

# 練習実験報告

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Galvano Sepctrum

REMPI scan

- Selected peaks

- Radius and angular distributions

- Peak assignments

- Speed correction

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## Galvano Sepctrum

### REMPI scan

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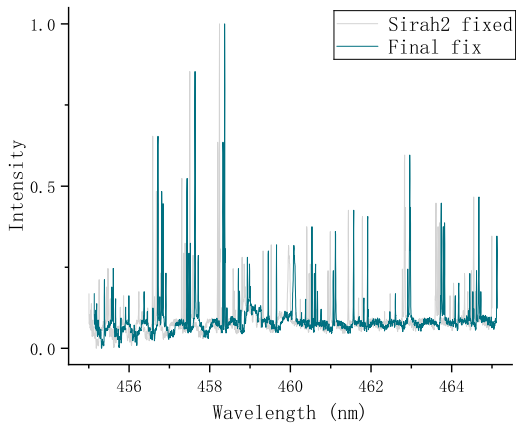
- Speed correction

# Galvano Sepctrum



**Fig. 1:** Wavelen. correction

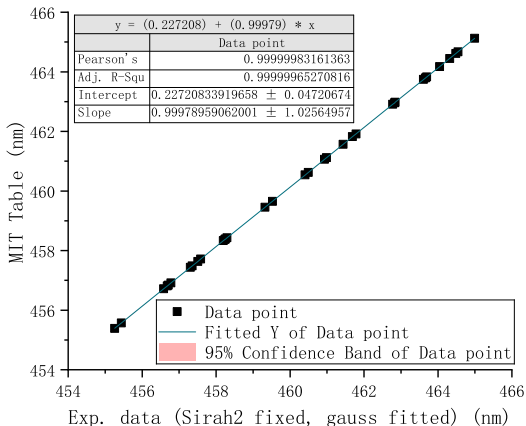
# Galvano Sepctrum



**Fig. 1:** Wavelen. correction

# Galvano Sepctrum

## Correction



**Fig. 2:** Correction function

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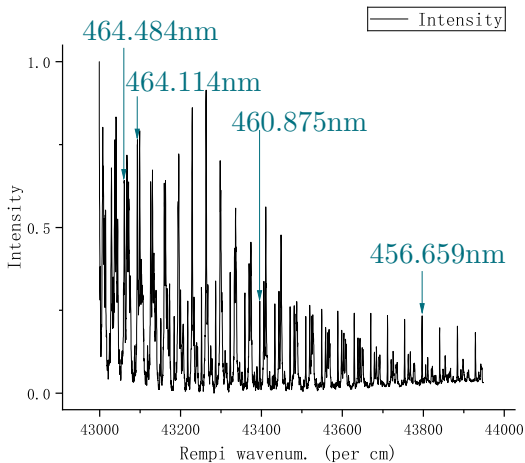
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# Selected peaks



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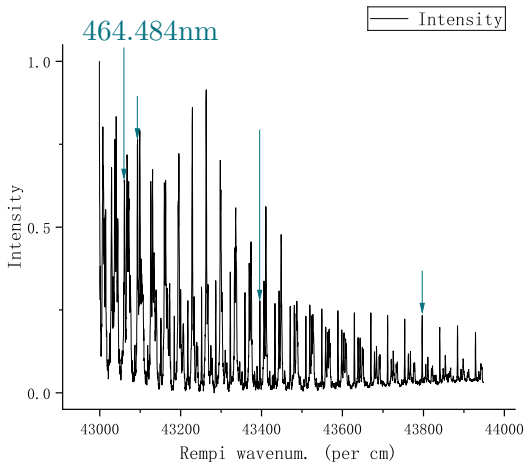
Selected peaks

Radius and angular distributions

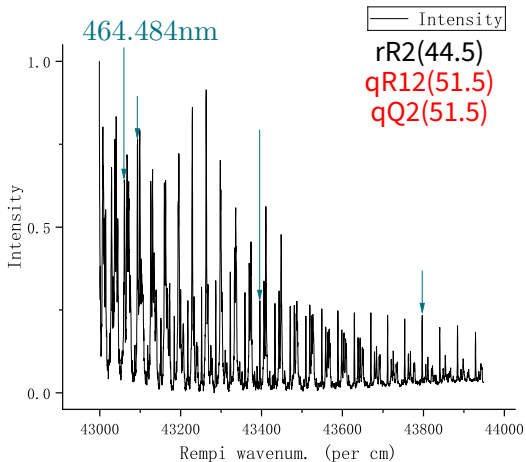
Peak assignments

Speed correction

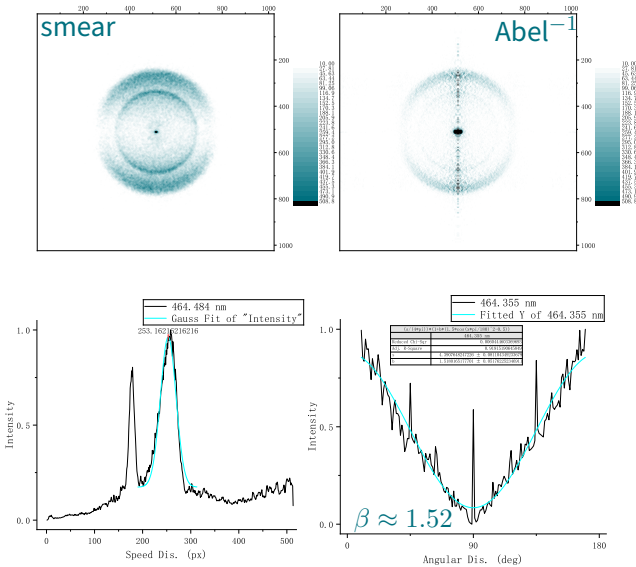
# Peak 1



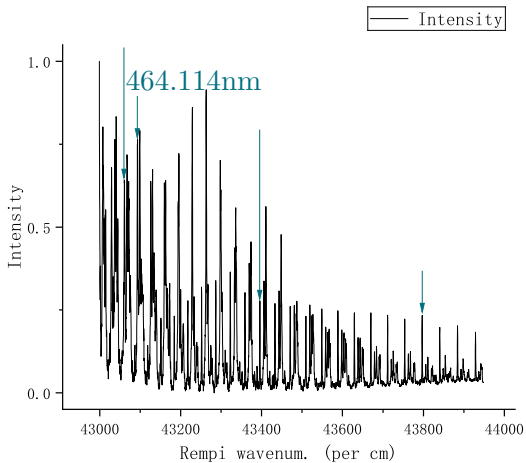
# Peak 1



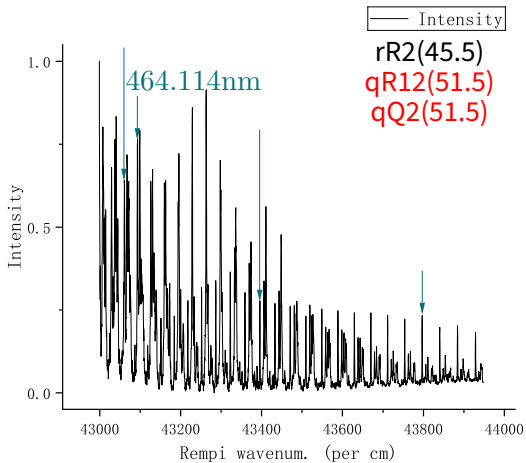
## Peak 1



## Peak 2

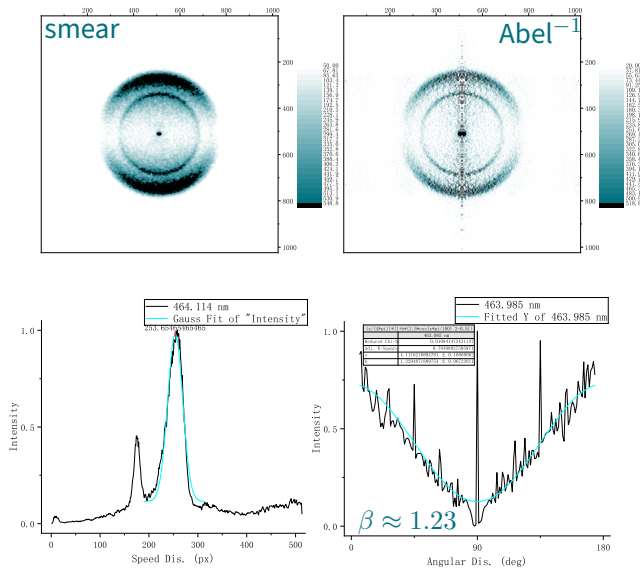


## Peak 2

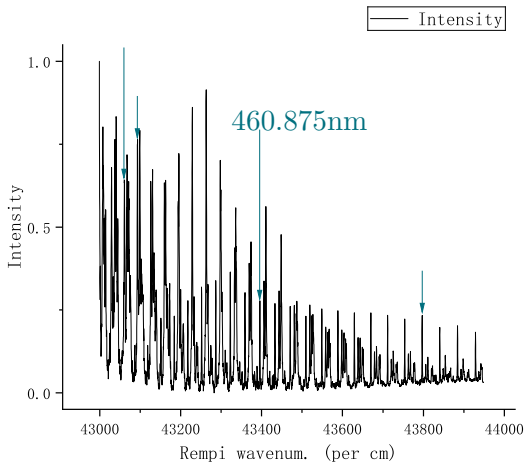




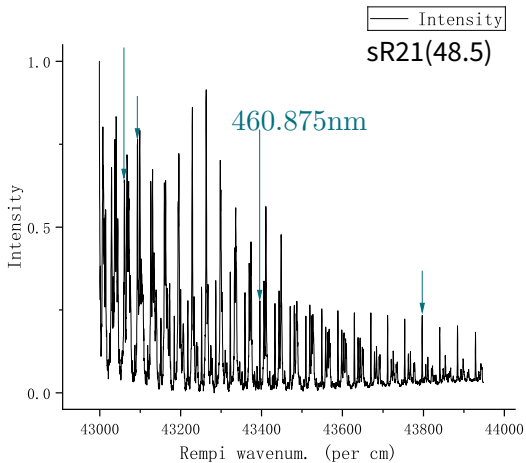
# Peak 2



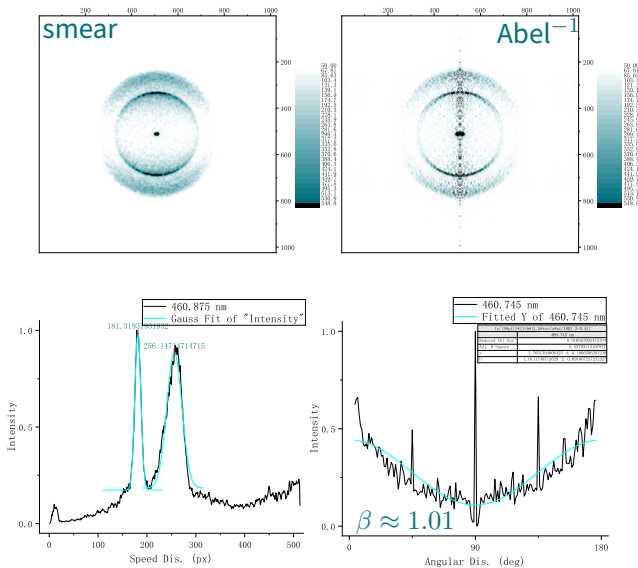
## Peak 3



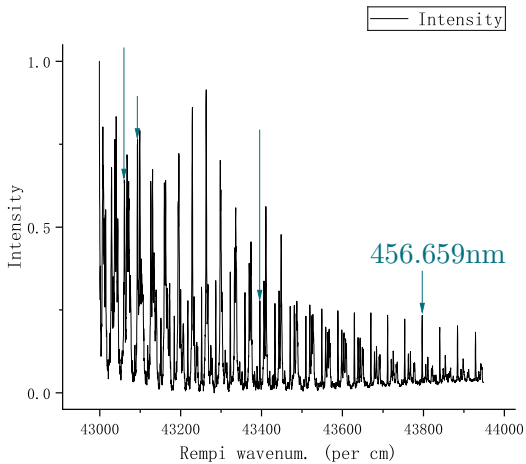
## Peak 3



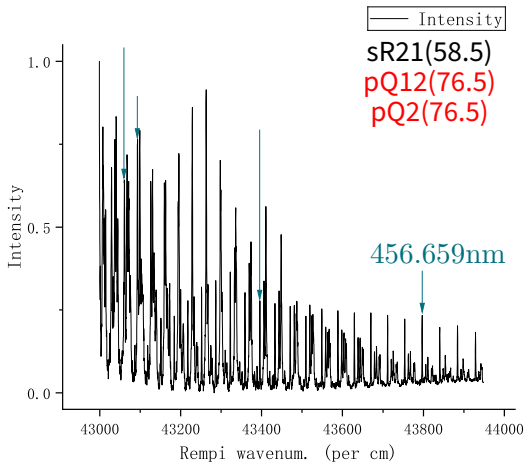
# Peak 3



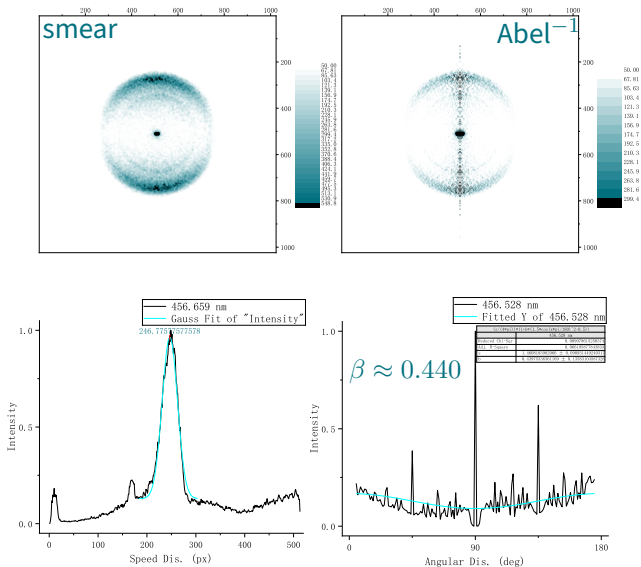
## Peak 4



## Peak 4



# Peak 4



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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
<i>rR2</i> 44.5 <i>qR12</i> 51.5 <i>qQ2</i> 51.5	<i>rR2</i> 45.5 <i>qR12</i> 51.5 <i>qQ2</i> 51.5	<i>sR21</i> 48.5	<i>sR21</i> 58.5 <i>pQ12</i> 76.5 <i>pP2</i> 76.5

## Notice

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

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# Speed correction

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

<sup>1</sup>Rémy Jost et al. *The Journal of Chemical Physics* **105.3** (July 1996).

# Speed correction

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

<sup>2</sup>Rémy Jost et al. *The Journal of Chemical Physics* **105.3** (July 1996).

<sup>3</sup>J. Danielak et al. *Journal of Molecular Spectroscopy* **181.2** (1997), pp. 394–402.

# Speed correction

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

## Vib. energy level<sup>3</sup>

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

<sup>2</sup>Rémy Jost et al. *The Journal of Chemical Physics* **105.3** (July 1996).

<sup>3</sup>J. Danielak et al. *Journal of Molecular Spectroscopy* **181.2** (1997), pp. 394–402.

# Speed correction

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

<sup>4</sup>Rémy Jost et al. *The Journal of Chemical Physics* **105**.3 (July 1996).

<sup>5</sup>J. Danielak et al. *Journal of Molecular Spectroscopy* **181**.2 (1997), pp. 394–402.



# Speed correction

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

## Rot. energy level<sup>5</sup>

$$E(J) = B_v (J^2 + J)$$

<sup>4</sup>Rémy Jost et al. *The Journal of Chemical Physics* **105.3** (July 1996).

<sup>5</sup>J. Danielak et al. *Journal of Molecular Spectroscopy* **181.2** (1997), pp. 394–402.

# Speed correction

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

<sup>6</sup>Charlotte Emma Moore and Jean W. Gallagher. "Tables of spectra of hydrogen, carbon, nitrogen, and oxygen atoms and ions". 1993.

# Speed correction

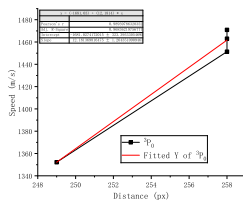
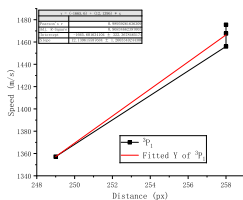
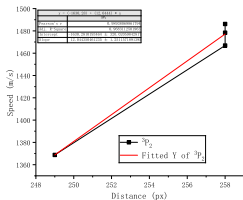
## y Trans. energy of NO

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

<sup>7</sup>Charlotte Emma Moore and Jean W. Gallagher. “Tables of spectra of hydrogen, carbon, nitrogen, and oxygen atoms and ions”. 1993.

# Speed correction

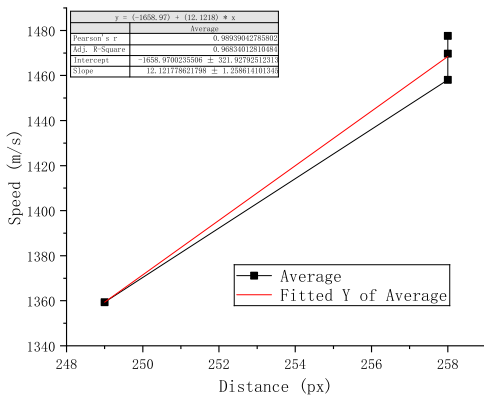
y Trans. energy of NO



$$\frac{dv}{dpx} = 12.04 \text{ m s}^{-1} / \text{px} @ {}^3P_2 \quad \frac{dv}{dpx} = 12.14 \text{ m s}^{-1} / \text{px} @ {}^3P_1 \quad \frac{dv}{dpx} = 12.18 \text{ m s}^{-1} / \text{px} @ {}^3P_0$$

# Speed correction

y Trans. energy of NO



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

# 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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