on the data cards not mentioned above, as these data are not necessary for the transmission-absorption calculations. The extra fields are the transition identification and asymmetric rigid rotator strength in fields four and six, respectively, of the water vapor card and a band identification in the last field for both water vapor and carbon dioxide. Note that the third field for α is blank on the carbon dioxide card. This is done to provide a distinguishing feature from the water vapor card because the half-width has a constant value for all lines of carbon dioxide. (This allows the cards to be mixed in a special program that calculates the absorption characteristics of the two gases in combination--not included here--and then to be separated again.)

At present, the line data available for calculations are those of Gates, Calfee, Hansen, and Benedict (1964) for the 2.7μ water-vapor region; Benedict and Calfee (1967) for the 1.9μ and 6.3μ water-vapor regions; and Calfee and Benedict (1966) for the 2.05μ and 2.7μ carbon-dioxide regions. The 1.1μ and 0.9μ regions of water vapor will be available in the future.

Both programs could easily be modified for other absorbers, such as ozone, or for other forms of input data through the variable formats and variable correction constants IAX, BX, CX. The variable IAX has a value of 10^3 for carbon dioxide because the line intensities punched on the carbon-dioxide line cards have been multiplied by 10^3 to fit the same format as the water-vapor intensities.

Output samples, with headings to indicate what the values are, are also shown. From program Spectrum, the frequency, absorption coefficient, transmission, absorption, and calculation-interval identification are printed. The pressure, temperature, and calculation-interval values are also given. Program Degrade prints the frequency, transmission, absorption, and total absorptance. The pressure, temperature, slit width, calculation interval, and BOUND value are also included in the output.

Figures 3 through 6 show the numerical output in a plotted form. Here, the per cent absorption is plotted against frequency under two sets of conditions to produce a visual spectrum of the information from both programs.

Program Spectrum is designed to increment the calculations across an interval by one of two frequency intervals depending on how close the calculation point is to a spectral line. This method is used to save computing time. The large calculation interval (DELV1) is used between lines; it is usually of the order of 0.1 wave number. The small interval (DELV2) is used near the lines and is of the order of 0.001 wave number. (The sizes of both DELV1 and DELV2 are inverse functions of the amount of money available for computing purposes.) The point at which the interval changes from large to small is determined by the value of the variable, SETBAK, part of the input data. A value of about 0.05 wave number is usually used; it is convenient if the quotient SETBAK/DELV2 is an integer. The small interval of calculation is used until the frequency of the line center is reached. A line is assumed to be symmetric about its center frequency so that transmission and absorption values at distances out to SETBAK on the high frequency side are the same as at the same distances on the low frequency side. The program then increments the frequency by the large interval and continues calculating with the next line as a reference unless another line is encountered with less than twice SETBAK separation; then the program automatically takes this into account and continues to calculate with the small interval. An identification of which calculation interval was used to determine a printed value is given with the value; ID = 1 indicates the large interval, ID = 2 indicates the small interval.

A short subroutine, called Abscoef, is utilized by both programs to calculate the Lorentz absorption coefficient. This calculation procedure is used in several of our programs, and the subroutine method is an easy way of entering the procedure into these programs. The calling sequence is standard with the variables as listed with the subroutine. The subroutine returns a single value of the absorption coefficient with each call. A shortcut is employed in the calculation of the absorption coefficient; whenever the first term in the denominator of (7), the expression for $k(\nu)$, is greater than 2, the half-width term is neglected because it is usually less than 0.01.

The variable BOUND used in this subroutine is discussed in section 2. Its value is read with the input data and varies with the concentration and pressure conditions used. An approximate value can be determined for a region by considering the strongest line in the region, and determining at what distance from that line the absorption due to that line falls below some small value--say 0.01. This calculation is done by means of (4) and finding the value of $(\nu - \nu_o)$, neglecting α^2 in the denominator, as it would be small. Note that α in the numerator must be pressure-corrected; hence, the value of BOUND will vary with the square root of both the pressure and concentration.

Using (2), (3), and (4), and letting the maximum absorption allowed be A_m, BOUND is found to be

$$\text{BOUND} = \left[-\frac{1}{\pi} \frac{S \alpha P w}{\ln(1-A_m)} \right]^{1/2} , \qquad (14)$$

where S and α are taken for the strongest line in the region. It should be noted that because $1-A_m$ is less than 1, the logarithm of that quantity will be negative and the entire bracketed quantity will be positive, so that the square root can be taken. The value of BOUND increases with the stringency placed on the maximum absorption allowed, everything else being held constant. Here, again, funds for computing may determine an upper limit to the accuracy from this source.

Some cautionary remarks concerning both programs should be included here. In the event that the line cards are not in order by frequency, the programs will continue to calculate; however, the resulting values will be incorrect. Usually errors from this source are easily detectable, as the transmission values from the point where a card is out of place are grossly in error. Program Spectrum will also produce incorrect values if there is more than one line at a given frequency. Multiple lines should be combined in some manner; generally, the intensities are summed, the half-widths weighted by the intensities, and the ground-state energy of the strongest line used. Program Degrade correctly handles such multiple lines. Both programs make use of the variable BOUND, and care must be taken to see that enough line cards for proper calculation are included. For program Spectrum, cards of frequency from V1 - BOUND to V2 + BOUND must be included. For program Degrade, cards of frequency from V1 - BOUND - A to V2 + BOUND + A must be used (see variable definitions with the programs). The spectral slit width, A, must be included because these frequency limits constitute the first and last calculation points. In some instances where line cards aren't available to these frequency limits, dummy line cards at these frequency limits, but with intensities equal to zero, must be included. Such dummy lines do not contribute to the calculated values, but do force the program to behave properly.

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Appendix

Programs and Associated Input Data and Results

PROGRAM DEGRADE

PROGRAM DEGRADE GENERATES A TRANSMISSION AND ABSORPTION SPECTRUM OF DESIRED RESOLUTION BY CALCULATING THE ABSORPTION COEFFICIENT, ABSORPTION AND TRANSMISSION AT EACH FREQUENCY IN A SELECTED FREQUENCY INTERVAL ACCORDING TO THE CALCULATION INTERVAL CHOSEN.

THE INTEGRATED ABSORPTION(ABSORPTANCE) IS ALSO CALCULATED.

THE PROGRAM CAN WORK WITH ONE TEMPERATURE, PRESSURE, AND SPECTRAL SLIT WIDTH AND UP TO FIVE ABSORBER CONCENTRATIONS AT ONE TIME.

THE VARIABLES ARE -
GNU = FREQUENCY IN WAVE NUMBERS
S = LINE INTENSITY AT A PRESSURE OF ONE ATMOSPHERE AND A REFERENCE TEMPERATURE,TEMPO
ALFAO = LORENTZ LINE HALF-WIDTH AT ONE ATMOSPHERE AND TEMPO. IT IS CONSTANT FOR CARBON DIOXIDE AT 0.08 WAVE NUMBERS
EPP = GROUND STATE ENERGY FOR A GIVEN LINE IN WAVE NUMBERS
W = ABSORBER CONCENTRATION (IN PRECIPITABLE CENTIMETERS FOR WATER AND IN ATMOSPHERE CENTIMETERS FOR CARBON DIOXIDE)
FMT1, FMT2, FMT3 AND FMT4 ARE VARIABLE FORMATS READ IN AT EXECUTION TIME IN ORDER TO ALLOW FLEXIBILITY IN INPUT
K1 = NUMBER OF ABSORBER CONCENTRATIONS TO BE USED (1 THROUGH 5)
K2 = PRINTOUT FREQUENCY VARIABLE. K2 = 1 PERMITS PRINTING AT EVERY CALCULATION POINT. K2 = 2 PERMITS PRINTING AT EVERY OTHER POINT AND SO ON. K2 CANNOT BE ZERO.
I7=APPROXIMATELY THE NUMBER OF LINE CARDS UP TO V1-A+BOUND (SEE DEFINITIONS BELOW). IT NEED NOT BE ACCURATE AS IT IS USED TO SAVE TIME. THE ESTIMATE MUST BE LESS THAN I1 -THE TOTAL NUMBER OF CARDS - AND MUST BE LESS THAN OR EQUAL TO THE CORRECT VALUE IN ORDER TO INCLUDE THE PROPER NUMBER OF WAVE NUMBERS IN THE CALCULATION. IF IT IS NOT, THE PROGRAM WILL STOP WITH A DIAGNOSTIC.
DV = CALCULATION INTERVAL ACROSS THE TRIANGULAR SLIT WIDTH. IT MUST BE LESS THAN THE PRESSURE-CORRECTED HALF-WIDTH. USUALLY IT IS ABOUT 1/20 OF A SLIT WIDTH, IF IT IS NOT HALF-WIDTH LIMITED
DELV = SCAN INCREMENT OF THE TRIANGLE ACROSS THE FREQUENCY INTERVAL. THIS IS THE CALCULATION POINT REFERRED TO IN K2 ABOVE
DELV/DV SHOULD BE AN INTEGER.
V1 AND V2 ARE THE FREQUENCY INTERVAL LIMITS IN WAVE NUMBERS. NOTE THAT V1-A IS THE FIRST CALCULATION POINT AND V2+A IS THE LAST SO CARDS FROM V1-A-BOUND TO V2+A+BOUND MUST BE INCLUDED.
A = SPECTRAL SLIT WIDTH IN WAVE NUMBERS. 2*A MUST BE GREATER THAN DELV-DV AND (2*A)/DV SHOULD BE AN INTEGER.
P = PRESSURE IN ATMOSPHERES
NP = PLOT TAPE PREPARATION VARIABLE. NP = 1 PREPARES A TAPE TO BE USED IN A PLOT PROGRAM. NP = 2 BY-PASSES TAPE PREPARATION
BOUND = THE NUMBER OF WAVE NUMBERS TO BE CONSIDERED ON EITHER SIDE OF A PARTICULAR FREQUENCY WHEN CALCULATING THE ABSORPTION COEF.
TEMP = TEMPERATURE IN DEGREES KELVIN
IAX = INTENSITY CORRECTION FACTOR. FOR WATER IAX=1 AND FOR CARBON DIOXIDE IAX = 1000
BX = TEMPERATURE CORRECTION COEFFICIENT FOR INTENSITIES. FOR WATER BX = 1.5. FOR CARBON DIOXIDE, BX = 2.0

```
CX = TEMPERATURE CORRECTION EXPONENT FOR HALF-WIDTHS. FOR WATER,
CX = 0.62 AND FOR CARBON DIOXIDE, CX = 0.58
ICHK = A CHECKING VARIABLE TO BE SURE THAT A CARD WITH ABSORBER
CONCENTRATIONS HAS BEEN INCLUDED. ITS VALUE IS 1 AND IS PLACED ON
THE CARD ACCORDING TO FMT2
ITAPE = COMPUTING LAB NUMBER OF THE TAPE ON WHICH THE DATA FOR
PLOTTING ARE PUT

NOTE - A BLANK CARD MUST BE PLACED AFTER THE LAST LINE CARD SO THE
COMPUTER WILL KNOW THAT ALL LINE CARDS HAVE BEEN READ. IF MORE
THAN 2450 CARDS ARE READ, THE PROGRAM WILL STOP WITH A DIAGNOSTIC.


   DIMENSION W(5),E(5),AB(5),TT(5),TF(5),SUMT(5),TRAPSUM(5),FMT1(9),
  1 FMT2(9),FMT3(9),FMT4(9)
   COMMON/1/GNU(2450),S(2450),ALFA0(2450),CAY(1)/2/T(2450,5),EPP(2450
  1)
 1 FORMAT(9A8)
 2 FORMAT(F9.2,F12.6,2F10.5,E13.4)
 3 FORMAT(/11H0PRESSURE =F9.5,3X8HSLIT A =F9.5,3X13HTEMPERATURE =F9.2
  1//12H ABSORPTANCE,9X13HCONCENTRATION/)
 4 FORMAT(24H KICKED OUT FROM ST. NO.,I4)
 5 FORMAT(7H0  FREQ,7X6HLAMBDA,5X5HTRANS,5X6HABSORB,7X1HW/)
 6 FORMAT(F8.2,5F10.5)
 7 FORMAT(11H1PRESSURE =F9.5,3X13HTEMPERATURE =F9.2,3X8HSLIT A =F9.5,
  13X4HDV =F7.4,3X6HDELV =F7.4,3X7HBOUND =F7.2/)
 8 FORMAT(E12.4,10X,E11.4)
 9 FORMAT(///33H0DATA FOR PLOTTING ARE ON TAPE C-,I4)
10 FORMAT(I4)
11 FORMAT(60H1TOO MANY LINE CARDS.EXCEEDS DIMENSION. LAST CARD READ W
  1AS =F9.2)
12 FORMAT(19H1I7 TOO LARGE. I7 =I5,5X9HGNU(I7) =F9.2,5X12HV1-A+BOUND
  1=F9.2)


13 READ 1,(FMT1(I),I=1,9)
14 READ 1,(FMT2(I),I=1,9)
15 READ 1,(FMT3(I),I=1,9)
16 READ 1,(FMT4(I),I = 1,9)
17 READ FMT3,K1,K2,I7,DV,DELV,V1,V2,A,P,NP,BOUND
18 READ FMT4,TEMP,TEMP0,IAX,BX,CX

   READ IN LINE DATA AND COUNT CARDS

20 I=0
21 I=I+1
22 IF(I .EQ. 2451)23,25
23 PRINT 11,GNU(2450)
24 GO TO 1001
25 READ FMT1,GNU(I),S(I),ALFA0(I),EPP(I)
26 IF(GNU(I))21,27,21
27 I1=I-1

   READ IN ABSORBER CONCENTRATIONS AND CHECK FOR PRESENCE OF ABSORBER
```

```
      CARD. ALSO CHECK THAT GNU(I7) IS NOT GREATER THAN V1-A+BOUND.

   30 READ FMT2,W,ICHK
   31 IF(ICHK .EQ. 1)32,500
   32 XBOUND = V1 -A + BOUND
   33 IF(GNU(I7) .GT. XBOUND)34,36
   34 PRINT 12,I7,GNU(I7),XBOUND
   35 GO TO 1001
   36 PRINT 7,P,TEMP,A,DV,DELV,BOUND
   37 PRINT 5

      SET UP TEMPERATURE CORRECTION CONSTANTS AND CALCULATION COUNTERS

   40 I5=1
   41 SLIT=2.*A
   43 CS1 = (TEMP0-TEMP)/(TEMP0*TEMP*.6950)
   44 CS2=(TEMP0/TEMP)**BX
   45 CA=(TEMP0/TEMP)**CX
   46 IDIV=DELV/DV+.01
   47 NODD1=IDIV+1
   48 NODD2 = (SLIT/DV) + 1.00001
   49 NODD3 = NODD2 - IDIV
   50 VI = V1
   51 V = V1 - A
   52 NJ = 1
   53 N=K2
   55 SLTFTR = DV/(A**2)

      TEMPERATURE CORRECT STRENGTHS AND HALF-WIDTHS

   60 DO 66 I=1,I1
   61 S(I)=S(I)*CS2*EXPF(-EPP(I)*CS1)/IAX
   62 IF(IAX .EQ. 1)63,65
   63 ALFA0(I)=ALFA0(I)*CA
   64 GO TO 66
   65 ALFA0(I) = 0.08*CA
   66 CONTINUE

      INITIALIZE SUMMATIONS

   70 DO 71 K=1,K1
   71 SUMT(K) = TRAPSUM(K) = 0.0

      ABSORPTION COEFFICIENT CALCULATION BY SUBROUTINE ABSCOEF

   79 DO 150 NN = NJ,NODD2
   80 CALL ABSCOEF(V,BOUND,I7,I1,P)

      TRANSMISSION SUMMATION AND APPLICATION OF VARIABLE PORTION OF SLIT
      FACTOR INTEGRAL

  130 DO 138 K=1,K1
  134 T(NN,K) = EXPF(-W(K)*CAY)
  136 TT(K)=(A-ABSF(V-VI))*T(NN,K)
```

```
138 SUMT(K)=SUMT(K)+TT(K)
150 V=V+DV
154 V=VI

    TRANSMISSION AND ABSORPTION CALCULATION WITH FINAL SLIT FACTOR
    APPLICATION

160 DO 176 K=1,K1
161 TF(K)=SUMT(K)*SLTFTR
162 E(K)=1.-TF(K)
163 IF(V-V1) 509,164,166
164 TRAPSUM(K) = TRAPSUM(K) +0.5*E(K)
165 GO TO 171
166 TRAPSUM(K) = TRAPSUM(K) + E(K)

    OUTPUT STATEMENTS AND FREQUENCY INCREMENTING

171 IF(N .EQ. K2)172,176
172 IF(K .EQ. K1)173,174
173 N=0
174 ALAM = 1.E+4/V
175 PRINT 2,V,ALAM,TF(K),E(K),W(K)
176 CONTINUE
177 GO TO(180,181),MP
180 WRITE(2,6)V,E(1),E(2),E(3),E(4),E(5)
181 V=V+DELV
190 DO 191 K=1,K1
191 SUMT(K)=0.0
192 N=N+1
200 IF(V-V2)201,201,235

    SAVING OF ALREADY CALCULATED TRANSMISSION VALUES FOR NEXT STEP
    IN THE CALCULATION

201 DO 205 K=1,K1
202 DO 204 NN = NODD1,NODD2
203 KK=NN-IDIV
204 T(KK,K)=T(NN,K)
205 CONTINUE
210 VI=V
211 V=V-A
215 DO 219 NN = 1,NODD3
216 DO 218 K=1,K1
217 TT(K)=(A-ABSF(V-VI))*T(NN,K)
218 SUMT(K)=SUMT(K)+TT(K)
219 V=V+DV
225 NJ = NODD3 + 1
229 GO TO 79

    TRAPAZOIDAL RULE CALCULATION OF TOTAL ABSORPTANCE

235 PRINT 3,P,A,TEMP
236 DO 238 K=1,K1
237 AB(K) = DELV*(TRAPSUM(K)-0.5*E(K))
```

```
238 PRINT 8,AB(K),W(K)
240 GO TO(241,1001),NP
241 END FILE 2
242 REWIND 2
243 READ 10,ITAPE
244 PRINT 9,ITAPE
245 GO TO 1001

    KICKOUT STATEMENTS

500 NX = 31
501 GO TO 1000
509 NX = 163
1000 PRINT 4,NX
1001 CALL EXIT
    END
```

VARIABLE FORMATS AND INPUT DATA (EXCEPT LINE DATA) FOR PROGRAM DEGRADE

```
(F8.2,F10.4,F8.4,22X,F7.2)                                          FMT1 DEG
(5E10.4,29X,I1)                                                     FMT2 DEG
(2I3,I5,2F7.4,2F8.2,2F8.4,I2,F8.2)                                  FMT3 DEG
(2F7.2,I5,2F5.2)                                                    FMT4 DEG
  2  1  300 0.0500 0.200   5182.00 5193.01   0.5000  1.0000 1    50.00
 287.70 287.70      1 1.50 0.62                                 WATER VAPOR

(LINE DATA CARDS PRECEDE THE CONCENTRATION CARD)
 .1000E+00 .1000E-01                                                      1
```

PROGRAM SPECTRUM
PROGRAM SPECTRUM GENERATES A THEORETICAL TRANSMISSION AND ABSORPTION SPECTRUM OF VERY HIGH RESOLUTION BY CALCULATING THE ABSORPTION COEFFICIENT, TRANSMISSION AND ABSORPTION AT EACH FREQUENCY IN A SELECTED FREQUENCY INTERVAL ACCORDING TO THE CALCULATION INTERVALS CHOSEN.
THE PROGRAM CAN WORK WITH ONE TEMPERATURE AND PRESSURE AND UP TO FIVE ABSORBER CONCENTRATIONS AT A TIME.

CAUTION - PROGRAM SPECTRUM WILL NOT CORRECTLY TREAT MORE THAN ONE LINE AT A GIVEN FREQUENCY. THESE MUST BE COMBINED INTO A SINGLE LINE AT THAT FREQUENCY.

THE PROGRAM VARIABLES ARE-
GNU = FREQUENCY IN WAVE NUMBERS
S = LINE INTENSITY AT A PRESSURE OF ONE ATMOSPHERE AND A REFERENCE TEMPERATURE,TEMPO
ALFAO = LORENTZ LINE HALF-WIDTH AT ONE ATMOSPHERE AND TEMPO. IT IS CONSTANT FOR CARBON DIOXIDE AT 0.08 WAVE NUMBERS
EPP = GROUND STATE ENERGY FOR A GIVEN LINE IN WAVE NUMBERS
W = ABSORBER CONCENTRATION (IN PRECIPITABLE CENTIMETERS FOR WATER AND IN ATMOSPHERE CENTIMETERS FOR CARBON DIOXIDE)
FMT1, FMT2, FMT3 AND FMT4 ARE VARIABLE FORMATS READ IN AT EXECUTION TIME TO ALLOW FLEXIBILITY IN INPUT
K1 = NUMBER OF ABSORBER CONCENTRATIONS USED (1 THROUGH 5)
K3 = PRINTOUT FREQUENCY VARIABLE FOR LARGE INCREMENT CALCULATION.
K3 = 1 PERMITS PRINTING AT EACH CALCULATION POINT. K3 = 2 PERMITS PRINTING AT EVERY OTHER CALCULATION POINT. K3 = 3 PERMITS PRINTING AT EVERY THIRD POINT AND SO ON. K3 CANNOT BE ZERO.
K4 = PRINTOUT VARIABLE FOR SMALL INCREMENT CALCULATION. ITS VALUES HAVE THE SAME EFFECT AS THOSE FOR K3
V1 AND V2 ARE THE FREQUENCY INTERVAL LIMITS FOR THE CALCULATION IN WAVE NUMBERS
DELV1 = THE FREQUENCY INCREMENT USED IN THE LARGE INTERVAL IN WAVE NUMBERS
DELV2 = THE FREQUENCY INCREMENT USED IN THE SMALL INTERVAL IN WAVE NUMBERS
SETBAK = THE SIZE OF THE INTERVAL(IN WAVE NUMBERS) THROUGH WHICH THE SMALL INCREMENT IS USED. SETBAK/DELV2 SHOULD BE AN INTEGER.
NP = PLOT TAPE PREPARATION VARIABLE. NP = 1 PREPARES A TAPE TO BE USED IN A PLOT PROGRAM. NP = 2 BY-PASSES TAPE PREPARATION.
I7 = APPROXIMATELY THE NUMBER OF LINE CARDS UP TO V1 + BOUND (SEE DEFINITIONS BELOW). IT NEED NOT BE ACCURATE AS IT IS USED TO SAVE TIME. THE ESTIMATE MUST BE LESS THAN I1 -THE TOTAL NUMBER OF CARDS - AND MUST BE LESS THAN OR EQUAL TO THE CORRECT VALUE IN ORDER TO INCLUDE THE PROPER NUMBER OF WAVE NUMBERS IN THE CALCULATION. IF IT IS NOT, THE PROGRAM WILL STOP WITH A DIAGNOSTIC.
BOUND = THE NUMBER OF WAVE NUMBERS TO BE CONSIDERED ON EITHER SIDE OF A PARTICULAR FREQUENCY WHEN CALCULATING THE ABSORPTION COEF.
P = PRESSURE IN ATMOSPHERES FOR WHICH THE CALCULATIONS ARE TO BE MADE
TEMP = TEMPERATURE IN DEGREES KELVIN AT WHICH THE CALCULATIONS ARE TO BE MADE
IAX = INTENSITY CORRECTION FACTOR. FOR WATER IAX=1 AND FOR CARBON

```
   DIOXIDE IAX = 1000
   BX = TEMPERATURE CORRECTION COEFFICIENT FOR INTENSITIES. FOR WATER
   BX = 1.5. FOR CARBON DIOXIDE, BX = 2.0
   CX = TEMPERATURE CORRECTION EXPONENT FOR HALF-WIDTHS. FOR WATER,
   CX = 0.62 AND FOR CARBON DIOXIDE, CX = 0.58
   ICHK = A CHECKING VARIABLE TO BE SURE A CARD WITH ABSORBER
   CONCENTRATIONS HAS BEEN INCLUDED. ITS VALUE IS 1 AND IS PLACED ON
   CARD ACCORDING TO FMT2
   ITAPE = COMPUTING LAB NUMBER OF THE TAPE ON WHICH THE DATA FOR
   PLOTTING ARE PUT

   NOTE - A BLANK CARD MUST BE PLACED AFTER THE LAST LINE CARD SO THE
   COMPUTER WILL KNOW THAT ALL LINE CARDS HAVE BEEN READ. IF MORE
   THAN 2450 CARDS ARE READ, THE PROGRAM WILL STOP WITH A DIAGNOSTIC.

   DIMENSION W(5),E(5),T(5),FMT1(9),FMT2(9),FMT3(9),FMT4(9)
   COMMON/1/GNU(2450),S(2450),ALFA0(2450),CAY(1)/2/EPP(2450)
 1 FORMAT(9A8)
 2 FORMAT(60H1TOO MANY LINE CARDS,EXCEEDS DIMENSION. LAST CARD READ W
  1AS =F9.2)
 3 FORMAT(F9.2,F12.6,E13.4,2F10.5,E13.4,I4)
 4 FORMAT(19H1I7 TOO LARGE. I7 =I5,5X9HGNU(I7) =F9.2,5X10HV1+BOUND =F
  19.2)
 5 FORMAT(24H KICKED OUT FROM ST. NO.,I4)
 6 FORMAT(7H0  FREQ,7X6HLAMBDA,9X1HK,8X5HTRANS,5X6HABSORB,7X1HW,8X2HI
  1D//)
 7 FORMAT(11H1PRESSURE =F9.5,3X13HTEMPERATURE =F8.2,3X7HDELV1 =F7.4,3
  1X7HDELV2 =F7.4,3X8HSETBAK =F7.4,3X7HBOUND =F7.2/)
 8 FORMAT(F8.2,5F10.5)
 9 FORMAT(///33H0DATA FOR PLOTTING ARE ON TAPE C-,I4)
10 FORMAT(I4)

13 READ 1,(FMT1(I),I = 1,9)
14 READ 1,(FMT2(I),I = 1,9)
15 READ 1,(FMT3(I),I = 1,9)
16 READ 1,(FMT4(I),I = 1,9)
17 READ FMT3,K1,V1,V2,DELV1,DELV2,SETBAK,NP,I7,BOUND
18 READ FMT4,TEMP,TEMPO,IAX,BX,CX

   READ IN LINE DATA, COUNT CARDS AND FIND THE INDEX VALUE FOR THE
   FIRST LINE IN THE INTERVAL

20 I=0
21 I=I+1
22 IF(I .EQ. 2451)23,25
23 PRINT 2 ,GNU(2450)
24 GO TO 1001
25 READ FMT1,GNU(I),S(I),ALFA0(I),EPP(I)
26 IF(GNU(I))21,27,21
27 I1=I-1
30 DO 34 I = 1,I1
31 IF(GNU(I)-V1)34,34,32
```

```
32 K2=I
33 GO TO 40
34 CONTINUE
    READ IN THE PRESSURE AND ABSORBER CONCENTRATIONS AND CHECK FOR
    PRESENCE OF ABSORBER CARD. ALSO CHECK THAT GNU(I7) IS NOT GREATER
    THAN V1 + BOUND.
40 READ FMT2,P,W,ICHK
41 IF(ICHK .EQ. 1)42,500
42 XBOUND = V1 + BOUND
43 IF(GNU(I7) .GT. XBOUND)44,50
44 PRINT 4,I7,GNU(I7),XBOUND
45 GO TO 1001
50 PRINT 7,P,TEMP,DELV1,DELV2,SETBAK,BOUND
51 PRINT 6
    SET UP TEMPERATURE CORRECTION CONSTANTS AND CALCULATION COUNTERS
    AND INDICES
52 CS1 = (TEMP0-TEMP)/(TEMP0*TEMP*.6950)
53 CS2=(TEMP0/TEMP)**BX
54 CA=(TEMP0/TEMP)**CX
60 V = V1
61 M1 = K2
    TEMPERATURE CORRECT STRENGTHS AND HALF-WIDTHS
65 DO 71 I=1,I1
66 S(I)=S(I)*CS2*EXPF(-EPP(I)*CS1)/IAX
67 IF(IAX .EQ. 1)68,70
68 ALFA0(I)=ALFA0(I)*CA
69 GO TO 71
70 ALFA0(I) = 0.08*CA
71 CONTINUE
72 GO TO 123
    CALCULATION OF ABSORPTION COEFFICIENT BY SUBROUTINE ABSCOEF
80 INDEX = 1
81 CALL ABSCOEF(V,BOUND,I7,I1,P)
82 GO TO 130
    DETERMINATION OF WHICH CALCULATION INTERVAL TO USE
112 M1=M1+1
114 XX=ABSF(V-GNU(M1))
115 IF(XX-2.*SETBAK)124,122,122
122 V=V+SETBAK
123 IF(ABSF(V-GNU(M1))-SETBAK-.005)124,124,80
124 V=GNU(M1)-SETBAK
126 INDEX = 2
128 IF(V-GNU(M1)) 81,112,112
```

TRANSMISSION AND ABSORPTION CALCULATIONS, OUTPUT STATEMENTS AND FREQUENCY INCREMENTING

```
 130 DO 162 K = 1,K1
 131 T(K) = EXPF(-CAY*W(K))
 132 E(K) = 1. - T(K)
 160 ALAM = 1.E+4/V
 161 PRINT 3,V,ALAM,CAY,T(K),E(K),W(K),INDEX
 162 CONTINUE
 165 GO TO(166,167),NP
 166 WRITE(2,8)V,E(1),E(2),E(3),E(4),E(5)
 167 GO TO(170,175),INDEX
 170 V = V + DELV1
 172 IF(V-V2)123,123,200
 175 V = V + DELV2
 177 IF(V-V2)128,128,200
```

EXIT AND KICKOUT STATEMENTS

```
 200 GO TO(201,1001),NP
 201 END FILE 2
 202 REWIND 2
 203 READ 10,ITAPE
 204 PRINT 9,ITAPE
 205 GO TO 1001
 500 NX = 41
1000 PRINT 5,NX
1001 CALL EXIT
     END
```

VARIABLE FORMATS AND INPUT DATA (EXCEPT LINE DATA) FOR PROGRAM SPECTRUM

```
(F8.2,F10.4,F8.4,22X,F7.2)                                          FMT1 SPC
(F7.4,5E10.4,22X,I1)                                                FMT2 SPC
(3I3,2F8.2,3F7.4,I2,I5,F8.2)                                        FMT3 SPC
(2F7.2,I5,2F5.2)                                                    FMT4 SPC
  2  1  1 5182.00 5193.01 0.1000 0.0100 0.0600 1  300    50.00
 287.70 287.70    1 1.50 0.62                                    WATER VAPOR
```

(LINE DATA CARDS PRECEDE THE CONCENTRATION-PRESSURE CARD)

```
 1.0000 .1000E+00 .1000E-01                                                 1
```

LINE DATA CARDS FOR WATER VAPOR

FREQ	INTENSITY	WIDTH	TRANSITION ID	EPP	STRENGTH	BAND ID	
5125.68	2.4270	0.0959	2 1 1 3 2 2	206.30	1.98017	NU1,NU2	F
5125.68	0.0034	0.0838	7 2 5 8 2 6	981.60	7.25670	NU2,NU3	**
5125.73	0.0016	0.0835	5 1 5 5 3 2	505.73	0.01938	NU2,NU3	*
5126.20	0.5381	0.0873	2 1 2 3 3 1	285.23	0.01307	NU2,NU3	
5126.38	0.0934	0.0520	9 6 3 10 6 4	1875.53	6.43954	NU2,NU3	
5126.60	0.1889	0.0502	6 5 2 6 6 1	1045.07	3.40389	NU1,NU2	F
5126.63	0.0630	0.0478	6 5 1 6 6 0	1045.07	3.40573	NU1,NU2	F
5126.79	0.2808	0.0508	9 6 4 10 6 5	1875.00	6.43938	NU2,NU3	
5126.89	1.9046	0.0880	4 0 4 5 1 5	326.64	2.83559	NU1,NU2	F
5127.71	0.0294	0.0917	5 2 3 6 2 4	2211.21	5.36196	2NU2,NU3	***

LINE DATA CARDS FOR CARBON DIOXIDE

FREQ	INTENSITY	EPP	STRENGTH	BAND ID
3528.53	0.5549	1914.86	55.9821	19 P 56
3528.56	0.1577	2052.03	16.9412	121 P 17
3528.76	0.6809	1869.23	54.9818	20 P 55
3528.77	0.0001	1529.72	64.0000	116 P 64
3528.85	1.0585	1653.08	27.8571	24 P 28
3528.89	0.1042	729.36	12.9231	125 P 13
3528.91	0.1043	729.47	12.9231	123 P 13
3529.12	0.0322	1456.56	45.9783	28 R 45
3529.21	0.2071	865.37	48.0000	21 P 48
3529.43	0.0375	1422.68	44.9778	27 R 44

OUTPUT FROM PROGRAM DEGRADE

PRESSURE = 1.00000 ATM. TEMPERATURE = 287.70 DEGREES KELVIN
SLIT A = 0.50000 DV = 0.0500 DELV = 0.2000 BOUND = 50.00

FREQ	LAMBDA	TRANS	ABSORB	W
5182.00	1.929757	0.81784	0.18216	1.0000-001
5182.00	1.929757	0.98008	0.01992	1.0000-002
5182.20	1.929682	0.79998	0.20002	1.0000-001
5182.20	1.929682	0.97762	0.02238	1.0000-002
5182.40	1.929608	0.75385	0.24615	1.0000-001
5182.40	1.929608	0.97143	0.02857	1.0000-002
5182.60	1.929533	0.71788	0.28212	1.0000-001
5182.60	1.929533	0.96658	0.03342	1.0000-002
5182.80	1.929459	0.73888	0.26112	1.0000-001
5182.80	1.929459	0.96961	0.03039	1.0000-002
5183.00	1.929385	0.76992	0.23008	1.0000-001
5183.00	1.929385	0.97395	0.02605	1.0000-002
5183.20	1.929310	0.77372	0.22628	1.0000-001
5183.20	1.929310	0.97463	0.02537	1.0000-002
5183.40	1.929236	0.74404	0.25596	1.0000-001
5183.40	1.929236	0.97072	0.02928	1.0000-002
5183.60	1.929161	0.69223	0.30777	1.0000-001
5183.60	1.929161	0.96345	0.03655	1.0000-002
5183.80	1.929087	0.61153	0.38847	1.0000-001
5183.80	1.929087	0.95067	0.04933	1.0000-002
5184.00	1.929012	0.49223	0.50777	1.0000-001
5184.00	1.929012	0.92644	0.07356	1.0000-002
5184.20	1.928938	0.33450	0.66550	1.0000-001
5184.20	1.928938	0.87079	0.12921	1.0000-002
5184.40	1.928864	0.17281	0.82719	1.0000-001
5184.40	1.928864	0.72575	0.27425	1.0000-002
5184.60	1.928789	0.05845	0.94155	1.0000-001
5184.60	1.928789	0.48280	0.51720	1.0000-002
5184.80	1.928715	0.00979	0.99021	1.0000-001
5184.80	1.928715	0.26251	0.73749	1.0000-002
5185.00	1.928640	0.00031	0.99969	1.0000-001
5185.00	1.928640	0.18699	0.81301	1.0000-002
5185.20	1.928566	0.00846	0.99154	1.0000-001
5185.20	1.928566	0.27360	0.72640	1.0000-002
5185.40	1.928492	0.05425	0.94575	1.0000-001
5185.40	1.928492	0.47314	0.52686	1.0000-002
5185.60	1.928417	0.15934	0.84066	1.0000-001
5185.60	1.928417	0.69625	0.30375	1.0000-002
5185.80	1.928343	0.30066	0.69934	1.0000-001
5185.80	1.928343	0.85625	0.14375	1.0000-002
5186.00	1.928268	0.44272	0.55728	1.0000-001
5186.00	1.928268	0.91682	0.08318	1.0000-002
5186.20	1.928194	0.56484	0.43516	1.0000-001
5186.20	1.928194	0.94245	0.05755	1.0000-002
5186.40	1.928120	0.65706	0.34294	1.0000-001

5186.40	1.928120	0.95805	0.04195	1.0000-002
5186.60	1.928045	0.71296	0.28704	1.0000-001
5186.60	1.928045	0.96660	0.03340	1.0000-002
5186.80	1.927971	0.73014	0.26986	1.0000-001
5186.80	1.927971	0.96898	0.03102	1.0000-002
5187.00	1.927897	0.71169	0.28831	1.0000-001
5187.00	1.927897	0.96634	0.03366	1.0000-002
5187.20	1.927822	0.63289	0.36711	1.0000-001
5187.20	1.927822	0.95173	0.04827	1.0000-002
5187.40	1.927748	0.48925	0.51075	1.0000-001
5187.40	1.927748	0.91834	0.08166	1.0000-002
5187.60	1.927674	0.36053	0.63947	1.0000-001
5187.60	1.927674	0.88670	0.11330	1.0000-002
5187.80	1.927599	0.35481	0.64519	1.0000-001
5187.80	1.927599	0.88900	0.11100	1.0000-002
5188.00	1.927525	0.39617	0.60383	1.0000-001
5188.00	1.927525	0.90229	0.09771	1.0000-002
5188.20	1.927451	0.34309	0.65691	1.0000-001
5188.20	1.927451	0.86833	0.13167	1.0000-002
5188.40	1.927376	0.18701	0.81299	1.0000-001
5188.40	1.927376	0.76219	0.23781	1.0000-002
5188.60	1.927302	0.05959	0.94041	1.0000-001
5188.60	1.927302	0.61822	0.38178	1.0000-002
5188.80	1.927228	0.00850	0.99150	1.0000-001
5188.80	1.927228	0.48403	0.51597	1.0000-002
5189.00	1.927154	0.00814	0.99186	1.0000-001
5189.00	1.927154	0.42818	0.57182	1.0000-002
5189.20	1.927079	0.01992	0.98008	1.0000-001
5189.20	1.927079	0.50446	0.49554	1.0000-002
5189.40	1.927005	0.02964	0.97036	1.0000-001
5189.40	1.927005	0.58507	0.41493	1.0000-002
5189.60	1.926931	0.05313	0.94687	1.0000-001
5189.60	1.926931	0.62635	0.37365	1.0000-002
5189.80	1.926857	0.15239	0.84761	1.0000-001
5189.80	1.926857	0.70097	0.29903	1.0000-002
5190.00	1.926782	0.34211	0.65789	1.0000-001
5190.00	1.926782	0.82816	0.17184	1.0000-002
5190.20	1.926708	0.54128	0.45872	1.0000-001
5190.20	1.926708	0.92867	0.07133	1.0000-002
5190.40	1.926634	0.66896	0.33104	1.0000-001
5190.40	1.926634	0.95947	0.04053	1.0000-002
5190.60	1.926560	0.72070	0.27930	1.0000-001
5190.60	1.926560	0.96763	0.03237	1.0000-002
5190.80	1.926485	0.74451	0.25549	1.0000-001
5190.80	1.926485	0.97075	0.02925	1.0000-002
5191.00	1.926411	0.77803	0.22197	1.0000-001
5191.00	1.926411	0.97501	0.02499	1.0000-002
5191.20	1.926337	0.79933	0.20067	1.0000-001
5191.20	1.926337	0.97773	0.02227	1.0000-002
5191.40	1.926263	0.75410	0.24590	1.0000-001
5191.40	1.926263	0.96861	0.03139	1.0000-002
5191.60	1.926188	0.58319	0.41681	1.0000-001
5191.60	1.926188	0.91900	0.08100	1.0000-002
5191.80	1.926114	0.37187	0.62813	1.0000-001
5191.80	1.926114	0.85698	0.14302	1.0000-002

5192.00	1.926040	0.32967	0.67033	1.0000-001
5192.00	1.926040	0.84621	0.15379	1.0000-002
5192.20	1.925966	0.50646	0.49354	1.0000-001
5192.20	1.925966	0.90026	0.09974	1.0000-002
5192.40	1.925892	0.72485	0.27515	1.0000-001
5192.40	1.925892	0.96020	0.03980	1.0000-002
5192.60	1.925818	0.84060	0.15940	1.0000-001
5192.60	1.925818	0.98249	0.01751	1.0000-002
5192.80	1.925743	0.87270	0.12730	1.0000-001
5192.80	1.925743	0.98646	0.01354	1.0000-002
5193.00	1.925669	0.88268	0.11732	1.0000-001
5193.00	1.925669	0.98760	0.01240	1.0000-002

PRESSURE = 1.00000 SLIT A = 0.50000 TEMPERATURE = 287.70

ABSORPTANCE	CONCENTRATION
5.8928+000	1.0000-001
1.9340+000	1.0000-002

OUTPUT FROM PROGRAM SPECTRUM

PRESSURE = 1.00000 ATM. TEMPERATURE = 287.70 DEGREES KELVIN
DELV1 = 0.1000 DELV2 = 0.0100 SETBAK = 0.0600 BOUND = 50.00

FREQ	LAMBDA	K	TRANS	ABSORB	W	ID
5182.000	1.929757	1.8939+000	0.82746	0.17254	1.0000-001	1
5182.000	1.929757	1.8939+000	0.98124	0.01876	1.0000-002	1
5182.100	1.929720	1.8592+000	0.83034	0.16966	1.0000-001	1
5182.100	1.929720	1.8592+000	0.98158	0.01842	1.0000-002	1
5182.200	1.929682	1.8831+000	0.82836	0.17164	1.0000-001	1
5182.200	1.929682	1.8831+000	0.98135	0.01865	1.0000-002	1
5182.200	1.929682	1.8831+000	0.82836	0.17164	1.0000-001	2
5182.200	1.929682	1.8831+000	0.98135	0.01865	1.0000-002	2
5182.210	1.929679	1.8902+000	0.82777	0.17223	1.0000-001	2
5182.210	1.929679	1.8902+000	0.98128	0.01872	1.0000-002	2
5182.220	1.929675	1.8983+000	0.82710	0.17290	1.0000-001	2
5182.220	1.929675	1.8983+000	0.98120	0.01880	1.0000-002	2
5182.230	1.929671	1.9074+000	0.82635	0.17365	1.0000-001	2
5182.230	1.929671	1.9074+000	0.98111	0.01889	1.0000-002	2
5182.240	1.929667	1.9173+000	0.82553	0.17447	1.0000-001	2
5182.240	1.929667	1.9173+000	0.98101	0.01899	1.0000-002	2
5182.250	1.929664	1.9279+000	0.82466	0.17534	1.0000-001	2
5182.250	1.929664	1.9279+000	0.98091	0.01909	1.0000-002	2
5182.260	1.929660	1.9389+000	0.82375	0.17625	1.0000-001	2
5182.260	1.929660	1.9389+000	0.98080	0.01920	1.0000-002	2
5182.330	1.929634	2.0487+000	0.81476	0.18524	1.0000-001	1
5182.330	1.929634	2.0487+000	0.97972	0.02028	1.0000-002	1
5182.430	1.929597	2.5064+000	0.77830	0.22170	1.0000-001	1
5182.430	1.929597	2.5064+000	0.97525	0.02475	1.0000-002	1
5182.530	1.929560	4.2923+000	0.65101	0.34899	1.0000-001	1
5182.530	1.929560	4.2923+000	0.95799	0.04201	1.0000-002	1
5182.540	1.929556	4.6321+000	0.62926	0.37074	1.0000-001	2
5182.540	1.929556	4.6321+000	0.95474	0.04526	1.0000-002	2
5182.550	1.929552	4.9968+000	0.60673	0.39327	1.0000-001	2
5182.550	1.929552	4.9968+000	0.95126	0.04874	1.0000-002	2
5182.560	1.929548	5.3694+000	0.58453	0.41547	1.0000-001	2
5182.560	1.929548	5.3694+000	0.94772	0.05228	1.0000-002	2
5182.570	1.929545	5.7227+000	0.56424	0.43576	1.0000-001	2
5182.570	1.929545	5.7227+000	0.94438	0.05562	1.0000-002	2
5182.580	1.929541	6.0200+000	0.54771	0.45229	1.0000-001	2
5182.580	1.929541	6.0200+000	0.94158	0.05842	1.0000-002	2
5182.590	1.929537	6.2215+000	0.53679	0.46321	1.0000-001	2
5182.590	1.929537	6.2215+000	0.93968	0.06032	1.0000-002	2
5182.600	1.929533	6.2961+000	0.53280	0.46720	1.0000-001	2
5182.600	1.929533	6.2961+000	0.93898	0.06102	1.0000-002	2
5182.670	1.929507	4.3483+000	0.64737	0.35263	1.0000-001	1
5182.670	1.929507	4.3483+000	0.95745	0.04255	1.0000-002	1
5182.770	1.929470	2.6466+000	0.76747	0.23253	1.0000-001	1
5182.770	1.929470	2.6466+000	0.97388	0.02612	1.0000-002	1
5182.850	1.929440	2.3275+000	0.79235	0.20765	1.0000-001	2

5182.850	1.929440	2.3275+000	0.97699	0.02301	1.0000-002	2
5182.860	1.929437	2.3121+000	0.79357	0.20643	1.0000-001	2
5182.860	1.929437	2.3121+000	0.97714	0.02286	1.0000-002	2
5182.870	1.929433	2.3014+000	0.79442	0.20558	1.0000-001	2
5182.870	1.929433	2.3014+000	0.97725	0.02275	1.0000-002	2
5182.880	1.929429	2.2937+000	0.79503	0.20497	1.0000-001	2
5182.880	1.929429	2.2937+000	0.97732	0.02268	1.0000-002	2
5182.890	1.929425	2.2878+000	0.79550	0.20450	1.0000-001	2
5182.890	1.929425	2.2878+000	0.97738	0.02262	1.0000-002	2
5182.900	1.929422	2.2825+000	0.79593	0.20407	1.0000-001	2
5182.900	1.929422	2.2825+000	0.97743	0.02257	1.0000-002	2
5182.910	1.929418	2.2765+000	0.79640	0.20360	1.0000-001	2
5182.910	1.929418	2.2765+000	0.97749	0.02251	1.0000-002	2
5182.980	1.929392	2.2362+000	0.79962	0.20038	1.0000-001	1
5182.980	1.929392	2.2362+000	0.97789	0.02211	1.0000-002	1
5183.040	1.929370	2.2822+000	0.79595	0.20405	1.0000-001	2
5183.040	1.929370	2.2822+000	0.97744	0.02256	1.0000-002	2
5183.050	1.929366	2.2988+000	0.79463	0.20537	1.0000-001	2
5183.050	1.929366	2.2988+000	0.97727	0.02273	1.0000-002	2
5183.060	1.929362	2.3175+000	0.79315	0.20685	1.0000-001	2
5183.060	1.929362	2.3175+000	0.97709	0.02291	1.0000-002	2
5183.070	1.929358	2.3375+000	0.79156	0.20844	1.0000-001	2
5183.070	1.929358	2.3375+000	0.97690	0.02310	1.0000-002	2
5183.080	1.929355	2.3572+000	0.79000	0.21000	1.0000-001	2
5183.080	1.929355	2.3572+000	0.97670	0.02330	1.0000-002	2
5183.090	1.929351	2.3745+000	0.78863	0.21137	1.0000-001	2
5183.090	1.929351	2.3745+000	0.97653	0.02347	1.0000-002	2
5183.100	1.929347	2.3877+000	0.78760	0.21240	1.0000-001	2
5183.100	1.929347	2.3877+000	0.97641	0.02359	1.0000-002	2
5183.170	1.929321	2.4186+000	0.78517	0.21483	1.0000-001	1
5183.170	1.929321	2.4186+000	0.97610	0.02390	1.0000-002	1
5183.170	1.929321	2.4186+000	0.78517	0.21483	1.0000-001	2
5183.170	1.929321	2.4186+000	0.97610	0.02390	1.0000-002	2
5183.180	1.929318	2.4291+000	0.78434	0.21566	1.0000-001	2
5183.180	1.929318	2.4291+000	0.97600	0.02400	1.0000-002	2
5183.190	1.929314	2.4421+000	0.78332	0.21668	1.0000-001	2
5183.190	1.929314	2.4421+000	0.97587	0.02413	1.0000-002	2
5183.200	1.929310	2.4573+000	0.78213	0.21787	1.0000-001	2
5183.200	1.929310	2.4573+000	0.97573	0.02427	1.0000-002	2
5183.210	1.929306	2.4741+000	0.78082	0.21918	1.0000-001	2
5183.210	1.929306	2.4741+000	0.97556	0.02444	1.0000-002	2
5183.220	1.929303	2.4918+000	0.77944	0.22056	1.0000-001	2
5183.220	1.929303	2.4918+000	0.97539	0.02461	1.0000-002	2
5183.230	1.929299	2.5098+000	0.77804	0.22196	1.0000-001	2
5183.230	1.929299	2.5098+000	0.97521	0.02479	1.0000-002	2
5183.220	1.929303	2.4918+000	0.77944	0.22056	1.0000-001	2
5183.220	1.929303	2.4918+000	0.97539	0.02461	1.0000-002	2
5183.230	1.929299	2.5098+000	0.77804	0.22196	1.0000-001	2
5183.230	1.929299	2.5098+000	0.97521	0.02479	1.0000-002	2
5183.240	1.929295	2.5279+000	0.77663	0.22337	1.0000-001	2
5183.240	1.929295	2.5279+000	0.97504	0.02496	1.0000-002	2
5183.250	1.929291	2.5464+000	0.77520	0.22480	1.0000-001	2
5183.250	1.929291	2.5464+000	0.97486	0.02514	1.0000-002	2
5183.260	1.929288	2.5652+000	0.77374	0.22626	1.0000-001	2
5183.260	1.929288	2.5652+000	0.97467	0.02533	1.0000-002	2

5183.270	1.929284	2.5834+000	0.77233	0.22767	1.0000-001	2
5183.270	1.929284	2.5834+000	0.97450	0.02550	1.0000-002	2
5183.280	1.929280	2.5989+000	0.77114	0.22886	1.0000-001	2
5183.280	1.929280	2.5989+000	0.97435	0.02565	1.0000-002	2
5183.220	1.929303	2.4918+000	0.77944	0.22056	1.0000-001	2
5183.220	1.929303	2.4918+000	0.97539	0.02461	1.0000-002	2
5183.230	1.929299	2.5098+000	0.77804	0.22196	1.0000-001	2
5183.230	1.929299	2.5098+000	0.97521	0.02479	1.0000-002	2
5183.240	1.929295	2.5279+000	0.77663	0.22337	1.0000-001	2
5183.240	1.929295	2.5279+000	0.97504	0.02496	1.0000-002	2
5183.250	1.929291	2.5464+000	0.77520	0.22480	1.0000-001	2
5183.250	1.929291	2.5464+000	0.97486	0.02514	1.0000-002	2
5183.260	1.929288	2.5652+000	0.77374	0.22626	1.0000-001	2
5183.260	1.929288	2.5652+000	0.97467	0.02533	1.0000-002	2
5183.270	1.929284	2.5834+000	0.77233	0.22767	1.0000-001	2
5183.270	1.929284	2.5834+000	0.97450	0.02550	1.0000-002	2
5183.280	1.929280	2.5989+000	0.77114	0.22886	1.0000-001	2
5183.280	1.929280	2.5989+000	0.97435	0.02565	1.0000-002	2
5183.350	1.929254	2.6925+000	0.76395	0.23605	1.0000-001	1
5183.350	1.929254	2.6925+000	0.97343	0.02657	1.0000-002	1
5183.450	1.929217	2.9368+000	0.74552	0.25448	1.0000-001	1
5183.450	1.929217	2.9368+000	0.97106	0.02894	1.0000-002	1
5183.550	1.929180	3.2682+000	0.72121	0.27879	1.0000-001	1
5183.550	1.929180	3.2682+000	0.96785	0.03215	1.0000-002	1
5183.650	1.929143	3.6994+000	0.69078	0.30922	1.0000-001	1
5183.650	1.929143	3.6994+000	0.96368	0.03632	1.0000-002	1
5183.750	1.929105	4.2754+000	0.65211	0.34789	1.0000-001	1
5183.750	1.929105	4.2754+000	0.95815	0.04185	1.0000-002	1
5183.770	1.929098	4.4137+000	0.64316	0.35684	1.0000-001	2
5183.770	1.929098	4.4137+000	0.95682	0.04318	1.0000-002	2
5183.780	1.929094	4.4858+000	0.63853	0.36147	1.0000-001	2
5183.780	1.929094	4.4858+000	0.95613	0.04387	1.0000-002	2
5183.790	1.929090	4.5598+000	0.63383	0.36617	1.0000-001	2
5183.790	1.929090	4.5598+000	0.95543	0.04457	1.0000-002	2
5183.800	1.929087	4.6351+000	0.62907	0.37093	1.0000-001	2
5183.800	1.929087	4.6351+000	0.95471	0.04529	1.0000-002	2
5183.810	1.929083	4.7116+000	0.62428	0.37572	1.0000-001	2
5183.810	1.929083	4.7116+000	0.95398	0.04602	1.0000-002	2
5183.820	1.929079	4.7887+000	0.61948	0.38052	1.0000-001	2
5183.820	1.929079	4.7887+000	0.95324	0.04676	1.0000-002	2
5183.830	1.929076	4.8662+000	0.61470	0.38530	1.0000-001	2
5183.830	1.929076	4.8662+000	0.95250	0.04750	1.0000-002	2
5183.900	1.929050	5.4409+000	0.58037	0.41963	1.0000-001	1
5183.900	1.929050	5.4409+000	0.94704	0.05296	1.0000-002	1
5184.000	1.929012	6.5351+000	0.52022	0.47978	1.0000-001	1
5184.000	1.929012	6.5351+000	0.93674	0.06326	1.0000-002	1
5184.040	1.928997	7.0979+000	0.49175	0.50825	1.0000-001	2
5184.040	1.928997	7.0979+000	0.93148	0.06852	1.0000-002	2
5184.050	1.928994	7.2521+000	0.48422	0.51578	1.0000-001	2
5184.050	1.928994	7.2521+000	0.93005	0.06995	1.0000-002	2
5184.060	1.928990	7.4121+000	0.47653	0.52347	1.0000-001	2
5184.060	1.928990	7.4121+000	0.92856	0.07144	1.0000-002	2
5184.070	1.928986	7.5783+000	0.46868	0.53132	1.0000-001	2
5184.070	1.928986	7.5783+000	0.92702	0.07298	1.0000-002	2
5184.080	1.928983	7.7506+000	0.46068	0.53932	1.0000-001	2

5184.080	1.928983	7.7506+000	0.92542	0.07458	1.0000-002	2
5184.090	1.928979	7.9292+000	0.45252	0.54748	1.0000-001	2
5184.090	1.928979	7.9292+000	0.92377	0.07623	1.0000-002	2
5184.100	1.928975	8.1142+000	0.44423	0.55577	1.0000-001	2
5184.100	1.928975	8.1142+000	0.92206	0.07794	1.0000-002	2
5184.170	1.928949	9.6268+000	0.38187	0.61813	1.0000-001	1
5184.170	1.928949	9.6268+000	0.90822	0.09178	1.0000-002	1
5184.270	1.928912	1.2760+001	0.27914	0.72086	1.0000-001	1
5184.270	1.928912	1.2760+001	0.88020	0.11980	1.0000-002	1
5184.370	1.928875	1.7902+001	0.16692	0.83308	1.0000-001	1
5184.370	1.928875	1.7902+001	0.83609	0.16391	1.0000-002	1
5184.470	1.928837	2.7226+001	0.06570	0.93430	1.0000-001	1
5184.470	1.928837	2.7226+001	0.76165	0.23835	1.0000-002	1
5184.560	1.928804	4.4092+001	0.01217	0.98783	1.0000-001	2
5184.560	1.928804	4.4092+001	0.64345	0.35655	1.0000-002	2
5184.570	1.928800	4.6913+001	0.00917	0.99083	1.0000-001	2
5184.570	1.928800	4.6913+001	0.62555	0.37445	1.0000-002	2
5184.580	1.928797	5.0017+001	0.00673	0.99327	1.0000-001	2
5184.580	1.928797	5.0017+001	0.60643	0.39357	1.0000-002	2
5184.590	1.928793	5.3442+001	0.00478	0.99522	1.0000-001	2
5184.590	1.928793	5.3442+001	0.58601	0.41399	1.0000-002	2
5184.600	1.928789	5.7231+001	0.00327	0.99673	1.0000-001	2
5184.600	1.928789	5.7231+001	0.56422	0.43578	1.0000-002	2
5184.610	1.928785	6.1435+001	0.00215	0.99785	1.0000-001	2
5184.610	1.928785	6.1435+001	0.54099	0.45901	1.0000-002	2
5184.620	1.928782	6.6118+001	0.00134	0.99866	1.0000-001	2
5184.620	1.928782	6.6118+001	0.51624	0.48376	1.0000-002	2
5184.690	1.928756	1.2100+002	0.00001	0.99999	1.0000-001	1
5184.690	1.928756	1.2100+002	0.29819	0.70181	1.0000-002	1
5184.790	1.928718	4.3012+002	0.00000	1.00000	1.0000-001	1
5184.790	1.928718	4.3012+002	0.01355	0.98645	1.0000-002	1
5184.800	1.928715	5.0095+002	0.00000	1.00000	1.0000-001	2
5184.800	1.928715	5.0095+002	0.00667	0.99333	1.0000-002	2
5184.810	1.928711	5.8229+002	0.00000	1.00000	1.0000-001	2
5184.810	1.928711	5.8229+002	0.00296	0.99704	1.0000-002	2
5184.820	1.928707	6.7174+002	0.00000	1.00000	1.0000-001	2
5184.820	1.928707	6.7174+002	0.00121	0.99879	1.0000-002	2
5184.830	1.928704	7.6309+002	0.00000	1.00000	1.0000-001	2
5184.830	1.928704	7.6309+002	0.00049	0.99951	1.0000-002	2
5184.840	1.928700	8.4537+002	0.00000	1.00000	1.0000-001	2
5184.840	1.928700	8.4537+002	0.00021	0.99979	1.0000-002	2
5184.850	1.928696	9.0399+002	0.00000	1.00000	1.0000-001	2
5184.850	1.928696	9.0399+002	0.00012	0.99988	1.0000-002	2
5184.860	1.928692	9.2560+002	0.00000	1.00000	1.0000-001	2
5184.860	1.928692	9.2560+002	0.00010	0.99990	1.0000-002	2
5184.930	1.928666	4.3500+002	0.00000	1.00000	1.0000-001	1
5184.930	1.928666	4.3500+002	0.01291	0.98709	1.0000-002	1
5185.030	1.928629	1.3658+002	0.00000	1.00000	1.0000-001	1
5185.030	1.928629	1.3658+002	0.25517	0.74483	1.0000-002	1
5185.080	1.928611	1.0314+002	0.00003	0.99997	1.0000-001	2
5185.080	1.928611	1.0314+002	0.35651	0.64349	1.0000-002	2
5185.090	1.928607	1.0017+002	0.00004	0.99996	1.0000-001	2
5185.090	1.928607	1.0017+002	0.36724	0.63276	1.0000-002	2
5185.100	1.928603	9.8262+001	0.00005	0.99995	1.0000-001	2
5185.100	1.928603	9.8262+001	0.37433	0.62567	1.0000-002	2

5185.110	1.928599	9.7397+001	0.00006	0.99994	1.0000-001	2
5185.110	1.928599	9.7397+001	0.37758	0.62242	1.0000-002	2
5185.120	1.928596	9.7600+001	0.00006	0.99994	1.0000-001	2
5185.120	1.928596	9.7600+001	0.37681	0.62319	1.0000-002	2
5185.130	1.928592	9.8931+001	0.00005	0.99995	1.0000-001	2
5185.130	1.928592	9.8931+001	0.37183	0.62817	1.0000-002	2
5185.140	1.928588	1.0149+002	0.00004	0.99996	1.0000-001	2
5185.140	1.928588	1.0149+002	0.36245	0.63755	1.0000-002	2
5185.170	1.928577	1.1821+002	0.00001	0.99999	1.0000-001	2
5185.170	1.928577	1.1821+002	0.30662	0.69338	1.0000-002	2
5185.180	1.928573	1.2768+002	0.00000	1.00000	1.0000-001	2
5185.180	1.928573	1.2768+002	0.27894	0.72106	1.0000-002	2
5185.190	1.928570	1.3968+002	0.00000	1.00000	1.0000-001	2
5185.190	1.928570	1.3968+002	0.24739	0.75261	1.0000-002	2
5185.200	1.928566	1.5467+002	0.00000	1.00000	1.0000-001	2
5185.200	1.928566	1.5467+002	0.21296	0.78704	1.0000-002	2
5185.210	1.928562	1.7308+002	0.00000	1.00000	1.0000-001	2
5185.210	1.928562	1.7308+002	0.17713	0.82287	1.0000-002	2
5185.220	1.928558	1.9526+002	0.00000	1.00000	1.0000-001	2
5185.220	1.928558	1.9526+002	0.14190	0.85810	1.0000-002	2
5185.230	1.928555	2.2117+002	0.00000	1.00000	1.0000-001	2
5185.230	1.928555	2.2117+002	0.10951	0.89049	1.0000-002	2
5185.220	1.928558	1.9526+002	0.00000	1.00000	1.0000-001	2
5185.220	1.928558	1.9526+002	0.14190	0.85810	1.0000-002	2
5185.230	1.928555	2.2117+002	0.00000	1.00000	1.0000-001	2
5185.230	1.928555	2.2117+002	0.10951	0.89049	1.0000-002	2
5185.240	1.928551	2.5001+002	0.00000	1.00000	1.0000-001	2
5185.240	1.928551	2.5001+002	0.08207	0.91793	1.0000-002	2
5185.250	1.928547	2.7971+002	0.00000	1.00000	1.0000-001	2
5185.250	1.928547	2.7971+002	0.06099	0.93901	1.0000-002	2
5185.260	1.928544	3.0649+002	0.00000	1.00000	1.0000-001	2
5185.260	1.928544	3.0649+002	0.04666	0.95334	1.0000-002	2
5185.270	1.928540	3.2532+002	0.00000	1.00000	1.0000-001	2
5185.270	1.928540	3.2532+002	0.03865	0.96135	1.0000-002	2
5185.280	1.928536	3.3154+002	0.00000	1.00000	1.0000-001	2
5185.280	1.928536	3.3154+002	0.03632	0.96368	1.0000-002	2
5185.350	1.928510	1.5788+002	0.00000	1.00000	1.0000-001	1
5185.350	1.928510	1.5788+002	0.20623	0.79377	1.0000-002	1
5185.450	1.928473	5.0397+001	0.00648	0.99352	1.0000-001	1
5185.450	1.928473	5.0397+001	0.60413	0.39587	1.0000-002	1
5185.550	1.928436	2.5621+001	0.07714	0.92286	1.0000-001	1
5185.550	1.928436	2.5621+001	0.77398	0.22602	1.0000-002	1
5185.570	1.928428	2.3162+001	0.09865	0.90135	1.0000-001	2
5185.570	1.928428	2.3162+001	0.79325	0.20675	1.0000-002	2
5185.580	1.928425	2.2099+001	0.10971	0.89029	1.0000-001	2
5185.580	1.928425	2.2099+001	0.80172	0.19828	1.0000-002	2
5185.590	1.928421	2.1131+001	0.12087	0.87913	1.0000-001	2
5185.590	1.928421	2.1131+001	0.80953	0.19047	1.0000-002	2
5185.600	1.928417	2.0245+001	0.13206	0.86794	1.0000-001	2
5185.600	1.928417	2.0245+001	0.81673	0.18327	1.0000-002	2
5185.610	1.928413	1.9429+001	0.14329	0.85671	1.0000-001	2
5185.610	1.928413	1.9429+001	0.82342	0.17658	1.0000-002	2
5185.620	1.928410	1.8671+001	0.15458	0.84542	1.0000-001	2
5185.620	1.928410	1.8671+001	0.82969	0.17031	1.0000-002	2
5185.630	1.928406	1.7959+001	0.16598	0.83402	1.0000-001	2

5185.630	1.928406	1.7959+001	0.83561	0.16439	1.0000-002	2
5185.580	1.928425	2.2099+001	0.10971	0.89029	1.0000-001	2
5185.580	1.928425	2.2099+001	0.80172	0.19828	1.0000-002	2
5185.590	1.928421	2.1131+001	0.12087	0.87913	1.0000-001	2
5185.590	1.928421	2.1131+001	0.80953	0.19047	1.0000-002	2
5185.600	1.928417	2.0245+001	0.13206	0.86794	1.0000-001	2
5185.600	1.928417	2.0245+001	0.81673	0.18327	1.0000-002	2
5185.610	1.928413	1.9429+001	0.14329	0.85671	1.0000-001	2
5185.610	1.928413	1.9429+001	0.82342	0.17658	1.0000-002	2
5185.620	1.928410	1.8671+001	0.15458	0.84542	1.0000-001	2
5185.620	1.928410	1.8671+001	0.82969	0.17031	1.0000-002	2
5185.630	1.928406	1.7959+001	0.16598	0.83402	1.0000-001	2
5185.630	1.928406	1.7959+001	0.83561	0.16439	1.0000-002	2
5185.640	1.928402	1.7287+001	0.17752	0.82248	1.0000-001	2
5185.640	1.928402	1.7287+001	0.84125	0.15875	1.0000-002	2
5185.710	1.928376	1.3675+001	0.25475	0.74525	1.0000-001	1
5185.710	1.928376	1.3675+001	0.87219	0.12781	1.0000-002	1
5185.760	1.928358	1.2245+001	0.29389	0.70611	1.0000-001	2
5185.760	1.928358	1.2245+001	0.88475	0.11525	1.0000-002	2
5185.770	1.928354	1.2046+001	0.29981	0.70019	1.0000-001	2
5185.770	1.928354	1.2046+001	0.88651	0.11349	1.0000-002	2
5185.780	1.928350	1.1863+001	0.30536	0.69464	1.0000-001	2
5185.780	1.928350	1.1863+001	0.88814	0.11186	1.0000-002	2
5185.790	1.928347	1.1686+001	0.31079	0.68921	1.0000-001	2
5185.790	1.928347	1.1686+001	0.88971	0.11029	1.0000-002	2
5185.800	1.928343	1.1506+001	0.31643	0.68357	1.0000-001	2
5185.800	1.928343	1.1506+001	0.89131	0.10869	1.0000-002	2
5185.810	1.928339	1.1313+001	0.32262	0.67738	1.0000-001	2
5185.810	1.928339	1.1313+001	0.89304	0.10696	1.0000-002	2
5185.820	1.928335	1.1098+001	0.32963	0.67037	1.0000-001	2
5185.820	1.928335	1.1098+001	0.89496	0.10504	1.0000-002	2
5185.890	1.928309	9.2270+000	0.39744	0.60256	1.0000-001	1
5185.890	1.928309	9.2270+000	0.91186	0.08814	1.0000-002	1
5185.990	1.928272	8.0876+000	0.44541	0.55459	1.0000-001	1
5185.990	1.928272	8.0876+000	0.92231	0.07769	1.0000-002	1
5186.000	1.928268	8.1375+000	0.44319	0.55681	1.0000-001	2
5186.000	1.928268	8.1375+000	0.92185	0.07815	1.0000-002	2
5186.010	1.928265	8.2133+000	0.43985	0.56015	1.0000-001	2
5186.010	1.928265	8.2133+000	0.92115	0.07885	1.0000-002	2
5186.020	1.928261	8.3047+000	0.43585	0.56415	1.0000-001	2
5186.020	1.928261	8.3047+000	0.92031	0.07969	1.0000-002	2
5186.030	1.928257	8.3943+000	0.43196	0.56804	1.0000-001	2
5186.030	1.928257	8.3943+000	0.91948	0.08052	1.0000-002	2
5186.040	1.928254	8.4578+000	0.42922	0.57078	1.0000-001	2
5186.040	1.928254	8.4578+000	0.91890	0.08110	1.0000-002	2
5186.050	1.928250	8.4679+000	0.42879	0.57121	1.0000-001	2
5186.050	1.928250	8.4679+000	0.91881	0.08119	1.0000-002	2
5186.060	1.928246	8.4021+000	0.43162	0.56838	1.0000-001	2
5186.060	1.928246	8.4021+000	0.91941	0.08059	1.0000-002	2
5186.100	1.928231	7.4325+000	0.47557	0.52443	1.0000-001	2
5186.100	1.928231	7.4325+000	0.92837	0.07163	1.0000-002	2
5186.110	1.928228	7.1183+000	0.49075	0.50925	1.0000-001	2
5186.110	1.928228	7.1183+000	0.93129	0.06871	1.0000-002	2
5186.120	1.928224	6.8163+000	0.50579	0.49421	1.0000-001	2
5186.120	1.928224	6.8163+000	0.93411	0.06589	1.0000-002	2

5186.130	1.928220	6.5359+000	0.52018	0.47982	1.0000-001	2
5186.130	1.928220	6.5359+000	0.93673	0.06327	1.0000-002	2
5186.140	1.928216	6.2806+000	0.53363	0.46637	1.0000-001	2
5186.140	1.928216	6.2806+000	0.93913	0.06087	1.0000-002	2
5186.150	1.928213	6.0506+000	0.54604	0.45396	1.0000-001	2
5186.150	1.928213	6.0506+000	0.94129	0.05871	1.0000-002	2
5186.160	1.928209	5.8439+000	0.55744	0.44256	1.0000-001	2
5186.160	1.928209	5.8439+000	0.94324	0.05676	1.0000-002	2
5186.140	1.928216	6.2806+000	0.53363	0.46637	1.0000-001	2
5186.140	1.928216	6.2806+000	0.93913	0.06087	1.0000-002	2
5186.150	1.928213	6.0506+000	0.54604	0.45396	1.0000-001	2
5186.150	1.928213	6.0506+000	0.94129	0.05871	1.0000-002	2
5186.160	1.928209	5.8439+000	0.55744	0.44256	1.0000-001	2
5186.160	1.928209	5.8439+000	0.94324	0.05676	1.0000-002	2
5186.170	1.928205	5.6579+000	0.56791	0.43209	1.0000-001	2
5186.170	1.928205	5.6579+000	0.94499	0.05501	1.0000-002	2
5186.180	1.928201	5.4897+000	0.57754	0.42246	1.0000-001	2
5186.180	1.928201	5.4897+000	0.94658	0.05342	1.0000-002	2
5186.190	1.928198	5.3368+000	0.58644	0.41356	1.0000-001	2
5186.190	1.928198	5.3368+000	0.94803	0.05197	1.0000-002	2
5186.200	1.928194	5.1968+000	0.59471	0.40529	1.0000-001	2
5186.200	1.928194	5.1968+000	0.94936	0.05064	1.0000-002	2
5186.270	1.928168	4.4703+000	0.63952	0.36048	1.0000-001	1
5186.270	1.928168	4.4703+000	0.95628	0.04372	1.0000-002	1
5186.370	1.928131	3.8700+000	0.67909	0.32091	1.0000-001	1
5186.370	1.928131	3.8700+000	0.96204	0.03796	1.0000-002	1
5186.470	1.928094	3.5385+000	0.70198	0.29802	1.0000-001	1
5186.470	1.928094	3.5385+000	0.96523	0.03477	1.0000-002	1
5186.500	1.928083	3.4886+000	0.70549	0.29451	1.0000-001	2
5186.500	1.928083	3.4886+000	0.96572	0.03428	1.0000-002	2
5186.510	1.928079	3.4768+000	0.70633	0.29367	1.0000-001	2
5186.510	1.928079	3.4768+000	0.96583	0.03417	1.0000-002	2
5186.520	1.928075	3.4662+000	0.70708	0.29292	1.0000-001	2
5186.520	1.928075	3.4662+000	0.96593	0.03407	1.0000-002	2
5186.530	1.928071	3.4556+000	0.70782	0.29218	1.0000-001	2
5186.530	1.928071	3.4556+000	0.96603	0.03397	1.0000-002	2
5186.540	1.928068	3.4434+000	0.70869	0.29131	1.0000-001	2
5186.540	1.928068	3.4434+000	0.96615	0.03385	1.0000-002	2
5186.550	1.928064	3.4278+000	0.70979	0.29021	1.0000-001	2
5186.550	1.928064	3.4278+000	0.96630	0.03370	1.0000-002	2
5186.560	1.928060	3.4074+000	0.71124	0.28876	1.0000-001	2
5186.560	1.928060	3.4074+000	0.96650	0.03350	1.0000-002	2
5186.630	1.928034	3.1763+000	0.72787	0.27213	1.0000-001	1
5186.630	1.928034	3.1763+000	0.96874	0.03126	1.0000-002	1
5186.730	1.927997	2.9573+000	0.74399	0.25601	1.0000-001	1
5186.730	1.927997	2.9573+000	0.97086	0.02914	1.0000-002	1
5186.830	1.927960	2.8730+000	0.75029	0.24971	1.0000-001	1
5186.830	1.927960	2.8730+000	0.97168	0.02832	1.0000-002	1
5186.930	1.927923	2.8897+000	0.74903	0.25097	1.0000-001	1
5186.930	1.927923	2.8897+000	0.97152	0.02848	1.0000-002	1
5187.030	1.927886	3.0504+000	0.73709	0.26291	1.0000-001	1
5187.030	1.927886	3.0504+000	0.96996	0.03004	1.0000-002	1
5187.130	1.927848	3.6096+000	0.69701	0.30299	1.0000-001	1
5187.130	1.927848	3.6096+000	0.96455	0.03545	1.0000-002	1
5187.150	1.927841	3.8360+000	0.68140	0.31860	1.0000-001	2

5187.150	1.927841	3.8360+000	0.96237	0.03763	1.0000-002	2
5187.160	1.927837	3.9673+000	0.67251	0.32749	1.0000-001	2
5187.160	1.927837	3.9673+000	0.96110	0.03890	1.0000-002	2
5187.170	1.927833	4.1065+000	0.66322	0.33678	1.0000-001	2
5187.170	1.927833	4.1065+000	0.95977	0.04023	1.0000-002	2
5187.180	1.927830	4.2465+000	0.65400	0.34600	1.0000-001	2
5187.180	1.927830	4.2465+000	0.95842	0.04158	1.0000-002	2
5187.190	1.927826	4.3767+000	0.64554	0.35446	1.0000-001	2
5187.190	1.927826	4.3767+000	0.95718	0.04282	1.0000-002	2
5187.200	1.927822	4.4847+000	0.63860	0.36140	1.0000-001	2
5187.200	1.927822	4.4847+000	0.95614	0.04386	1.0000-002	2
5187.210	1.927819	4.5601+000	0.63381	0.36619	1.0000-001	2
5187.210	1.927819	4.5601+000	0.95542	0.04458	1.0000-002	2
5187.190	1.927826	4.3767+000	0.64554	0.35446	1.0000-001	2
5187.190	1.927826	4.3767+000	0.95718	0.04282	1.0000-002	2
5187.200	1.927822	4.4847+000	0.63860	0.36140	1.0000-001	2
5187.200	1.927822	4.4847+000	0.95614	0.04386	1.0000-002	2
5187.210	1.927819	4.5601+000	0.63381	0.36619	1.0000-001	2
5187.210	1.927819	4.5601+000	0.95542	0.04458	1.0000-002	2
5187.220	1.927815	4.5986+000	0.63137	0.36863	1.0000-001	2
5187.220	1.927815	4.5986+000	0.95506	0.04494	1.0000-002	2
5187.230	1.927811	4.6034+000	0.63107	0.36893	1.0000-001	2
5187.230	1.927811	4.6034+000	0.95501	0.04499	1.0000-002	2
5187.240	1.927807	4.5839+000	0.63230	0.36770	1.0000-001	2
5187.240	1.927807	4.5839+000	0.95520	0.04480	1.0000-002	2
5187.250	1.927804	4.5509+000	0.63439	0.36561	1.0000-001	2
5187.250	1.927804	4.5509+000	0.95551	0.04449	1.0000-002	2
5187.210	1.927819	4.5601+000	0.63381	0.36619	1.0000-001	2
5187.210	1.927819	4.5601+000	0.95542	0.04458	1.0000-002	2
5187.220	1.927815	4.5986+000	0.63137	0.36863	1.0000-001	2
5187.220	1.927815	4.5986+000	0.95506	0.04494	1.0000-002	2
5187.230	1.927811	4.6034+000	0.63107	0.36893	1.0000-001	2
5187.230	1.927811	4.6034+000	0.95501	0.04499	1.0000-002	2
5187.240	1.927807	4.5839+000	0.63230	0.36770	1.0000-001	2
5187.240	1.927807	4.5839+000	0.95520	0.04480	1.0000-002	2
5187.250	1.927804	4.5509+000	0.63439	0.36561	1.0000-001	2
5187.250	1.927804	4.5509+000	0.95551	0.04449	1.0000-002	2
5187.260	1.927800	4.5138+000	0.63675	0.36325	1.0000-001	2
5187.260	1.927800	4.5138+000	0.95587	0.04413	1.0000-002	2
5187.270	1.927796	4.4800+000	0.63891	0.36109	1.0000-001	2
5187.270	1.927796	4.4800+000	0.95619	0.04381	1.0000-002	2
5187.340	1.927770	4.5931+000	0.63172	0.36828	1.0000-001	1
5187.340	1.927770	4.5931+000	0.95511	0.04489	1.0000-002	1
5187.440	1.927733	6.2088+000	0.53747	0.46253	1.0000-001	1
5187.440	1.927733	6.2088+000	0.93980	0.06020	1.0000-002	1
5187.540	1.927696	1.1733+001	0.30935	0.69065	1.0000-001	1
5187.540	1.927696	1.1733+001	0.88929	0.11071	1.0000-002	1
5187.590	1.927677	1.8168+001	0.16254	0.83746	1.0000-001	2
5187.590	1.927677	1.8168+001	0.83386	0.16614	1.0000-002	2
5187.600	1.927674	1.9756+001	0.13868	0.86132	1.0000-001	2
5187.600	1.927674	1.9756+001	0.82073	0.17927	1.0000-002	2
5187.610	1.927670	2.1335+001	0.11842	0.88158	1.0000-001	2
5187.610	1.927670	2.1335+001	0.80787	0.19213	1.0000-002	2
5187.620	1.927666	2.2806+001	0.10222	0.89778	1.0000-001	2
5187.620	1.927666	2.2806+001	0.79607	0.20393	1.0000-002	2

5187.630	1.927663	2.4052+001	0.09025	0.90975	1.0000-001	2
5187.630	1.927663	2.4052+001	0.78622	0.21378	1.0000-002	2
5187.640	1.927659	2.4953+001	0.08247	0.91753	1.0000-001	2
5187.640	1.927659	2.4953+001	0.77917	0.22083	1.0000-002	2
5187.650	1.927655	2.5422+001	0.07869	0.92131	1.0000-001	2
5187.650	1.927655	2.5422+001	0.77552	0.22448	1.0000-002	2
5187.680	1.927644	2.4227+001	0.08868	0.91132	1.0000-001	2
5187.680	1.927644	2.4227+001	0.78484	0.21516	1.0000-002	2
5187.690	1.927640	2.3223+001	0.09805	0.90195	1.0000-001	2
5187.690	1.927640	2.3223+001	0.79276	0.20724	1.0000-002	2
5187.700	1.927637	2.2093+001	0.10978	0.89022	1.0000-001	2
5187.700	1.927637	2.2093+001	0.80177	0.19823	1.0000-002	2
5187.710	1.927633	2.0918+001	0.12347	0.87653	1.0000-001	2
5187.710	1.927633	2.0918+001	0.81125	0.18875	1.0000-002	2
5187.720	1.927629	1.9745+001	0.13883	0.86117	1.0000-001	2
5187.720	1.927629	1.9745+001	0.82082	0.17918	1.0000-002	2
5187.730	1.927625	1.8594+001	0.15576	0.84424	1.0000-001	2
5187.730	1.927625	1.8594+001	0.83032	0.16968	1.0000-002	2
5187.740	1.927622	1.7467+001	0.17434	0.82566	1.0000-001	2
5187.740	1.927622	1.7467+001	0.83973	0.16027	1.0000-002	2
5187.810	1.927596	1.0814+001	0.33910	0.66090	1.0000-001	1
5187.810	1.927596	1.0814+001	0.89750	0.10250	1.0000-002	1
5187.910	1.927558	6.9878+000	0.49719	0.50281	1.0000-001	1
5187.910	1.927558	6.9878+000	0.93251	0.06749	1.0000-002	1
5188.010	1.927521	6.3006+000	0.53256	0.46744	1.0000-001	1
5188.010	1.927521	6.3006+000	0.93894	0.06106	1.0000-002	1
5188.110	1.927484	6.8843+000	0.50236	0.49764	1.0000-001	1
5188.110	1.927484	6.8843+000	0.93347	0.06653	1.0000-002	1
5188.210	1.927447	8.6589+000	0.42068	0.57932	1.0000-001	1
5188.210	1.927447	8.6589+000	0.91705	0.08295	1.0000-002	1
5188.310	1.927410	1.2760+001	0.27915	0.72085	1.0000-001	1
5188.310	1.927410	1.2760+001	0.88020	0.11980	1.0000-002	1
5188.400	1.927376	2.2114+001	0.10955	0.89045	1.0000-001	2
5188.400	1.927376	2.2114+001	0.80160	0.19840	1.0000-002	2
5188.410	1.927373	2.3805+001	0.09251	0.90749	1.0000-001	2
5188.410	1.927373	2.3805+001	0.78817	0.21183	1.0000-002	2
5188.420	1.927369	2.5654+001	0.07689	0.92311	1.0000-001	2
5188.420	1.927369	2.5654+001	0.77372	0.22628	1.0000-002	2
5188.430	1.927365	2.7651+001	0.06297	0.93703	1.0000-001	2
5188.430	1.927365	2.7651+001	0.75842	0.24158	1.0000-002	2
5188.440	1.927362	2.9771+001	0.05094	0.94906	1.0000-001	2
5188.440	1.927362	2.9771+001	0.74252	0.25748	1.0000-002	2
5188.450	1.927358	3.1969+001	0.04089	0.95911	1.0000-001	2
5188.450	1.927358	3.1969+001	0.72638	0.27362	1.0000-002	2
5188.460	1.927354	3.4180+001	0.03278	0.96722	1.0000-001	2
5188.460	1.927354	3.4180+001	0.71049	0.28951	1.0000-002	2
5188.440	1.927362	2.9771+001	0.05094	0.94906	1.0000-001	2
5188.440	1.927362	2.9771+001	0.74252	0.25748	1.0000-002	2
5188.450	1.927358	3.1969+001	0.04089	0.95911	1.0000-001	2
5188.450	1.927358	3.1969+001	0.72638	0.27362	1.0000-002	2
5188.460	1.927354	3.4180+001	0.03278	0.96722	1.0000-001	2
5188.460	1.927354	3.4180+001	0.71049	0.28951	1.0000-002	2
5188.470	1.927350	3.6322+001	0.02646	0.97354	1.0000-001	2
5188.470	1.927350	3.6322+001	0.69543	0.30457	1.0000-002	2
5188.480	1.927347	3.8302+001	0.02171	0.97829	1.0000-001	2

5188.480	1.927347	3.8302+001	0.68180	0.31820	1.0000-002	2
5188.490	1.927343	4.0036+001	0.01825	0.98175	1.0000-001	2
5188.490	1.927343	4.0036+001	0.67008	0.32992	1.0000-002	2
5188.500	1.927339	4.1471+001	0.01581	0.98419	1.0000-001	2
5188.500	1.927339	4.1471+001	0.66053	0.33947	1.0000-002	2
5188.570	1.927313	4.8847+001	0.00756	0.99244	1.0000-001	1
5188.570	1.927313	4.8847+001	0.61357	0.38643	1.0000-002	1
5188.610	1.927298	5.9210+001	0.00268	0.99732	1.0000-001	2
5188.610	1.927298	5.9210+001	0.55317	0.44683	1.0000-002	2
5188.620	1.927295	6.2547+001	0.00192	0.99808	1.0000-001	2
5188.620	1.927295	6.2547+001	0.53501	0.46499	1.0000-002	2
5188.630	1.927291	6.5887+001	0.00138	0.99862	1.0000-001	2
5188.630	1.927291	6.5887+001	0.51744	0.48256	1.0000-002	2
5188.640	1.927287	6.8980+001	0.00101	0.99899	1.0000-001	2
5188.640	1.927287	6.8980+001	0.50167	0.49833	1.0000-002	2
5188.650	1.927284	7.1544+001	0.00078	0.99922	1.0000-001	2
5188.650	1.927284	7.1544+001	0.48898	0.51102	1.0000-002	2
5188.660	1.927280	7.3307+001	0.00066	0.99934	1.0000-001	2
5188.660	1.927280	7.3307+001	0.48043	0.51957	1.0000-002	2
5188.670	1.927276	7.4072+001	0.00061	0.99939	1.0000-001	2
5188.670	1.927276	7.4072+001	0.47677	0.52323	1.0000-002	2
5188.680	1.927272	7.3763+001	0.00063	0.99937	1.0000-001	2
5188.680	1.927272	7.3763+001	0.47825	0.52175	1.0000-002	2
5188.690	1.927269	7.2449+001	0.00071	0.99929	1.0000-001	2
5188.690	1.927269	7.2449+001	0.48457	0.51543	1.0000-002	2
5188.700	1.927265	7.0325+001	0.00088	0.99912	1.0000-001	2
5188.700	1.927265	7.0325+001	0.49497	0.50503	1.0000-002	2
5188.710	1.927261	6.7656+001	0.00115	0.99885	1.0000-001	2
5188.710	1.927261	6.7656+001	0.50836	0.49164	1.0000-002	2
5188.720	1.927258	6.4721+001	0.00155	0.99845	1.0000-001	2
5188.720	1.927258	6.4721+001	0.52350	0.47650	1.0000-002	2
5188.730	1.927254	6.1765+001	0.00208	0.99792	1.0000-001	2
5188.730	1.927254	6.1765+001	0.53921	0.46079	1.0000-002	2
5188.740	1.927250	5.8980+001	0.00274	0.99726	1.0000-001	2
5188.740	1.927250	5.8980+001	0.55444	0.44556	1.0000-002	2
5188.810	1.927224	5.0588+001	0.00635	0.99365	1.0000-001	1
5188.810	1.927224	5.0588+001	0.60297	0.39703	1.0000-002	1
5188.910	1.927187	8.2437+001	0.00026	0.99974	1.0000-001	1
5188.910	1.927187	8.2437+001	0.43851	0.56149	1.0000-002	1
5188.980	1.927161	1.6440+002	0.00000	1.00000	1.0000-001	2
5188.980	1.927161	1.6440+002	0.19321	0.80679	1.0000-002	2
5188.990	1.927157	1.8115+002	0.00000	1.00000	1.0000-001	2
5188.990	1.927157	1.8115+002	0.16341	0.83659	1.0000-002	2
5189.000	1.927154	1.9785+002	0.00000	1.00000	1.0000-001	2
5189.000	1.927154	1.9785+002	0.13827	0.86173	1.0000-002	2
5189.010	1.927150	2.1330+002	0.00000	1.00000	1.0000-001	2
5189.010	1.927150	2.1330+002	0.11849	0.88151	1.0000-002	2
5189.020	1.927146	2.2597+002	0.00000	1.00000	1.0000-001	2
5189.020	1.927146	2.2597+002	0.10439	0.89561	1.0000-002	2
5189.030	1.927142	2.3431+002	0.00000	1.00000	1.0000-001	2
5189.030	1.927142	2.3431+002	0.09603	0.90397	1.0000-002	2
5189.040	1.927139	2.3715+002	0.00000	1.00000	1.0000-001	2
5189.040	1.927139	2.3715+002	0.09334	0.90666	1.0000-002	2
5189.110	1.927113	1.4635+002	0.00000	1.00000	1.0000-001	1
5189.110	1.927113	1.4635+002	0.23142	0.76858	1.0000-002	1

5189.210	1.927076	5.4578+001	0.00426	0.99574	1.0000-001	1
5189.210	1.927076	5.4578+001	0.57939	0.42061	1.0000-002	1
5189.310	1.927038	3.0148+001	0.04906	0.95094	1.0000-001	1
5189.310	1.927038	3.0148+001	0.73973	0.26027	1.0000-002	1
5189.410	1.927001	2.5463+001	0.07837	0.92163	1.0000-001	1
5189.410	1.927001	2.5463+001	0.77520	0.22480	1.0000-002	1
5189.510	1.926964	3.6277+001	0.02658	0.97342	1.0000-001	1
5189.510	1.926964	3.6277+001	0.69575	0.30425	1.0000-002	1
5189.550	1.926949	4.9814+001	0.00686	0.99314	1.0000-001	2
5189.550	1.926949	4.9814+001	0.60766	0.39234	1.0000-002	2
5189.560	1.926946	5.4759+001	0.00419	0.99581	1.0000-001	2
5189.560	1.926946	5.4759+001	0.57834	0.42166	1.0000-002	2
5189.570	1.926942	6.0503+001	0.00236	0.99764	1.0000-001	2
5189.570	1.926942	6.0503+001	0.54606	0.45394	1.0000-002	2
5189.580	1.926938	6.7102+001	0.00122	0.99878	1.0000-001	2
5189.580	1.926938	6.7102+001	0.51119	0.48881	1.0000-002	2
5189.590	1.926934	7.4513+001	0.00058	0.99942	1.0000-001	2
5189.590	1.926934	7.4513+001	0.47467	0.52533	1.0000-002	2
5189.600	1.926931	8.2489+001	0.00026	0.99974	1.0000-001	2
5189.600	1.926931	8.2489+001	0.43829	0.56171	1.0000-002	2
5189.610	1.926927	9.0528+001	0.00012	0.99988	1.0000-001	2
5189.610	1.926927	9.0528+001	0.40443	0.59557	1.0000-002	2
5189.550	1.926949	4.9814+001	0.00686	0.99314	1.0000-001	2
5189.550	1.926949	4.9814+001	0.60766	0.39234	1.0000-002	2
5189.560	1.926946	5.4759+001	0.00419	0.99581	1.0000-001	2
5189.560	1.926946	5.4759+001	0.57834	0.42166	1.0000-002	2
5189.570	1.926942	6.0503+001	0.00236	0.99764	1.0000-001	2
5189.570	1.926942	6.0503+001	0.54606	0.45394	1.0000-002	2
5189.580	1.926938	6.7102+001	0.00122	0.99878	1.0000-001	2
5189.580	1.926938	6.7102+001	0.51119	0.48881	1.0000-002	2
5189.590	1.926934	7.4513+001	0.00058	0.99942	1.0000-001	2
5189.590	1.926934	7.4513+001	0.47467	0.52533	1.0000-002	2
5189.600	1.926931	8.2489+001	0.00026	0.99974	1.0000-001	2
5189.600	1.926931	8.2489+001	0.43829	0.56171	1.0000-002	2
5189.610	1.926927	9.0528+001	0.00012	0.99988	1.0000-001	2
5189.610	1.926927	9.0528+001	0.40443	0.59557	1.0000-002	2
5189.600	1.926931	8.2489+001	0.00026	0.99974	1.0000-001	2
5189.600	1.926931	8.2489+001	0.43829	0.56171	1.0000-002	2
5189.610	1.926927	9.0528+001	0.00012	0.99988	1.0000-001	2
5189.610	1.926927	9.0528+001	0.40443	0.59557	1.0000-002	2
5189.620	1.926923	9.8083+001	0.00005	0.99995	1.0000-001	2
5189.620	1.926923	9.8083+001	0.37500	0.62500	1.0000-002	2
5189.630	1.926920	1.0474+002	0.00003	0.99997	1.0000-001	2
5189.630	1.926920	1.0474+002	0.35085	0.64915	1.0000-002	2
5189.640	1.926916	1.1006+002	0.00002	0.99998	1.0000-001	2
5189.640	1.926916	1.1006+002	0.33267	0.66733	1.0000-002	2
5189.650	1.926912	1.1346+002	0.00001	0.99999	1.0000-001	2
5189.650	1.926912	1.1346+002	0.32156	0.67844	1.0000-002	2
5189.660	1.926909	1.1439+002	0.00001	0.99999	1.0000-001	2
5189.660	1.926909	1.1439+002	0.31859	0.68141	1.0000-002	2
5189.690	1.926897	1.0211+002	0.00004	0.99996	1.0000-001	2
5189.690	1.926897	1.0211+002	0.36020	0.63980	1.0000-002	2
5189.700	1.926894	9.4658+001	0.00008	0.99992	1.0000-001	2
5189.700	1.926894	9.4658+001	0.38807	0.61193	1.0000-002	2
5189.710	1.926890	8.6692+001	0.00017	0.99983	1.0000-001	2

5189.710	1.926890	8.6692+001	0.42024	0.57976	1.0000-002	2
5189.720	1.926886	7.8769+001	0.00038	0.99962	1.0000-001	2
5189.720	1.926886	7.8769+001	0.45490	0.54510	1.0000-002	2
5189.730	1.926883	7.1245+001	0.00081	0.99919	1.0000-001	2
5189.730	1.926883	7.1245+001	0.49044	0.50956	1.0000-002	2
5189.740	1.926879	6.4298+001	0.00161	0.99839	1.0000-001	2
5189.740	1.926879	6.4298+001	0.52572	0.47428	1.0000-002	2
5189.750	1.926875	5.7980+001	0.00303	0.99697	1.0000-001	2
5189.750	1.926875	5.7980+001	0.56001	0.43999	1.0000-002	2
5189.740	1.926879	6.4298+001	0.00161	0.99839	1.0000-001	2
5189.740	1.926879	6.4298+001	0.52572	0.47428	1.0000-002	2
5189.750	1.926875	5.7980+001	0.00303	0.99697	1.0000-001	2
5189.750	1.926875	5.7980+001	0.56001	0.43999	1.0000-002	2
5189.760	1.926871	5.2281+001	0.00536	0.99464	1.0000-001	2
5189.760	1.926871	5.2281+001	0.59285	0.40715	1.0000-002	2
5189.770	1.926868	4.7178+001	0.00894	0.99106	1.0000-001	2
5189.770	1.926868	4.7178+001	0.62389	0.37611	1.0000-002	2
5189.780	1.926864	4.2643+001	0.01406	0.98594	1.0000-001	2
5189.780	1.926864	4.2643+001	0.65283	0.34717	1.0000-002	2
5189.790	1.926860	3.8643+001	0.02098	0.97902	1.0000-001	2
5189.790	1.926860	3.8643+001	0.67948	0.32052	1.0000-002	2
5189.800	1.926857	3.5130+001	0.02981	0.97019	1.0000-001	2
5189.800	1.926857	3.5130+001	0.70377	0.29623	1.0000-002	2
5189.870	1.926831	1.9936+001	0.13621	0.86379	1.0000-001	1
5189.870	1.926831	1.9936+001	0.81926	0.18074	1.0000-002	1
5189.920	1.926812	1.4720+001	0.22948	0.77052	1.0000-001	2
5189.920	1.926812	1.4720+001	0.86312	0.13688	1.0000-002	2
5189.930	1.926808	1.3977+001	0.24716	0.75284	1.0000-001	2
5189.930	1.926808	1.3977+001	0.86956	0.13044	1.0000-002	2
5189.940	1.926805	1.3305+001	0.26434	0.73566	1.0000-001	2
5189.940	1.926805	1.3305+001	0.87542	0.12458	1.0000-002	2
5189.950	1.926801	1.2692+001	0.28106	0.71894	1.0000-001	2
5189.950	1.926801	1.2692+001	0.88081	0.11919	1.0000-002	2
5189.960	1.926797	1.2127+001	0.29741	0.70259	1.0000-001	2
5189.960	1.926797	1.2127+001	0.88580	0.11420	1.0000-002	2
5189.970	1.926793	1.1599+001	0.31352	0.68648	1.0000-001	2
5189.970	1.926793	1.1599+001	0.89048	0.10952	1.0000-002	2
5189.980	1.926790	1.1101+001	0.32953	0.67047	1.0000-001	2
5189.980	1.926790	1.1101+001	0.89493	0.10507	1.0000-002	2
5190.050	1.926764	8.2234+000	0.43940	0.56060	1.0000-001	1
5190.050	1.926764	8.2234+000	0.92106	0.07894	1.0000-002	1
5190.150	1.926727	5.8085+000	0.55942	0.44058	1.0000-001	1
5190.150	1.926727	5.8085+000	0.94357	0.05643	1.0000-002	1
5190.250	1.926689	4.4891+000	0.63832	0.36168	1.0000-001	1
5190.250	1.926689	4.4891+000	0.95610	0.04390	1.0000-002	1
5190.350	1.926652	3.6838+000	0.69186	0.30814	1.0000-001	1
5190.350	1.926652	3.6838+000	0.96383	0.03617	1.0000-002	1
5190.450	1.926615	3.1947+000	0.72653	0.27347	1.0000-001	1
5190.450	1.926615	3.1947+000	0.96856	0.03144	1.0000-002	1
5190.470	1.926608	3.1365+000	0.73077	0.26923	1.0000-001	2
5190.470	1.926608	3.1365+000	0.96912	0.03088	1.0000-002	2
5190.480	1.926604	3.1145+000	0.73239	0.26761	1.0000-001	2
5190.480	1.926604	3.1145+000	0.96934	0.03066	1.0000-002	2
5190.490	1.926600	3.0978+000	0.73361	0.26639	1.0000-001	2
5190.490	1.926600	3.0978+000	0.96950	0.03050	1.0000-002	2

5190.500	1.926597	3.0867+000	0.73442	0.26558	1.0000-001	2
5190.500	1.926597	3.0867+000	0.96960	0.03040	1.0000-002	2
5190.510	1.926593	3.0808+000	0.73485	0.26515	1.0000-001	2
5190.510	1.926593	3.0808+000	0.96966	0.03034	1.0000-002	2
5190.520	1.926589	3.0785+000	0.73502	0.26498	1.0000-001	2
5190.520	1.926589	3.0785+000	0.96968	0.03032	1.0000-002	2
5190.530	1.926586	3.0770+000	0.73514	0.26486	1.0000-001	2
5190.530	1.926586	3.0770+000	0.96970	0.03030	1.0000-002	2
5190.500	1.926597	3.0867+000	0.73442	0.26558	1.0000-001	2
5190.500	1.926597	3.0867+000	0.96960	0.03040	1.0000-002	2
5190.510	1.926593	3.0808+000	0.73485	0.26515	1.0000-001	2
5190.510	1.926593	3.0808+000	0.96966	0.03034	1.0000-002	2
5190.520	1.926589	3.0785+000	0.73502	0.26498	1.0000-001	2
5190.520	1.926589	3.0785+000	0.96968	0.03032	1.0000-002	2
5190.530	1.926586	3.0770+000	0.73514	0.26486	1.0000-001	2
5190.530	1.926586	3.0770+000	0.96970	0.03030	1.0000-002	2
5190.540	1.926582	3.0725+000	0.73547	0.26453	1.0000-001	2
5190.540	1.926582	3.0725+000	0.96974	0.03026	1.0000-002	2
5190.550	1.926578	3.0609+000	0.73632	0.26368	1.0000-001	2
5190.550	1.926578	3.0609+000	0.96985	0.03015	1.0000-002	2
5190.560	1.926574	3.0384+000	0.73798	0.26202	1.0000-001	2
5190.560	1.926574	3.0384+000	0.97007	0.02993	1.0000-002	2
5190.630	1.926548	2.8021+000	0.75562	0.24438	1.0000-001	1
5190.630	1.926548	2.8021+000	0.97237	0.02763	1.0000-002	1
5190.720	1.926515	3.0933+000	0.73394	0.26606	1.0000-001	2
5190.720	1.926515	3.0933+000	0.96954	0.03046	1.0000-002	2
5190.730	1.926511	3.1990+000	0.72622	0.27378	1.0000-001	2
5190.730	1.926511	3.1990+000	0.96852	0.03148	1.0000-002	2
5190.740	1.926508	3.3230+000	0.71727	0.28273	1.0000-001	2
5190.740	1.926508	3.3230+000	0.96732	0.03268	1.0000-002	2
5190.750	1.926504	3.4611+000	0.70743	0.29257	1.0000-001	2
5190.750	1.926504	3.4611+000	0.96598	0.03402	1.0000-002	2
5190.760	1.926500	3.6038+000	0.69741	0.30259	1.0000-001	2
5190.760	1.926500	3.6038+000	0.96460	0.03540	1.0000-002	2
5190.770	1.926496	3.7368+000	0.68820	0.31180	1.0000-001	2
5190.770	1.926496	3.7368+000	0.96332	0.03668	1.0000-002	2
5190.780	1.926493	3.8455+000	0.68075	0.31925	1.0000-001	2
5190.780	1.926493	3.8455+000	0.96227	0.03773	1.0000-002	2
5190.780	1.926493	3.8455+000	0.68075	0.31925	1.0000-001	2
5190.780	1.926493	3.8455+000	0.96227	0.03773	1.0000-002	2
5190.790	1.926489	3.9217+000	0.67559	0.32441	1.0000-001	2
5190.790	1.926489	3.9217+000	0.96154	0.03846	1.0000-002	2
5190.800	1.926485	3.9658+000	0.67262	0.32738	1.0000-001	2
5190.800	1.926485	3.9658+000	0.96112	0.03888	1.0000-002	2
5190.810	1.926482	3.9830+000	0.67146	0.32854	1.0000-001	2
5190.810	1.926482	3.9830+000	0.96095	0.03905	1.0000-002	2
5190.820	1.926478	3.9762+000	0.67192	0.32808	1.0000-001	2
5190.820	1.926478	3.9762+000	0.96102	0.03898	1.0000-002	2
5190.830	1.926474	3.9426+000	0.67418	0.32582	1.0000-001	2
5190.830	1.926474	3.9426+000	0.96134	0.03866	1.0000-002	2
5190.840	1.926470	3.8773+000	0.67860	0.32140	1.0000-001	2
5190.840	1.926470	3.8773+000	0.96197	0.03803	1.0000-002	2
5190.910	1.926444	2.8883+000	0.74914	0.25086	1.0000-001	1
5190.910	1.926444	2.8883+000	0.97153	0.02847	1.0000-002	1
5191.010	1.926407	2.1565+000	0.80602	0.19398	1.0000-001	1

5191.010	1.926407	2.1565+000	0.97867	0.02133	1.0000-002	1
5191.110	1.926370	1.9456+000	0.82320	0.17680	1.0000-001	1
5191.110	1.926370	1.9456+000	0.98073	0.01927	1.0000-002	1
5191.210	1.926333	1.8913+000	0.82768	0.17232	1.0000-001	1
5191.210	1.926333	1.8913+000	0.98127	0.01873	1.0000-002	1
5191.310	1.926296	1.9380+000	0.82382	0.17618	1.0000-001	1
5191.310	1.926296	1.9380+000	0.98081	0.01919	1.0000-002	1
5191.410	1.926259	2.1088+000	0.80987	0.19013	1.0000-001	1
5191.410	1.926259	2.1088+000	0.97913	0.02087	1.0000-002	1
5191.510	1.926222	2.5036+000	0.77852	0.22148	1.0000-001	1
5191.510	1.926222	2.5036+000	0.97527	0.02473	1.0000-002	1
5191.610	1.926185	3.4337+000	0.70938	0.29062	1.0000-001	1
5191.610	1.926185	3.4337+000	0.96625	0.03375	1.0000-002	1
5191.710	1.926148	6.1415+000	0.54110	0.45890	1.0000-001	1
5191.710	1.926148	6.1415+000	0.94043	0.05957	1.0000-002	1
5191.810	1.926111	1.8842+001	0.15196	0.84804	1.0000-001	1
5191.810	1.926111	1.8842+001	0.82827	0.17173	1.0000-002	1
5191.830	1.926103	2.5898+001	0.07503	0.92497	1.0000-001	2
5191.830	1.926103	2.5898+001	0.77183	0.22817	1.0000-002	2
5191.840	1.926099	3.0547+001	0.04714	0.95286	1.0000-001	2
5191.840	1.926099	3.0547+001	0.73678	0.26322	1.0000-002	2
5191.850	1.926096	3.5922+001	0.02754	0.97246	1.0000-001	2
5191.850	1.926096	3.5922+001	0.69822	0.30178	1.0000-002	2
5191.860	1.926092	4.1726+001	0.01541	0.98459	1.0000-001	2
5191.860	1.926092	4.1726+001	0.65885	0.34115	1.0000-002	2
5191.870	1.926088	4.7264+001	0.00886	0.99114	1.0000-001	2
5191.870	1.926088	4.7264+001	0.62335	0.37665	1.0000-002	2
5191.880	1.926085	5.1442+001	0.00583	0.99417	1.0000-001	2
5191.880	1.926085	5.1442+001	0.59785	0.40215	1.0000-002	2
5191.890	1.926081	5.3136+001	0.00492	0.99508	1.0000-001	2
5191.890	1.926081	5.3136+001	0.58781	0.41219	1.0000-002	2
5191.960	1.926055	2.5792+001	0.07583	0.92417	1.0000-001	1
5191.960	1.926055	2.5792+001	0.77265	0.22735	1.0000-002	1
5191.990	1.926044	2.1251+001	0.11942	0.88058	1.0000-001	2
5191.990	1.926044	2.1251+001	0.80855	0.19145	1.0000-002	2
5192.000	1.926040	2.1100+001	0.12124	0.87876	1.0000-001	2
5192.000	1.926040	2.1100+001	0.80978	0.19022	1.0000-002	2
5192.010	1.926036	2.1493+001	0.11657	0.88343	1.0000-001	2
5192.010	1.926036	2.1493+001	0.80660	0.19340	1.0000-002	2
5192.020	1.926033	2.2269+001	0.10787	0.89213	1.0000-001	2
5192.020	1.926033	2.2269+001	0.80037	0.19963	1.0000-002	2
5192.030	1.926029	2.3144+001	0.09883	0.90117	1.0000-001	2
5192.030	1.926029	2.3144+001	0.79339	0.20661	1.0000-002	2
5192.040	1.926025	2.3706+001	0.09342	0.90658	1.0000-001	2
5192.040	1.926025	2.3706+001	0.78894	0.21106	1.0000-002	2
5192.050	1.926022	2.3538+001	0.09501	0.90499	1.0000-001	2
5192.050	1.926022	2.3538+001	0.79027	0.20973	1.0000-002	2
5192.120	1.925996	1.0572+001	0.34743	0.65257	1.0000-001	1
5192.120	1.925996	1.0572+001	0.89968	0.10032	1.0000-002	1
5192.220	1.925958	4.1366+000	0.66123	0.33877	1.0000-001	1
5192.220	1.925958	4.1366+000	0.95948	0.04052	1.0000-002	1
5192.320	1.925921	2.5713+000	0.77327	0.22673	1.0000-001	1
5192.320	1.925921	2.5713+000	0.97462	0.02538	1.0000-002	1
5192.420	1.925884	1.9500+000	0.82283	0.17717	1.0000-001	1
5192.420	1.925884	1.9500+000	0.98069	0.01931	1.0000-002	1

5192.520	1.925847	1.6374+000	0.84896	0.15104	1.0000-001	1
5192.520	1.925847	1.6374+000	0.98376	0.01624	1.0000-002	1
5192.620	1.925810	1.4587+000	0.86427	0.13573	1.0000-001	1
5192.620	1.925810	1.4587+000	0.98552	0.01448	1.0000-002	1
5192.720	1.925773	1.3490+000	0.87381	0.12619	1.0000-001	1
5192.720	1.925773	1.3490+000	0.98660	0.01340	1.0000-002	1
5192.820	1.925736	1.2794+000	0.87991	0.12009	1.0000-001	1
5192.820	1.925736	1.2794+000	0.98729	0.01271	1.0000-002	1
5192.920	1.925699	1.2356+000	0.88377	0.11623	1.0000-001	1
5192.920	1.925699	1.2356+000	0.98772	0.01228	1.0000-002	1

```
      SUBROUTINE ABSCOEF(V,BOUND,I7,I1,P)
      COMMON/1/GNU(2550),S(2550),ALFA0(2550),CAY(1)

      DETERMINATION OF INDEXING VALUES FOR ABSORPTION COEFFICIENT CALC.

   10 DO 14 I = 1,I1
   11 IF(V-BOUND-GNU(I))12,12,14
   12 I5 = I
   13 GO TO 15
   14 CONTINUE
   15 DO 19 K = I7,I1
   16 IF(V+BOUND-GNU(K))17,17,19
   17 I6 = K
   18 GO TO 25
   19 CONTINUE

      CALCULATION OF ABSORPTION COEFFICIENT WITH LORENTZ LINE SHAPE

   25 CAY1 = CAY2 = 0.0
   30 DO 46 I = I5,I6
   32 Y = ABSF(V-GNU(I))
   34 IF(Y-2.)36,36,42
   36 SUM1 = S(I)*ALFA0(I)/(Y**2+(ALFA0(I)*P)**2)
   38 CAY1 = CAY1 + SUM1
   40 GO TO 46
   42 SUM2 = S(I)*ALFA0(I)/Y**2
   44 CAY2 = CAY2 + SUM2
   46 CONTINUE
   50 CAY = P*0.3183*(CAY1+CAY2)
   52 RETURN
      END
```

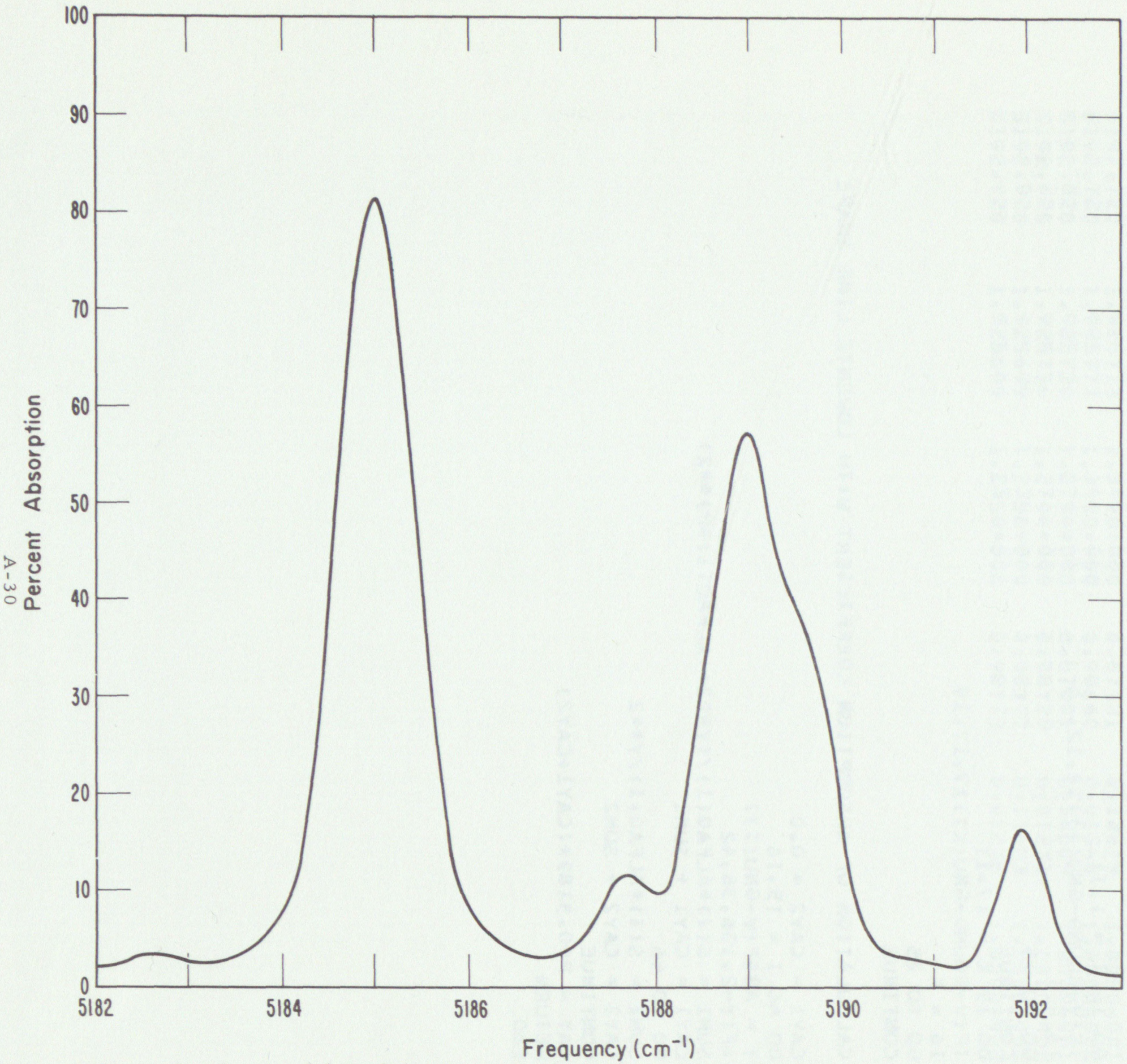

Figure 3. Computed degraded water vapor absorption spectrum for the frequency range 5182 to 5193 cm^{-1} at a pressure of 1.0 atm., at a concentration of 0.01 cm of precipitable water vapor for a temperature of 287.7°K, and for a spectral slit width, a, of 0.5 cm^{-1}.

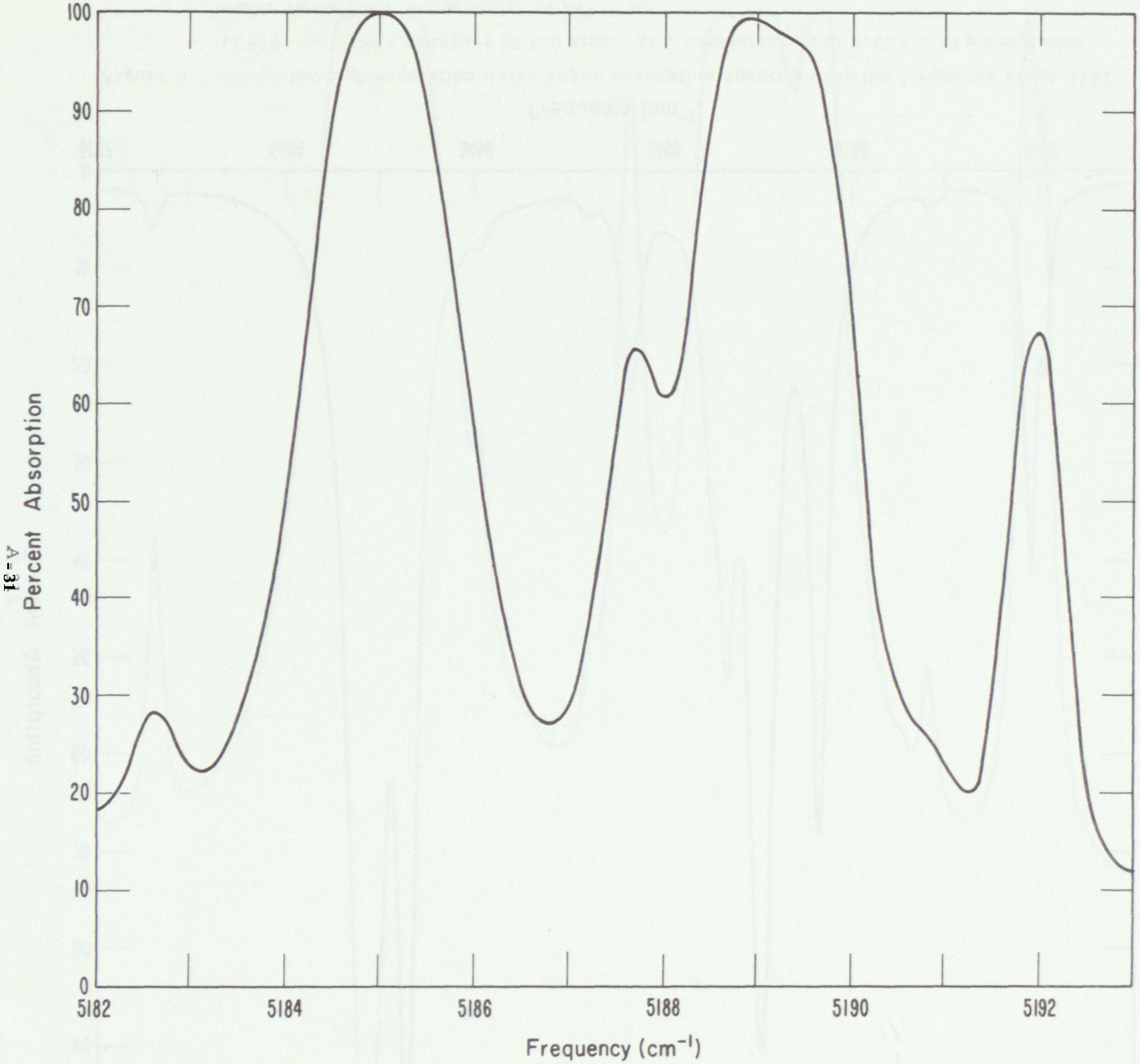

Figure 4. Computed degraded water vapor absorption spectrum for the frequency range 5182 to 5193 cm^{-1} at a pressure of 1.0 atm., at a concentration of 0.1 cm of precipitable water vapor for a temperature of 287.7°K, and for a spectral slit width, a, of 0.5 cm^{-1}.

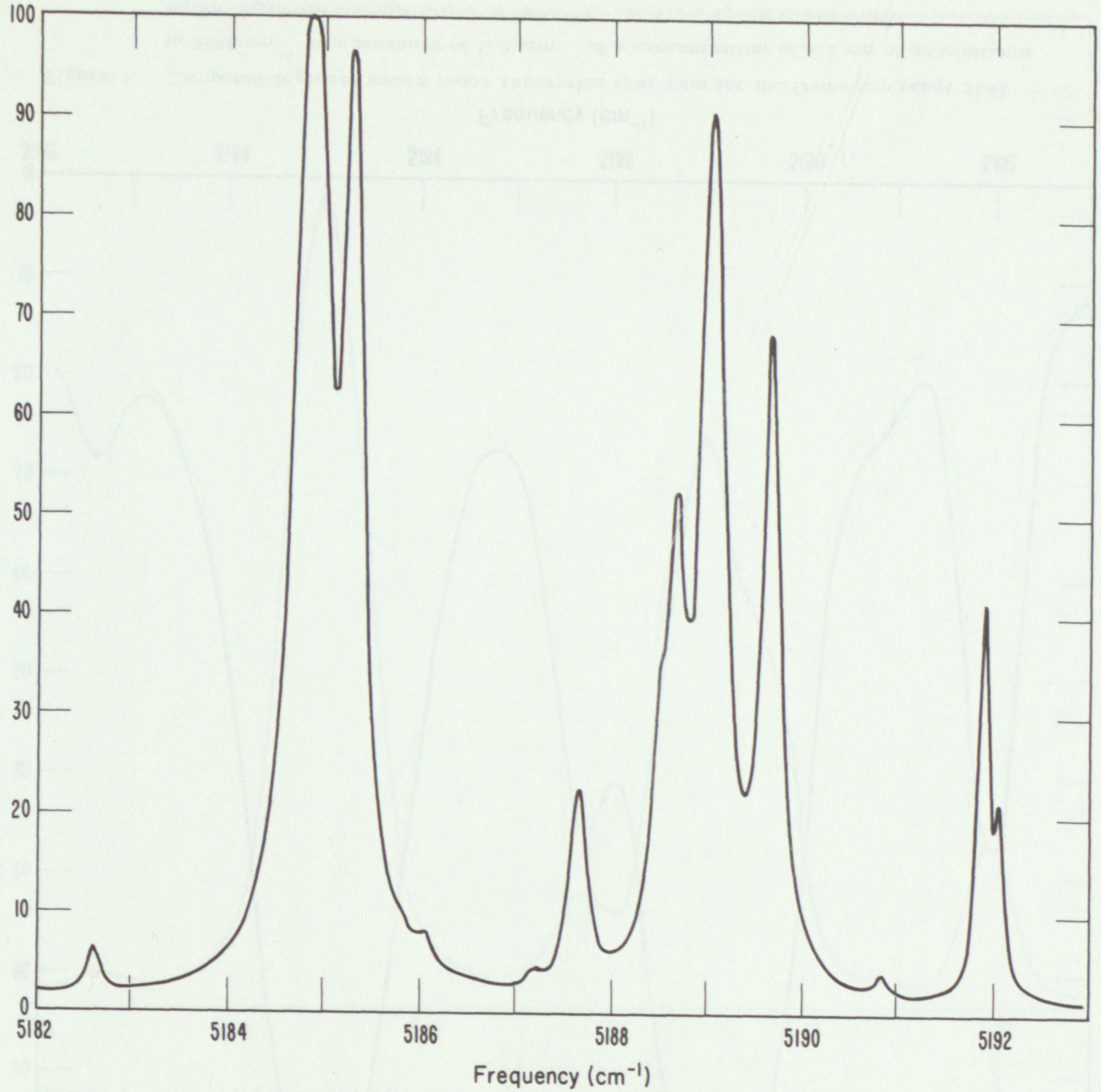

Figure 5. Computed high resolution water vapor absorption spectrum for the frequency range 5182 to 5193 cm^{-1} at a pressure of 1.0 atm., at a concentration of 0.01 cm of precipitable water vapor for a temperature of 287.7°K.

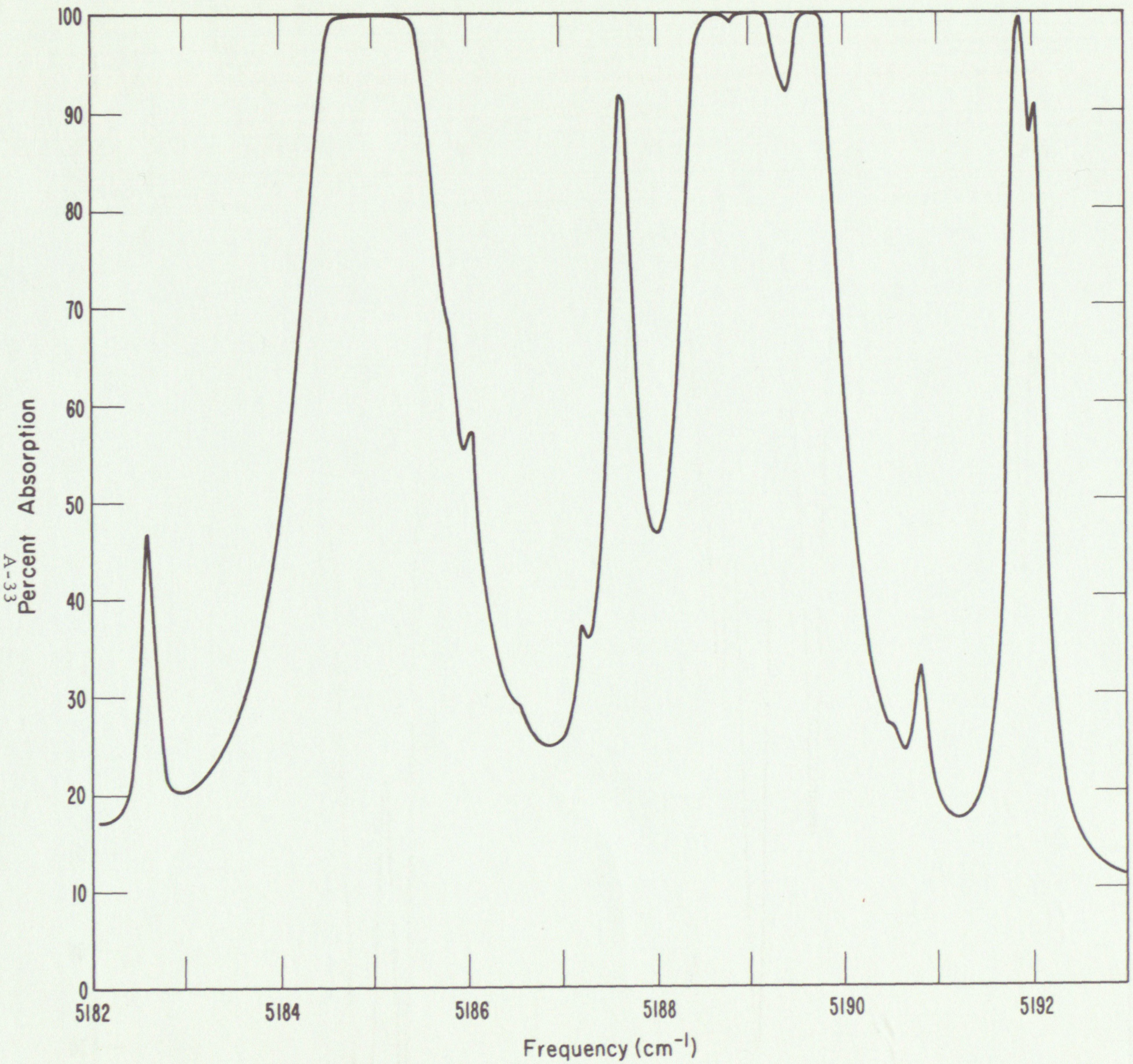

Figure 6. Computed high resolution water vapor absorption spectrum for the frequency range 5182 to 5193 cm^{-1} at a pressure of 1.0 atm., at a concentration of 0.1 cm of precipitable water vapor for a temperature of 287.7°K.

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