

# 練習実験報告

肖宇笑

May 24, 2024

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## Galvano Sepctrum

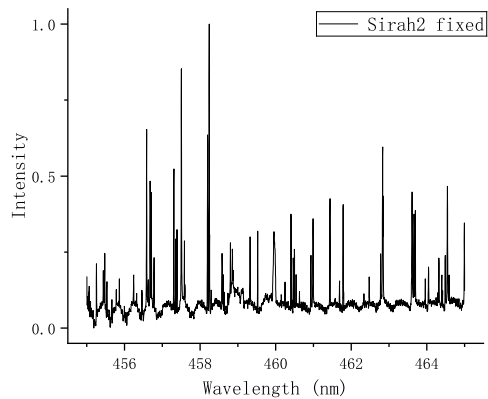


Fig. 1: Wavelen. correction

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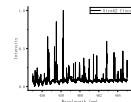


Fig. 1: Wavelen. correction

## Galvano Sepctrum

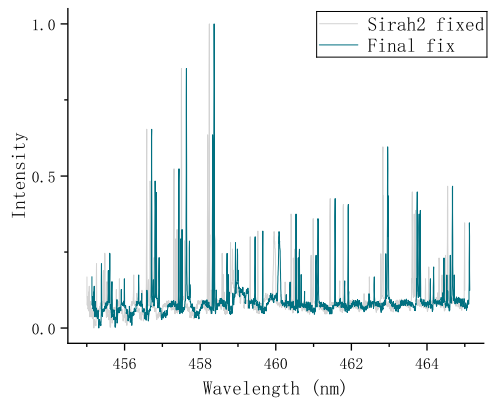


Fig. 1: Wavelen. correction

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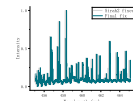


Fig. 1: Wavelen. correction

## Galvano Sepctrum

Correction

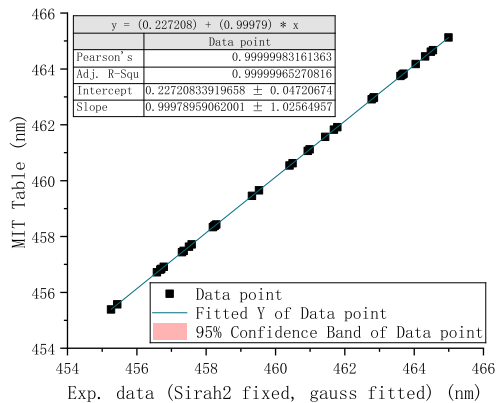


Fig. 2: Correction function

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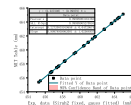


Fig. 2: Correction function

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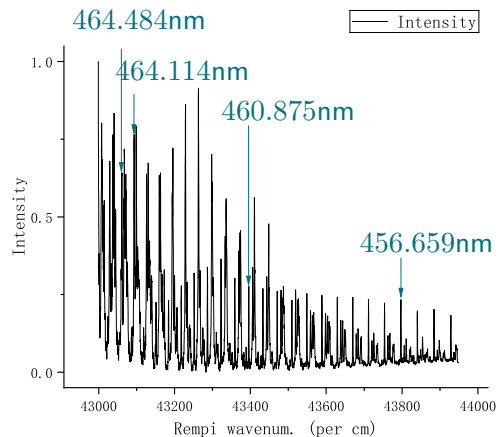
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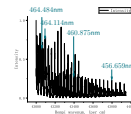
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## Selected peaks



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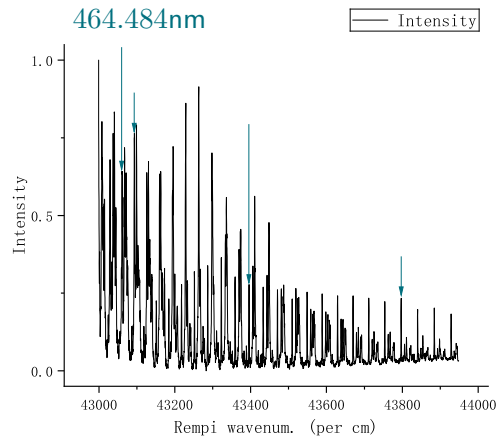
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## Peak 1



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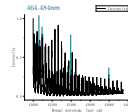
## 練習実験報告

└ REMPI scan

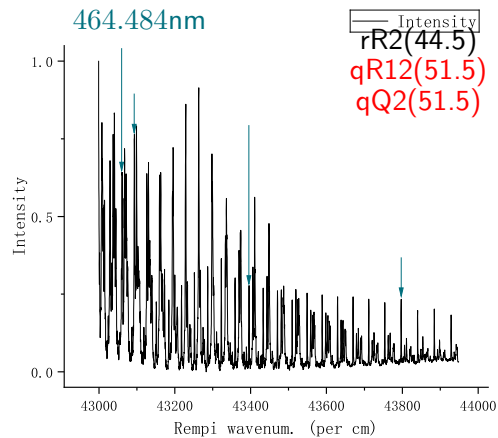
└ Radius and angular distributions

└ Peak 1

Peak 1



## Peak 1



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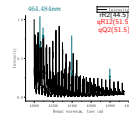
## 練習実験報告

└ REMPI scan

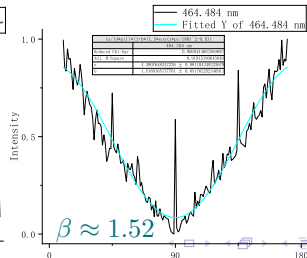
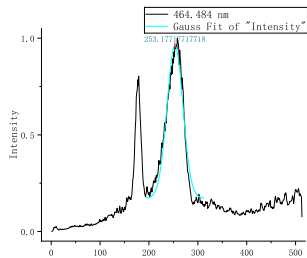
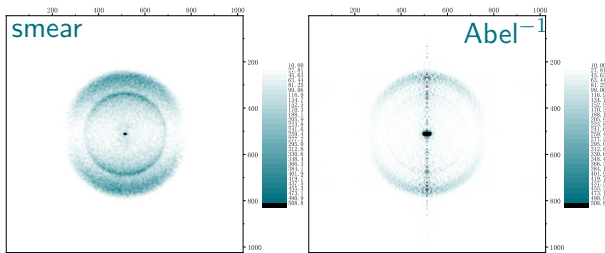
└ Radius and angular distributions

└ Peak 1

Peak 1



## Peak 1



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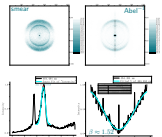
## 練習実験報告

└ REMPI scan

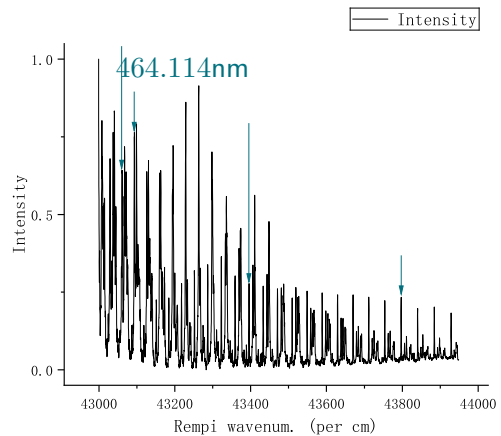
└ Radius and angular distributions

└ Peak 1

Peak 1



## Peak 2



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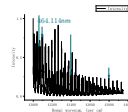
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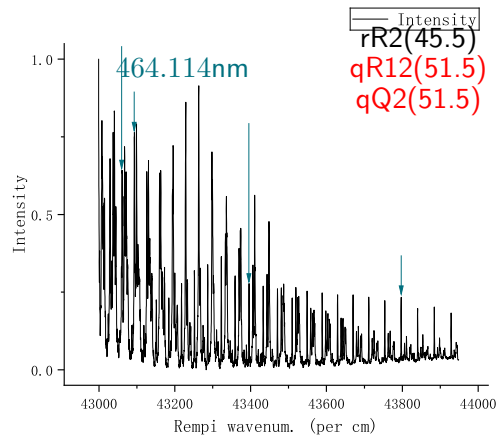
└ Peak 2

Peak 2





## Peak 2



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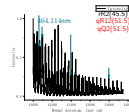
## 練習実験報告

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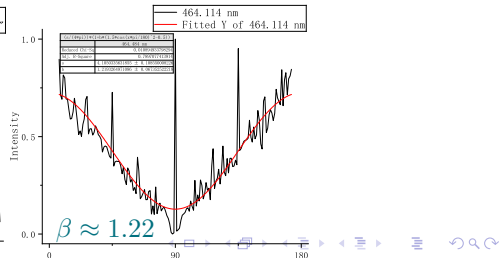
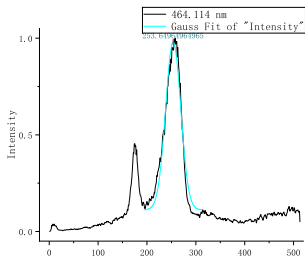
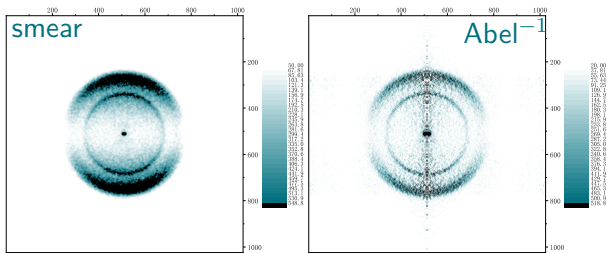
└ Radius and angular distributions

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Peak 2



## Peak 2



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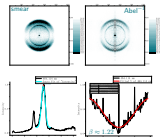
## 練習実験報告

└ REMPI scan

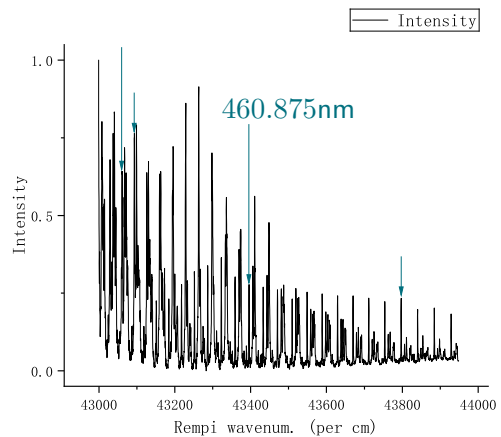
└ Radius and angular distributions

└ Peak 2

Peak 2



## Peak 3



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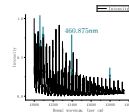
## 練習実験報告

└ REMPI scan

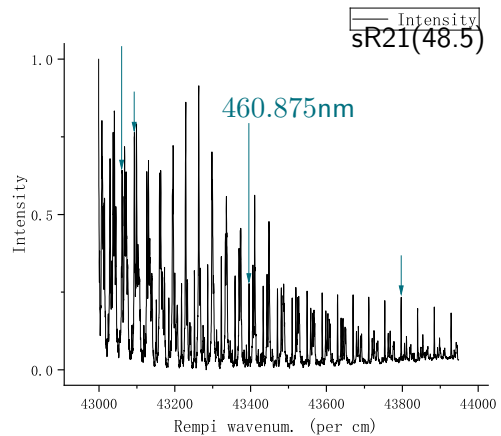
└ Radius and angular distributions

└ Peak 3

Peak 3



## Peak 3



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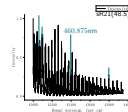
## 練習実験報告

└ REMPI scan

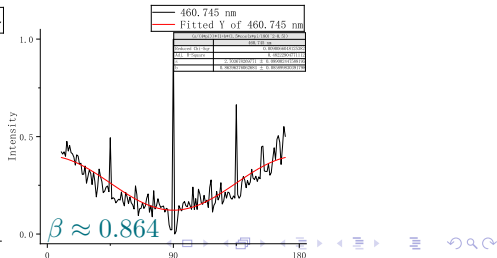
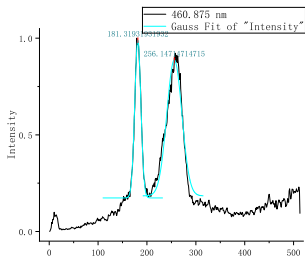
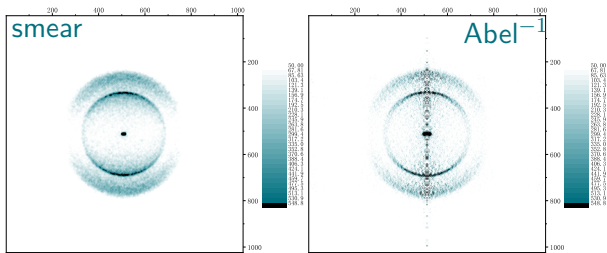
└ Radius and angular distributions

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Peak 3



## Peak 3



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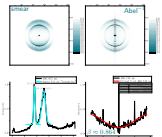
## 練習実験報告

└ REMPI scan

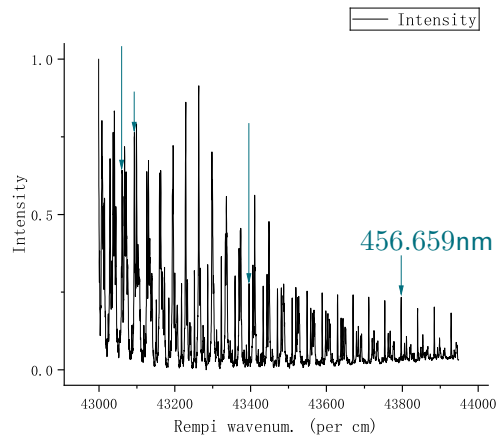
└ Radius and angular distributions

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## Peak 4



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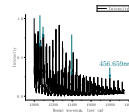
## 練習実験報告

└ REMPI scan

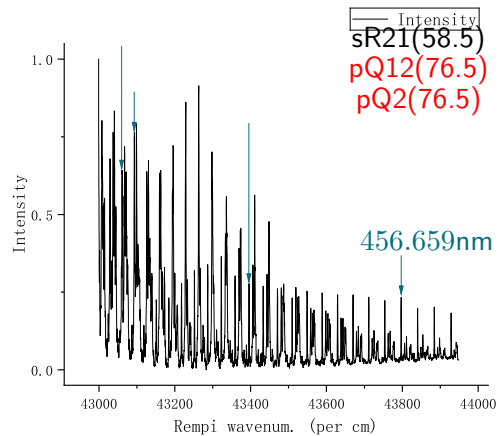
└ Radius and angular distributions

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Peak 4



## Peak 4



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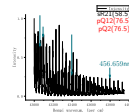
## 練習実験報告

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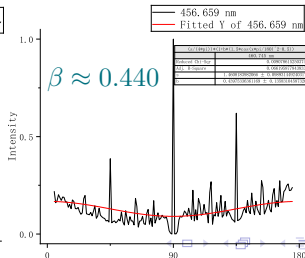
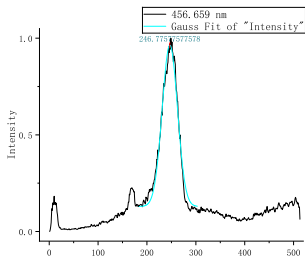
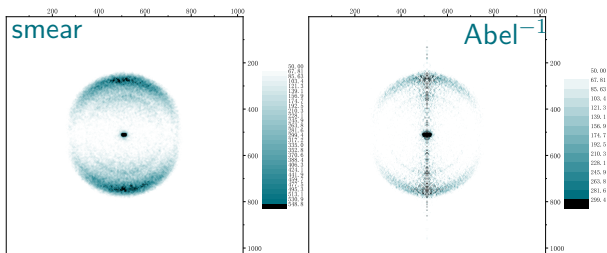
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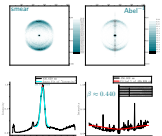
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## ■ Galvano Spectrum

■ **REMPI scan**

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## Peak assignments

181.319

*qR12 51.5*  
*qQ2 51.5**qR12 51.5*  
*qQ2 51.5**pQ12 76.5*  
*pP2 76.5*

## Notice

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

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└ REMPI scan

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└ Peak assignments

## Peak assignments

464.46nm to 43036.46cm <sup>-1</sup>	464.13nm to 43062.81cm <sup>-1</sup>	465.875nm to 43095.46cm <sup>-1</sup>	476.67nm to 42766.33cm <sup>-1</sup>
pe = 253.177	pe = 253.650	pe = 181.319 & 256.147	pe = 246.776
rR2 44.5	rR2 45.5	rR21 49.5	rR21 58.5
qR2 51.5	qR2 51.5	qQ2 51.5	qQ2 76.5
qQ2 51.5	qQ2 51.5	pP2 76.5	pP2 76.5

## Notice

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

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## Speed correction

 $y$  trans. energy of NO

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## Speed correction

 $y$  trans. energy of NO

	$R_{\text{trans}}$	$R_{\text{trans}}(15 \rightarrow 16)^a$	$R_{\text{trans}}(16/15)$
Peak 1			
400.07nm	$42.0054 \pm 0.0001$		$\Delta R_{\text{trans}}(15 \rightarrow 16) \pm R_1(f \rightarrow 0)$
Peak 2			
400.11nm	$42.0052 \pm 0.0001$		$\Delta R_{\text{trans}}(15 \rightarrow 16) \pm R_1(f \rightarrow 0)$
Peak 3			
400.477nm	$42.0051 \pm 0.0001$	$20.126 \pm 0.70$	$\Delta R_{\text{trans}}(15 \rightarrow 16) \pm R_1(f \rightarrow 0)$
Peak 4			
400.475nm	$42.0050 \pm 0.0001$		$\Delta R_{\text{trans}}(15 \rightarrow 16) \pm R_1(f \rightarrow 0)$

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

$y$  trans. energy of NO

<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.

	$R_{\text{total}}$	$R_{\text{total}}(\text{O}+\text{N})^{1/2}$	$R_{\text{eq}}(\text{NGI})$
Peak 1			
404.44nm	$41.05\pm 4.4\text{nm}^{-1}$		$334\pm 332\text{ } 775\text{nm}^{-1} + \lambda/\lambda^2 = 44$
Peak 2			
404.11nm	$41.09\pm 8.9\text{nm}^{-1}$		$334\pm 332\text{ } 775\text{nm}^{-1} + \lambda/\lambda^2 = 45$
Peak 3		$25.1\pm 8.57\text{nm}^{-1}$	
403.87nm	$41.30\pm 6.9\text{nm}^{-1}$		$334\pm 332\text{ } 775\text{nm}^{-1} + \lambda/\lambda^2 = 46$
Peak 4			
436.43nm	$43.79\pm 3.4\text{nm}^{-1}$		$334\pm 332\text{ } 775\text{nm}^{-1} + \lambda/\lambda^2 = 56$

<sup>3</sup> Namy Jost et al. *The Journal of Chemical Physics* 105.3 (July 1996).

<sup>4</sup>J. Danielak et al. *Journal of Molecular Spectroscopy* **181**:2 (1997), pp. 394–402.

## Speed correction

 $y$  trans. energy of NO

2

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),

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## Speed correction

 $y$  trans. energy of NO

	$\nu_{trans}$	$\nu_{trans}(25-300)^{\circ}$	$\nu_{trans}(300)$
Peak 1	402.45(4nm)	42.0574.4(4nm) <sup>-1</sup>	2340.432.775(4nm) <sup>-1</sup> (J. 81.2 = 40)
Peak 2	402.45(4nm)	42.0574.4(4nm) <sup>-1</sup>	2340.432.775(4nm) <sup>-1</sup> (J. 81.2 = 40)
Peak 3	402.45(4nm)	42.0574.4(4nm) <sup>-1</sup>	2340.432.775(4nm) <sup>-1</sup> (J. 81.2 = 40)
Peak 4	402.45(4nm)	42.0574.4(4nm) <sup>-1</sup>	2340.432.775(4nm) <sup>-1</sup> (J. 81.2 = 40)

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.



y trans. energy of NO

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-REMPI scan

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## Speed correction

	$R_{\text{total}}$	$R_{\text{total}}/(\text{O} + \text{NO})^b$	$R_{\text{O}} (\text{NO})$
Peak 1			
65.4.18 km	43.018.49 km <sup>-1</sup>		5814.03 km <sup>-1</sup>
Peak 2			
65.6.11 km	43.092.81 km <sup>-1</sup>		5943.96 km <sup>-1</sup>
Peak 3		25 126.37 km <sup>-1</sup>	
65.8.77 km	43.303.69 km <sup>-1</sup>		6230.69 km <sup>-1</sup>
Peak 4			
65.6.59 km	43.706.34 km <sup>-1</sup>		6004.27 km <sup>-1</sup>

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

<sup>8</sup>J. Danielak et al. *Journal of Molecular Spectroscopy* 181.2 (1997), pp. 304–313.

<sup>6</sup>Colin M. Western, *Journal of Quantitative Spectroscopy and Radiative Transfer*

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

<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.

<sup>6</sup>Colin M. Western. *Journal of Quantitative Spectroscopy and Radiative Transfer* **186** (2017), pp. 221–242.

y trans. energy of NO

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Simulated data generated by PGOPHER<sup>6</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.

<sup>6</sup>Colin M. Western. *Journal of Quantitative Spectroscopy and Radiative Transfer* **186** (2017), pp. 221–242.

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	$R_{\text{total}}$	$R_{\text{total}}/(\text{O} + \text{NO})^b$	$R_{\text{28}} \text{ [NO]}$
Peak 1			
45.4–48 km	43.078, 49 km <sup>-1</sup>		5814, 612 km <sup>-1</sup>
Peak 2			
46.5–51 km	43.093, 8 km <sup>-1</sup>		5963, 96 km <sup>-1</sup>
Peak 3		25 128, 57 km <sup>-1</sup>	
46.0–47.7 km	43.205, 69 km <sup>-1</sup>		6230, 69 km <sup>-1</sup>
Peak 4			
45.6–45.9 km	43.796, 3 km <sup>-1</sup>		8094, 27 km <sup>-1</sup>

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

Simulated data generated by PGOPHER<sup>6</sup>.

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

J. Danilšak et al. *Journal of Molecular Spectroscopy* 181.2 (1997), pp. 394–402.

<sup>a</sup>Colin M. Western, *Journal of Quantitative Spectroscopy and Radiative Transfer* 186 (2017), pp. 221–242.

# Speed correction

y trans. energy of NO

7

2024-05-24

$R_{\text{NO}}(T)$	$R_{\text{NO}}(\text{ideal}) = 3.471484 R_{\text{NO}}(200)$ $= R_{\text{NO}}(20) + R_{\text{NO}}(10) + R_{\text{NO}}(10) + R_{\text{NO}}(200)$	$R_{\text{NO}}(200)$ $= 3.471484 R_{\text{NO}}(200)$
$^2P_{1/2}$	0.000 000e+00 0.000 000e+00 0.000 000e+00	0.000 000e+00 0.000 000e+00 0.000 000e+00
$^2P_{3/2}$	0.000 000e+00 0.000 000e+00 0.000 000e+00	0.000 000e+00 0.000 000e+00 0.000 000e+00
$^2P_{1/2}$	0.000 000e+00 0.000 000e+00 0.000 000e+00	0.000 000e+00 0.000 000e+00 0.000 000e+00
$^2P_{3/2}$	0.000 000e+00 0.000 000e+00 0.000 000e+00	0.000 000e+00 0.000 000e+00 0.000 000e+00

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

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

$y$  Trans. speed of NO

2024-05-24

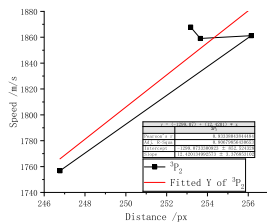
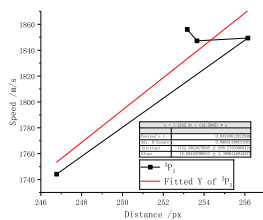
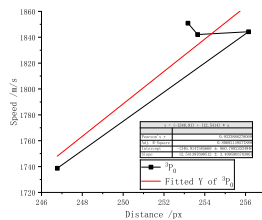
└─ REMPI scan

- Speed correction

Speed correction

$\mathcal{E}_{\text{ion}} \text{ [eV]}$	$\alpha \text{ [GeV]}$ $\alpha = \frac{\mathcal{E}_{\text{ion}} \times \text{mass}_p}{\text{mass}_e \times \text{mass}_p}$	$\Delta_B$
$^3\text{P}_2$ ( $1000 \text{ eV}$ )	$18667.616 \text{ GeV}^{-1}$ $2050.000 \text{ GeV}^{-1}$	$203.1777$ $203.6700$
$^3\text{P}_0$ ( $1306.632 \text{ GeV}^{-1}$ )	$18661.286 \text{ GeV}^{-1}$ $17766.718 \text{ GeV}^{-1}$	$206.5447$ $2466.7736$
$^3\text{F}_4$ ( $1306.632 \text{ GeV}^{-1}$ )	$18666.033 \text{ GeV}^{-1}$ $18447.220 \text{ GeV}^{-1}$	$203.1777$ $203.6700$
$^3\text{F}_2$ ( $1306.632 \text{ GeV}^{-1}$ )	$18661.286 \text{ GeV}^{-1}$ $17746.165 \text{ GeV}^{-1}$	$206.5448$ $2466.7736$
$^3\text{F}_3$ ( $2036.067 \text{ GeV}^{-1}$ )	$18666.033 \text{ GeV}^{-1}$ $18442.080 \text{ GeV}^{-1}$	$203.1777$ $203.6700$
$^3\text{F}_4$ ( $2036.067 \text{ GeV}^{-1}$ )	$18661.286 \text{ GeV}^{-1}$ $17736.720 \text{ GeV}^{-1}$	$206.5447$ $2466.7736$

## Speed correction

 $y$  Trans. speed of NO $12.42\text{m s}^{-1}/\text{px} @ {}^3P_2$  $12.54\text{m s}^{-1}/\text{px} @ {}^3P_1$  $12.50\text{m s}^{-1}/\text{px} @ {}^3P_0$ 

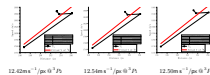
2024-05-24

## 練習実験報告

└ REMPI scan

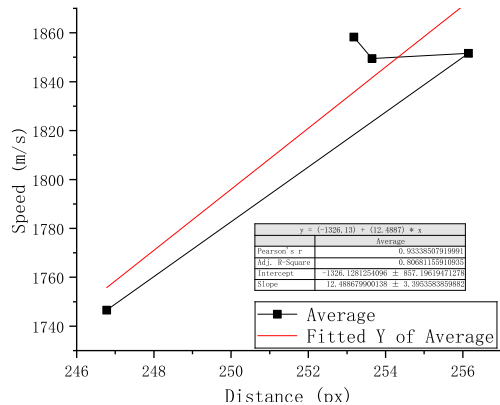
└ Speed correction

└ Speed correction



## Speed correction

y Trans. speed of NO

12.49m s<sup>-1</sup>/px @ Average

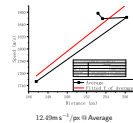
2024-05-24

## 練習実験報告

└ REMPI scan

└ Speed correction

└ Speed correction



## 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.

- [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.