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The Temperature Dependence of Ultra Violet Sulfur Dioxide Absorption Cross Sections

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The Temperature Dependence of Sulfur Dioxide Ultra Violet Absorption Cross Sections

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INTRODUCTION

Sulfur dioxide, SO_2, plays an important role in atmospheric chemistry. Volcanoes are the primary source of stratospheric SO_2 , a major precursor of sulfuric acid aerosols. Global cooling, observed after past major eruptions, has been partially attributed to these aerosols. Sulfur dioxide is also of atmospheric interest due to its relationship to the determination of the amount of ozone in the stratosphere. The daily global total ozone field is currently mapped by the Total Ozone Mapping Spectrometer, TOMS, aboard Nimbus-7. TOMS is an Ebert monochromator with specific exit slits at wavelengths 312.5, 317.5, 331.2, 339.8, 360.0 and 380.0 nm with a fixed spectral band pass of 1 nm. In March and April 1982, increased absorptions in the shortest wavelength channels of the instrument were observed which corresponded to the time during and after the eruptions of El Chichon in Mexico. The absorption was later determined to be due to SO_2.[1]

The data obtained was used to determine the total column ozone by comparing the observed with theoretical response, which were computed with a model for the full range of geophysical conditions. The TOMS atmospheric model was not accurate when large amounts of absorbing gases other than ozone were present. These deviations were detected under certain conditions and were found to be consistent with the El Chichon data from 1982. The contaminated atmospheric volumes produced a higher apparent total ozone amount.

The wavelength dependence of the cloud absorption allows discrimination of the

two known volcanic constituents that absorb at TOMS wavelengths, SO_2 and CS_2. Sulfur dioxide has an absorption band between 260 and 320 nm and carbon disulfide absorbs between 300 and 340 nm. Carbon disulfide was ruled out as the source of the deviation because, had it been present, increased absorption at 331.2 and 339.8 nm would also have been seen. As there was no increase in absorption at these wavelengths, SO_2 was determined to be the major gaseous substituent.

An additional method used to test for the presence of SO_2 is to compare the column amounts at the two absorbed wavelengths. When this comparison was made, a 10% difference in the abundance of the SO_2 was found between the two wavelengths. The difference was believed to be within the error of SO_2 absorption coefficients and their temperature dependence. At the time the above described work was done[2], the available measurements for SO_2 absorption coefficients were at room temp while the experimental conditions of the stratosphere were below -50 °C. Given the extreme spatial and temporal variability of volcanoes, it has not been possible to design a retrieval algorithm that removes their effect from the TOMS data. It has, however, been possible to detect the presence of SO_2 in the instrument field-of-view and to flag these data for affected scans[3]. To definitively analyze the data, low temperature data of SO_2 absorption cross sections is needed.

The initial objective for this project was to quantitatively define the temperature dependence of SO_2 absorption cross sections. Data was to be collected in the wavelength region 290-340 nm, at 298 K, 210 K and a third temperature between the two. Previous studies have been reported on SO_2 absorption in the near ultra violet at wavelengths

ranging from 106 nm to 403 nm. The majority of this data, however, has only been run at 298 K. A data set containing three temperatures is necessary to determine whether the temperature dependence of the cross sections has a linear or a higher order dependency. The data is needed to develop a more accurate atmospheric model and algorithm.

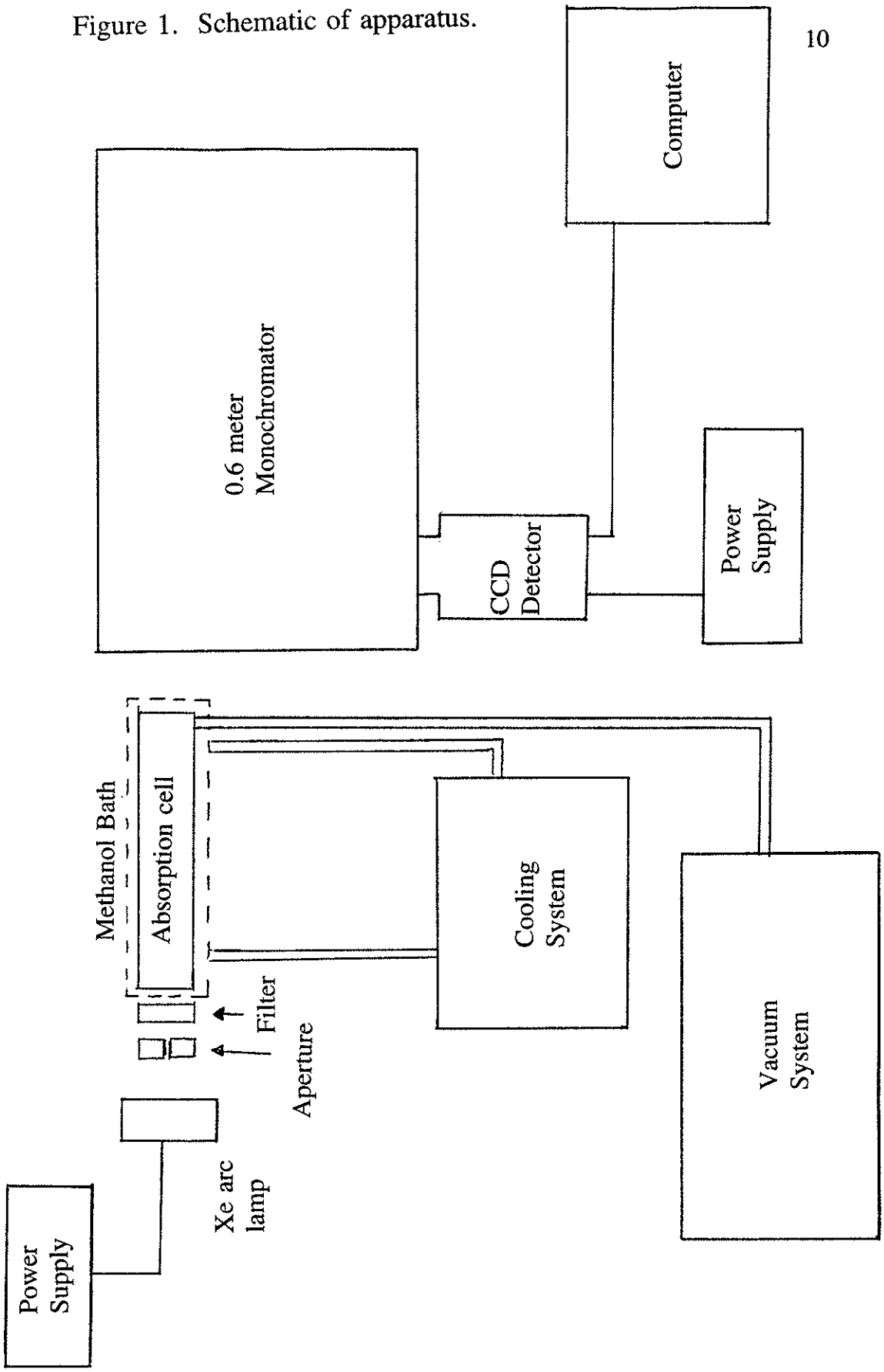
Due to technical difficulties during the time spent at NASA/Goddard Space Flight Center, appropriate data sets were not obtained to determine the temperature dependence of the SO_2 absorption cross sections. No low temperature data was collected. The focus of the project was shifted from a quantitative to a qualitative analysis of the temperature dependence. I have attempted to elucidate the underlying principles of the temperature dependence of the spectra obtained. In the following pages I will describe the laboratory work I accomplished as well as explain the temperature dependence of SO_2 absorption cross sections.

EXPERIMENTAL

Sulfur dioxide absorption spectra were collected using the apparatus as seen in Figure 1. The light source was a filtered 150 W xenon arc lamp. During the data collection process in June - August, 1995, a 7-54 filter was used to minimize both photolysis of SO_2 at 220 nm and fluorescence from the strong absorption at 220 nm. The filter also reduced the total amount of light entering the cell and thereby the detector. An aperture was also placed between the lamp and the filter to further reduce the amount of light entering the cell.

Photolysis of SO_2 results in the formation of sulfur trioxide and sulfur oxide as

Figure 1. Schematic of apparatus.



shown below[4],

$$SO_2 + SO_2 \rightarrow SO_2^*$$

$$SO_2^* + SO_2 \rightarrow SO_3 + SO$$

First one molecule is excited by a photon, then it in turn reacts with a second molecule to form the products. Sulfur trioxide reacts with water droplets to form sulfuric acid aerosols. Fluorescence occurs when the SO_2* molecule undergoes spontaneous emission. The remaining excess energy is emitted as radiation during the transition of the molecule from the excited state to the ground state.

The SO_2 was contained in an absorption cell, 50.5 cm in length, with an evacuated double-window configuration at each end to eliminate the possibility of frost formation on the windows during low temperature runs. Surrounding the cell was a cylinder which contained the bath for low temperature readings. Methanol, cooled by a digital low temperature bath circulator, Neslab ULT-80, served as the bath. When the experiment was run in January, 1996, the filter and aperture were removed and the cell was replaced with a 239.9 cm stainless steel cell that had only a single window configuration. At the time of the experiment, a cooling system had not yet been designed for the longer cell. In both cases the cell was placed between a 0.6 meter monochromator, with a 24 nm exit slit, and the lamp. The detector used was a 1530-PUV 1024S charge coupled device (CCD) detector from EG & G Instruments. Like a photo diode array (PDA) detector, charge is collected on the CCD. The operating mode differs, however. Light incident on the CCD detector frees an electron which drifts toward the depletion region where it is collected. Wherein a PDA consists of individual diode elements which are read out

indivudually, the CCD is one continuous material. Individual pixels or picture elements are defined within a readout column. The pixel information is read out by a read out register. Pixels can be read out individually or binned. Binning is combining the charges from several pixels of one row, and allows the averaging of the signal and noise from several rows. Figure 2 shows an example of improving the signal to noise ratio through binning[5].

To ensure its purity, the SO_2 was vacuum distilled daily. The vacuum was attached directly to the cell so the alignment was not disturbed as the pressure was changed. The pressure, ranging from 0.04 to 100 Torr, was measured with two or three MKS Baratron Pressure Meters equipped with 1 and 100 Torr heads. The calibration of the monochromator was checked daily with a Hg/Ne low intensity lamp with known spectral lines, Table 1[6]. The total wavelength region was divided into three regions and each was individually calibrated with Hg/Ne lines as shown below in Table 1 and Figure 3. Experimental resolution of 0.045 nm was reached with the Hg/Ne calibration lines.

Figure 2. Improved S/N with binning.

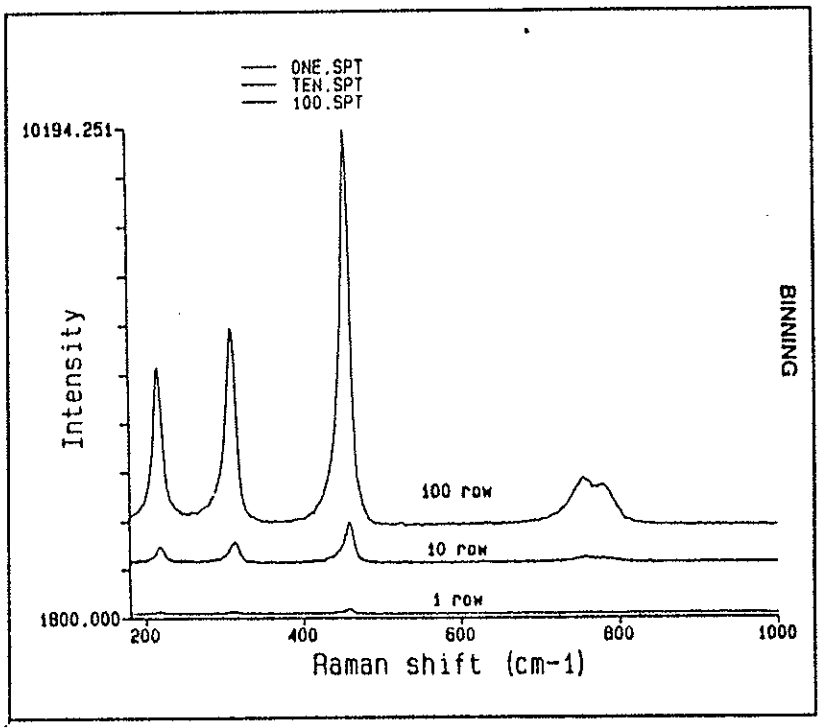
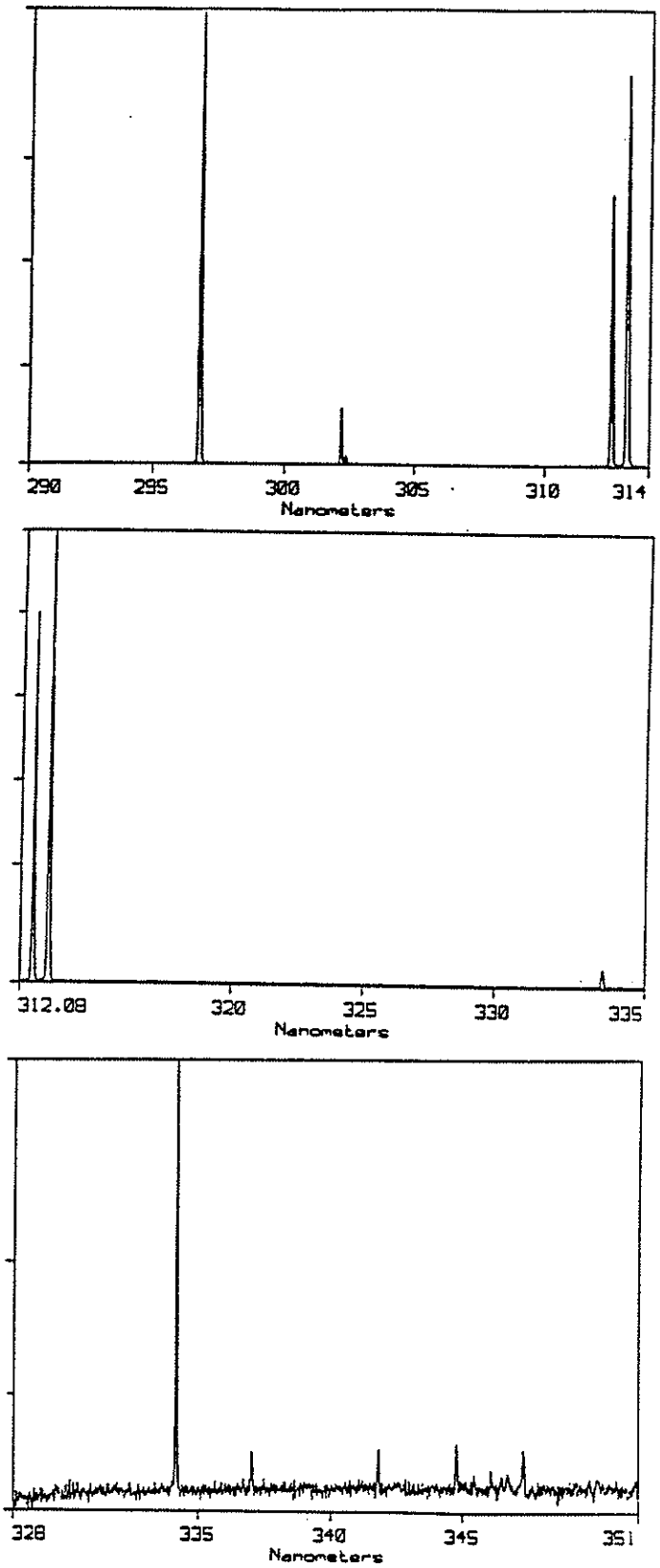


Table 1. Hg/Ne calibration lines.

wavelength (nanometers)
296.73
302.15
312.57
313.17
334.18
336.99
341.79
344.77
347.26

Figure 3. Calibration of monochromator.



Spectra were obtained in the following manner. First, to obtain a scan of the detector noise, equivalent to 0% transmittance, the monochromator slit was covered and a scan was taken. Next a given pressure of SO_2 was put into the cell. The SO_2 was then frozen into a liquid nitrogen cold finger to obtain a background spectrum of the Xe lamp and the empty cell, equivalent to 100% transmittance. Finally a sample scan was obtained with the SO_2 in the cell. Figure 4 is an example of a transmission spectrum of SO_2 . Using the software package associated with the detector, EG & G Instruments OMA 4000, the absorption was calculated. The calculations involved first subtracting the detector noise from both the background and sample scans, then taking the log I_o/I. Figure 5 is an absorption spectrum of SO_2 . The absorption spectrum is due to electronic transitions. Each individual peak is a single vibrational transition with a rotational fine structure superimposed on the vibrational manifold. Each absorption peak has been assigned a vibrational transition, for example the peak at 300.18 nm is due to the (0,0,0)″ - (1,0,0)′ transition[7]. The assignments correspond to the three vibrational modes for a SO_2 molecule.

The exposure time was maximized to increase the signal to noise ratio and multiple scans were added together to further increase the ratio. Eight to ten pressures were taken for each wavelength region. For each wavelength, graphs of absorption vs pressure were created for the set of pressures to ensure that Beer's law was followed. Using a linear regression program ln I_o/I vs P was plotted, as shown in Figure 6. The absorption cross sections were then calculated using the slope of the line, as follows,

Figure 4. SO_2 transmission spectrum.

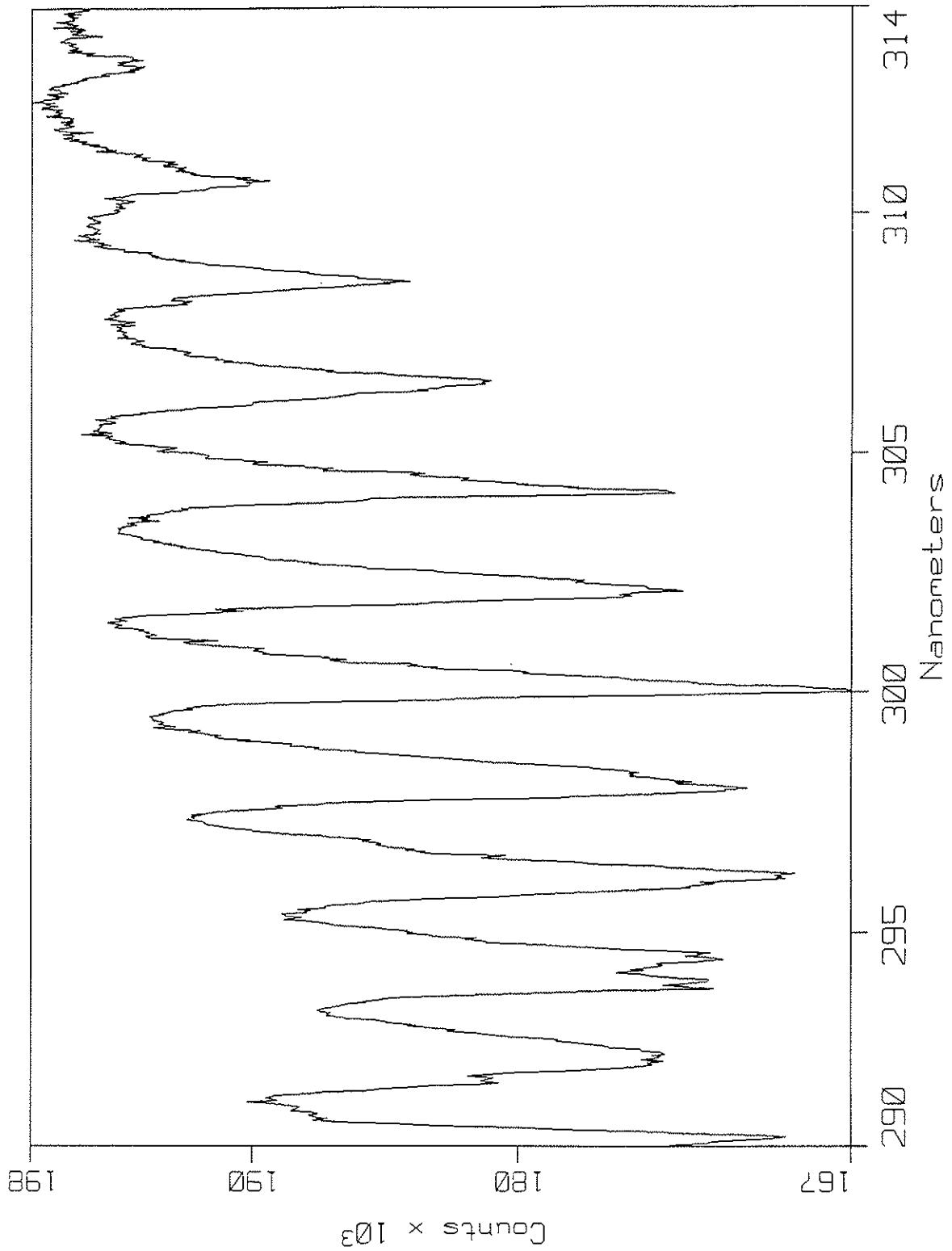


Figure 5. SO_2 absorption spectrum.

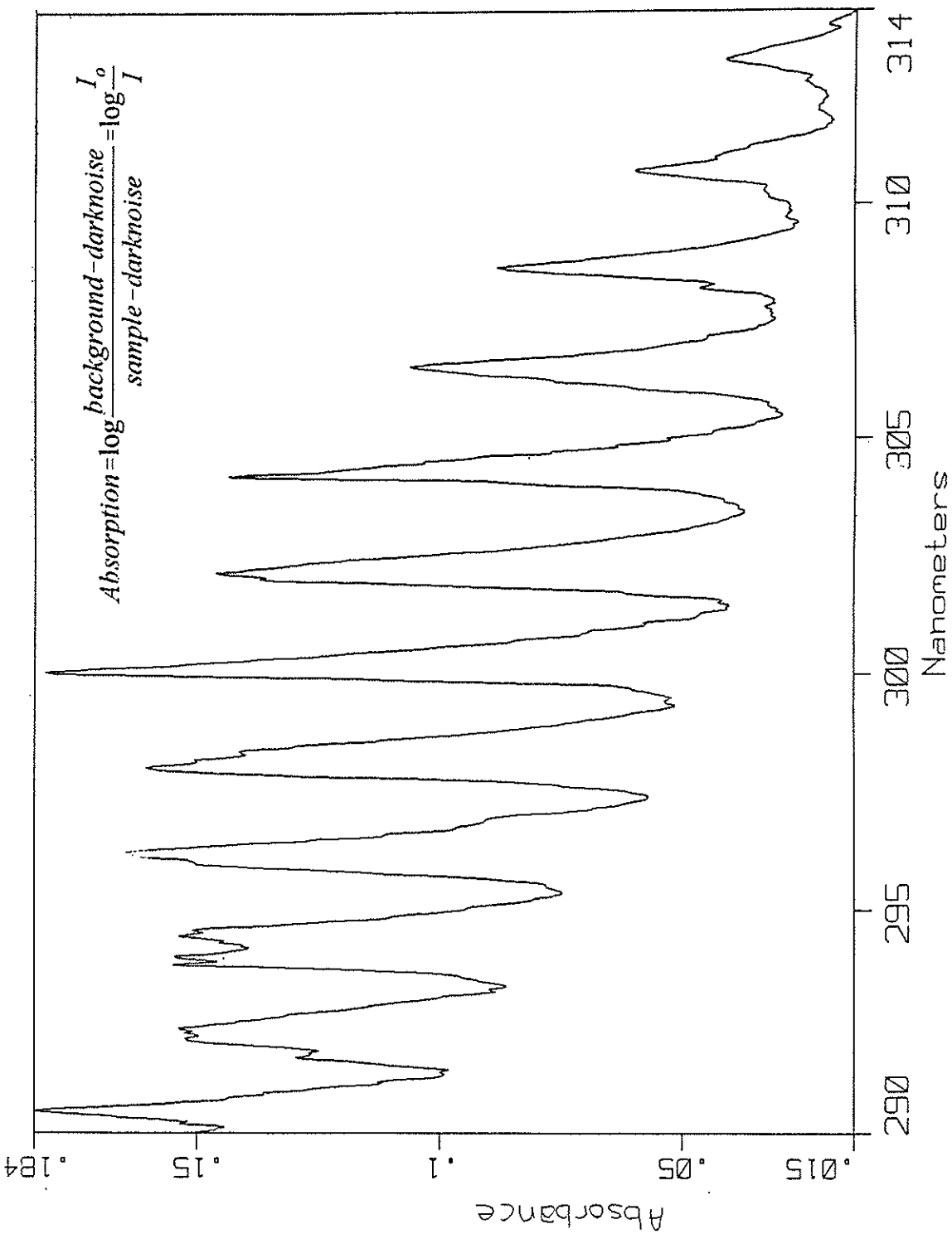


Figure 6. Absorption vs pressure.

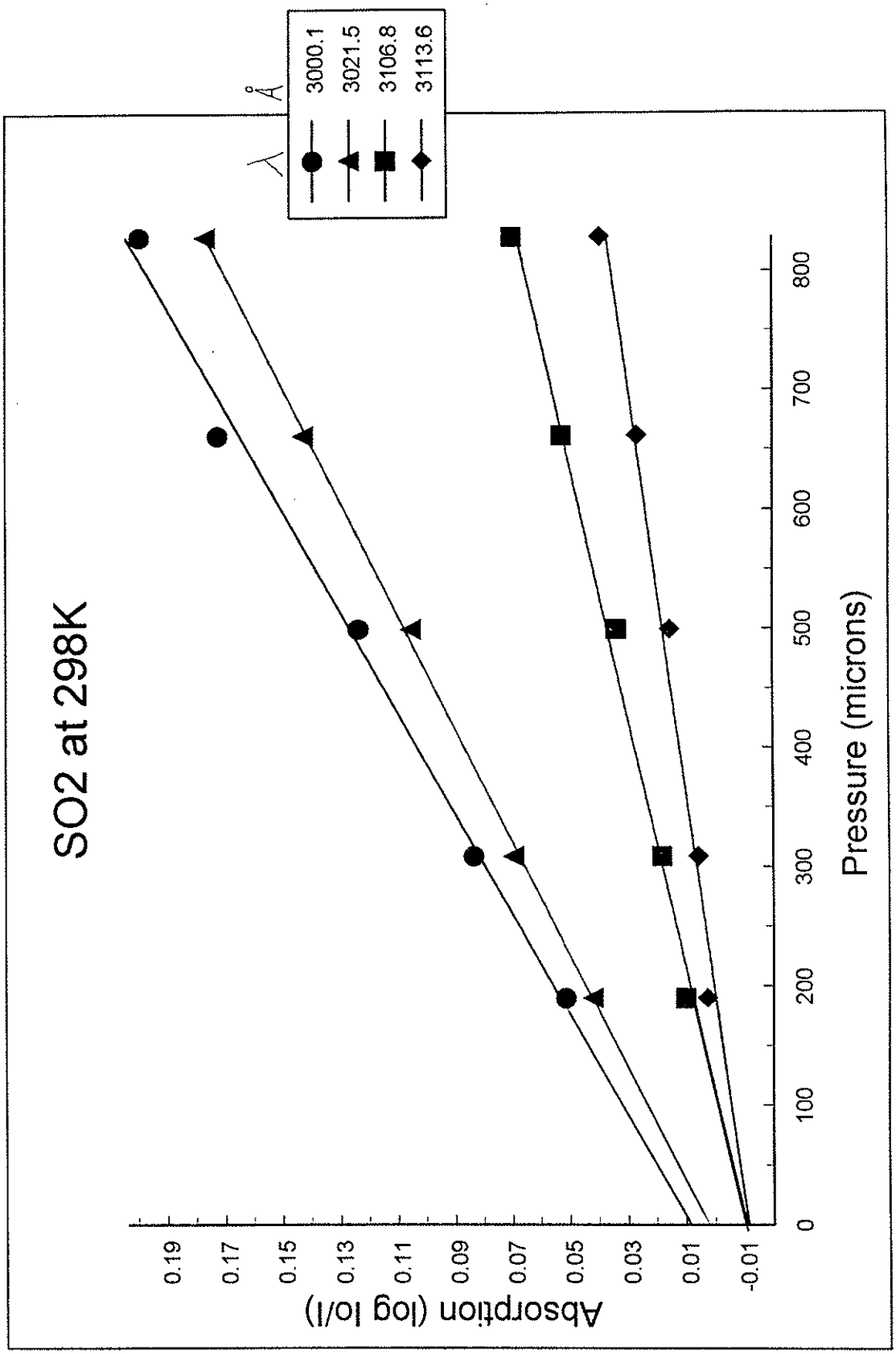
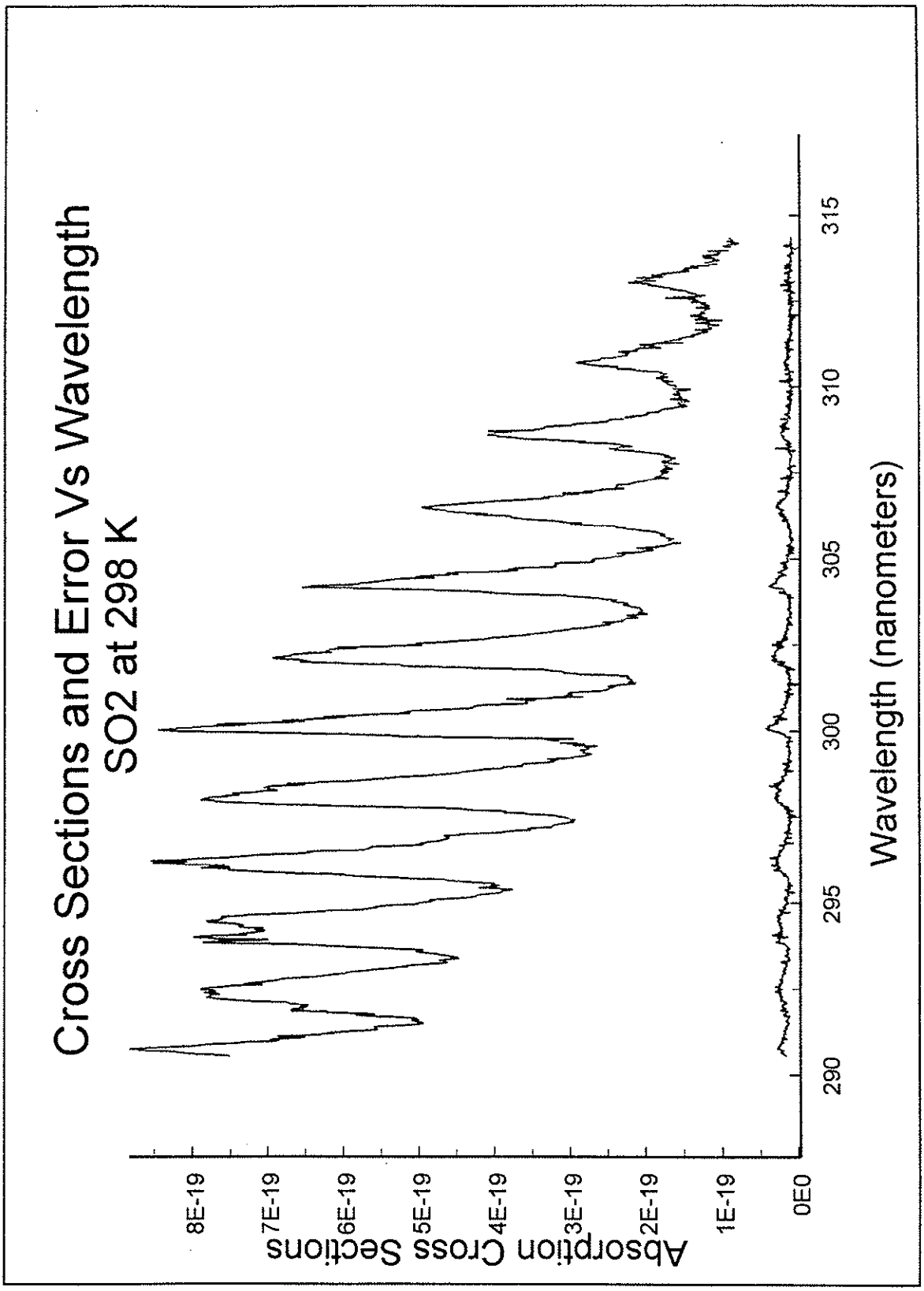


Figure 7. SO_2 absorption cross section spectrum.



$$\sigma = \frac{bkT}{l}$$

Where σ = cross sections, b= slope, k = Boltzmann constant, T = temperature in Kelvin and l = length of the cell in cm. The absorption cross sections were then plotted as a function of wavelength. Figure 7 is a cross section spectrum with errors.

THEORETICAL

In order to understand why there is a temperature dependence in the absorption cross sections, absorption must first be understood. Secondly, the relationship between cross sections and absorption needs to be defined. The temperature dependence can then be attributed to a number of factors which can be explained through theories of spectroscopy and quantum mechanics.

Absorption

The absorption of a photon, by a molecule, results in the excitation of the molecule from a ground energy level, E, to higher energy level, E'. The difference in energy between the two energy levels is equal to the energy of the photon used to excite the molecule[8].

$$E' - E = h\nu$$

In an ideal experiment, if monochromatic light were used as the source of radiation, the

primary absorption observed would correspond to the transition that has equivalent energy as the energy of the radiation. The absorption would result in an infinitesimally narrow intensity line. In practice this perfect line is not observed, so the absorption coefficient is modified by a multiplicative factor to account for the finite width of the line. There are five factors which determine the line width. The natural line width and Doppler effect determine the lower limit of the line width in the absence of any other more dominant effects. The remaining three factors which usually determine the line width at lower frequencies are intermolecular collisions, wall collisions and reaching a saturation level of radiation.

The natural line width of a transition is related to the rate of spontaneous emission, or the length of time the molecule remains in the excited state. When the Schrödinger equation is solved for a system changing with time, it is impossible to specify the energy levels exactly. If the lifetime of the excited state is time, τ, then the energy of the transition is[9],

$$\Delta E \cong \hbar / \tau$$

which is another form of the Heisenberg uncertainty principle. The result is the shorter the lifetime of the excited state the broader the spectral line. The lifetime of an excited electronic vibrational state is 10^{-8} sec leading to broadening on the order of 100 MHz.

Doppler broadening occurs in gaseous samples when a component of the velocity of the random motion of a molecule is moving in the direction of the incident radiation. It is most evident in samples where molecular velocities are high and time between

collisions is long. There is a shift in the frequency given by[10],

$$\varepsilon = \pm \nu \left(\frac{V}{V_p} \right)$$

where ν is the transition frequency, V is the average molecular velocity and V_p is the phase velocity of the radiation or free space propagation of radiation. The detected spectral line is the absorption arising from the Doppler shifts. The Doppler effect causes broadening on the order of 300 MHz for the wavelength region studied.

Intermolecular collision broadening is the most important contribution to the line width if the frequency is low. Natural line width and Doppler line width are small when frequency is low. The broadening related to intermolecular collisions is related to the natural line width. Collisions with other molecules tend to bump the excited molecule back into a lower energy state resulting in a shortened lifetime of the excited state. As previously stated, the shorter the lifetime the greater the broadening. The time between collisions for an ideal gas is[11],

$$t = \frac{1}{\pi p^2 V N}$$

where p is the collision diameter, V is the average velocity and N is the concentration. The broadening can be reduced by lowering the temperature, thus lowering the velocity, and decreasing the concentration by lowering the pressure. Except at very low pressures intermolecular collision broadening is larger than Doppler broadening. Wall collisions

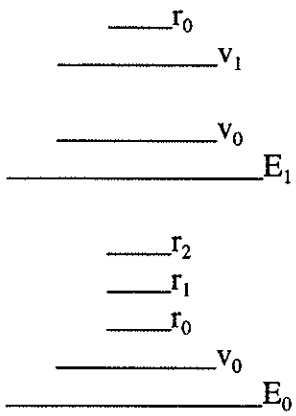
are comparable to intermolecular collisions, but if the cell is large enough the collisions with the wall are negligible. The relative contribution to the line width due to collisions is 10 MHz per torr of gas pressure which makes it very small considering the 0.02-100 x 10^{-3} torr pressure range used in the experimental design.

Saturation broadening occurs when the incident radiation is so large as to induce absorption at a faster rate than the excited state population is relaxed. The result is a depletion in the lower energy population. Saturation can be controlled if the incident radiation is properly regulated.

Transitions

The energy levels of molecules are labeled according to three types of possible transitions, electronic, vibrational and rotational. The difference in energy between consecutive energy levels is greatest for electronic and least for rotational. A small portion of an energy level diagram is shown in Figure 8.

Figure 8.



Only certain transitions are allowed as determined by selection rules. First a gross selection rule must be followed which specifies the general features a molecule must have to produce a specific kind of spectrum. Finally, specific selection rules give the allowed transitions in terms of the quantum numbers assigned to the energy levels.

For a molecule to interact with an electromagnetic field and absorb a photon of frequency v, it must possess a dipole oscillating at that frequency. The dipole is quantum mechanically expressed as the transition dipole moment. For a transition between two states with wavefunction Ψ_1 and Ψ_2 the transition dipole moment is[12],

$$\mu_{21} = \int \psi_2^* \mu \psi_1 d\tau$$

The size of the dipole is a measure of the charge redistribution that accompanies the

transition. The transition will be allowed and absorption will occur, if the accompanying charge redistribution is dipolar.

The coefficient of stimulated absorption, and the intensity of the transition is proportional to the square of the dipole moment by the following equation[13],

$$B = \frac{|\mu_{fi}|^2}{6\varepsilon_o h^2}$$

B is the coefficient of stimulated absorption, μ_{fi} is the dipole moment, ε_o is the vacuum permittivity and h is Plank's constant. Only if the transition dipole moment is non zero does the transition appear on the spectrum. Selection rules are established for vibrational and rotational transitions which make $\mu_{fi} \neq 0$.

The gross selection rule for molecular vibration is that the electric dipole moment of the molecule must change when the atoms of the molecule are displaced. The change need not be a permanent electric dipole. The specific selection rule is that $\Delta v = \pm 1$, where v is the vibrational quantum number. The specific selection rule is obtained from an analysis of the expression of the transition moment. The selection rules for vibrational transitions within electronic transitions are different than for vibrational transitions alone, due to extended Franck-Condon principles.

Rotational transitions can only occur if the molecule has a permanent dipole moment according to gross selection rules. The specific selection rules are $\Delta J = \pm 1$ and $M_j = 0, \pm 1$. J is the rotational quantum number. Its values are determined by the

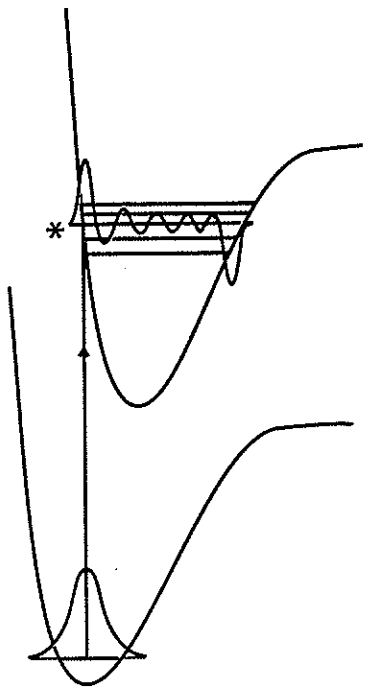
conservation of angular momentum when a photon is absorbed. The values for M_j take into account the conservation of angular momentum as well as the direction in which the photon enters the molecule.

Line Shape

Vibrational and sometimes rotational fine structure are observed in electronic transitions. The Franck-Condon principle is used to explain the intensities of the vibrational structure during an electronic transition. Because the nuclei are so much more massive than the electrons, an electronic transition takes place much faster than the nuclei can respond. The result of this difference is that the electron density surrounding the nuclei is changed and the nuclei respond by changing their vibrational state. Because the nuclear framework remains constant during the excitation, we can imagine the transition as being the vertical line in Figure 9.

Before absorption, the molecule is in the lowest vibrational state of its lowest electronic state at normal temperature. The form of the vibrational wavefunction shows the most probable distance between the nuclei is the equilibrium separation, R_e. This equilibrium separation in the initial electronic state can become the stationary turning point, the point of vibration when the nuclei are at the endpoints of their swing, for the final electronic excited state. When the transition occurs, the molecule is excited to the state represented by the upper curve in Figure 9. The nuclear framework remains constant during excitation so the most likely transition is one between the ground state and an excited state with equal nuclear separation. The vibrational level, marked * is

Figure 9.



where the nuclei are most probably at the same initial separation R_e, because the Ψ^2 is a maximum at this level. Transitions also occur to other neighboring vibrational states because there is some probability that the R_e can be attained in those states as well. The transition with the vibrational wavefunction with maximum nearest Re has the highest intensity however.

Quantitatively, the Frank-Condon principle can be used with the equation concerning the transition dipole moment,

$$\mu_{fi} = -e\int \Psi_f^* \mu \Psi_i d\tau$$

where Ψ_f and Ψ_i are the final and initial wavelengths. The transition dipole moment is largest when there is the greatest overlap between the two wavefunctions. Therefore the greater the overlap of the vibrational state wavefunction in the upper electronic state with the vibrational state wavefunction of the lower electronic state, the greater the absorption intensity of that particular electronic, vibrational transition.

The intensity of the absorption peak depends on factors other than the overlap integral of the wavefunctions of the states involved. The population of the ground and excited states and the strength of the interaction of molecules with the incident radiation also play a role in the intensity of the peak. The transition from low energy to high energy states in stimulated absorption is driven by a source with frequencies the same as the transition frequency. Therefore, the more intense the incident radiation, the rate of induced transitions is increased which produces a higher intensity. The net rate of absorption is proportional to the population difference between the two states involved.

The higher the population in the lower state the higher the intensity can be, as there are more possible molecules to absorb the incident radiation.

Absorption Cross Sections

Having the previous information established we need only to define what a cross-section is before its temperature dependence can be explained. An absorption cross section is directly related to the absorption coefficient or extinction coefficient found in Beer's Law. The relationship between the two is[14],

$$k=\sigma n_o$$

where k is the absorption coefficient, σ is the cross-section and $n_o = 2.69 \times 10^{19}$ /cm^3 is Loschmidt's number. Beer's Law can be written using absorption cross-section and is defined as[15],

$$\ln\frac{I}{I_o}=-\sigma N l$$

where N is the concentration of particles per cubic centimeter and l is the path length of the cell in cm.

TEMPERATURE DEPENDENCE

The temperature dependence of the absorption coefficient or cross section can be determined following the previous discussions. There are several factors giving a net temperature dependence, which include a dependence associated with the Doppler effect and collision interactions, and the population of the energy states. The temperature dependence of the Doppler effect is such that with increased temperature there is increased intensity. This is the case because Doppler broadening makes the individual rotation lines broader, which means they absorb more. Collision broadening also increases with temperature because there are more collisions as the velocity of the particles is increased. The increase in collisions increases the effective interaction time with the radiation thereby increasing the intensity.

The most important factor to the temperature dependence when dealing with SO_2 is the population of the energy states. The temperature dependence of the population of states is determined by the Boltzmann distribution[16],

$$\frac{N}{N_o} = e^{\frac{-h\nu}{kT}}$$

N and N_o are the populations of an excited state and the ground state respectively. The energy difference between electronic and vibrational states is great enough that at room temperature all molecules will be in the ground electronic state. Rotational energy level differences, however, are small enough to play a role in the SO_2 spectrum. Excited states of rotational levels can be populated at room temperature which cannot be populated at

210 K. As the temperature is decreased, only lower rotational energy levels are populated and the transitions which originate at those levels have increased intensity. The transitions which originate at the higher rotational energy levels have decreased intensity as their population has been reduced.

RESULTS

The wavelength region studied was divided into three segments: 290 - 314 nm, 312 -335 nm and 328- 351 nm. The 290-314 nm region provided an overlap with previous data by McGee and Burris[17] and was used to check the accuracy of the data. The McGee and Burris data has been previously verified through a comparison of other SO_2 cross section data by Manatt and Lane[18]. No quantitative results were obtained for the cross sections of wavelengths longer than 314 nm, nor were low temperature values obtained due to the problems encountered with the shorter wavelengths, technical difficulties and the limited amount of time.

Two sets of pressure data were collected during June - August, 1995 and one set in January, 1996. In set A, the SO_2 cross sections were 30-60% smaller than the values reported by McGee and Burris. The SO_2 cross sections of set B were improved to 10-30% smaller than literature values, see Appendix A. Again in January, 1996, SO_2 cross sections, set C, were 30% smaller than the literature values for the 290-314nm wavelength region, see Appendix B. The SO_2 cross section values were outside of the 2-10% error range reported by McGee and Burris.

The large deviation of set A from literature values has been attributed to two

problems with the experimental design. At the time of collection the detector noise was not being subtracted from the background and sample scans. Neither the 7-54 filter nor aperture were in place. Subtracting the dark noise of the detector is equivalent to setting the 0% transmittance on a Spec 20 and is a necessary set up procedure for the instrument. Secondly, saturation of the detector played a role. The software for the detector enables one to set exposure time, multiplicity of scans and binning. Knowing the parameters, a saturation level for the detector can be calculated. The intensities of the scans were significantly higher than the recommended value for set A. To resolve these problems the detector noise was subtracted from the background and sample scans and a 7-54 filter and aperture we added to the apparatus.

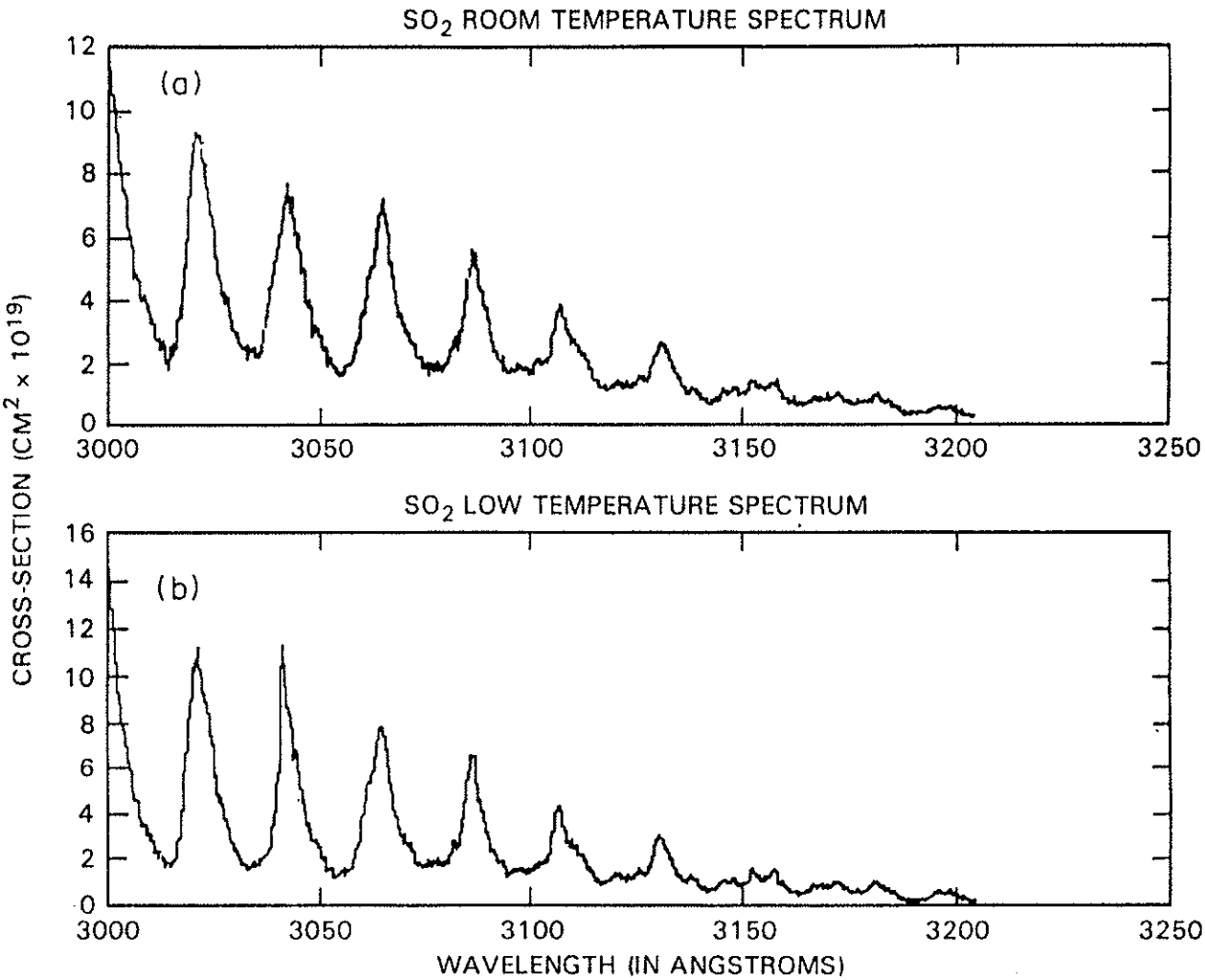
Set B was obtained after alterations to the experimental design were made from set A. The cross sections values were improved but were still outside of the reported error of the literature values. Another short coming of the apparatus was the lack of a pressure gauge at the cell. The two gauges used were located at the pump, connected to the cell through 15 ft of narrow copper tubing. A significant amount of time was allowed for the system to reach equilibrium before the cell was closed to account for this set up.

During January, 1996, the apparatus was significantly changed because the original cell was cracked during the interim. The aperature was removed because saturation of the detector was not an issue due to the longer length of the cell. Also a third pressure gauge was added at the cell. The results were not significantly different from those of set B, however. Since set C was obtained, tests were run on the detector and it was deemed nonlinear. Tests involved filling the cell twice with different pressures

of SO_2 and observing the spectra produced. Two identical spectra with a change of intensity proportional to the change in pressure of SO_2 was expected, however, two different spectra were observed. It has not been determined whether the nonlinearity was due to internal malfunction or improper alignment. The alignment of the detector with the monochromator was extremely touchy and the slightest movement had significant effects on the spectrum.

No low temperature data was obtained during the summer or in January because the room temperature cross sections were outside of the error reported by McGee and Burris. A qualitative analysis of the temperature dependence can be illustrated using the McGee, Burris data however. The data provides a wavelength region of 300-320 nm at 295 K and 210 K. The comparison of Figure 10a and b indicates that the low temperature spectrum shows an increase in cross sections at the peaks of up to 20% and a decrease in cross section between the peaks. These observations directly relate to the previous discussion of the temperature dependence of the population of various rotational energy levels. The transitions which correspond to the peaks of the spectrum at 302.13, 304.11, 306.48, 308.55 and 310.68 nm originate from low lying rotational energy levels. At decreased temperature the cross sections corresponding to these wavelengths are increased. The wavelengths in the valleys of the spectrum correspond to transitions that originate at higher rotational energy levels. The cross section of these wavelengths are decreased with decrease in temperature.

Figure 10. (a) Plot of the measured cross sections vs wavelength at 295 K. (b) Plot of the measured cross sections vs wavelength at 210 K.



FUTURE WORK

Future work concerning the quantitative analysis of the temperature dependence of sulfur dioxide absorption cross sections is essential in the development of accurate atmospheric models and algorithms for the detection of total ozone amounts. Continued data collection from experiments similar to those described in this paper is necessary, with low temperature data the most pressing isssue.

Appendix A.

290.57	7.51E-19	1.68E-20
290.60	7.68E-19	1.94E-20
290.62	7.84E-19	1.99E-20
290.64	8.04E-19	2.06E-20
290.67	8.17E-19	2.39E-20
290.69	8.28E-19	2.26E-20
290.71	8.58E-19	1.95E-20
290.74	8.71E-19	2.24E-20
290.76	8.84E-19	2.84E-20
290.78	8.73E-19	2.62E-20
290.81	8.48E-19	2.67E-20
290.83	8.30E-19	2.64E-20
290.85	8.03E-19	2.48E-20
290.88	7.89E-19	2.45E-20
290.90	7.74E-19	2.40E-20
290.92	7.44E-19	2.09E-20
290.95	7.42E-19	2.09E-20
290.97	7.19E-19	2.30E-20
290.99	6.90E-19	2.25E-20
291.02	6.88E-19	2.02E-20
291.04	6.99E-19	2.14E-20
291.06	6.87E-19	2.05E-20
291.08	6.63E-19	2.20E-20
291.11	6.52E-19	1.85E-20
291.13	6.69E-19	1.93E-20
291.15	6.56E-19	2.00E-20
291.18	6.34E-19	1.98E-20
291.20	6.21E-19	1.80E-20
291.22	6.22E-19	1.82E-20
291.25	6.12E-19	1.81E-20
291.27	5.96E-19	1.81E-20
291.29	5.75E-19	1.95E-20
291.32	5.56E-19	1.70E-20
291.34	5.55E-19	1.64E-20
291.36	5.56E-19	1.72E-20
291.39	5.59E-19	1.54E-20
291.41	5.58E-19	1.79E-20
291.43	5.37E-19	1.63E-20
291.46	5.18E-19	1.37E-20
291.48	5.01E-19	1.52E-20
291.50	4.95E-19	1.29E-20
291.53	4.96E-19	1.52E-20
291.55	5.00E-19	1.55E-20
291.57	5.05E-19	1.70E-20
291.60	5.09E-19	1.46E-20
291.62	4.98E-19	1.58E-20
291.64	5.04E-19	1.44E-20
291.67	5.10E-19	1.37E-20
291.69	5.30E-19	1.46E-20
291.71	5.55E-19	1.64E-20
291.73	5.67E-19	1.90E-20
291.76	5.85E-19	1.67E-20
291.78	5.85E-19	1.71E-20
291.80	6.09E-19	1.63E-20
291.83	6.24E-19	1.61E-20
291.85	6.42E-19	1.51E-20
291.87	6.68E-19	1.92E-20
291.90	6.66E-19	2.27E-20
291.92	6.55E-19	1.77E-20
291.94	6.52E-19	1.67E-20
291.97	6.58E-19	2.12E-20
291.99	6.47E-19	2.10E-20
292.01	6.56E-19	2.11E-20
292.04	6.44E-19	1.96E-20
292.06	6.52E-19	2.04E-20
292.08	6.70E-19	1.61E-20
292.11	6.72E-19	1.94E-20
292.13	6.81E-19	1.53E-20
292.15	7.18E-19	1.93E-20
292.18	7.42E-19	2.42E-20
292.20	7.52E-19	2.19E-20
292.22	7.69E-19	2.40E-20
292.25	7.73E-19	2.26E-20
292.27	7.83E-19	2.16E-20
292.29	7.78E-19	2.46E-20
292.32	7.77E-19	2.46E-20
292.34	7.76E-19	2.43E-20
292.36	7.64E-19	2.54E-20
292.39	7.73E-19	2.34E-20
292.41	7.86E-19	2.52E-20
292.43	7.75E-19	2.59E-20
292.45	7.69E-19	2.48E-20
292.48	7.76E-19	2.70E-20
292.50	7.91E-19	2.46E-20
292.52	7.89E-19	2.52E-20
292.55	7.68E-19	2.59E-20
292.57	7.61E-19	2.70E-20
292.59	7.55E-19	2.50E-20
292.62	7.38E-19	2.49E-20
292.64	7.27E-19	2.43E-20

292.66	7.31E-19	2.29E-20
292.69	7.13E-19	2.24E-20
292.71	7.03E-19	2.20E-20
292.73	7.01E-19	2.21E-20
292.76	6.84E-19	2.46E-20
292.78	6.85E-19	2.05E-20
292.80	6.82E-19	2.36E-20
292.83	6.67E-19	2.19E-20
292.85	6.47E-19	2.19E-20
292.87	6.30E-19	2.14E-20
292.90	6.21E-19	2.12E-20
292.92	6.08E-19	2.07E-20
292.94	6.04E-19	1.90E-20
292.97	5.94E-19	1.72E-20
292.99	5.93E-19	1.88E-20
293.01	5.82E-19	1.86E-20
293.04	5.69E-19	2.10E-20
293.06	5.61E-19	1.82E-20
293.08	5.50E-19	1.79E-20
293.11	5.29E-19	1.95E-20
293.13	5.26E-19	1.72E-20
293.15	5.18E-19	1.60E-20
293.17	5.16E-19	1.58E-20
293.20	5.07E-19	1.72E-20
293.22	4.94E-19	1.67E-20
293.24	4.80E-19	1.58E-20
293.27	4.60E-19	1.64E-20
293.29	4.60E-19	1.56E-20
293.31	4.66E-19	1.25E-20
293.34	4.72E-19	1.61E-20
293.36	4.57E-19	1.41E-20
293.38	4.47E-19	1.41E-20
293.41	4.49E-19	1.27E-20
293.43	4.50E-19	1.37E-20
293.45	4.59E-19	1.57E-20
293.48	4.63E-19	1.77E-20
293.50	4.76E-19	1.33E-20
293.52	4.74E-19	1.39E-20
293.55	4.87E-19	1.47E-20
293.57	5.00E-19	1.39E-20
293.59	5.04E-19	1.60E-20
293.62	4.93E-19	1.56E-20
293.64	4.98E-19	1.63E-20
293.66	5.23E-19	1.23E-20
293.69	5.41E-19	1.47E-20
293.71	5.64E-19	1.51E-20
293.73	5.95E-19	1.45E-20
293.76	6.25E-19	1.63E-20
293.78	6.42E-19	1.80E-20
293.80	6.70E-19	1.86E-20
293.83	7.48E-19	2.06E-20
293.85	7.87E-19	2.59E-20
293.87	7.82E-19	2.68E-20
293.89	7.59E-19	2.55E-20
293.92	7.33E-19	2.58E-20
293.94	7.38E-19	2.37E-20
293.96	7.70E-19	2.51E-20
293.99	7.74E-19	2.73E-20
294.01	7.83E-19	2.30E-20
294.03	7.81E-19	2.82E-20
294.06	7.70E-19	2.90E-20
294.08	7.42E-19	2.70E-20
294.10	7.38E-19	2.21E-20
294.13	7.28E-19	2.54E-20
294.15	7.17E-19	2.66E-20
294.17	7.10E-19	2.25E-20
294.20	7.06E-19	2.25E-20
294.22	7.19E-19	2.43E-20
294.24	7.12E-19	2.30E-20
294.27	7.09E-19	2.26E-20
294.29	7.26E-19	2.42E-20
294.31	7.37E-19	2.12E-20
294.34	7.38E-19	2.56E-20
294.36	7.32E-19	2.44E-20
294.38	7.39E-19	2.60E-20
294.41	7.49E-19	2.27E-20
294.43	7.65E-19	2.60E-20
294.45	7.79E-19	2.54E-20
294.48	7.79E-19	2.86E-20
294.50	7.68E-19	2.73E-20
294.52	7.61E-19	2.54E-20
294.55	7.65E-19	2.47E-20
294.57	7.62E-19	2.43E-20
294.59	7.65E-19	2.52E-20
294.61	7.62E-19	2.57E-20
294.64	7.30E-19	2.75E-20
294.66	7.09E-19	2.41E-20
294.68	6.81E-19	2.45E-20
294.71	6.62E-19	2.30E-20
294.73	6.52E-19	2.01E-20
294.75	6.41E-19	2.31E-20
294.78	6.09E-19	2.05E-20
294.80	5.84E-19	2.11E-20
294.82	5.76E-19	1.84E-20
294.85	5.61E-19	1.86E-20
294.87	5.56E-19	1.92E-20

294.89	5.57E-19	2.08E-20
294.92	5.43E-19	1.79E-20
294.94	5.28E-19	1.89E-20
294.96	5.07E-19	1.76E-20
294.99	5.01E-19	1.35E-20
295.01	4.98E-19	1.66E-20
295.03	4.88E-19	1.44E-20
295.06	4.83E-19	1.65E-20
295.08	4.86E-19	1.78E-20
295.10	4.72E-19	1.84E-20
295.13	4.52E-19	1.46E-20
295.15	4.37E-19	1.55E-20
295.17	4.32E-19	1.85E-20
295.20	4.23E-19	1.45E-20
295.22	4.25E-19	1.26E-20
295.24	4.20E-19	1.44E-20
295.27	4.07E-19	1.47E-20
295.29	3.90E-19	1.50E-20
295.31	3.90E-19	1.16E-20
295.33	3.90E-19	1.48E-20
295.36	3.87E-19	1.45E-20
295.38	3.86E-19	1.43E-20
295.40	3.92E-19	1.19E-20
295.43	3.95E-19	1.28E-20
295.45	4.01E-19	1.33E-20
295.47	3.97E-19	1.47E-20
295.50	4.08E-19	1.36E-20
295.52	4.04E-19	1.20E-20
295.54	4.02E-19	1.44E-20
295.57	4.04E-19	1.40E-20
295.59	4.26E-19	1.31E-20
295.61	4.40E-19	1.34E-20
295.64	4.51E-19	1.39E-20
295.66	4.63E-19	1.50E-20
295.68	4.70E-19	1.48E-20
295.71	5.06E-19	1.34E-20
295.73	5.21E-19	1.49E-20
295.75	5.51E-19	1.42E-20
295.78	5.88E-19	1.74E-20
295.80	5.95E-19	2.10E-20
295.82	6.02E-19	1.74E-20
295.85	6.30E-19	1.89E-20
295.87	6.67E-19	2.00E-20
295.89	6.85E-19	2.20E-20
295.92	7.07E-19	2.21E-20
295.94	7.26E-19	2.37E-20
295.96	7.51E-19	2.75E-20
295.98	7.53E-19	2.65E-20
296.01	7.53E-19	2.85E-20
296.03	7.66E-19	2.69E-20
296.05	7.53E-19	2.64E-20
296.08	7.62E-19	2.65E-20
296.10	7.83E-19	3.00E-20
296.12	8.09E-19	2.81E-20
296.15	8.13E-19	2.94E-20
296.17	8.21E-19	2.93E-20
296.19	8.07E-19	3.02E-20
296.22	8.19E-19	2.92E-20
296.24	8.19E-19	3.03E-20
296.26	8.01E-19	2.96E-20
296.29	7.99E-19	2.77E-20
296.31	7.71E-19	3.08E-20
296.33	7.54E-19	2.86E-20
296.36	7.37E-19	2.82E-20
296.38	7.20E-19	2.43E-20
296.40	7.06E-19	2.57E-20
296.43	6.75E-19	2.62E-20
296.45	6.46E-19	2.50E-20
296.47	6.42E-19	2.54E-20
296.50	6.45E-19	2.30E-20
296.52	6.17E-19	2.62E-20
296.54	5.83E-19	2.30E-20
296.57	5.64E-19	2.12E-20
296.59	5.68E-19	1.96E-20
296.61	5.63E-19	1.84E-20
296.64	5.58E-19	2.06E-20
296.66	5.16E-19	1.99E-20
296.68	4.97E-19	2.05E-20
296.70	4.94E-19	1.80E-20
296.73	4.99E-19	1.72E-20
296.75	4.96E-19	1.41E-20
296.77	4.90E-19	1.82E-20
296.80	4.76E-19	1.72E-20
296.82	4.72E-19	1.74E-20
296.84	4.67E-19	1.79E-20
296.87	4.60E-19	1.76E-20
296.89	4.62E-19	1.50E-20
296.91	4.62E-19	1.61E-20
296.94	4.58E-19	1.39E-20
296.96	4.51E-19	1.39E-20
296.98	4.46E-19	1.49E-20
297.01	4.42E-19	1.57E-20
297.03	4.11E-19	1.60E-20
297.05	3.94E-19	1.82E-20
297.08	3.80E-19	1.43E-20
297.10	3.69E-19	1.34E-20

297.12	3.53E-19	1.19E-20
297.15	3.55E-19	1.48E-20
297.17	3.55E-19	1.08E-20
297.19	3.39E-19	1.22E-20
297.22	3.23E-19	1.32E-20
297.24	3.24E-19	1.27E-20
297.26	3.22E-19	1.44E-20
297.29	3.12E-19	1.03E-20
297.31	3.06E-19	1.16E-20
297.33	3.02E-19	1.22E-20
297.36	2.94E-19	1.02E-20
297.38	2.99E-19	1.01E-20
297.40	2.95E-19	1.21E-20
297.42	2.93E-19	1.14E-20
297.45	3.02E-19	1.11E-20
297.47	3.03E-19	1.20E-20
297.49	3.07E-19	1.38E-20
297.52	3.17E-19	1.21E-20
297.54	3.20E-19	1.01E-20
297.56	3.32E-19	1.19E-20
297.59	3.60E-19	1.09E-20
297.61	3.76E-19	1.50E-20
297.63	3.87E-19	1.55E-20
297.66	3.87E-19	1.32E-20
297.68	4.06E-19	1.28E-20
297.70	4.26E-19	1.48E-20
297.73	4.45E-19	1.31E-20
297.75	4.76E-19	1.58E-20
297.77	5.10E-19	1.36E-20
297.80	5.54E-19	1.43E-20
297.82	6.17E-19	2.01E-20
297.84	6.49E-19	2.05E-20
297.87	6.76E-19	2.35E-20
297.89	7.03E-19	2.01E-20
297.91	7.26E-19	2.29E-20
297.94	7.61E-19	2.79E-20
297.96	7.72E-19	2.70E-20
297.98	7.73E-19	2.93E-20
298.01	7.93E-19	2.67E-20
298.03	7.85E-19	2.99E-20
298.05	7.79E-19	3.09E-20
298.08	7.76E-19	2.73E-20
298.10	7.48E-19	3.03E-20
298.12	7.46E-19	2.68E-20
298.14	7.39E-19	2.70E-20
298.17	7.43E-19	2.95E-20
298.19	7.38E-19	2.90E-20
298.21	7.25E-19	2.87E-20
298.24	7.11E-19	2.69E-20
298.26	6.94E-19	2.60E-20
298.28	6.87E-19	2.54E-20
298.31	7.00E-19	2.41E-20
298.33	7.01E-19	2.87E-20
298.35	7.05E-19	2.90E-20
298.38	6.96E-19	2.76E-20
298.40	6.83E-19	3.07E-20
298.42	6.61E-19	2.62E-20
298.45	6.50E-19	2.52E-20
298.47	6.51E-19	2.57E-20
298.49	6.39E-19	2.34E-20
298.52	6.26E-19	2.59E-20
298.54	5.96E-19	2.35E-20
298.56	5.81E-19	1.90E-20
298.59	5.62E-19	2.00E-20
298.61	5.58E-19	2.13E-20
298.63	5.40E-19	2.08E-20
298.66	5.25E-19	2.23E-20
298.68	4.97E-19	2.09E-20
298.70	4.92E-19	1.86E-20
298.73	4.72E-19	1.53E-20
298.75	4.64E-19	1.78E-20
298.77	4.55E-19	1.82E-20
298.80	4.45E-19	1.63E-20
298.82	4.37E-19	1.80E-20
298.84	4.24E-19	1.58E-20
298.86	4.16E-19	1.89E-20
298.89	4.11E-19	1.42E-20
298.91	3.91E-19	1.48E-20
298.93	3.87E-19	1.35E-20
298.96	3.87E-19	1.44E-20
298.98	3.69E-19	1.51E-20
299.00	3.65E-19	1.54E-20
299.03	3.61E-19	1.32E-20
299.05	3.52E-19	1.52E-20
299.07	3.34E-19	1.16E-20
299.10	3.22E-19	1.05E-20
299.12	3.23E-19	1.24E-20
299.14	3.21E-19	1.35E-20
299.17	3.15E-19	1.17E-20
299.19	3.15E-19	1.33E-20
299.21	3.05E-19	1.31E-20
299.24	2.95E-19	1.20E-20
299.26	2.82E-19	1.22E-20
299.28	2.80E-19	1.28E-20
299.31	2.71E-19	1.17E-20
299.33	2.72E-19	1.17E-20

299.35	2.77E-19	1.03E-20
299.38	2.83E-19	1.15E-20
299.40	2.80E-19	1.33E-20
299.42	2.82E-19	1.10E-20
299.45	2.85E-19	1.30E-20
299.47	2.73E-19	1.12E-20
299.49	2.77E-19	1.23E-20
299.52	2.73E-19	1.18E-20
299.54	2.82E-19	1.18E-20
299.56	2.80E-19	1.33E-20
299.58	2.93E-19	1.27E-20
299.61	2.95E-19	1.28E-20
299.63	2.98E-19	1.10E-20
299.65	3.12E-19	1.22E-20
299.68	3.09E-19	1.57E-20
299.70	3.12E-19	1.27E-20
299.72	3.21E-19	1.32E-20
299.75	3.30E-19	1.11E-20
299.77	3.35E-19	1.19E-20
299.79	3.73E-19	1.11E-20
299.82	4.32E-19	1.15E-20
299.84	5.04E-19	1.59E-20
299.86	5.26E-19	1.67E-20
299.89	5.59E-19	1.76E-20
299.91	5.92E-19	2.02E-20
299.93	6.40E-19	2.29E-20
299.96	7.15E-19	2.55E-20
299.98	7.69E-19	3.02E-20
300.00	8.17E-19	3.31E-20
300.03	8.36E-19	3.76E-20
300.05	8.45E-19	4.14E-20
300.07	8.25E-19	4.18E-20
300.10	8.14E-19	3.75E-20
300.12	8.04E-19	3.88E-20
300.14	7.80E-19	3.88E-20
300.17	7.39E-19	3.29E-20
300.19	7.29E-19	3.33E-20
300.21	7.41E-19	2.96E-20
300.23	7.21E-19	3.03E-20
300.26	7.01E-19	2.98E-20
300.28	6.81E-19	2.73E-20
300.30	6.81E-19	2.93E-20
300.33	6.48E-19	2.92E-20
300.35	6.37E-19	2.46E-20
300.37	6.14E-19	2.60E-20
300.40	5.97E-19	2.23E-20
300.42	6.00E-19	2.63E-20
300.44	5.86E-19	2.41E-20
300.47	5.74E-19	2.34E-20
300.49	5.39E-19	2.14E-20
300.51	5.13E-19	2.04E-20
300.54	5.19E-19	2.04E-20
300.56	5.14E-19	1.99E-20
300.58	5.05E-19	2.01E-20
300.61	4.84E-19	2.09E-20
300.63	4.56E-19	2.18E-20
300.65	4.38E-19	1.91E-20
300.68	4.29E-19	1.64E-20
300.70	4.28E-19	1.70E-20
300.72	4.24E-19	1.70E-20
300.75	4.18E-19	1.79E-20
300.77	4.02E-19	1.89E-20
300.79	3.72E-19	1.78E-20
300.82	3.55E-19	1.57E-20
300.84	3.57E-19	1.43E-20
300.86	3.59E-19	1.68E-20
300.89	3.55E-19	1.26E-20
300.91	3.44E-19	1.39E-20
300.93	3.55E-19	1.51E-20
300.95	3.34E-19	1.56E-20
300.98	3.18E-19	1.47E-20
301.00	3.04E-19	1.45E-20
301.02	3.08E-19	1.59E-20
301.05	2.95E-19	1.22E-20
301.07	2.98E-19	1.16E-20
301.09	3.03E-19	1.40E-20
301.12	2.96E-19	1.31E-20
301.14	2.78E-19	1.41E-20
301.16	2.62E-19	1.34E-20
301.19	2.52E-19	1.37E-20
301.21	2.50E-19	1.14E-20
301.23	2.48E-19	1.22E-20
301.26	2.46E-19	1.15E-20
301.28	2.47E-19	9.74E-21
301.30	2.49E-19	1.08E-20
301.33	2.36E-19	1.34E-20
301.35	2.24E-19	1.09E-20
301.37	2.14E-19	1.34E-20
301.40	2.15E-19	7.57E-21
301.42	2.22E-19	1.20E-20
301.44	2.21E-19	1.09E-20
301.47	2.16E-19	1.19E-20
301.49	2.18E-19	9.40E-21
301.51	2.19E-19	1.13E-20
301.54	2.25E-19	1.32E-20
301.56	2.21E-19	1.11E-20

301.58	2.22E-19	1.11E-20
301.61	2.29E-19	1.13E-20
301.63	2.50E-19	1.10E-20
301.65	2.78E-19	1.17E-20
301.67	2.92E-19	1.13E-20
301.70	3.10E-19	1.35E-20
301.72	3.14E-19	1.34E-20
301.74	3.21E-19	1.33E-20
301.77	3.32E-19	1.44E-20
301.79	3.55E-19	1.01E-20
301.81	3.92E-19	1.41E-20
301.84	4.30E-19	1.61E-20
301.86	4.65E-19	1.59E-20
301.88	5.02E-19	1.88E-20
301.91	5.23E-19	1.77E-20
301.93	5.47E-19	1.98E-20
301.95	5.83E-19	1.84E-20
301.98	6.20E-19	2.39E-20
302.00	6.48E-19	2.62E-20
302.02	6.57E-19	3.15E-20
302.05	6.43E-19	2.94E-20
302.07	6.50E-19	2.91E-20
302.09	6.62E-19	2.85E-20
302.12	6.86E-19	3.19E-20
302.14	6.93E-19	3.15E-20
302.16	6.83E-19	3.39E-20
302.19	6.67E-19	2.78E-20
302.21	6.72E-19	3.05E-20
302.23	6.65E-19	3.07E-20
302.26	6.53E-19	3.05E-20
302.28	6.37E-19	2.97E-20
302.30	6.15E-19	3.09E-20
302.33	6.27E-19	2.84E-20
302.35	6.16E-19	2.83E-20
302.37	6.06E-19	2.73E-20
302.39	5.88E-19	2.73E-20
302.42	5.82E-19	2.54E-20
302.44	5.74E-19	2.71E-20
302.46	5.44E-19	2.81E-20
302.49	5.30E-19	2.05E-20
302.51	5.05E-19	2.64E-20
302.53	5.04E-19	2.30E-20
302.56	4.95E-19	2.24E-20
302.58	4.73E-19	2.32E-20
302.60	4.60E-19	2.05E-20
302.63	4.38E-19	1.99E-20
302.65	4.24E-19	1.84E-20
302.67	4.13E-19	2.08E-20
302.70	4.04E-19	1.84E-20
302.72	3.97E-19	1.61E-20
302.74	3.84E-19	1.75E-20
302.77	3.73E-19	1.88E-20
302.79	3.64E-19	1.83E-20
302.81	3.55E-19	1.57E-20
302.84	3.39E-19	1.65E-20
302.86	3.31E-19	1.78E-20
302.88	3.24E-19	1.63E-20
302.91	3.19E-19	1.55E-20
302.93	3.10E-19	1.53E-20
302.95	3.01E-19	1.25E-20
302.98	2.93E-19	1.53E-20
303.00	2.80E-19	1.53E-20
303.02	2.74E-19	1.40E-20
303.05	2.62E-19	1.41E-20
303.07	2.54E-19	1.46E-20
303.09	2.53E-19	1.14E-20
303.11	2.52E-19	1.31E-20
303.14	2.43E-19	1.32E-20
303.16	2.43E-19	1.21E-20
303.18	2.31E-19	1.29E-20
303.21	2.30E-19	1.27E-20
303.23	2.31E-19	1.31E-20
303.25	2.27E-19	1.28E-20
303.28	2.18E-19	1.37E-20
303.30	2.15E-19	1.20E-20
303.32	2.16E-19	1.18E-20
303.35	2.12E-19	1.03E-20
303.37	2.10E-19	1.20E-20
303.39	1.98E-19	1.18E-20
303.42	2.00E-19	8.62E-21
303.44	2.05E-19	9.53E-21
303.46	2.05E-19	1.08E-20
303.49	2.05E-19	1.17E-20
303.51	2.03E-19	1.14E-20
303.53	2.07E-19	1.37E-20
303.56	2.06E-19	1.23E-20
303.58	2.07E-19	1.02E-20
303.60	2.14E-19	1.08E-20
303.63	2.20E-19	1.15E-20
303.65	2.23E-19	1.22E-20
303.67	2.29E-19	1.12E-20
303.70	2.20E-19	1.17E-20
303.72	2.25E-19	9.69E-21
303.74	2.33E-19	1.14E-20
303.77	2.45E-19	1.20E-20
303.79	2.44E-19	1.09E-20

303.81	2.44E-19	1.06E-20
303.83	2.52E-19	1.16E-20
303.86	2.61E-19	1.33E-20
303.88	2.72E-19	1.16E-20
303.90	2.85E-19	1.38E-20
303.93	3.04E-19	1.16E-20
303.95	3.30E-19	1.42E-20
303.97	3.62E-19	1.71E-20
304.00	3.90E-19	1.66E-20
304.02	4.05E-19	1.91E-20
304.04	4.12E-19	1.75E-20
304.07	4.26E-19	1.99E-20
304.09	4.53E-19	1.90E-20
304.11	4.94E-19	1.91E-20
304.14	5.70E-19	2.41E-20
304.16	6.24E-19	3.02E-20
304.18	6.54E-19	3.45E-20
304.21	6.41E-19	3.84E-20
304.23	6.33E-19	3.52E-20
304.25	6.01E-19	3.50E-20
304.28	5.78E-19	3.15E-20
304.30	5.79E-19	2.80E-20
304.32	5.62E-19	3.03E-20
304.35	5.53E-19	2.93E-20
304.37	5.45E-19	2.80E-20
304.39	5.41E-19	2.89E-20
304.42	5.22E-19	2.86E-20
304.44	5.01E-19	2.53E-20
304.46	4.93E-19	2.30E-20
304.48	5.03E-19	2.31E-20
304.51	4.90E-19	2.53E-20
304.53	4.69E-19	2.05E-20
304.55	4.49E-19	2.09E-20
304.58	4.51E-19	2.10E-20
304.60	4.48E-19	2.37E-20
304.62	4.15E-19	2.32E-20
304.65	3.80E-19	2.25E-20
304.67	3.76E-19	1.96E-20
304.69	3.82E-19	1.78E-20
304.72	3.73E-19	1.68E-20
304.74	3.53E-19	1.88E-20
304.76	3.26E-19	1.98E-20
304.79	3.19E-19	1.56E-20
304.81	3.20E-19	1.75E-20
304.83	3.19E-19	1.84E-20
304.86	3.13E-19	1.70E-20
304.88	3.00E-19	1.82E-20
304.90	2.77E-19	1.50E-20
304.93	2.69E-19	1.44E-20
304.95	2.68E-19	1.34E-20
304.97	2.72E-19	1.39E-20
305.00	2.68E-19	1.45E-20
305.02	2.60E-19	1.46E-20
305.04	2.46E-19	1.45E-20
305.07	2.38E-19	1.30E-20
305.09	2.29E-19	1.32E-20
305.11	2.29E-19	1.66E-20
305.14	2.27E-19	1.27E-20
305.16	2.27E-19	1.32E-20
305.18	2.22E-19	1.03E-20
305.20	2.06E-19	1.29E-20
305.23	2.02E-19	1.21E-20
305.25	1.94E-19	1.11E-20
305.27	1.92E-19	1.29E-20
305.30	1.92E-19	9.10E-21
305.32	1.93E-19	1.06E-20
305.34	1.84E-19	1.20E-20
305.37	1.87E-19	8.31E-21
305.39	1.76E-19	1.18E-20
305.41	1.72E-19	1.17E-20
305.44	1.69E-19	1.15E-20
305.46	1.64E-19	1.00E-20
305.48	1.66E-19	9.76E-21
305.51	1.63E-19	9.93E-21
305.53	1.69E-19	1.02E-20
305.55	1.71E-19	1.05E-20
305.58	1.69E-19	8.09E-21
305.60	1.69E-19	8.60E-21
305.62	1.73E-19	1.10E-20
305.65	1.74E-19	1.22E-20
305.67	1.76E-19	1.06E-20
305.69	1.81E-19	1.11E-20
305.72	1.74E-19	1.19E-20
305.74	1.82E-19	9.93E-21
305.76	1.82E-19	9.28E-21
305.79	1.88E-19	1.17E-20
305.81	1.90E-19	1.08E-20
305.83	2.03E-19	1.08E-20
305.86	2.11E-19	1.07E-20
305.88	2.18E-19	1.14E-20
305.90	2.28E-19	1.15E-20
305.92	2.32E-19	1.20E-20
305.95	2.46E-19	1.49E-20
305.97	2.70E-19	1.31E-20
305.99	2.91E-19	1.36E-20
306.02	2.99E-19	1.43E-20

306.04	3.01E-19	1.50E-20
306.06	3.10E-19	1.53E-20
306.09	3.11E-19	1.48E-20
306.11	3.30E-19	1.61E-20
306.13	3.48E-19	1.41E-20
306.16	3.63E-19	1.82E-20
306.18	3.72E-19	2.05E-20
306.20	3.78E-19	2.02E-20
306.23	3.78E-19	1.62E-20
306.25	3.88E-19	1.99E-20
306.27	4.08E-19	1.95E-20
306.30	4.28E-19	2.17E-20
306.32	4.36E-19	2.31E-20
306.34	4.53E-19	2.24E-20
306.37	4.53E-19	2.38E-20
306.39	4.64E-19	2.26E-20
306.41	4.67E-19	2.01E-20
306.44	4.82E-19	2.41E-20
306.46	4.85E-19	2.64E-20
306.48	4.93E-19	2.67E-20
306.51	4.93E-19	2.93E-20
306.53	4.80E-19	2.60E-20
306.55	4.68E-19	2.84E-20
306.58	4.48E-19	2.59E-20
306.60	4.41E-19	2.49E-20
306.62	4.30E-19	2.41E-20
306.64	4.19E-19	2.23E-20
306.67	4.02E-19	2.33E-20
306.69	3.82E-19	2.13E-20
306.71	3.67E-19	1.92E-20
306.74	3.51E-19	2.07E-20
306.76	3.40E-19	1.87E-20
306.78	3.39E-19	1.78E-20
306.81	3.23E-19	1.65E-20
306.83	3.13E-19	1.68E-20
306.85	2.97E-19	1.76E-20
306.88	2.88E-19	1.63E-20
306.90	2.90E-19	1.59E-20
306.92	2.74E-19	1.64E-20
306.95	2.70E-19	1.57E-20
306.97	2.66E-19	1.91E-20
306.99	2.59E-19	1.59E-20
307.02	2.58E-19	1.61E-20
307.04	2.40E-19	1.45E-20
307.06	2.40E-19	1.48E-20
307.09	2.39E-19	1.36E-20
307.11	2.38E-19	1.23E-20
307.13	2.36E-19	1.64E-20
307.16	2.36E-19	1.42E-20
307.18	2.21E-19	1.27E-20
307.20	2.18E-19	1.43E-20
307.23	2.13E-19	1.43E-20
307.25	2.01E-19	1.40E-20
307.27	2.07E-19	1.05E-20
307.30	1.88E-19	1.29E-20
307.32	1.87E-19	9.04E-21
307.34	1.82E-19	1.21E-20
307.36	1.88E-19	7.44E-21
307.39	1.82E-19	1.32E-20
307.41	1.81E-19	1.24E-20
307.43	1.79E-19	9.35E-21
307.46	1.77E-19	1.08E-20
307.48	1.77E-19	1.11E-20
307.50	1.72E-19	1.07E-20
307.53	1.70E-19	8.54E-21
307.55	1.74E-19	1.04E-20
307.57	1.74E-19	1.10E-20
307.60	1.78E-19	1.09E-20
307.62	1.75E-19	1.01E-20
307.64	1.76E-19	9.64E-21
307.67	1.69E-19	1.19E-20
307.69	1.73E-19	8.95E-21
307.71	1.76E-19	1.16E-20
307.74	1.74E-19	1.10E-20
307.76	1.74E-19	1.03E-20
307.78	1.77E-19	1.01E-20
307.81	1.69E-19	1.19E-20
307.83	1.80E-19	1.18E-20
307.85	1.69E-19	1.20E-20
307.88	1.67E-19	1.05E-20
307.90	1.66E-19	1.11E-20
307.92	1.61E-19	1.04E-20
307.95	1.75E-19	8.52E-21
307.97	1.75E-19	8.40E-21
307.99	1.70E-19	9.54E-21
308.02	1.75E-19	9.58E-21
308.04	1.80E-19	1.03E-20
308.06	1.86E-19	1.07E-20
308.08	1.93E-19	1.14E-20
308.11	2.06E-19	1.28E-20
308.13	2.23E-19	1.15E-20
308.15	2.37E-19	1.38E-20
308.18	2.40E-19	1.22E-20
308.20	2.36E-19	1.77E-20
308.22	2.30E-19	1.23E-20
308.25	2.34E-19	1.35E-20

308.27	2.25E-19	1.11E-20
308.29	2.26E-19	1.33E-20
308.32	2.34E-19	1.57E-20
308.34	2.52E-19	1.27E-20
308.36	2.75E-19	1.34E-20
308.39	2.90E-19	1.33E-20
308.41	2.97E-19	1.40E-20
308.43	3.10E-19	1.62E-20
308.46	3.22E-19	1.85E-20
308.48	3.51E-19	1.97E-20
308.50	3.67E-19	2.04E-20
308.53	3.77E-19	1.94E-20
308.55	3.91E-19	1.91E-20
308.57	3.99E-19	2.11E-20
308.60	4.10E-19	2.26E-20
308.62	4.04E-19	2.30E-20
308.64	3.97E-19	2.37E-20
308.67	3.87E-19	2.24E-20
308.69	3.76E-19	1.97E-20
308.71	3.80E-19	2.07E-20
308.73	3.53E-19	2.16E-20
308.76	3.44E-19	1.81E-20
308.78	3.36E-19	1.82E-20
308.80	3.34E-19	2.13E-20
308.83	3.32E-19	1.71E-20
308.85	3.19E-19	1.96E-20
308.87	3.01E-19	1.77E-20
308.90	2.93E-19	1.81E-20
308.92	2.89E-19	1.72E-20
308.94	2.77E-19	1.51E-20
308.97	2.65E-19	1.60E-20
308.99	2.56E-19	1.39E-20
309.01	2.52E-19	1.35E-20
309.04	2.42E-19	1.58E-20
309.06	2.37E-19	1.47E-20
309.08	2.22E-19	1.09E-20
309.11	2.16E-19	1.49E-20
309.13	2.17E-19	1.22E-20
309.15	2.08E-19	1.22E-20
309.18	2.03E-19	1.47E-20
309.20	2.02E-19	1.39E-20
309.22	2.00E-19	1.22E-20
309.25	1.89E-19	1.36E-20
309.27	1.84E-19	1.29E-20
309.29	1.81E-19	1.29E-20
309.32	1.81E-19	1.20E-20
309.34	1.77E-19	1.03E-20
309.36	1.73E-19	1.28E-20
309.39	1.61E-19	1.05E-20
309.41	1.60E-19	1.08E-20
309.43	1.51E-19	1.29E-20
309.45	1.49E-19	1.03E-20
309.48	1.48E-19	1.06E-20
309.50	1.52E-19	1.10E-20
309.52	1.53E-19	9.89E-21
309.55	1.56E-19	1.14E-20
309.57	1.50E-19	1.04E-20
309.59	1.49E-19	9.37E-21
309.62	1.47E-19	8.89E-21
309.64	1.56E-19	1.07E-20
309.66	1.52E-19	1.01E-20
309.69	1.55E-19	1.23E-20
309.71	1.55E-19	1.25E-20
309.73	1.54E-19	1.07E-20
309.76	1.56E-19	9.92E-21
309.78	1.58E-19	1.02E-20
309.80	1.55E-19	1.12E-20
309.83	1.57E-19	9.25E-21
309.85	1.58E-19	9.34E-21
309.87	1.58E-19	8.20E-21
309.90	1.57E-19	1.12E-20
309.92	1.56E-19	8.35E-21
309.94	1.64E-19	8.00E-21
309.97	1.60E-19	9.99E-21
309.99	1.60E-19	9.34E-21
310.01	1.58E-19	1.22E-20
310.04	1.62E-19	1.05E-20
310.06	1.66E-19	1.00E-20
310.08	1.71E-19	1.09E-20
310.11	1.71E-19	1.24E-20
310.13	1.75E-19	1.10E-20
310.15	1.72E-19	1.30E-20
310.17	1.77E-19	8.57E-21
310.20	1.75E-19	1.47E-20
310.22	1.74E-19	1.08E-20
310.24	1.77E-19	1.14E-20
310.27	1.85E-19	1.22E-20
310.29	1.78E-19	1.14E-20
310.31	1.80E-19	1.08E-20
310.34	1.76E-19	1.14E-20
310.36	1.72E-19	1.28E-20
310.38	1.72E-19	1.14E-20
310.41	1.82E-19	1.22E-20
310.43	1.86E-19	1.02E-20
310.45	2.00E-19	1.17E-20
310.48	2.15E-19	1.12E-20

310.50	2.24E-19	1.33E-20
310.52	2.36E-19	1.22E-20
310.55	2.39E-19	1.38E-20
310.57	2.45E-19	1.39E-20
310.59	2.57E-19	1.44E-20
310.62	2.67E-19	1.80E-20
310.64	2.75E-19	1.50E-20
310.66	2.80E-19	1.61E-20
310.69	2.84E-19	1.83E-20
310.71	2.91E-19	1.86E-20
310.73	2.80E-19	1.67E-20
310.76	2.66E-19	1.60E-20
310.78	2.61E-19	1.62E-20
310.80	2.61E-19	1.30E-20
310.83	2.55E-19	1.48E-20
310.85	2.44E-19	1.52E-20
310.87	2.35E-19	1.41E-20
310.89	2.29E-19	1.52E-20
310.92	2.24E-19	1.25E-20
310.94	2.27E-19	1.37E-20
310.96	2.27E-19	1.42E-20
310.99	2.21E-19	1.50E-20
311.01	2.22E-19	1.33E-20
311.03	2.12E-19	1.39E-20
311.06	2.13E-19	1.22E-20
311.08	2.12E-19	1.19E-20
311.10	2.11E-19	1.43E-20
311.13	2.05E-19	1.30E-20
311.15	1.92E-19	1.50E-20
311.17	1.92E-19	1.28E-20
311.20	1.89E-19	1.12E-20
311.22	1.94E-19	1.37E-20
311.24	1.89E-19	1.30E-20
311.27	1.84E-19	1.30E-20
311.29	1.72E-19	1.29E-20
311.31	1.79E-19	1.06E-20
311.34	1.68E-19	1.28E-20
311.36	1.59E-19	1.29E-20
311.38	1.54E-19	1.35E-20
311.41	1.56E-19	9.73E-21
311.43	1.50E-19	1.17E-20
311.45	1.45E-19	9.33E-21
311.48	1.35E-19	9.46E-21
311.50	1.40E-19	9.32E-21
311.52	1.36E-19	1.12E-20
311.55	1.28E-19	8.89E-21
311.57	1.33E-19	7.91E-21
311.59	1.23E-19	9.75E-21
311.61	1.18E-19	1.03E-20
311.64	1.24E-19	9.97E-21
311.66	1.26E-19	1.19E-20
311.68	1.16E-19	1.04E-20
311.71	1.13E-19	9.42E-21
311.73	1.13E-19	1.07E-20
311.75	1.14E-19	1.14E-20
311.78	1.19E-19	7.41E-21
311.80	1.15E-19	8.00E-21
311.82	1.18E-19	7.55E-21
311.85	1.15E-19	1.13E-20
311.87	1.21E-19	1.09E-20
311.89	1.17E-19	1.20E-20
311.92	1.21E-19	1.03E-20
311.94	1.23E-19	8.93E-21
311.96	1.35E-19	1.03E-20
311.99	1.25E-19	9.34E-21
312.01	1.28E-19	7.26E-21
312.03	1.31E-19	1.07E-20
312.06	1.24E-19	1.15E-20
312.08	1.29E-19	8.73E-21
312.10	1.27E-19	1.18E-20
312.13	1.28E-19	8.85E-21
312.15	1.21E-19	1.11E-20
312.17	1.25E-19	1.13E-20
312.20	1.27E-19	8.86E-21
312.22	1.22E-19	1.18E-20
312.24	1.21E-19	1.12E-20
312.27	1.21E-19	8.70E-21
312.29	1.16E-19	9.39E-21
312.31	1.24E-19	1.01E-20
312.33	1.18E-19	8.71E-21
312.36	1.17E-19	6.91E-21
312.38	1.21E-19	8.63E-21
312.40	1.25E-19	1.22E-20
312.43	1.27E-19	1.29E-20
312.45	1.30E-19	1.07E-20
312.47	1.39E-19	1.13E-20
312.50	1.37E-19	9.53E-21
312.52	1.35E-19	1.10E-20
312.54	1.35E-19	8.94E-21
312.57	1.38E-19	8.64E-21
312.59	1.45E-19	1.14E-20
312.61	1.32E-19	1.09E-20
312.64	1.39E-19	9.03E-21
312.66	1.32E-19	1.02E-20
312.68	1.34E-19	1.01E-20
312.71	1.34E-19	1.04E-20

312.73	1.41E-19	8.44E-21
312.75	1.44E-19	9.51E-21
312.78	1.46E-19	1.00E-20
312.80	1.52E-19	1.18E-20
312.82	1.62E-19	1.04E-20
312.85	1.67E-19	1.31E-20
312.87	1.64E-19	1.05E-20
312.89	1.70E-19	1.27E-20
312.92	1.82E-19	7.78E-21
312.94	1.87E-19	1.10E-20
312.96	1.91E-19	1.46E-20
312.98	1.92E-19	1.09E-20
313.01	2.03E-19	1.38E-20
313.03	2.06E-19	1.21E-20
313.05	2.03E-19	1.65E-20
313.08	2.14E-19	1.46E-20
313.10	2.00E-19	1.49E-20
313.12	2.01E-19	1.26E-20
313.15	1.94E-19	1.26E-20
313.17	1.92E-19	1.25E-20
313.19	1.78E-19	1.35E-20
313.22	1.84E-19	1.20E-20
313.24	1.81E-19	1.33E-20
313.26	1.73E-19	1.34E-20
313.29	1.77E-19	1.12E-20
313.31	1.70E-19	1.23E-20
313.33	1.60E-19	1.10E-20
313.36	1.56E-19	1.28E-20
313.38	1.49E-19	1.00E-20
313.40	1.50E-19	9.64E-21
313.43	1.45E-19	1.11E-20
313.45	1.38E-19	1.44E-20
313.47	1.31E-19	1.13E-20
313.50	1.35E-19	8.90E-21
313.52	1.28E-19	1.06E-20
313.54	1.17E-19	8.42E-21
313.57	1.19E-19	1.17E-20
313.59	1.19E-19	1.03E-20
313.61	1.22E-19	8.32E-21
313.64	1.13E-19	1.04E-20
313.66	1.13E-19	8.10E-21
313.68	1.08E-19	9.40E-21
313.70	1.09E-19	9.91E-21
313.73	1.12E-19	9.22E-21
313.75	1.19E-19	7.87E-21
313.77	1.24E-19	8.53E-21
313.80	1.13E-19	1.17E-20
313.82	1.14E-19	1.01E-20
313.84	1.06E-19	8.24E-21
313.87	1.07E-19	1.07E-20
313.89	1.06E-19	8.92E-21
313.91	1.05E-19	9.66E-21
313.94	1.02E-19	7.68E-21
313.96	1.01E-19	7.72E-21
313.98	9.17E-20	8.31E-21
314.01	9.95E-20	8.48E-21
314.03	9.42E-20	7.44E-21
314.05	8.97E-20	1.06E-20
314.08	9.03E-20	9.15E-21
314.10	9.77E-20	1.15E-20
314.12	9.58E-20	7.75E-21
314.15	8.75E-20	8.61E-21
314.17	8.66E-20	9.47E-21
314.19	8.84E-20	9.80E-21
314.22	8.32E-20	1.04E-20
314.24	8.62E-20	9.59E-21
314.26	8.57E-20	8.79E-21
314.29	9.19E-20	8.96E-21
314.31	8.86E-20	9.82E-21
314.33	9.46E-20	9.58E-21

Appendix B.

290.12	7.43E-19	5.54E-20
290.15	7.33E-19	6.01E-20
290.17	7.48E-19	5.36E-20
290.19	7.27E-19	5.19E-20
290.22	7.02E-19	5.50E-20
290.24	7.04E-19	5.35E-20
290.26	6.89E-19	5.61E-20
290.29	6.82E-19	6.14E-20
290.31	6.77E-19	5.63E-20
290.33	6.82E-19	5.33E-20
290.36	6.77E-19	5.35E-20
290.38	6.62E-19	5.48E-20
290.40	6.45E-19	5.45E-20
290.42	6.22E-19	6.66E-20
290.45	6.61E-19	6.81E-20
290.47	7.05E-19	5.34E-20
290.49	7.08E-19	5.05E-20
290.52	6.77E-19	6.16E-20
290.54	6.92E-19	5.83E-20
290.57	7.07E-19	5.96E-20
290.59	7.51E-19	5.90E-20
290.61	7.59E-19	5.52E-20
290.63	7.60E-19	5.71E-20
290.66	7.83E-19	5.59E-20
290.68	7.88E-19	5.90E-20
290.70	8.27E-19	6.11E-20
290.73	8.56E-19	5.32E-20
290.75	8.74E-19	6.04E-20
290.77	8.62E-19	5.88E-20
290.80	8.47E-19	5.34E-20
290.82	8.12E-19	5.60E-20
290.84	7.83E-19	5.65E-20
290.87	7.63E-19	5.10E-20
290.89	7.62E-19	5.06E-20
290.91	7.44E-19	5.65E-20
290.94	7.28E-19	5.22E-20
290.96	7.09E-19	4.88E-20
290.98	6.43E-19	5.59E-20
291.01	6.64E-19	5.98E-20
291.03	6.55E-19	5.93E-20
291.05	6.62E-19	4.94E-20
291.08	6.38E-19	5.32E-20
291.10	6.27E-19	5.72E-20
291.12	6.24E-19	5.57E-20
291.15	6.22E-19	5.37E-20
291.17	6.10E-19	5.04E-20
291.19	5.89E-19	5.19E-20
291.22	5.92E-19	5.14E-20
291.24	5.80E-19	5.27E-20
291.26	5.84E-19	4.82E-20
291.29	5.46E-19	5.29E-20
291.31	5.21E-19	5.33E-20
291.33	5.10E-19	5.61E-20
291.36	5.20E-19	5.72E-20
291.38	5.36E-19	5.63E-20
291.40	5.04E-19	5.31E-20
291.42	4.99E-19	5.49E-20
291.45	4.81E-19	5.34E-20
291.47	4.53E-19	5.69E-20
291.49	4.65E-19	6.07E-20
291.52	4.69E-19	5.78E-20
291.54	4.83E-19	5.38E-20
291.57	4.74E-19	5.74E-20
291.59	4.64E-19	5.72E-20
291.61	4.53E-19	5.92E-20
291.63	4.53E-19	5.99E-20
291.66	4.59E-19	6.13E-20
291.68	4.63E-19	6.44E-20
291.70	5.20E-19	5.51E-20
291.73	5.20E-19	5.95E-20
291.75	5.40E-19	5.57E-20
291.77	5.56E-19	5.60E-20
291.80	5.58E-19	5.85E-20
291.82	5.77E-19	6.18E-20
291.84	5.98E-19	5.83E-20
291.87	6.32E-19	5.39E-20
291.89	6.37E-19	4.81E-20
291.91	6.14E-19	5.58E-20
291.94	6.30E-19	4.91E-20
291.96	6.32E-19	5.23E-20
291.98	6.29E-19	5.13E-20
292.01	5.99E-19	5.26E-20
292.03	6.11E-19	5.28E-20
292.05	5.94E-19	5.52E-20
292.08	6.33E-19	5.47E-20
292.10	6.32E-19	5.61E-20
292.12	6.49E-19	5.70E-20
292.15	6.64E-19	5.93E-20

292.17	6.95E-19	5.38E-20
292.19	7.15E-19	5.06E-20
292.22	7.42E-19	5.02E-20
292.24	7.43E-19	5.14E-20
292.26	7.57E-19	5.03E-20
292.29	7.52E-19	4.68E-20
292.31	7.58E-19	4.97E-20
292.33	7.40E-19	4.77E-20
292.36	7.12E-19	5.53E-20
292.38	7.55E-19	4.71E-20
292.40	7.56E-19	4.89E-20
292.42	7.50E-19	5.23E-20
292.45	7.57E-19	4.66E-20
292.47	7.51E-19	5.48E-20
292.49	7.59E-19	5.22E-20
292.52	7.48E-19	5.40E-20
292.54	7.40E-19	5.61E-20
292.57	7.27E-19	5.50E-20
292.59	7.22E-19	5.17E-20
292.61	7.11E-19	5.18E-20
292.63	6.95E-19	4.80E-20
292.66	6.98E-19	5.14E-20
292.68	6.91E-19	5.39E-20
292.70	6.67E-19	5.11E-20
292.73	6.68E-19	5.04E-20
292.75	6.61E-19	4.77E-20
292.77	6.54E-19	4.94E-20
292.80	6.68E-19	5.33E-20
292.82	6.35E-19	5.19E-20
292.84	6.25E-19	5.24E-20
292.87	6.05E-19	4.99E-20
292.89	5.87E-19	5.34E-20
292.91	5.73E-19	5.53E-20
292.94	5.70E-19	5.07E-20
292.96	5.65E-19	5.64E-20
292.98	5.53E-19	5.30E-20
293.01	5.71E-19	5.24E-20
293.03	5.31E-19	5.43E-20
293.05	5.28E-19	5.02E-20
293.08	5.18E-19	4.92E-20
293.10	5.22E-19	5.33E-20
293.12	5.15E-19	5.21E-20
293.15	4.82E-19	5.95E-20
293.17	4.91E-19	5.11E-20
293.19	4.80E-19	5.65E-20
293.22	4.68E-19	5.51E-20
293.24	4.55E-19	5.27E-20
293.26	4.36E-19	5.64E-20
293.29	4.08E-19	5.94E-20
293.31	4.27E-19	5.70E-20
293.33	4.36E-19	5.81E-20
293.36	4.14E-19	5.97E-20
293.38	4.09E-19	5.47E-20
293.40	3.98E-19	5.78E-20
293.42	4.07E-19	5.71E-20
293.45	4.26E-19	5.70E-20
293.47	4.24E-19	5.65E-20
293.49	4.17E-19	5.99E-20
293.52	4.41E-19	5.86E-20
293.54	4.46E-19	5.50E-20
293.57	4.50E-19	5.58E-20
293.59	4.64E-19	5.53E-20
293.61	4.51E-19	5.46E-20
293.64	4.60E-19	5.62E-20
293.66	4.44E-19	6.79E-20
293.68	4.79E-19	6.31E-20
293.70	5.12E-19	6.25E-20
293.73	5.28E-19	6.23E-20
293.75	5.51E-19	6.08E-20
293.77	5.67E-19	6.37E-20
293.80	6.03E-19	7.25E-20
293.82	6.75E-19	7.22E-20
293.84	7.59E-19	5.44E-20
293.87	7.58E-19	5.06E-20
293.89	7.24E-19	5.03E-20
293.91	6.68E-19	5.17E-20
293.94	6.95E-19	5.24E-20
293.96	7.24E-19	4.64E-20
293.98	7.39E-19	5.44E-20
294.01	7.79E-19	5.00E-20
294.03	7.66E-19	5.26E-20
294.05	7.26E-19	5.67E-20
294.08	7.10E-19	5.28E-20
294.10	6.74E-19	5.70E-20
294.12	7.03E-19	4.70E-20
294.15	6.74E-19	4.87E-20
294.17	6.90E-19	5.09E-20
294.19	6.55E-19	5.68E-20
294.22	6.57E-19	5.45E-20
294.24	6.60E-19	5.29E-20
294.26	6.56E-19	5.20E-20
294.29	6.53E-19	5.46E-20
294.31	6.93E-19	5.08E-20
294.33	7.04E-19	4.94E-20
294.36	6.94E-19	4.92E-20
294.38	6.74E-19	5.26E-20

294.40	7.15E-19	5.24E-20
294.42	7.30E-19	5.07E-20
294.45	7.25E-19	5.31E-20
294.47	7.44E-19	4.83E-20
294.49	7.09E-19	5.21E-20
294.52	7.23E-19	4.91E-20
294.54	7.33E-19	5.35E-20
294.57	7.32E-19	5.31E-20
294.59	7.43E-19	5.34E-20
294.61	7.28E-19	5.39E-20
294.64	7.07E-19	5.14E-20
294.66	6.92E-19	5.30E-20
294.68	6.63E-19	4.94E-20
294.70	6.37E-19	5.38E-20
294.73	6.19E-19	5.50E-20
294.75	6.01E-19	5.64E-20
294.77	5.74E-19	5.38E-20
294.80	5.63E-19	5.17E-20
294.82	5.31E-19	5.31E-20
294.84	5.37E-19	5.18E-20
294.87	5.16E-19	5.63E-20
294.89	5.34E-19	5.22E-20
294.91	4.96E-19	5.50E-20
294.94	4.81E-19	5.58E-20
294.96	4.77E-19	5.74E-20
294.98	4.73E-19	4.99E-20
295.01	4.60E-19	5.31E-20
295.03	4.63E-19	5.45E-20
295.05	4.53E-19	5.62E-20
295.08	4.36E-19	5.82E-20
295.10	4.38E-19	5.51E-20
295.12	4.24E-19	5.66E-20
295.15	4.16E-19	5.24E-20
295.17	3.87E-19	5.91E-20
295.19	3.99E-19	5.78E-20
295.22	4.03E-19	5.60E-20
295.24	3.97E-19	5.22E-20
295.26	3.75E-19	5.74E-20
295.29	3.78E-19	5.70E-20
295.31	3.59E-19	5.77E-20
295.33	3.57E-19	5.93E-20
295.36	3.49E-19	5.88E-20
295.38	3.60E-19	5.95E-20
295.40	3.74E-19	5.84E-20
295.43	3.47E-19	6.20E-20
295.45	3.65E-19	5.59E-20
295.47	3.65E-19	5.93E-20
295.49	3.60E-19	5.93E-20
295.52	3.67E-19	5.72E-20
295.54	3.82E-19	5.71E-20
295.57	3.64E-19	6.51E-20
295.59	3.87E-19	5.85E-20
295.61	3.78E-19	6.26E-20
295.64	4.08E-19	6.01E-20
295.66	4.17E-19	6.03E-20
295.68	4.09E-19	6.60E-20
295.70	4.56E-19	6.01E-20
295.73	4.49E-19	6.77E-20
295.75	4.70E-19	6.66E-20
295.77	5.24E-19	5.98E-20
295.80	5.25E-19	5.99E-20
295.82	5.59E-19	5.69E-20
295.84	5.69E-19	5.79E-20
295.87	5.99E-19	5.81E-20
295.89	6.40E-19	5.36E-20
295.91	6.28E-19	5.73E-20
295.94	6.69E-19	5.44E-20
295.96	7.13E-19	5.01E-20
295.98	7.26E-19	5.67E-20
296.01	7.16E-19	5.43E-20
296.03	7.34E-19	4.91E-20
296.05	7.06E-19	5.13E-20
296.08	6.86E-19	5.55E-20
296.10	7.48E-19	5.22E-20
296.12	7.86E-19	5.08E-20
296.15	7.74E-19	4.90E-20
296.17	7.60E-19	5.53E-20
296.19	7.82E-19	5.30E-20
296.22	7.80E-19	5.27E-20
296.24	8.01E-19	5.45E-20
296.26	7.81E-19	5.70E-20
296.29	7.63E-19	5.66E-20
296.31	7.59E-19	5.04E-20
296.33	7.19E-19	5.69E-20
296.36	7.00E-19	5.63E-20
296.38	6.93E-19	5.90E-20
296.40	6.79E-19	5.67E-20
296.43	6.37E-19	5.33E-20
296.45	5.90E-19	5.68E-20
296.47	6.12E-19	5.35E-20
296.49	6.07E-19	5.71E-20
296.52	5.74E-19	5.86E-20
296.54	5.60E-19	5.93E-20
296.57	5.47E-19	5.48E-20
296.59	5.25E-19	5.59E-20
296.61	5.17E-19	5.70E-20

296.64	5.13E-19	5.13E-20
296.66	4.91E-19	5.42E-20
296.68	4.75E-19	5.52E-20
296.70	4.58E-19	5.79E-20
296.73	4.73E-19	5.20E-20
296.75	4.70E-19	5.31E-20
296.77	4.64E-19	5.61E-20
296.80	4.45E-19	5.69E-20
296.82	4.40E-19	5.73E-20
296.84	4.23E-19	5.46E-20
296.87	4.56E-19	5.61E-20
296.89	4.35E-19	5.67E-20
296.91	4.22E-19	5.73E-20
296.94	4.30E-19	5.61E-20
296.96	4.16E-19	5.86E-20
296.98	4.09E-19	6.36E-20
297.01	4.00E-19	5.81E-20
297.03	4.00E-19	5.55E-20
297.05	3.77E-19	5.42E-20
297.08	3.45E-19	5.90E-20
297.10	3.62E-19	5.57E-20
297.12	3.24E-19	6.15E-20
297.15	3.24E-19	6.14E-20
297.17	3.19E-19	5.94E-20
297.19	2.97E-19	6.20E-20
297.22	3.13E-19	5.90E-20
297.24	2.91E-19	6.27E-20
297.26	2.96E-19	5.85E-20
297.29	2.82E-19	6.06E-20
297.31	2.85E-19	6.12E-20
297.33	2.69E-19	6.18E-20
297.36	2.57E-19	6.42E-20
297.38	2.73E-19	6.30E-20
297.40	2.42E-19	6.50E-20
297.43	2.67E-19	6.13E-20
297.45	2.61E-19	6.94E-20
297.47	2.86E-19	6.19E-20
297.50	2.89E-19	6.17E-20
297.52	2.85E-19	6.20E-20
297.54	2.77E-19	6.96E-20
297.57	2.84E-19	7.13E-20
297.59	3.25E-19	6.55E-20
297.61	3.29E-19	6.44E-20
297.64	3.49E-19	6.15E-20
297.66	3.39E-19	6.35E-20
297.68	3.68E-19	6.64E-20
297.70	3.81E-19	6.27E-20
297.73	3.85E-19	7.15E-20
297.75	3.84E-19	7.20E-20
297.77	4.52E-19	7.18E-20
297.80	4.98E-19	6.95E-20
297.82	5.45E-19	6.29E-20
297.84	5.97E-19	6.17E-20
297.87	5.99E-19	5.87E-20
297.89	6.66E-19	5.90E-20
297.91	6.82E-19	5.19E-20
297.94	6.88E-19	5.76E-20
297.96	6.98E-19	5.70E-20
297.98	7.32E-19	5.27E-20
298.01	7.73E-19	5.09E-20
298.03	7.27E-19	5.53E-20
298.05	7.34E-19	5.58E-20
298.08	7.02E-19	5.22E-20
298.10	6.97E-19	5.65E-20
298.12	6.79E-19	5.94E-20
298.15	6.84E-19	5.42E-20
298.17	6.85E-19	5.79E-20
298.19	6.88E-19	5.47E-20
298.22	6.80E-19	5.62E-20
298.24	6.70E-19	5.52E-20
298.26	6.77E-19	5.23E-20
298.29	6.39E-19	5.79E-20
298.31	6.49E-19	5.88E-20
298.33	6.53E-19	5.63E-20
298.36	6.70E-19	5.58E-20
298.38	6.50E-19	5.65E-20
298.40	6.28E-19	5.75E-20
298.43	6.28E-19	5.86E-20
298.45	6.38E-19	5.60E-20
298.47	6.05E-19	5.79E-20
298.50	6.15E-19	5.62E-20
298.52	5.71E-19	5.56E-20
298.54	5.71E-19	5.70E-20
298.57	5.40E-19	5.67E-20
298.59	5.22E-19	5.87E-20
298.61	5.04E-19	5.71E-20
298.64	5.03E-19	5.53E-20
298.66	4.98E-19	5.53E-20
298.68	4.59E-19	6.12E-20
298.70	4.68E-19	5.45E-20
298.73	4.21E-19	6.39E-20
298.75	4.27E-19	6.02E-20
298.77	4.20E-19	6.06E-20
298.80	4.09E-19	6.14E-20
298.82	4.13E-19	6.02E-20
298.85	4.06E-19	5.90E-20

298.87	3.77E-19	6.01E-20
298.89	3.61E-19	6.24E-20
298.91	3.68E-19	6.05E-20
298.94	3.56E-19	5.94E-20
298.96	3.69E-19	6.02E-20
298.98	3.45E-19	6.26E-20
299.01	3.28E-19	6.33E-20
299.03	3.55E-19	5.91E-20
299.05	3.24E-19	5.72E-20
299.08	3.31E-19	6.14E-20
299.10	3.08E-19	6.83E-20
299.12	2.97E-19	6.23E-20
299.15	2.83E-19	6.40E-20
299.17	2.89E-19	6.18E-20
299.19	2.74E-19	6.37E-20
299.22	2.75E-19	6.51E-20
299.24	2.58E-19	6.72E-20
299.26	2.60E-19	6.63E-20
299.29	2.71E-19	6.73E-20
299.31	2.71E-19	6.66E-20
299.33	2.27E-19	6.97E-20
299.36	2.56E-19	6.71E-20
299.38	2.58E-19	6.77E-20
299.40	2.60E-19	6.46E-20
299.43	2.48E-19	6.73E-20
299.45	2.44E-19	6.77E-20
299.47	2.67E-19	6.62E-20
299.50	2.44E-19	6.59E-20
299.52	2.40E-19	6.62E-20
299.54	2.61E-19	7.25E-20
299.57	2.49E-19	7.03E-20
299.59	2.41E-19	6.99E-20
299.61	2.79E-19	6.50E-20
299.64	2.80E-19	6.56E-20
299.66	2.52E-19	7.26E-20
299.68	2.51E-19	7.03E-20
299.70	2.85E-19	6.50E-20
299.73	2.59E-19	6.94E-20
299.75	2.71E-19	7.10E-20
299.77	2.50E-19	8.66E-20
299.80	3.25E-19	8.22E-20
299.82	3.75E-19	7.54E-20
299.85	3.99E-19	7.28E-20
299.87	4.44E-19	7.60E-20
299.89	4.74E-19	7.41E-20
299.91	5.10E-19	7.65E-20
299.94	5.33E-19	8.57E-20
299.96	6.25E-19	6.85E-20
299.98	6.71E-19	7.21E-20
300.01	7.31E-19	6.14E-20
300.03	8.02E-19	5.50E-20
300.05	7.95E-19	5.40E-20
300.08	8.05E-19	6.03E-20
300.10	7.80E-19	6.77E-20
300.12	7.95E-19	5.61E-20
300.15	7.84E-19	5.97E-20
300.17	7.08E-19	5.57E-20
300.19	6.65E-19	5.96E-20
300.22	6.89E-19	5.53E-20
300.24	6.94E-19	5.87E-20
300.26	6.65E-19	5.51E-20
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300.38	5.56E-19	6.46E-20
300.40	5.72E-19	5.78E-20
300.43	5.69E-19	5.72E-20
300.45	5.20E-19	5.88E-20
300.47	5.43E-19	5.60E-20
300.50	4.96E-19	6.00E-20
300.52	4.56E-19	5.96E-20
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300.61	4.41E-19	5.76E-20
300.64	4.41E-19	5.71E-20
300.66	3.96E-19	6.44E-20
300.68	4.12E-19	6.07E-20
300.70	3.68E-19	6.38E-20
300.73	3.92E-19	6.25E-20
300.75	4.01E-19	6.06E-20
300.77	3.43E-19	6.35E-20
300.80	3.44E-19	6.22E-20
300.82	3.44E-19	6.25E-20
300.85	3.25E-19	6.70E-20
300.87	3.30E-19	6.84E-20
300.89	3.35E-19	6.31E-20
300.92	3.15E-19	6.54E-20
300.94	3.31E-19	6.08E-20
300.96	2.98E-19	6.40E-20
300.98	2.91E-19	6.64E-20
301.01	2.88E-19	6.19E-20
301.03	2.59E-19	6.73E-20
301.05	2.80E-19	6.46E-20
301.08	2.73E-19	6.49E-20

301.10	2.86E-19	6.27E-20
301.12	2.60E-19	6.76E-20
301.15	2.61E-19	6.09E-20
301.17	2.45E-19	6.32E-20
301.19	2.49E-19	6.46E-20
301.22	2.17E-19	6.91E-20
301.24	2.11E-19	6.98E-20
301.26	2.29E-19	6.54E-20
301.29	2.28E-19	6.74E-20
301.31	2.28E-19	6.34E-20
301.33	2.02E-19	6.61E-20
301.36	1.95E-19	6.48E-20
301.38	2.06E-19	7.03E-20
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301.43	1.87E-19	7.11E-20
301.45	1.77E-19	7.59E-20
301.47	1.94E-19	7.04E-20
301.50	1.90E-19	7.15E-20
301.52	2.21E-19	6.52E-20
301.54	2.07E-19	6.69E-20
301.57	2.25E-19	7.11E-20
301.59	1.97E-19	7.19E-20
301.61	1.86E-19	7.14E-20
301.64	2.10E-19	7.47E-20
301.66	2.16E-19	7.88E-20
301.68	2.59E-19	6.83E-20
301.70	2.78E-19	6.58E-20
301.73	2.69E-19	6.74E-20
301.75	2.93E-19	6.90E-20
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301.80	2.96E-19	7.49E-20
301.82	3.21E-19	7.29E-20
301.85	3.62E-19	6.99E-20
301.87	4.23E-19	6.77E-20
301.89	4.46E-19	6.80E-20
301.92	4.57E-19	6.78E-20
301.94	4.71E-19	6.63E-20
301.96	5.30E-19	6.45E-20
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302.03	5.89E-19	5.79E-20
302.05	5.76E-19	6.23E-20
302.08	5.95E-19	5.98E-20
302.10	6.03E-19	6.11E-20
302.12	6.33E-19	5.60E-20
302.15	6.56E-19	5.48E-20
302.17	6.35E-19	5.41E-20
302.19	6.34E-19	5.46E-20
302.22	6.01E-19	5.98E-20
302.24	6.12E-19	5.85E-20
302.26	5.94E-19	5.71E-20
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302.43	5.56E-19	5.58E-20
302.45	5.21E-19	5.88E-20
302.47	5.40E-19	6.32E-20
302.50	4.67E-19	6.00E-20
302.52	4.46E-19	6.30E-20
302.54	4.51E-19	6.17E-20
302.57	4.54E-19	5.79E-20
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302.73	3.39E-19	7.15E-20
302.75	3.66E-19	5.77E-20
302.77	3.47E-19	6.45E-20
302.80	3.42E-19	6.35E-20
302.82	3.18E-19	6.34E-20
302.85	2.82E-19	6.89E-20
302.87	3.01E-19	6.69E-20
302.89	2.84E-19	6.30E-20
302.92	2.71E-19	6.35E-20
302.94	2.74E-19	6.40E-20
302.96	2.75E-19	6.49E-20
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303.03	2.48E-19	6.62E-20
303.05	2.36E-19	6.57E-20
303.08	2.39E-19	6.88E-20
303.10	2.31E-19	6.34E-20
303.12	2.31E-19	6.51E-20
303.15	2.17E-19	6.71E-20
303.17	1.92E-19	6.97E-20
303.19	2.00E-19	6.81E-20
303.22	2.09E-19	6.61E-20
303.24	2.13E-19	6.83E-20
303.26	2.10E-19	6.83E-20
303.29	2.03E-19	6.87E-20
303.31	1.82E-19	7.31E-20

303.33	2.17E-19	6.70E-20
303.36	1.96E-19	7.10E-20
303.38	1.91E-19	6.86E-20
303.40	2.04E-19	6.82E-20
303.43	2.05E-19	6.79E-20
303.45	1.48E-19	7.22E-20
303.47	1.95E-19	6.41E-20
303.50	1.86E-19	6.89E-20
303.52	1.84E-19	6.77E-20
303.54	1.77E-19	7.44E-20
303.57	1.98E-19	6.69E-20
303.59	1.97E-19	7.21E-20
303.61	1.82E-19	7.20E-20
303.64	2.13E-19	6.79E-20
303.66	1.92E-19	7.00E-20
303.68	2.24E-19	6.95E-20
303.71	1.73E-19	7.57E-20
303.73	1.69E-19	7.87E-20
303.75	1.91E-19	7.29E-20
303.77	2.20E-19	6.52E-20
303.80	2.11E-19	6.80E-20
303.82	2.36E-19	6.72E-20
303.85	2.11E-19	7.15E-20
303.87	2.24E-19	7.32E-20
303.89	2.43E-19	6.72E-20
303.92	2.60E-19	7.30E-20
303.94	2.49E-19	7.54E-20
303.96	2.93E-19	6.83E-20
303.98	3.09E-19	7.21E-20
304.01	3.45E-19	6.76E-20
304.03	3.58E-19	6.31E-20
304.05	3.39E-19	7.14E-20
304.08	3.65E-19	7.57E-20
304.10	4.13E-19	7.47E-20
304.12	4.28E-19	7.54E-20
304.15	5.27E-19	5.92E-20
304.17	5.27E-19	6.61E-20
304.19	5.50E-19	6.59E-20
304.22	5.92E-19	6.37E-20
304.24	5.82E-19	5.78E-20
304.26	5.37E-19	6.92E-20
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304.43	4.65E-19	6.24E-20
304.45	4.28E-19	7.07E-20
304.47	4.80E-19	6.12E-20
304.50	4.58E-19	5.97E-20
304.52	4.19E-19	6.58E-20
304.54	4.17E-19	6.26E-20
304.57	4.12E-19	6.03E-20
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304.77	3.21E-19	6.72E-20
304.80	2.99E-19	6.47E-20
304.82	2.77E-19	6.37E-20
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304.87	2.73E-19	6.40E-20
304.89	2.35E-19	6.87E-20
304.92	2.27E-19	6.97E-20
304.94	2.36E-19	6.63E-20
304.96	2.48E-19	6.31E-20
304.98	2.36E-19	6.58E-20
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305.03	2.47E-19	6.42E-20
305.05	1.99E-19	7.19E-20
305.08	2.16E-19	6.48E-20
305.10	2.03E-19	7.07E-20
305.12	2.13E-19	6.76E-20
305.15	1.98E-19	7.04E-20
305.17	1.84E-19	7.14E-20
305.19	1.89E-19	6.85E-20
305.22	1.85E-19	7.09E-20
305.24	1.53E-19	6.78E-20
305.26	1.43E-19	7.64E-20
305.29	1.68E-19	6.76E-20
305.31	1.53E-19	7.01E-20
305.33	1.84E-19	6.66E-20
305.36	1.65E-19	6.89E-20
305.38	1.67E-19	6.82E-20
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305.43	1.35E-19	7.18E-20
305.45	1.49E-19	7.45E-20
305.47	1.43E-19	7.08E-20
305.50	1.51E-19	7.15E-20
305.52	1.33E-19	7.34E-20
305.54	1.50E-19	6.89E-20

305.57	1.60E-19	7.19E-20
305.59	1.64E-19	6.89E-20
305.61	1.54E-19	7.21E-20
305.64	1.53E-19	7.13E-20
305.66	1.47E-19	6.90E-20
305.68	1.28E-19	7.54E-20
305.71	1.71E-19	7.01E-20
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305.82	1.64E-19	7.07E-20
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305.92	2.04E-19	6.99E-20
305.94	2.12E-19	6.97E-20
305.96	2.07E-19	7.45E-20
305.98	2.47E-19	6.28E-20
306.01	2.39E-19	6.92E-20
306.03	2.16E-19	7.44E-20
306.05	2.53E-19	7.26E-20
306.08	2.80E-19	6.47E-20
306.10	2.58E-19	7.26E-20
306.12	3.00E-19	6.75E-20
306.15	3.00E-19	6.84E-20
306.17	3.31E-19	6.04E-20
306.19	2.91E-19	7.07E-20
306.22	3.14E-19	6.63E-20
306.24	2.98E-19	7.30E-20
306.26	3.36E-19	6.78E-20
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306.33	3.73E-19	7.01E-20
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306.54	4.16E-19	6.12E-20
306.57	4.18E-19	6.31E-20
306.59	3.93E-19	6.42E-20
306.61	4.02E-19	6.06E-20
306.64	4.08E-19	6.00E-20
306.66	4.10E-19	6.73E-20
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306.78	3.17E-19	6.19E-20
306.80	3.35E-19	6.37E-20
306.82	3.08E-19	6.65E-20
306.85	2.60E-19	6.86E-20
306.87	2.81E-19	6.12E-20
306.89	2.39E-19	6.89E-20
306.92	2.37E-19	7.02E-20
306.94	2.26E-19	6.77E-20
306.96	2.32E-19	7.15E-20
306.98	2.35E-19	6.84E-20
307.01	2.37E-19	6.21E-20
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307.75	1.66E-19	7.38E-20
307.78	1.38E-19	7.94E-20

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313.85	1.17E-19	7.40E-20
313.87	5.56E-20	7.62E-20
313.89	7.52E-20	7.52E-20
313.92	7.27E-20	7.45E-20

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