練習実験報告

肖宇笑

May 18, 2024

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Galvano Sepctrum

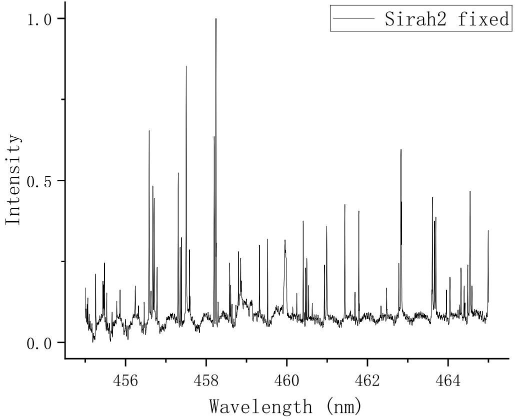

Fig. 1: Wavelen. correction

Galvano Sepctrum

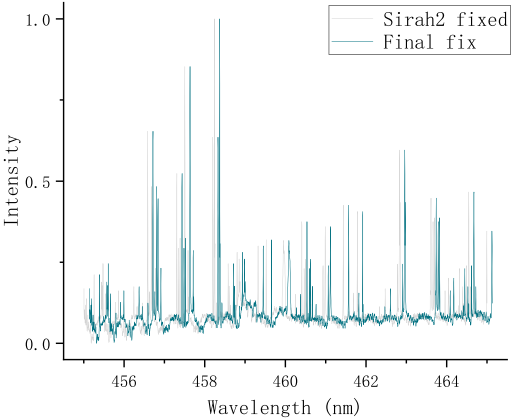

Fig. 1: Wavelen. correction

Galvano Sepctrum

Correction

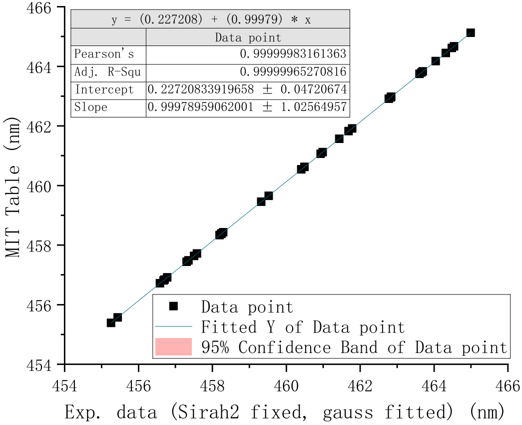

Fig. 2: Correction function

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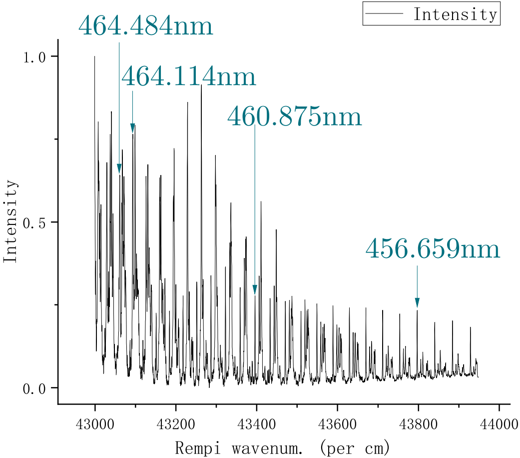
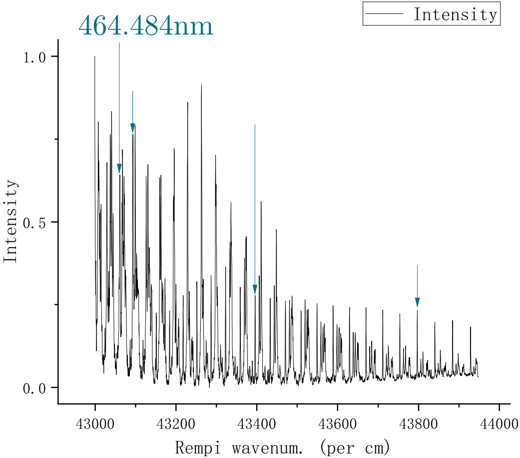
Selected peaks



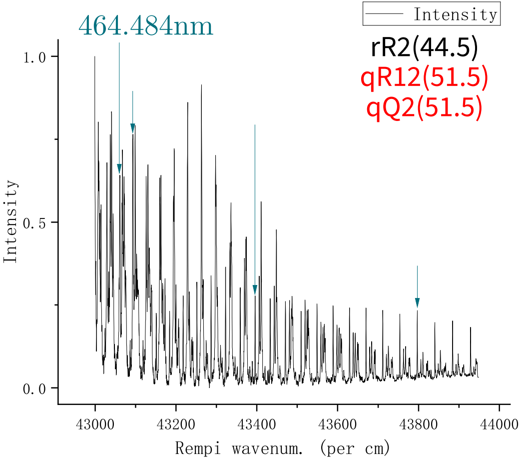
Contents

Contents

Peak 1

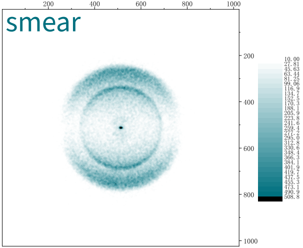

464.484nm
Intensity
1.0
0.5
0.0
Intensity
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

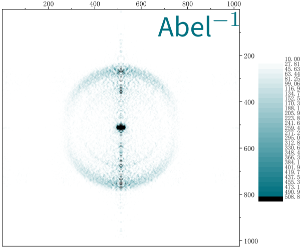
Peak 1

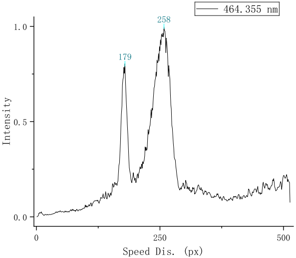


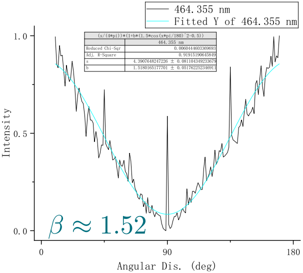
464.484nm
Intensity
rR2(44.5)
qR12(51.5)
qQ2(51.5)
1.0
0.5
0.0
Intensity
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

Peak 1

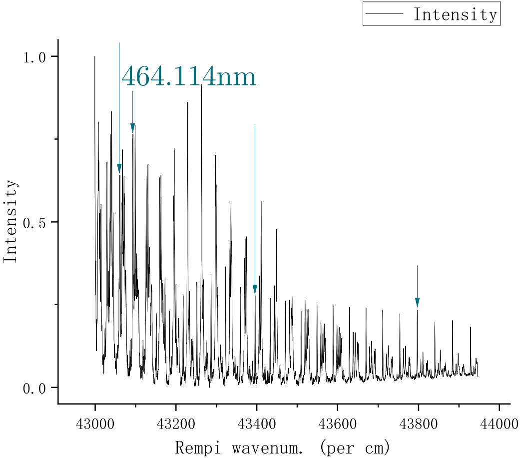

smear


Abel^{-1}


464.355 nm
179
258
Intensity
Speed Dis. (px)

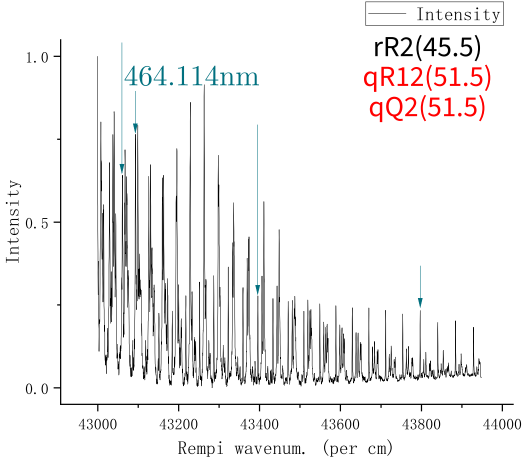

464.355 nm
Fitted Y of 464.355 nm
(s/(4*pi))*(1+b*(1.5*cos(x*pi/180)^2-0.5))
464.355 nm
Reduced Chi-Sqr 0.00604446033369693
Adj. R-Square 0.91915190645849
s 4.3907648247226 ± 0.081104349233679
b 1.5180165177701 ± 0.051762252346911
Intensity
Angular Dis. (deg)
$\beta \approx 1.52$

Peak 2



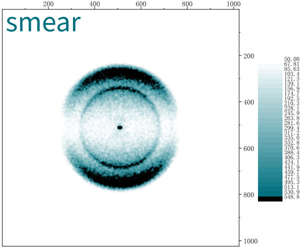
Intensity
464.114nm
1.0
0.5
0.0
Intensity
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

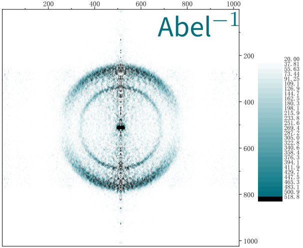
Peak 2

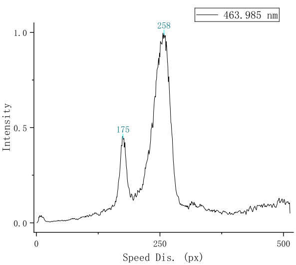


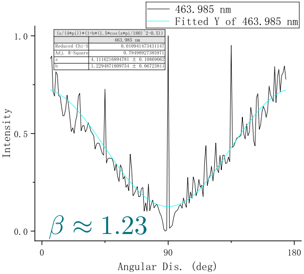
Intensity
rR2(45.5)
qR12(51.5)
qQ2(51.5)
464.114nm
1.0
0.5
0.0
Intensity
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

Peak 2

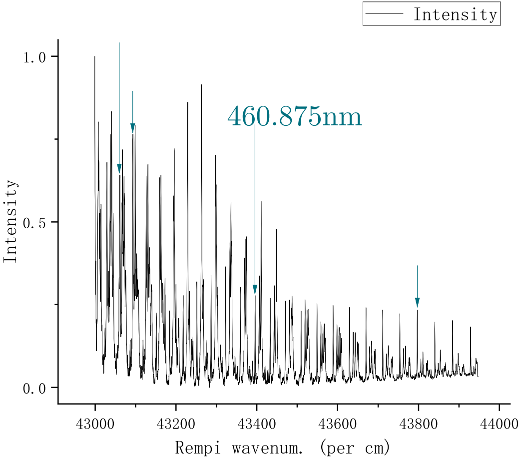

smear
200 400 600 800 1000
200 400 600 800 1000


Abel^{-1}
200 400 600 800 1000
200 400 600 800 1000


463.985 nm
258
175
Intensity
1.0
0.5
0.0
0
250
500
Speed Dis. (px)

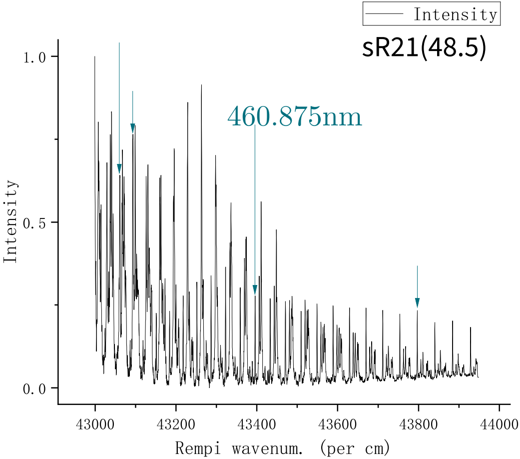

463.985 nm
Fitted Y of 463.985 nm
(s/(4*pi))*(1+b*(1.5*cos(x*pi/180)^2-0.5))
463.985 nm
Reduced Chi-S 0.010941473431147
Adj. R-Square 0.79498927385971
s 4.1116216894781 ± 0.10869062
b 1.2294871809754 ± 0.06723811
Intensity
1.0
0.5
0.0
0
90
180
Angular Dis. (deg)
$\beta \approx 1.23$

Peak 3



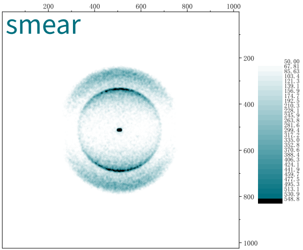
Intensity
460.875nm
1.0
0.5
0.0
Intensity
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

Peak 3

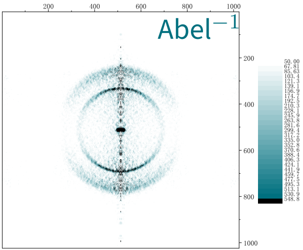


Intensity
sR21(48.5)
460.875nm
1.0
0.5
0.0
Intensity
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

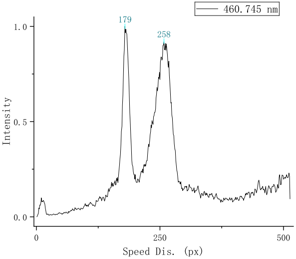
Peak 3



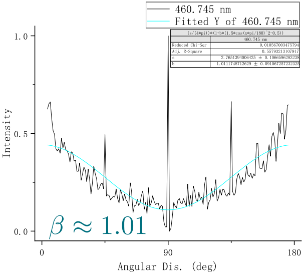
smear
200
400
600
800
1000
50.00
67.81
85.63
103.4
121.3
139.1
156.9
174.7
192.5
210.3
228.1
245.9
263.8
281.6
299.4
317.2
335.0
352.8
370.6
388.4
406.3
424.1
441.9
459.7
477.5
495.3
513.1
530.9
548.8



Abel^{-1}
200
400
600
800
1000
50.00
67.81
85.63
103.4
121.3
139.1
156.9
174.7
192.5
210.3
228.1
245.9
263.8
281.6
299.4
317.2
335.0
352.8
370.6
388.4
406.3
424.1
441.9
459.7
477.5
495.3
513.1
530.9
548.8

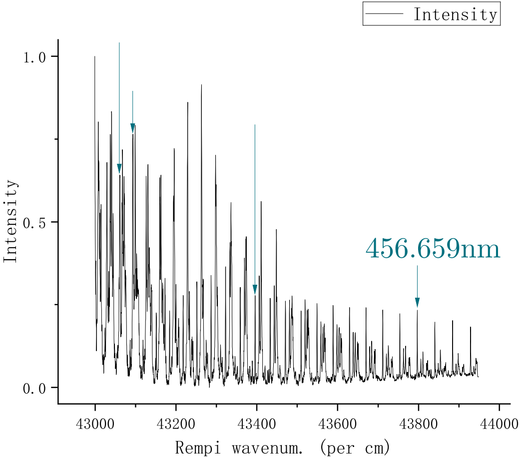


460.745 nm
179
258
Intensity
1.0
0.5
0.0
0
250
500
Speed Dis. (px)



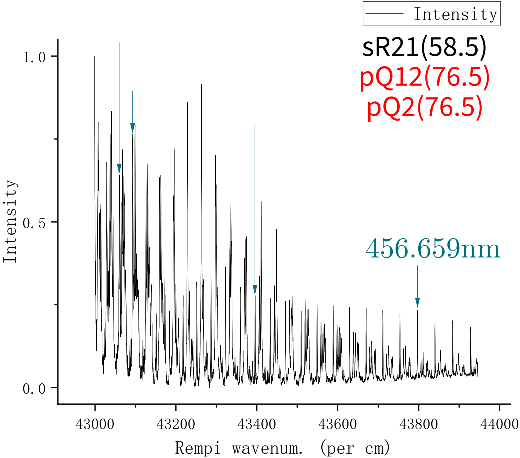
460.745 nm
Fitted Y of 460.745 nm
(s/(4*pi))*(1+b*(1.5*cos(x*pi/180)^2-0.5))
460.745 nm
Reduced Chi-Sqr 0.010567003475794
Adj. R-Square 0.55793213107917
s 2.7651394006425 ± 0.1066596283238
b 1.0111748712629 ± 0.091067257232325
Intensity
1.0
0.5
0.0
0
90
180
Angular Dis. (deg)
$\beta \approx 1.01$

Peak 4



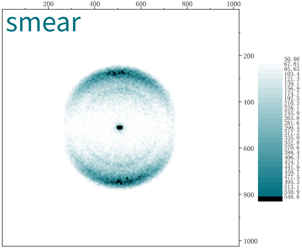
Intensity
1.0
0.5
0.0
Intensity
456.659nm
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

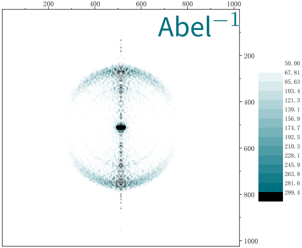
Peak 4

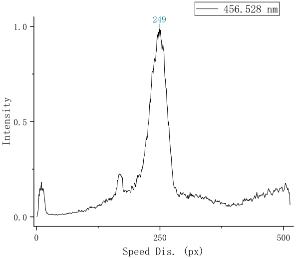


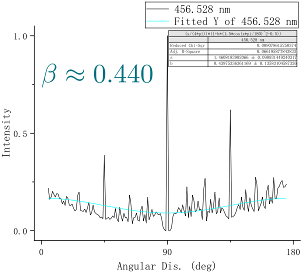
Intensity
sR21(58.5)
pQ12(76.5)
pQ2(76.5)
456.659nm
1.0
0.5
0.0
Intensity
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

Peak 4


smear
200
400
600
800
1000
50.00
548.8


Abel^{-1}
200
400
600
800
1000
50.00
67.81
85.63
103.4
121.3
139.1
156.9
174.7
192.5
210.3
228.1
245.9
263.8
281.6
299.4


456.528 nm
249
Intensity
Speed Dis. (px)
0
250
500
0.0
0.5
1.0


456.528 nm
Fitted Y of 456.528 nm
(s/(4*pi))*(1+b*(1.5*cos(x*pi/180)^2-0.5))
456.528 nm
Reduced Chi-Sqr 0.009078615250374
Adj. R-Square 0.066195877843833
s 1.4608183982066 ± 0.098931449240317
b 0.43975336361169 ± 0.13583104587326
$\beta \approx 0.440$
Intensity
Angular Dis. (deg)
0
90
180
0.0
0.5
1.0

Contents

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Peak assignments

464.484nm $\approx 43058.49\text{cm}^{-1}$	464.114nm $\approx 43092.81\text{cm}^{-1}$	460.875nm $\approx 43395.69\text{cm}^{-1}$	456.659nm $\approx 43796.34\text{cm}^{-1}$
px $= 258$	px $= 258$	px $= 258$	px $= 249$
$rR2$ 44.5 $qR12$ 51.5 $qQ2$ 51.5	$rR2$ 45.5 $qR12$ 51.5 $qQ2$ 51.5	$sR21$ 48.5	$sR21$ 58.5 $pQ12$ 76.5 $pP2$ 76.5

Notice

Colored assignments are mismatched, and will not be used to calculate.

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Speed correction

	E_{total}	$E_{\text{bond}}(\mathrm{O{-}NO})$[1]	$E_{\text{int.}}(\mathrm{NO})$
Peak 1 $464.484\mathrm{nm}$	$43\,058.49\mathrm{cm}^{-1}$	$25\,128.57\mathrm{cm}^{-1}$	$E(v=1)+E(J=44)$
Peak 2 $464.114\mathrm{nm}$	$43\,092.81\mathrm{cm}^{-1}$		$E(v=1)+E(J=45)$
Peak 3 $460.875\mathrm{nm}$	$43\,395.69\mathrm{cm}^{-1}$		$E(v=1)+E(J=48)$
Peak 4 $456.659\mathrm{nm}$	$43\,796.34\mathrm{cm}^{-1}$		$E(v=1)+E(J=58)$

[1] Rémy Jost et al. *The Journal of Chemical Physics* **105**.3 (July 1996).

Speed correction

	E_{total}	$E_{\text{bond}}(\text{O}-\text{NO})$[2]	$E_{\text{int.}}(\text{NO})$
Peak 1 464.484nm	$43\,058.49\text{cm}^{-1}$	$25\,128.57\text{cm}^{-1}$	$3525.074\,362\,5\text{cm}^{-1} + E(J=44)$
Peak 2 464.114nm	$43\,092.81\text{cm}^{-1}$		$3525.074\,362\,5\text{cm}^{-1} + E(J=45)$
Peak 3 460.875nm	$43\,395.69\text{cm}^{-1}$		$3525.074\,362\,5\text{cm}^{-1} + E(J=48)$
Peak 4 456.659nm	$43\,796.34\text{cm}^{-1}$		$3525.074\,362\,5\text{cm}^{-1} + E(J=58)$

[2] Rémy Jost et al. *The Journal of Chemical Physics* **105**.3 (July 1996).
[3] J. Danielak et al. *Journal of Molecular Spectroscopy* **181**.2 (1997), pp. 394–402.

Speed correction

	E_{total}	$E_{\text{bond}}(\mathrm{O{-}NO})^2$	$E_{\text{int.}}(\mathrm{NO})$
Peak 1 $464.484\mathrm{nm}$	$43\,058.49\mathrm{cm}^{-1}$		$3525.074\,362\,5\mathrm{cm}^{-1} + E(J=44)$
Peak 2 $464.114\mathrm{nm}$	$43\,092.81\mathrm{cm}^{-1}$		$3525.074\,362\,5\mathrm{cm}^{-1} + E(J=45)$
Peak 3 $460.875\mathrm{nm}$	$43\,395.69\mathrm{cm}^{-1}$	$25\,128.57\mathrm{cm}^{-1}$	$3525.074\,362\,5\mathrm{cm}^{-1} + E(J=48)$
Peak 4 $456.659\mathrm{nm}$	$43\,796.34\mathrm{cm}^{-1}$		$3525.074\,362\,5\mathrm{cm}^{-1} + E(J=58)$

Vib. energy level[3]

$$E\left(v\right) = \omega_e\left(v+\tfrac{1}{2}\right) - \omega_e x_e\left(v+\tfrac{1}{2}\right)^2 + \omega_e y_e\left(v+\tfrac{1}{2}\right)^3.$$

[2] Rémy Jost et al. *The Journal of Chemical Physics* **105**.3 (July 1996).

[3] J. Danielak et al. *Journal of Molecular Spectroscopy* **181**.2 (1997), pp. 394–402.

Speed correction

	E_{total}	$E_{\text{bond}}(\mathrm{O{-}NO})$[4]	$E_{\text{int.}}(\mathrm{NO})$
Peak 1 $464.484\mathrm{nm}$	$43\,058.49\mathrm{cm}^{-1}$		$6848.563\,763\mathrm{cm}^{-1}$
Peak 2 $464.114\mathrm{nm}$	$43\,092.81\mathrm{cm}^{-1}$		$6999.631\,462\mathrm{cm}^{-1}$
Peak 3 $460.875\mathrm{nm}$	$43\,395.69\mathrm{cm}^{-1}$	$25\,128.57\mathrm{cm}^{-1}$	$7472.976\,923\mathrm{cm}^{-1}$
Peak 4 $456.659\mathrm{nm}$	$43\,796.34\mathrm{cm}^{-1}$		$9269.004\,023\mathrm{cm}^{-1}$

[4] Rémy Jost et al. *The Journal of Chemical Physics* **105**.3 (July 1996).

[5] J. Danielak et al. *Journal of Molecular Spectroscopy* **181**.2 (1997), pp. 394–402.

Speed correction

	E_{total}	$E_{\text{bond}}(\mathrm{O{-}NO})$[4]	$E_{\text{int.}}(\mathrm{NO})$
Peak 1 $464.484\,\mathrm{nm}$	$43\,058.49\,\mathrm{cm}^{-1}$		$6848.563\,763\,\mathrm{cm}^{-1}$
Peak 2 $464.114\,\mathrm{nm}$	$43\,092.81\,\mathrm{cm}^{-1}$		$6999.631\,462\,\mathrm{cm}^{-1}$
Peak 3 $460.875\,\mathrm{nm}$	$43\,395.69\,\mathrm{cm}^{-1}$	$25\,128.57\,\mathrm{cm}^{-1}$	$7472.976\,923\,\mathrm{cm}^{-1}$
Peak 4 $456.659\,\mathrm{nm}$	$43\,796.34\,\mathrm{cm}^{-1}$		$9269.004\,023\,\mathrm{cm}^{-1}$

Rot. energy level[5]

$$E(J) = B_v\left(J^2 + J\right)$$

[4] Rémy Jost et al. *The Journal of Chemical Physics* **105**.3 (July 1996).
[5] J. Danielak et al. *Journal of Molecular Spectroscopy* **181**.2 (1997), pp. 394–402.

Speed correction

$E_{\text{int.}}(\text{O})$ [6]	$E_{\text{trans}}(total) \approx 2.88 E_{\text{trans}}(\text{NO})$ $= E_{\text{total}} - E_{\text{bond}}(\text{O–NO}) - E_{\text{int.}}(\text{O}) - E_{\text{int.}}(\text{O})$	$E_{\text{trans}}(\text{NO})$ $= \frac{1}{2} m(\text{NO}) v^2(\text{NO})$
$^3P_2$ (0cm^{-1})	$11081.356237\text{cm}^{-1}$	$1923.84656892361\text{cm}^{-1}$
	$10964.608538\text{cm}^{-1}$	$1903.57787118055\text{cm}^{-1}$
	$10794.143077\text{cm}^{-1}$	$1873.98317309028\text{cm}^{-1}$
	$9398.765977\text{cm}^{-1}$	$1631.73020434028\text{cm}^{-1}$
$^3P_1$ (158.625cm^{-1})	$10922.731237\text{cm}^{-1}$	$1896.30750642361\text{cm}^{-1}$
	$10805.983538\text{cm}^{-1}$	$1876.03880868055\text{cm}^{-1}$
	$10635.518077\text{cm}^{-1}$	$1846.44411059028\text{cm}^{-1}$
	$9240.140977\text{cm}^{-1}$	$1604.19114184028\text{cm}^{-1}$
$^3P_0$ (226.977cm^{-1})	$10854.379237\text{cm}^{-1}$	$1884.44083975695\text{cm}^{-1}$
	$10737.631538\text{cm}^{-1}$	$1864.17214201389\text{cm}^{-1}$
	$10567.166077\text{cm}^{-1}$	$1834.57744392361\text{cm}^{-1}$
	$9171.788977\text{cm}^{-1}$	$1592.32447517361\text{cm}^{-1}$

[6] Charlotte Emma Moore and Jean W. Gallagher. “Tables of spectra of hydrogen, carbon, nitrogen, and oxygen atoms and ions”. 1993.

Speed correction

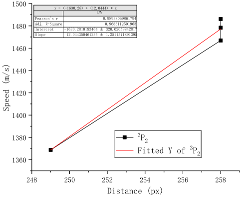
y Trans. energy of NO

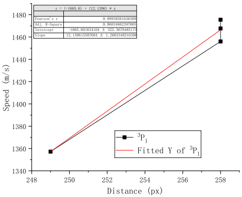
$E_{\text{int.}}(\text{O})$ [7]	$v(\text{NO}) = \sqrt{\frac{2E_{\text{trans}}(\text{NO})}{m(\text{NO})}}$	Δy
$^3P_2$ $(0\,\text{cm}^{-1})$	$1486.240384\,\text{m}\,\text{s}^{-1}$	258 px
	$1478.3905065\,\text{m}\,\text{s}^{-1}$	258 px
	$1466.8533085\,\text{m}\,\text{s}^{-1}$	258 px
	$1368.7622455\,\text{m}\,\text{s}^{-1}$	249 px
$^3P_1$ $(158.625\,\text{cm}^{-1})$	$1475.5645855\,\text{m}\,\text{s}^{-1}$	258 px
	$1467.6576085\,\text{m}\,\text{s}^{-1}$	258 px
	$1456.0353685\,\text{m}\,\text{s}^{-1}$	258 px
	$1357.162647\,\text{m}\,\text{s}^{-1}$	249 px
$^3P_0$ $(226.977\,\text{cm}^{-1})$	$1470.940464\,\text{m}\,\text{s}^{-1}$	258 px
	$1463.0084955\,\text{m}\,\text{s}^{-1}$	258 px
	$1451.3490265\,\text{m}\,\text{s}^{-1}$	258 px
	$1352.133667\,\text{m}\,\text{s}^{-1}$	249 px

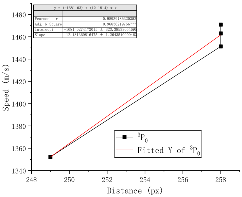
[7] Charlotte Emma Moore and Jean W. Gallagher. “Tables of spectra of hydrogen, carbon, nitrogen, and oxygen atoms and ions”. 1993.

Speed correction

y Trans. energy of NO



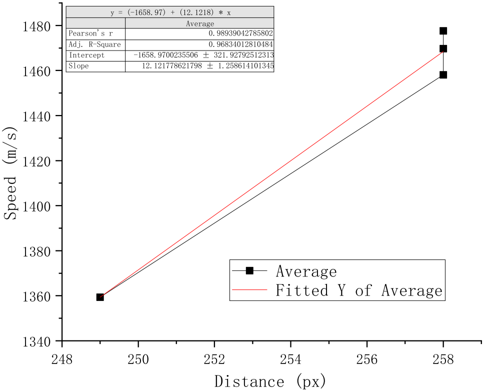




$$\frac{dv}{d\,\mathsf{px}} = 12.04\mathrm{m\,s^{-1}}/\mathsf{px} \,@\, {}^3P_2 \quad \frac{dv}{d\,\mathsf{px}} = 12.14\mathrm{m\,s^{-1}}/\mathsf{px} \,@\, {}^3P_1 \quad \frac{dv}{d\,\mathsf{px}} = 12.18\mathrm{m\,s^{-1}}/\mathsf{px} \,@\, {}^3P_0$$

Speed correction

y Trans. energy of NO



$$\frac{dv}{d\,\mathsf{px}} = 12.12\,\mathrm{m\,s^{-1}}/\mathsf{px}\ @\ \mathsf{Average}$$

Reference

[1] J. Danielak et al. *Journal of Molecular Spectroscopy* **181**.2 (1997), pp. 394–402.

[2] Rémy Jost et al. *The Journal of Chemical Physics* **105**.3 (July 1996).

[3] Charlotte Emma Moore and Jean W. Gallagher. “Tables of spectra of hydrogen, carbon, nitrogen, and oxygen atoms and ions”. 1993.

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