練習実験報告

肖宇笑

May 18, 2024

Contents

Contents

Galvano Sepctrum

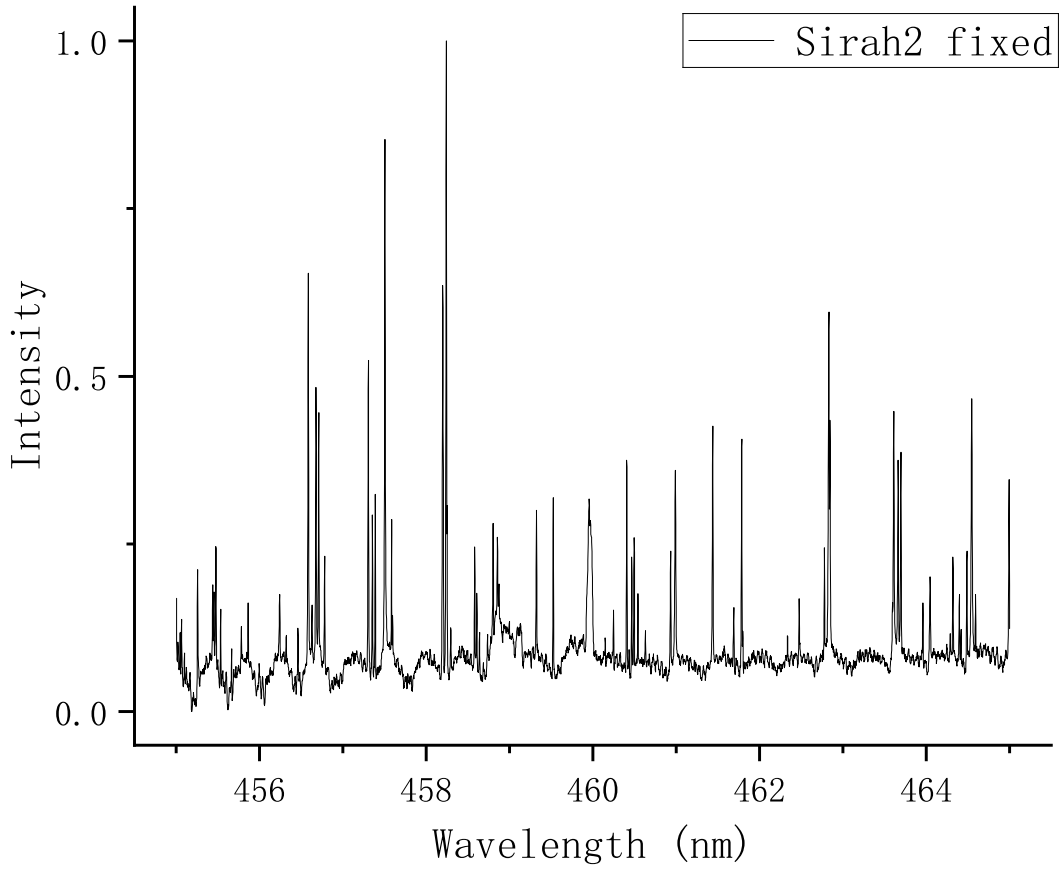

Fig. 1: Wavelen. correction

Galvano Sepctrum

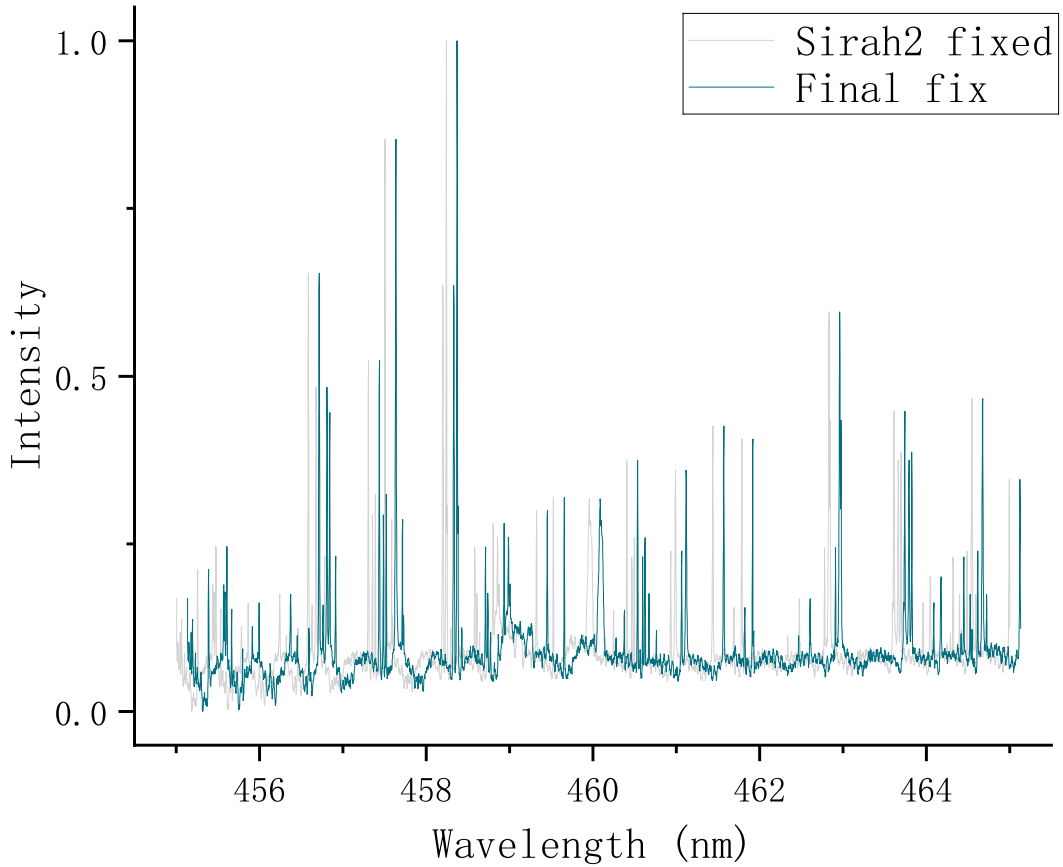

Fig. 1: Wavelen. correction

Galvano Sepctrum

Correction

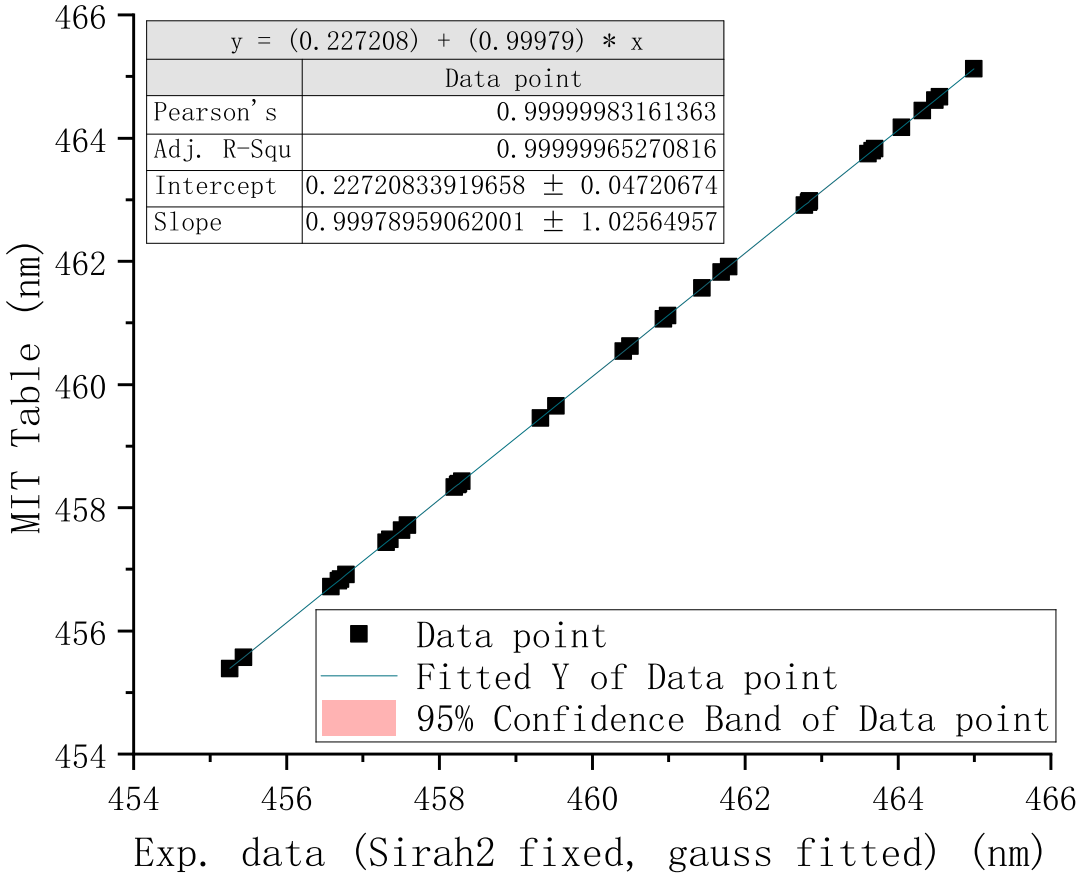

Fig. 2: Correction function

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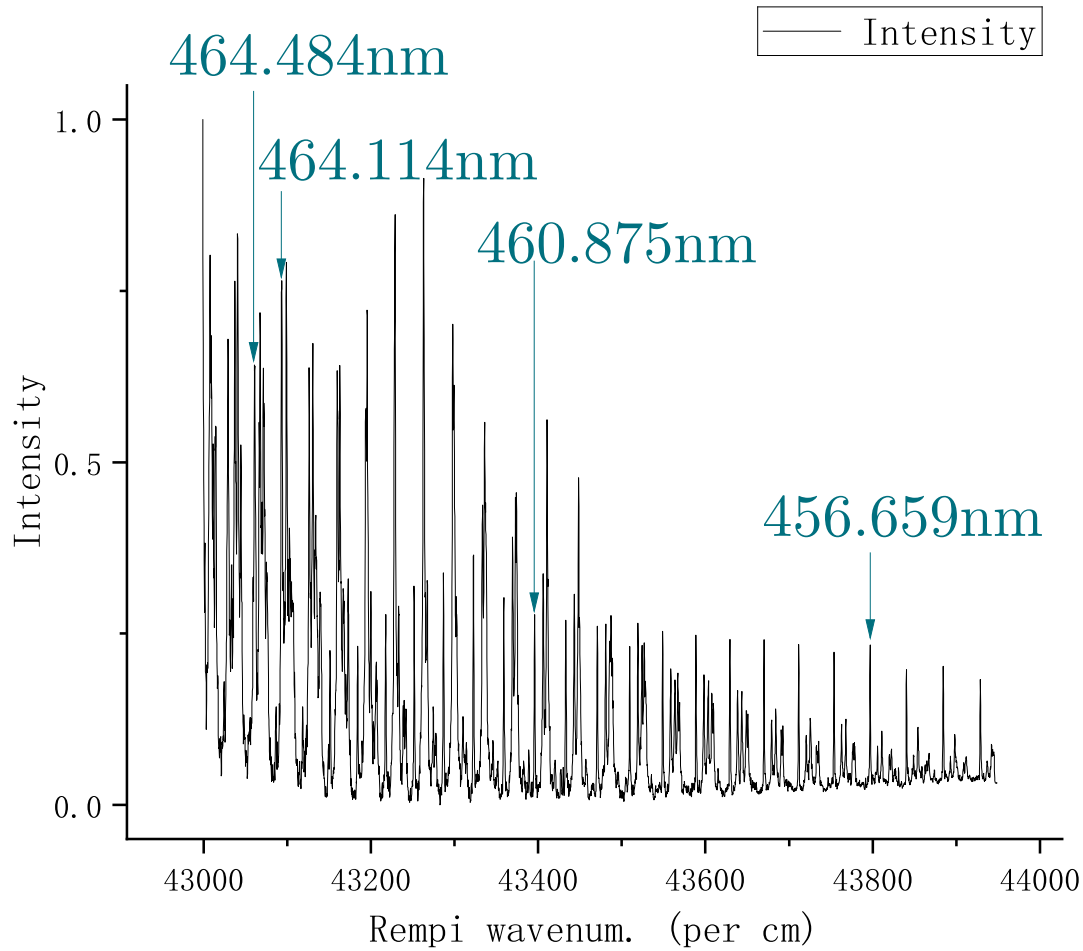
Selected peaks



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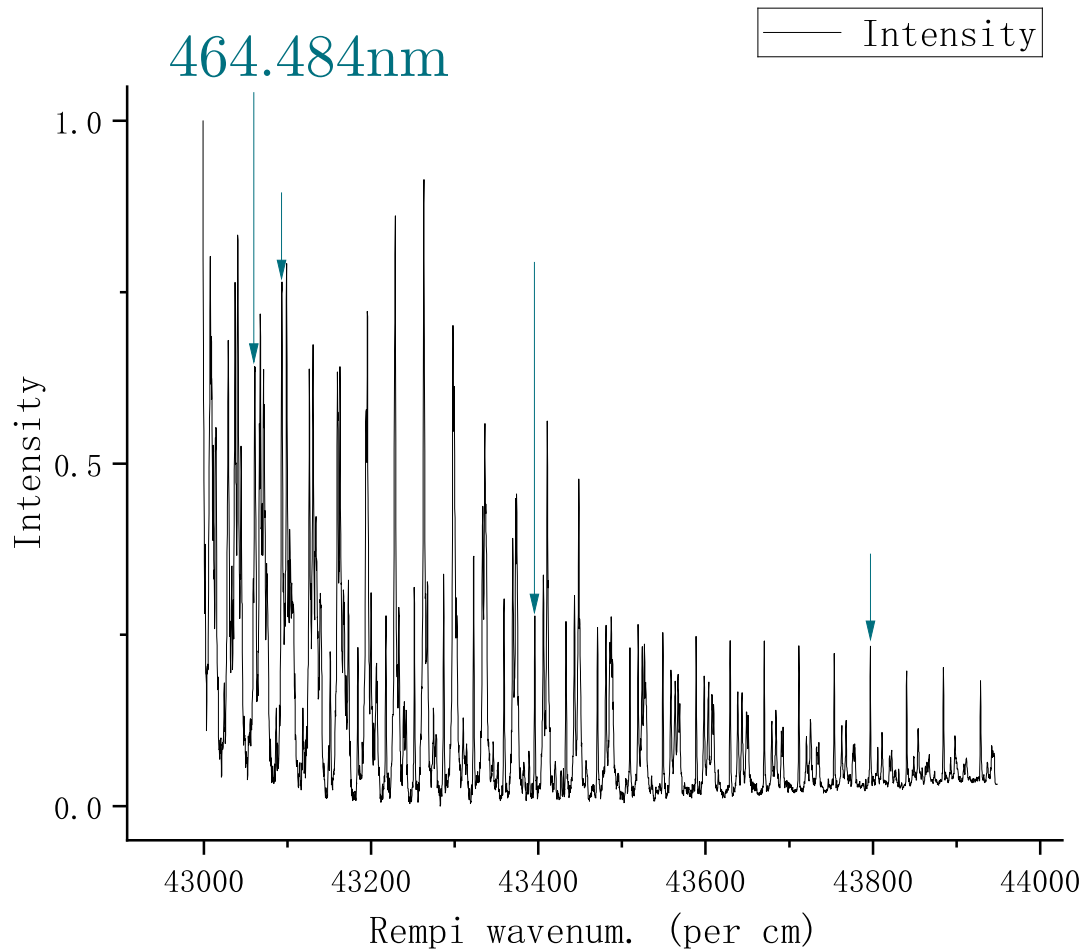
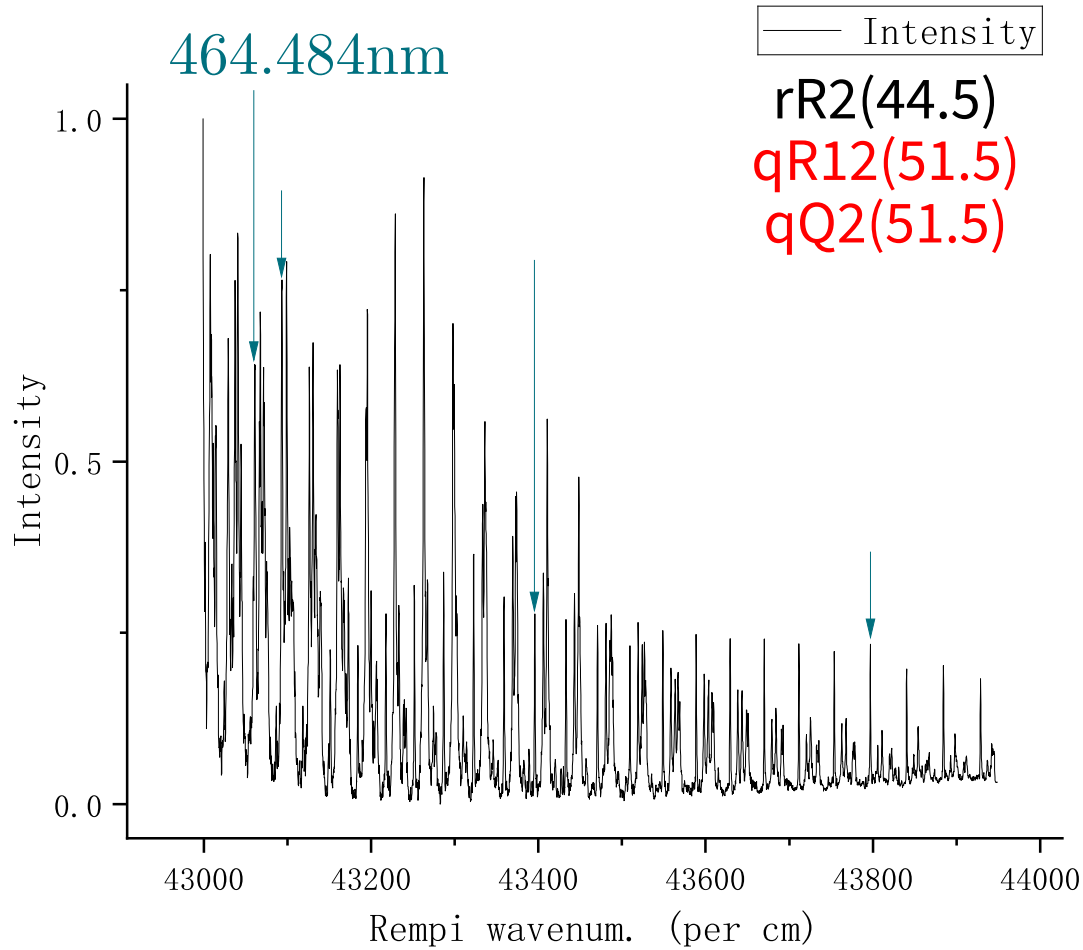
Contents

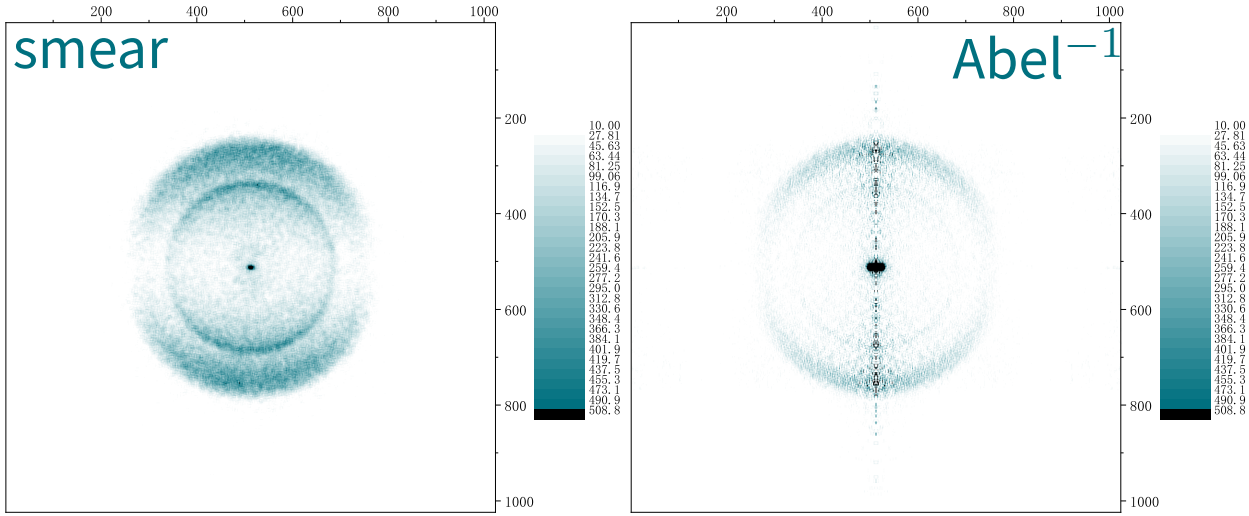
Peak 1

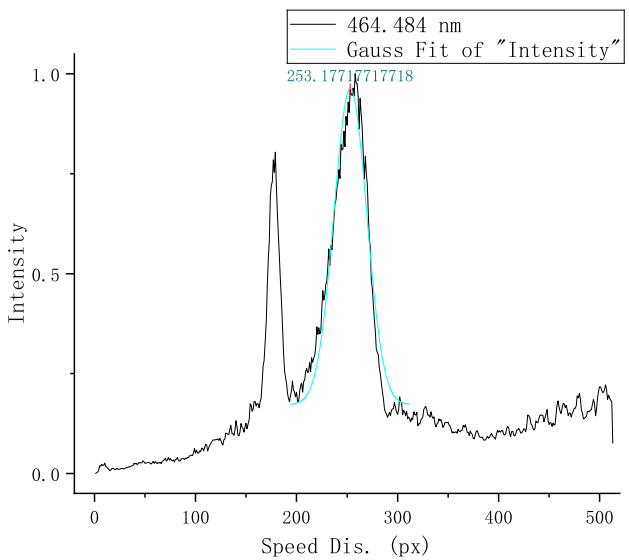

464.484nm
Intensity
1.0
0.5
0.0
Intensity
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

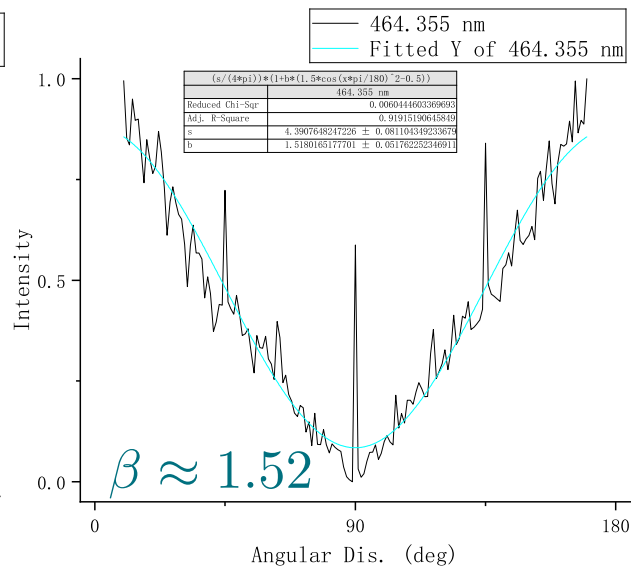
Peak 1


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)

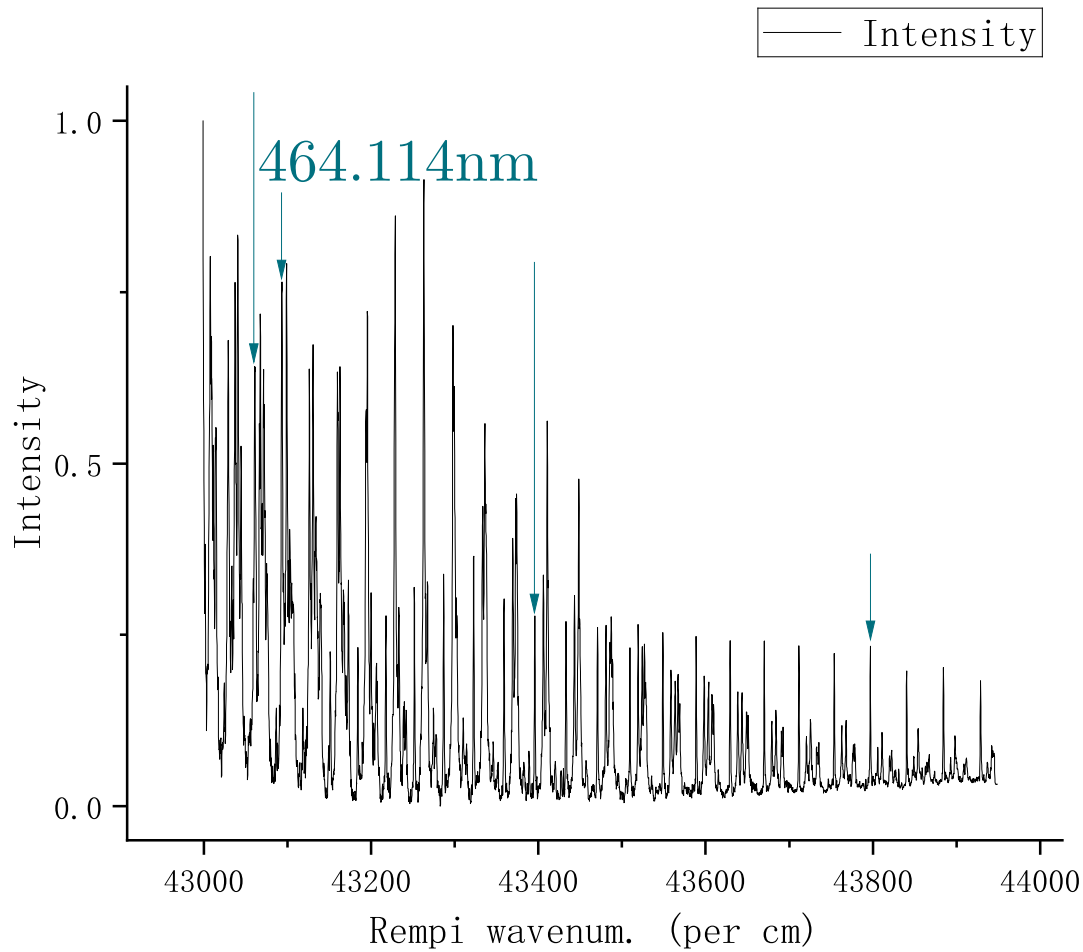
Peak 1


smear
Abel^{-1}

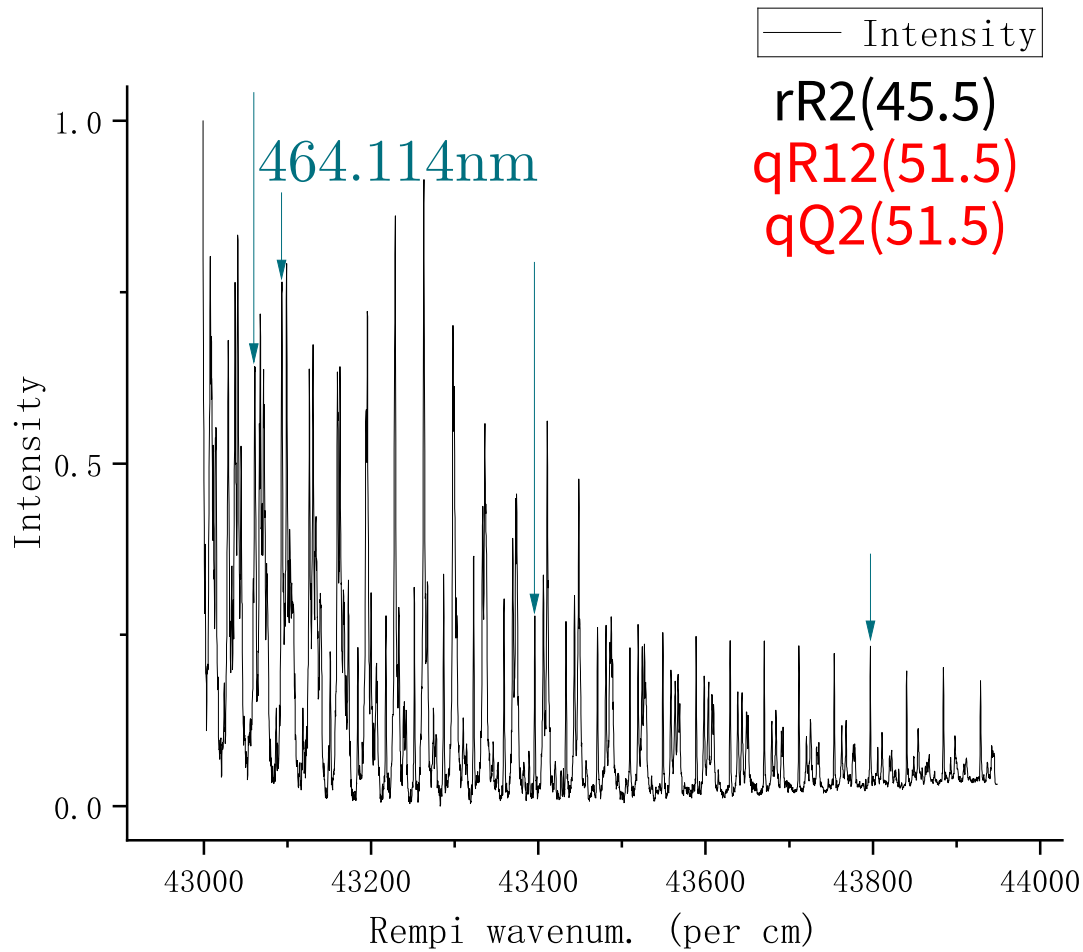

464.484 nm
Gauss Fit of "Intensity"
253.17717717718
Intensity
Speed Dis. (px)


464.355 nm
Fitted Y of 464.355 nm
Reduced Chi-Sqr 0.0060444603369693
Adj. R-Square 0.91915190645849
a 4.3907648247226 ± 0.081104349233679
b 1.5180165177701 ± 0.051762252346911
$\beta \approx 1.52$
Intensity
Angular Dis. (deg)

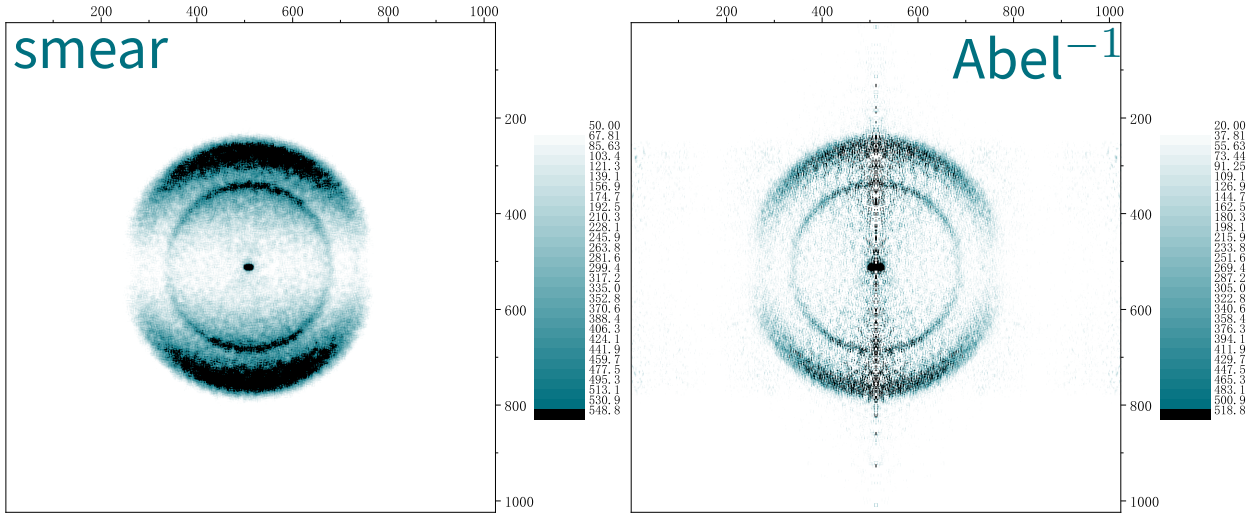
Peak 2

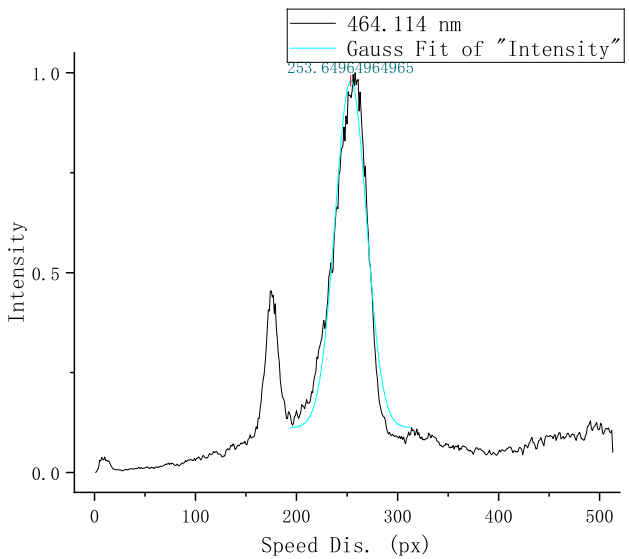

Intensity
464.114nm
1.0
0.5
0.0
Intensity
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

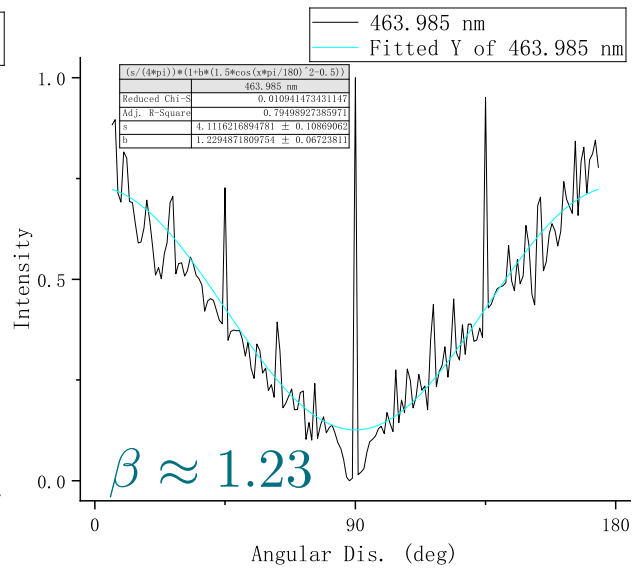
Peak 2


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

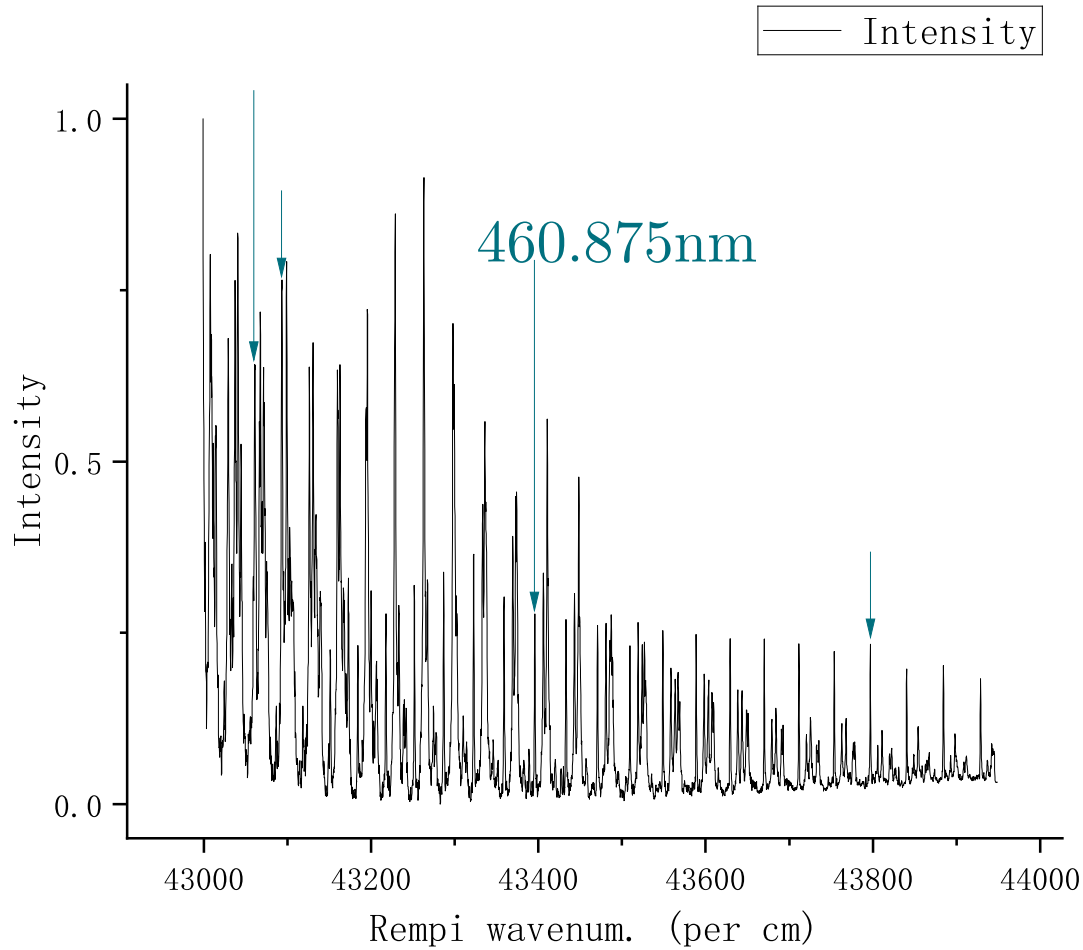
Peak 2


smear
Abel^{-1}

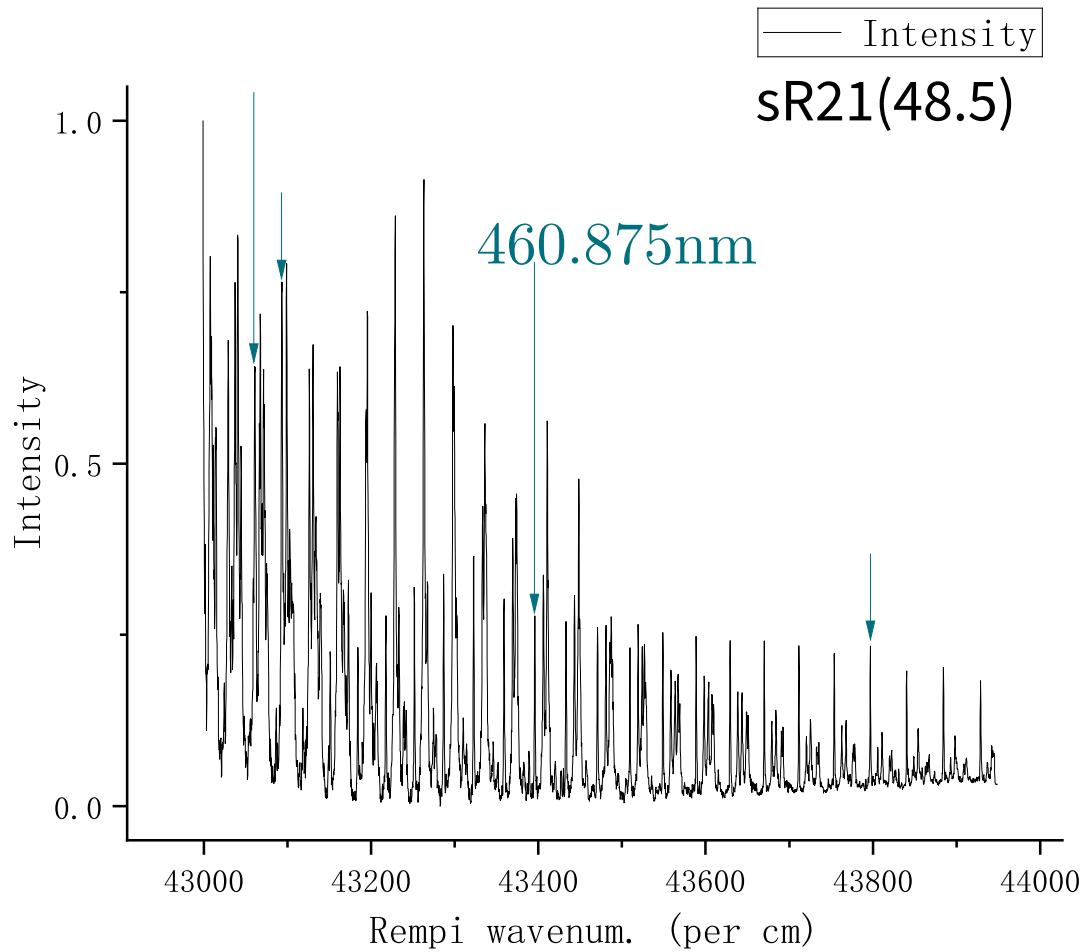

464.114 nm
Gauss Fit of "Intensity"
253.64964964965
Intensity
Speed Dis. (px)


463.985 nm
Fitted Y of 463.985 nm
Reduced Chi-S 0.01094147343147
Adj. R-Square 0.79498927385971
a 4.1116216894781 ± 0.10869062
b 1.2294871809754 ± 0.06723811
$\beta \approx 1.23$
Intensity
Angular Dis. (deg)

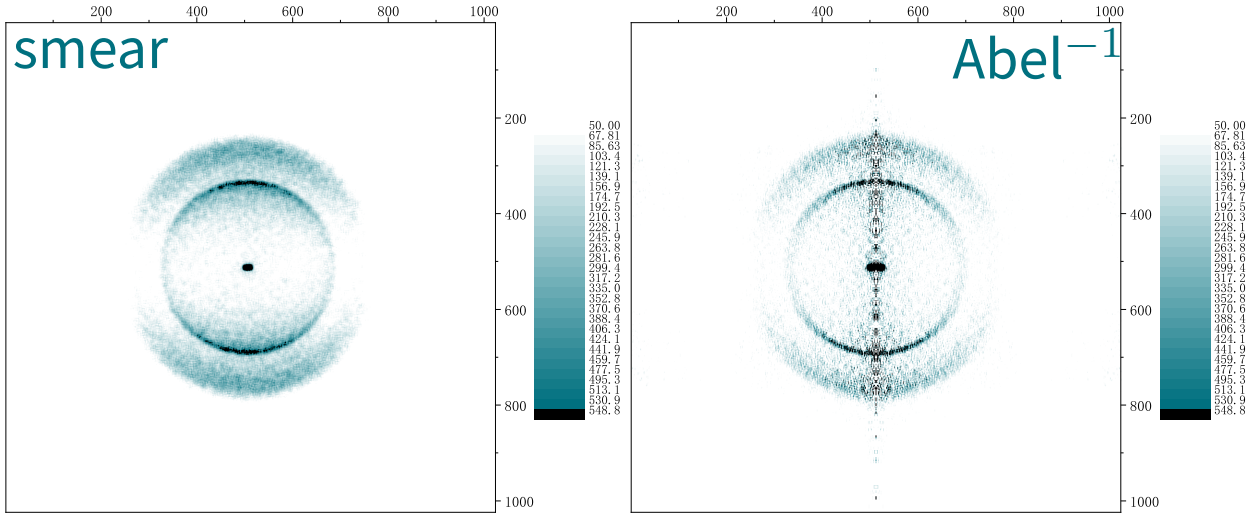
Peak 3

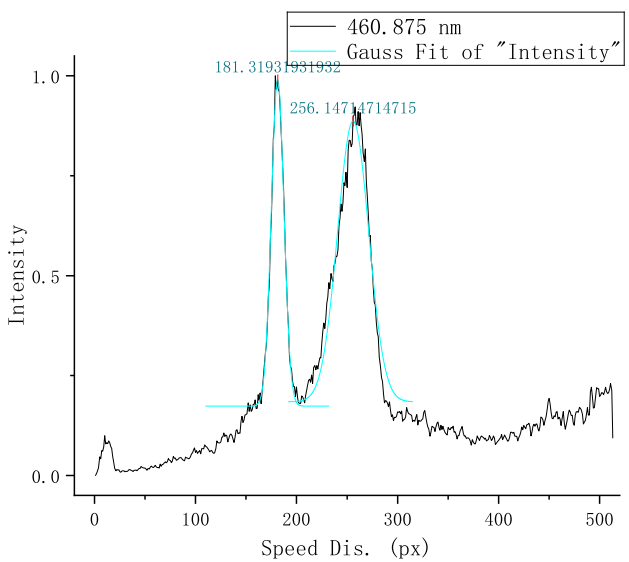

Intensity
460.875nm
1.0
0.5
0.0
Intensity
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

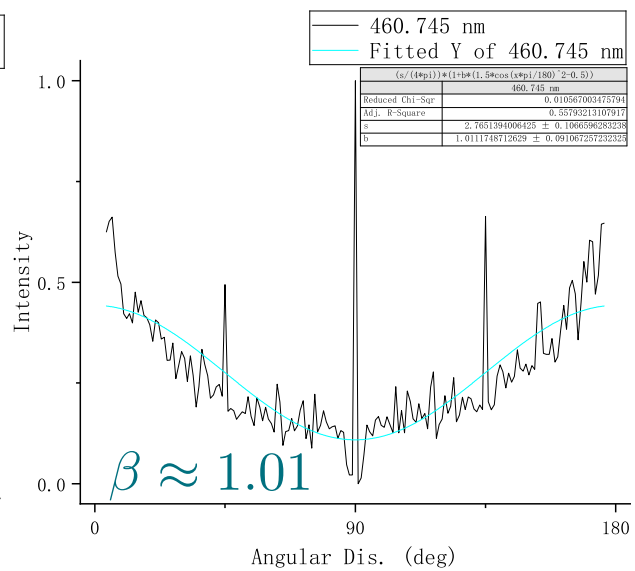
Peak 3


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

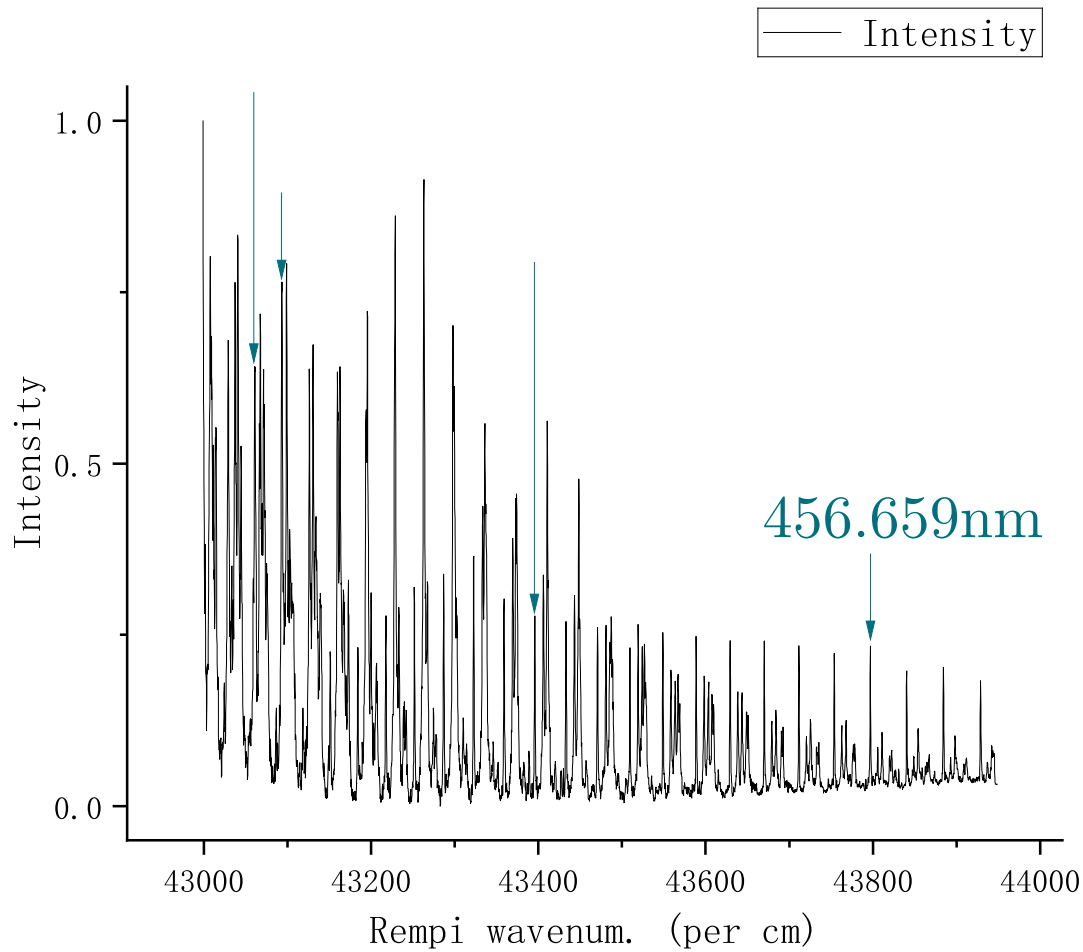
Peak 3


smear
Abel^{-1}

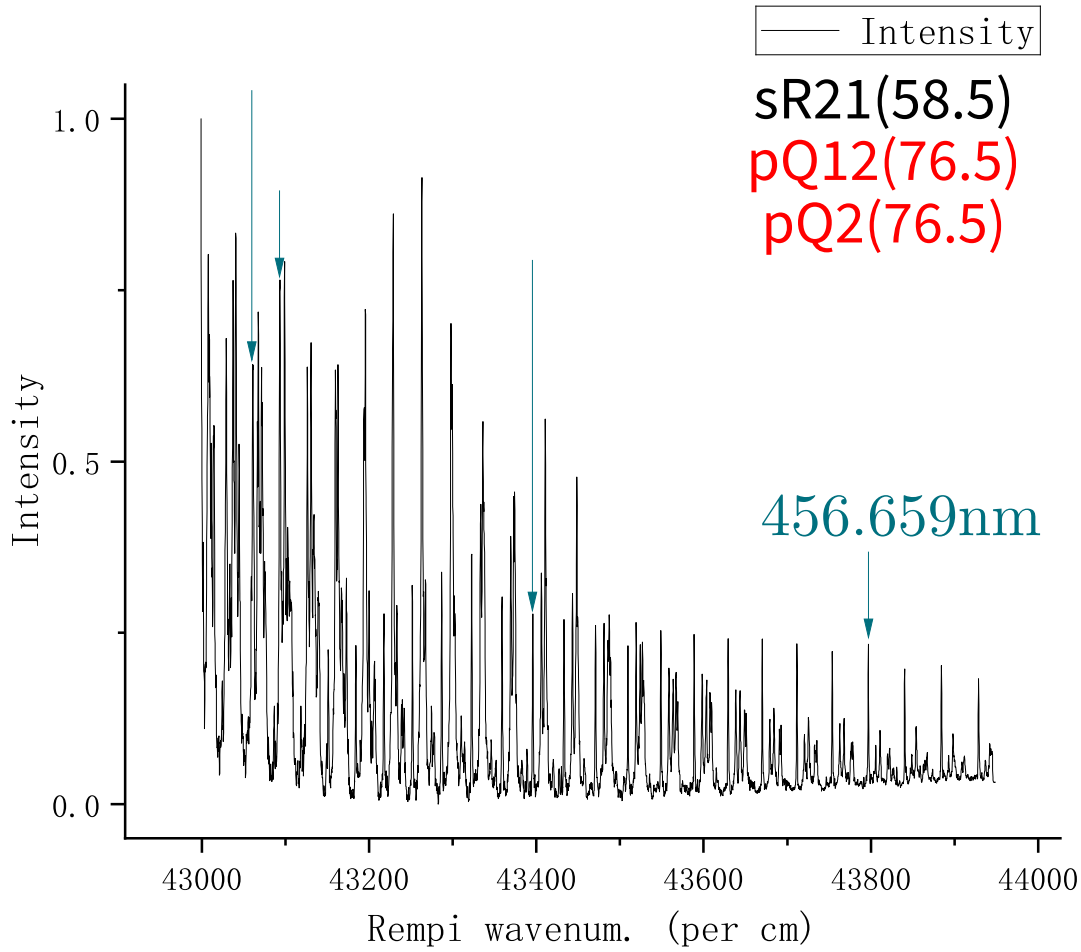

460.875 nm
Gauss Fit of "Intensity"
181.31931931932
256.14714714715
Intensity
Speed Dis. (px)


460.745 nm
Fitted Y of 460.745 nm
Reduced Chi-Sqr 0.01056700347579
Adj. R-Square 0.55793213107917
s 2.7651394006425 ± 0.1066598283238
b 1.0111748712629 ± 0.091067257232325
$\beta \approx 1.01$
Intensity
Angular Dis. (deg)

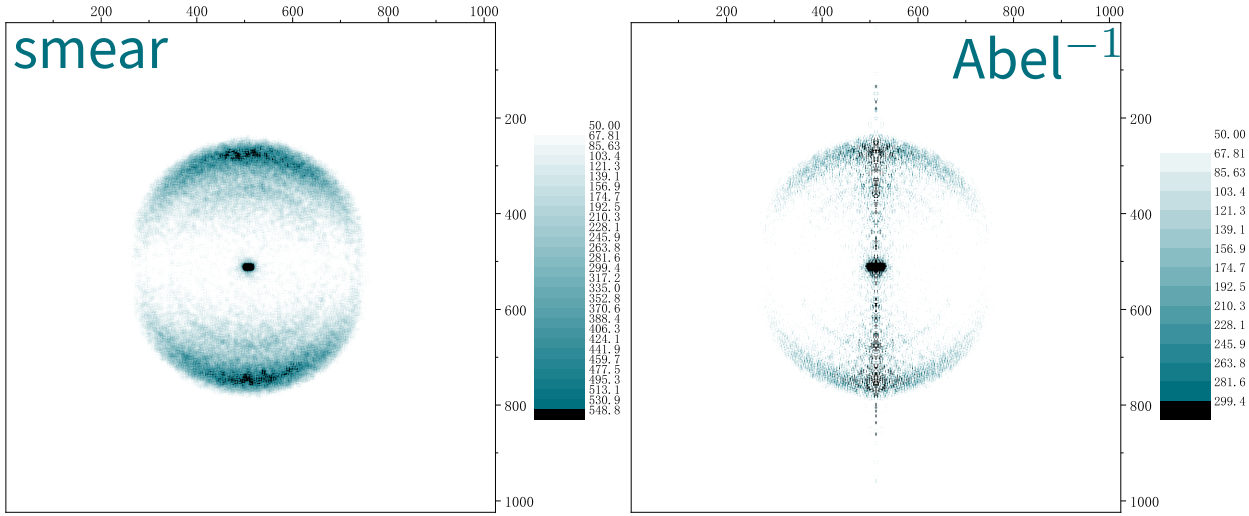
Peak 4

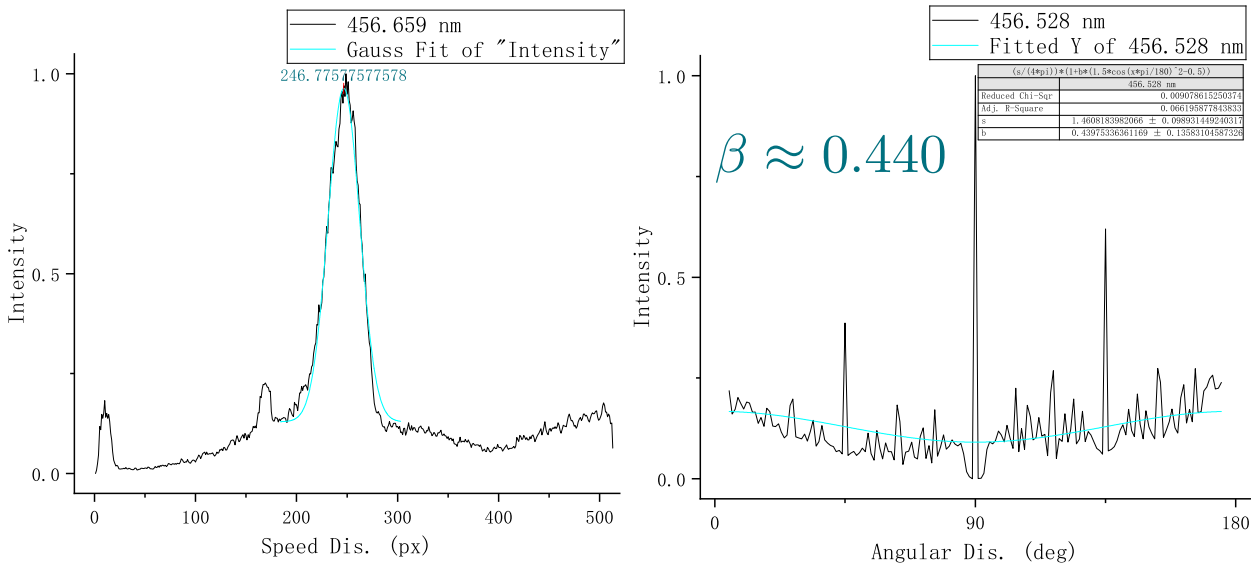

Intensity
1.0
0.5
0.0
Intensity
456.659nm
43000
43200
43400
43600
43800
44000
Rempi wavenum. (per cm)

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
Abel^{-1}


456.659 nm
Gauss Fit of "Intensity"
246.77577577578
Intensity
Speed Dis. (px)
456.528 nm
Fitted Y of 456.528 nm
$\beta \approx 0.440$
Intensity
Angular Dis. (deg)

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.

Contents

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Speed correction

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

[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}	$E_{\text{bond}}(\text{O}-\text{NO})$[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	$43\,796.34\text{cm}^{-1}$		$3525.074\,362\,5\text{cm}^{-1} + E(J=58)$

Vib. energy level[3]

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

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

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

Rot. energy level[5]

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

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

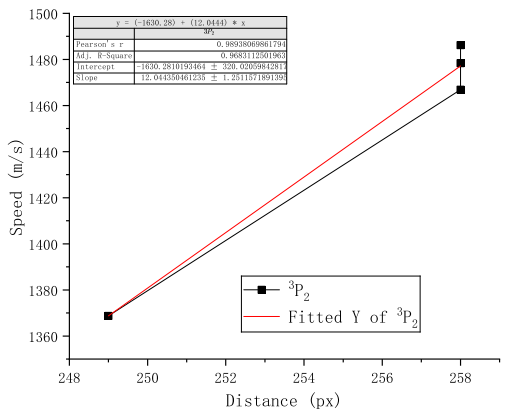
y Trans. energy of NO

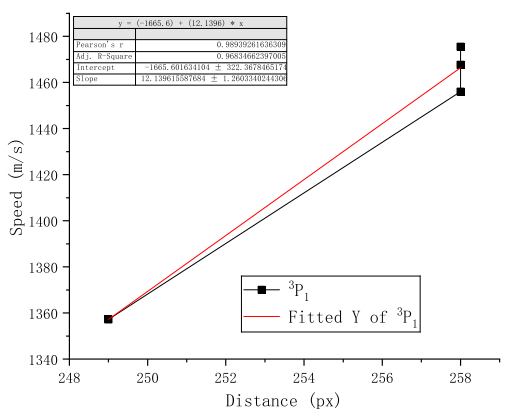
$E_{\text{int.}}(\text{O})$[7]	$v(\text{NO}) = \sqrt{\frac{2E_{\text{trans}}(\text{NO})}{m(\text{NO})}}$	Δy
$^3P_2$	$1486.240384\,\text{m s}^{-1}$	258 px
	$1478.3905065\,\text{m s}^{-1}$	258 px
($0\,\text{cm}^{-1}$)	$1466.8533085\,\text{m s}^{-1}$	258 px
	$1368.7622455\,\text{m s}^{-1}$	249 px
$^3P_1$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

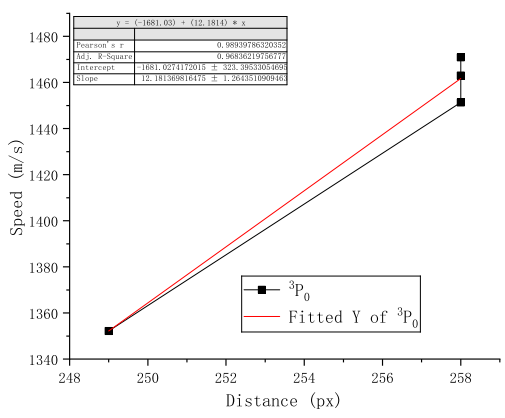
[7] Charlotte Emma Moore and Jean W. Gallagher. “Tables of spectra of hydrogen, carbon, nitrogen, and oxygen atoms and ions”. 1993.

Speed correction

y Trans. energy of NO



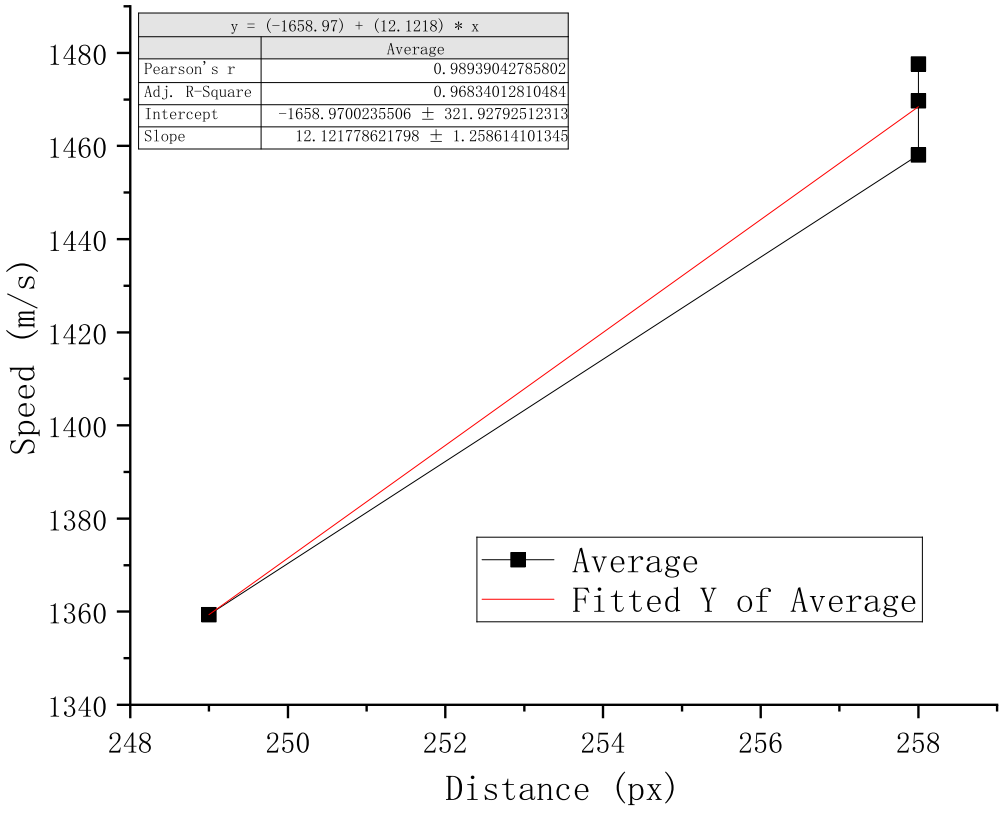




$\frac{dv}{d\,\mathrm{px}} = 12.04\mathrm{m\,s^{-1}/px} @ {}^3P_2$ $\frac{dv}{d\,\mathrm{px}} = 12.14\mathrm{m\,s^{-1}/px} @ {}^3P_1$ $\frac{dv}{d\,\mathrm{px}} = 12.18\mathrm{m\,s^{-1}/px} @ {}^3P_0$

Speed correction

y Trans. energy of NO



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

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.

[4] Colin M. Western. *Journal of Quantitative Spectroscopy and Radiative Transfer* **186** (2017), pp. 221–242.

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