Steven Labalme
26 January 2023

2 February 2023

1 TITLE

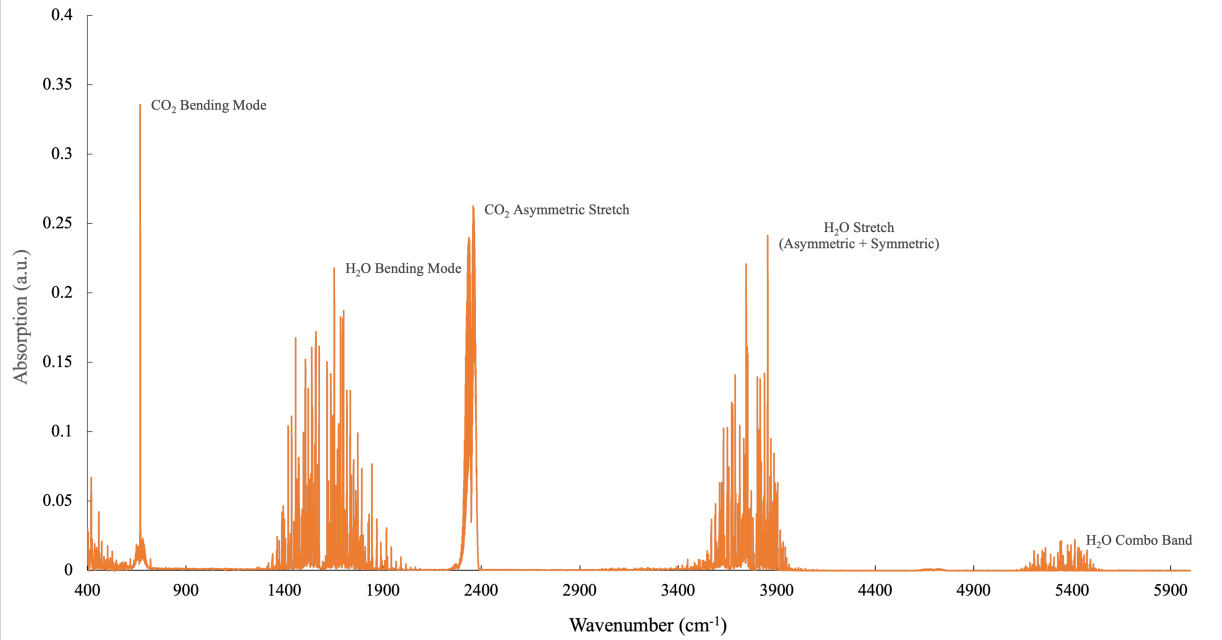
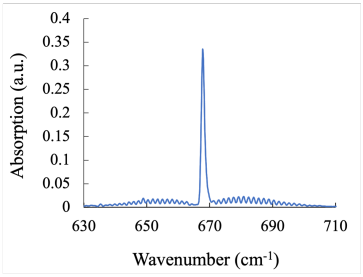
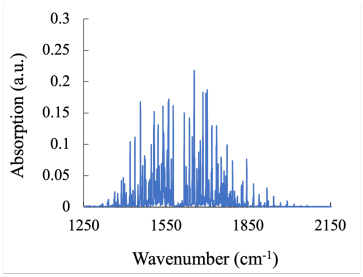


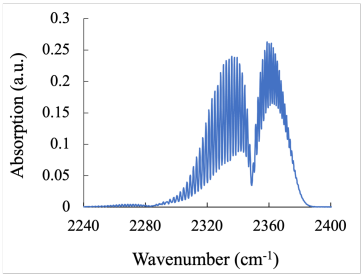
Figure 1: Infrared absorption spectrum of air (background spectrum).



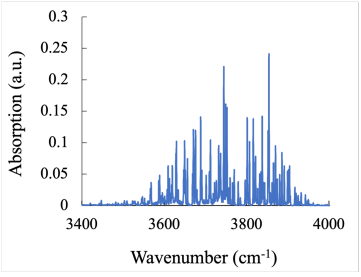
(a) CO_2 bending mode.



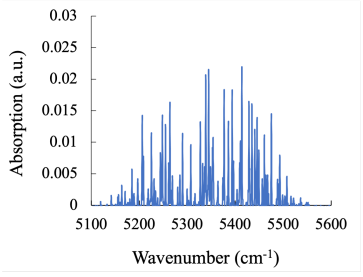
(b) H_2O bending mode.



(c) CO_2 asymmetric stretch.



(d) H_2O stretches.



(e) H_2O combo band.

Figure 2: The five primary vibrational bands in a sample of air.

Wavenumber Range (cm^{-1})	**Molecule**	**Vibrational Band**
630-710	CO_2	Bending
1250-2150	H_2O	Bending
2240-2400	CO_2	Asymmetric stretch
3400-4000	H_2O	Asymmetric & symmetric stretch
5100-5600	H_2O	Combo band

Table 1: Infrared-active vibrational modes in air molecules.

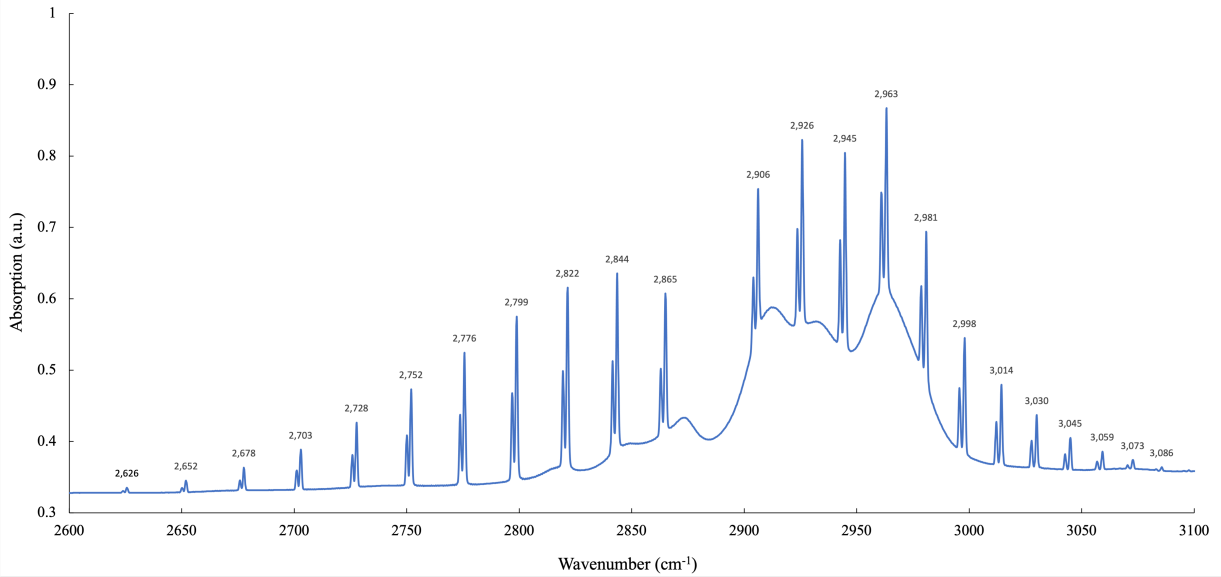


Figure 3: Rovibrational absorption spectrum of HCl.

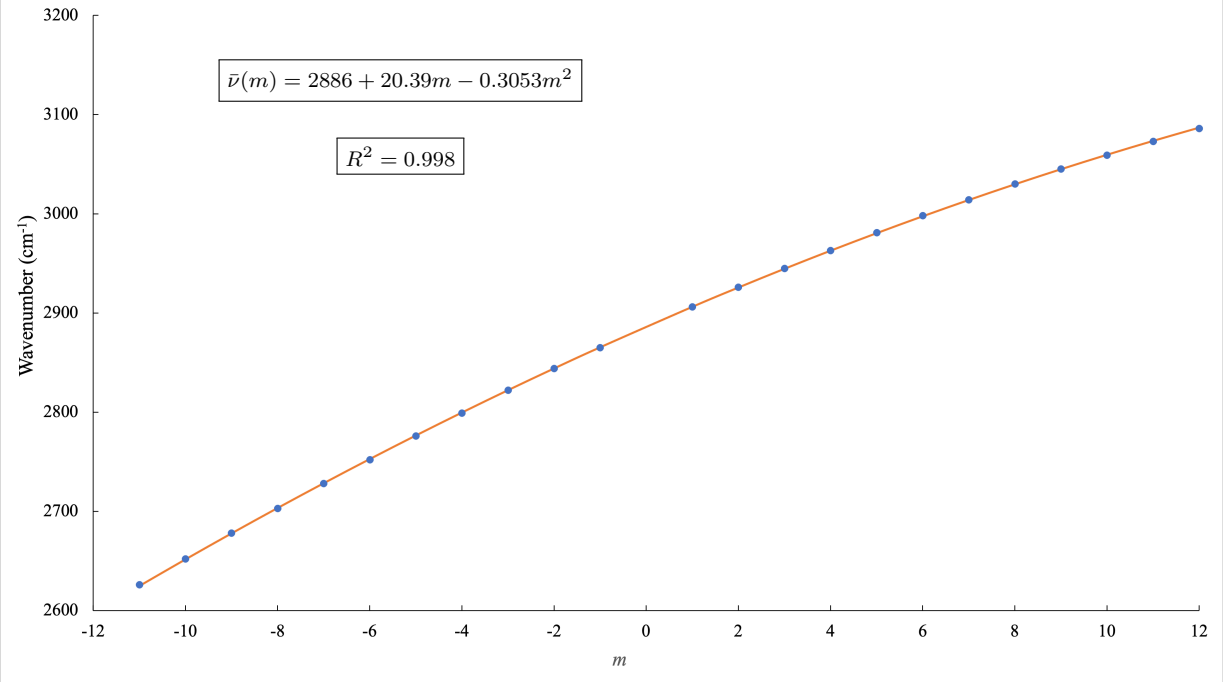


Figure 4: Fitting data on the rovibrational transition wavenumbers $\bar{\nu}$ of HCl vs. a parameter m related to the rotational energy level from which such a rovibrational transition begins.

	B_e ($\mathbf{cm^{-1}}$)	α_e ($\mathbf{cm^{-1}}$)	$\bar{\nu}_0$ ($\mathbf{cm^{-1}}$)
Calculated values	10.50	0.3053	2886
Literature values	10.59[1]	0.3072[1]	2991[1]

Table 2: Calculated spectroscopic constants and their reported values.

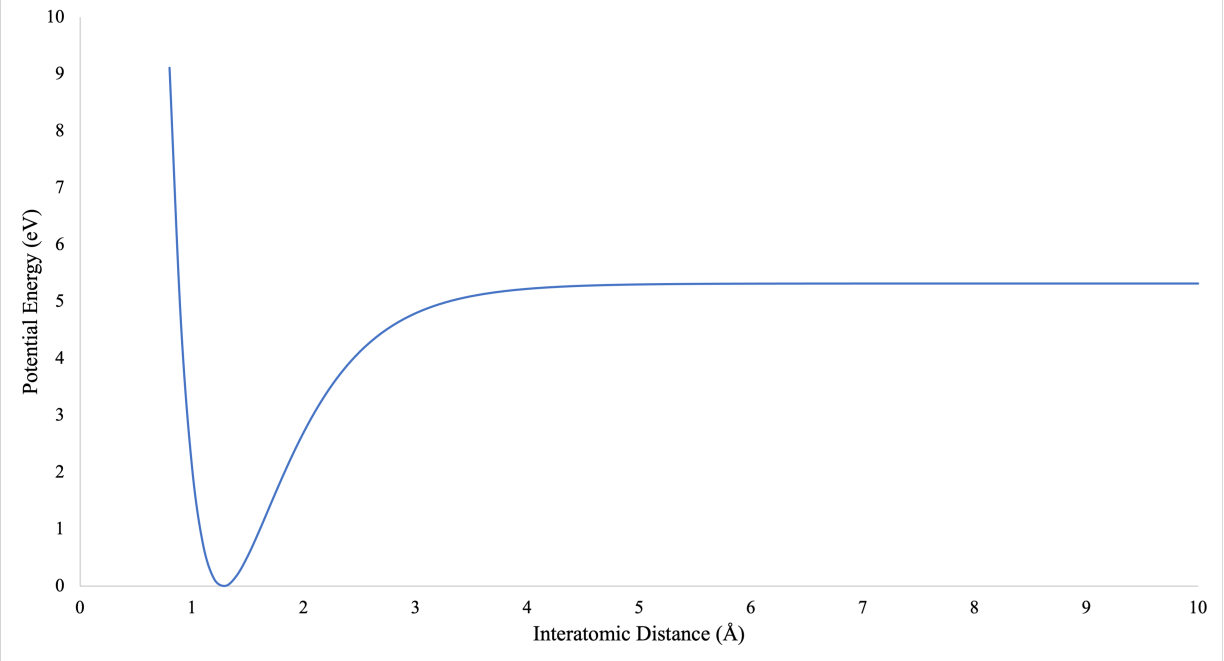


Figure 5: Morse potential curve.

	$\bar{\nu}_e$ (cm^{-1})	x_e	D_e (eV)	r_e (Å)
Calculated values	2990	0.017 41	5.320	1.281
Literature values	2991[1]	0.017 66[1]	5.319[1]	1.275[1]

Table 3: Calculated energy constants and their reported values.

References

(1) Huber, K. P.; Herzberg, G. H. In *NIST Chemistry WebBook, NIST Standard Reference Database Number 69*, Linstrom, P. J., Mallard, W. G., Eds., `https://doi.org/10.18434/T4D303`; National Institute of Standards and Technology: Gaithersburg MD, 20899; Chapter Constants of Diatomic Molecules.