

練習実験報告

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May 21, 2024

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Galvano Sepctrum

REMPI scan

- Selected peaks

- Radius and angular distributions

- Peak assignments

- Speed correction

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Galvano Sepctrum



Fig. 1: Wavelen. correction

Galvano Sepctrum

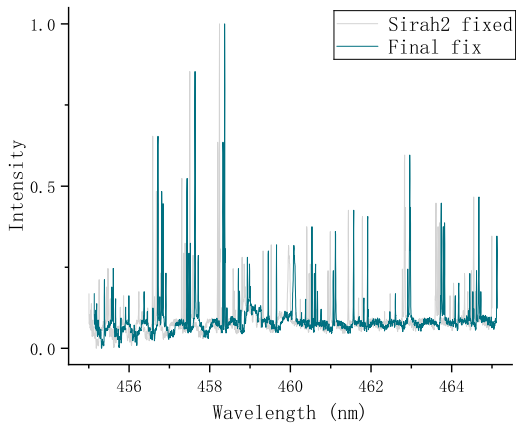


Fig. 1: Wavelen. correction

Galvano Sepctrum

Correction

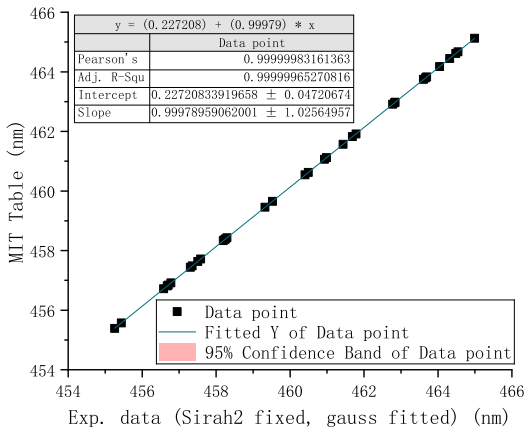


Fig. 2: Correction function

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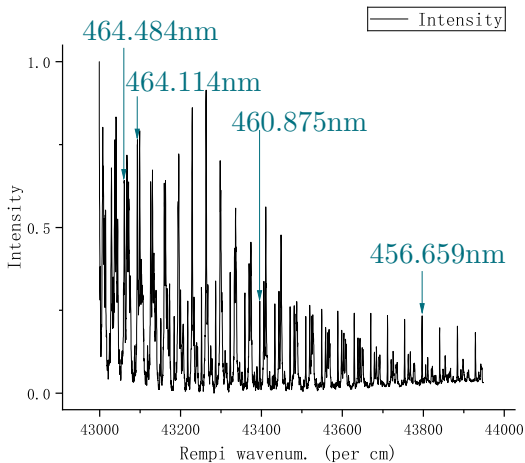
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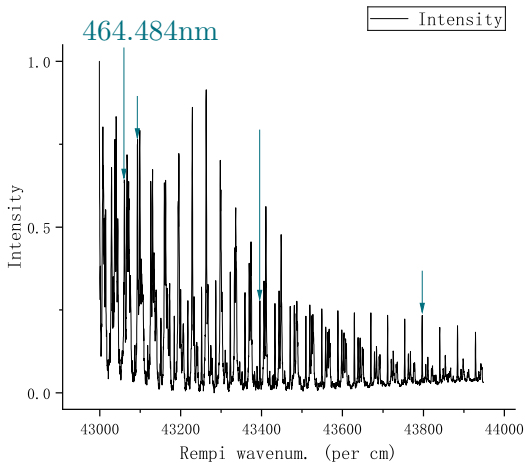
Selected peaks

Radius and angular distributions

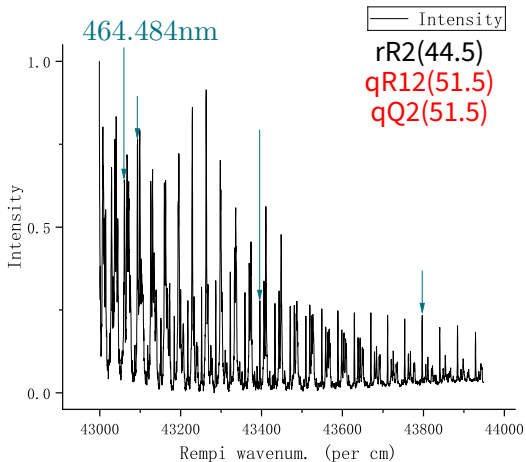
Peak assignments

Speed correction

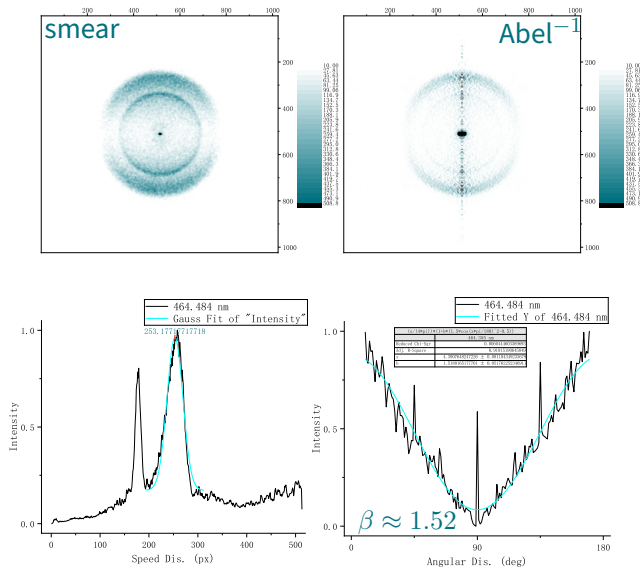
Peak 1



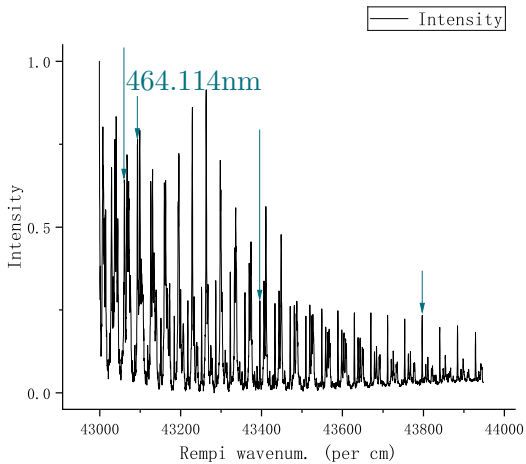
Peak 1



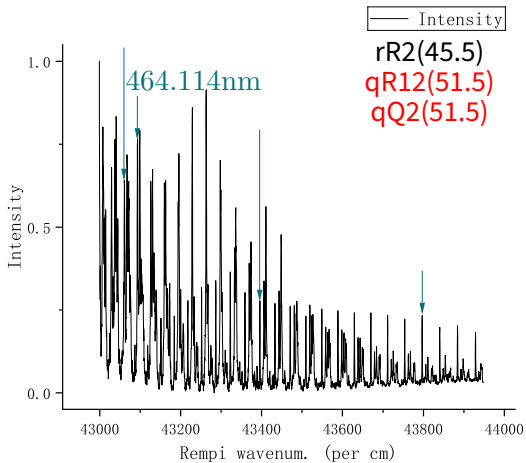
Peak 1



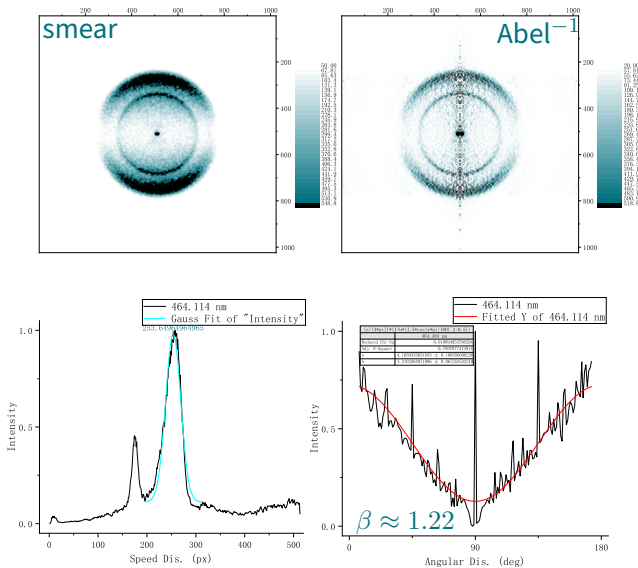
Peak 2



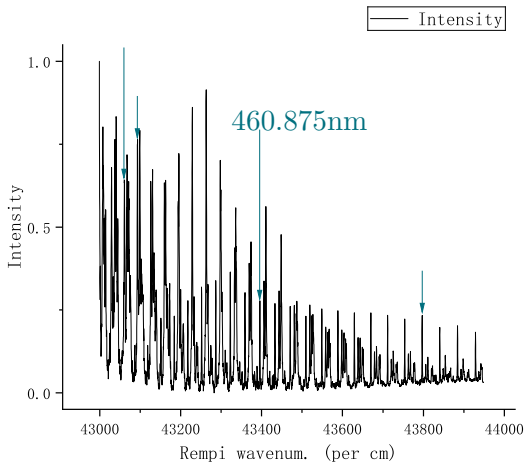
Peak 2



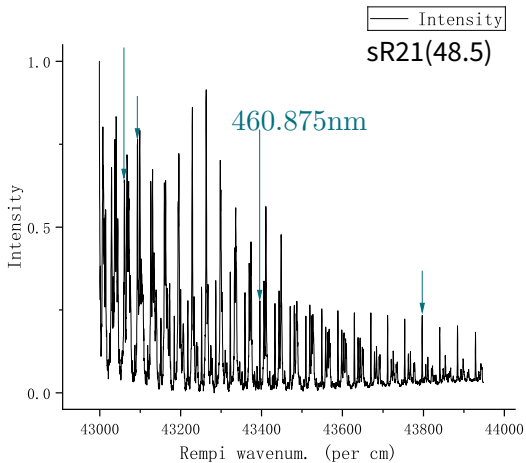
Peak 2



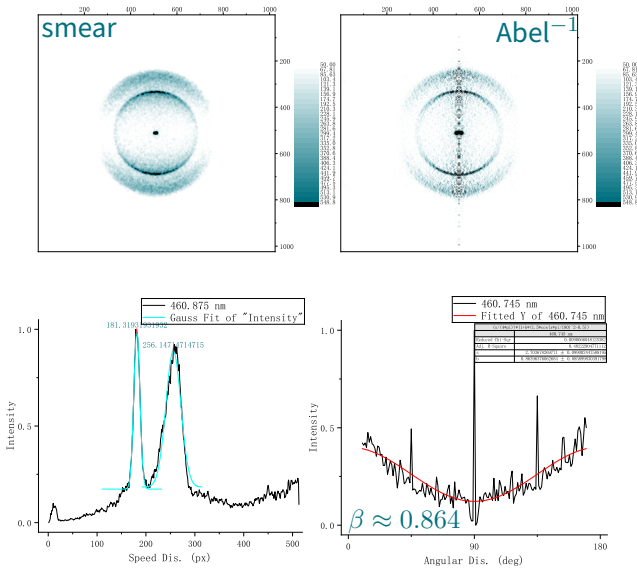
Peak 3



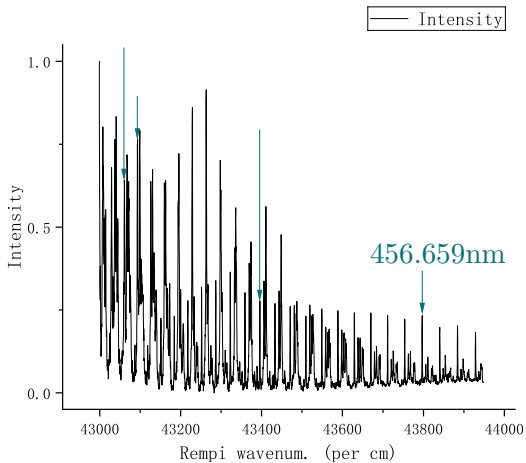
Peak 3



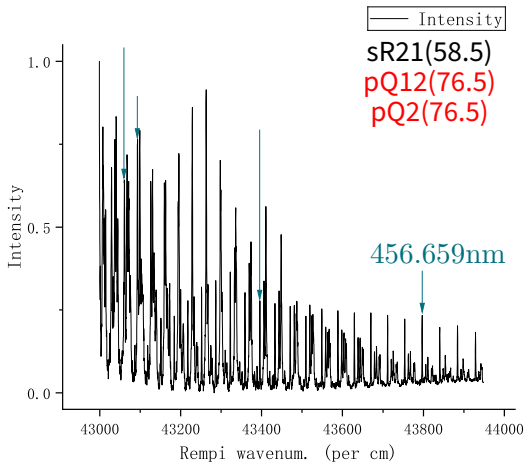
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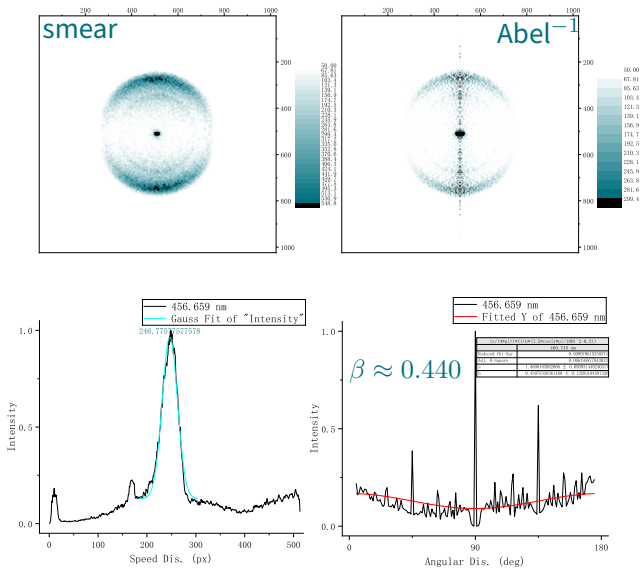
Peak 4



Peak 4



Peak 4



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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 = 253.177	px = 253.650	px = 181.319 & 256.147	px = 246.776
<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

y trans. energy of NO

	E_{total}	$E_{\text{bond}}(\text{O}-\text{NO})^1$	$E_{\text{int.}}(\text{NO})$
Peak 1 464.484nm	43 058.49cm ⁻¹	25 128.57cm ⁻¹	$\Delta E_v(1 \rightarrow 0) + E(J = 44)$
Peak 2 464.114nm	43 092.81cm ⁻¹		$\Delta E_v(1 \rightarrow 0) + E(J = 45)$
Peak 3 460.875nm	43 395.69cm ⁻¹		$\Delta E_v(1 \rightarrow 0) + E(J = 48)$
Peak 4 456.659nm	43 796.34cm ⁻¹		$\Delta E_v(1 \rightarrow 0) + E(J = 58)$

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

Speed correction

y trans. energy of NO

	E_{total}	$E_{\text{bond}}(\text{O}-\text{NO})^2$	$E_{\text{int.}}(\text{NO})$
Peak 1 464.484nm	43 058.49cm ⁻¹	25 128.57cm ⁻¹	2341.932 775 0cm ⁻¹ + $E(J = 44)$
Peak 2 464.114nm	43 092.81cm ⁻¹		2341.932 775 0cm ⁻¹ + $E(J = 45)$
Peak 3 460.875nm	43 395.69cm ⁻¹		2341.932 775 0cm ⁻¹ + $E(J = 48)$
Peak 4 456.659nm	43 796.34cm ⁻¹		2341.932 775 0cm ⁻¹ + $E(J = 58)$

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

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

Speed correction

y trans. energy of NO

	E_{total}	$E_{\text{bond}}(\text{O}-\text{NO})^2$	$E_{\text{int.}}(\text{NO})$
Peak 1 464.484nm	43 058.49cm ⁻¹	25 128.57cm ⁻¹	2341.932 775 0cm ⁻¹ + $E(J = 44)$
Peak 2 464.114nm	43 092.81cm ⁻¹		2341.932 775 0cm ⁻¹ + $E(J = 45)$
Peak 3 460.875nm	43 395.69cm ⁻¹		2341.932 775 0cm ⁻¹ + $E(J = 48)$
Peak 4 456.659nm	43 796.34cm ⁻¹		2341.932 775 0cm ⁻¹ + $E(J = 58)$

Vib. energy level³

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

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

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

Speed correction

y trans. energy of NO

	E_{total}	$E_{\text{bond}}(\text{O}-\text{NO})^4$	$E_{\text{int.}}(\text{NO})$
Peak 1 464.484nm	43 058.49cm ⁻¹	25 128.57cm ⁻¹	5814.033cm ⁻¹
Peak 2 464.114nm	43 092.81cm ⁻¹		5965.969cm ⁻¹
Peak 3 460.875nm	43 395.69cm ⁻¹		6239.696cm ⁻¹
Peak 4 456.659nm	43 796.34cm ⁻¹		8004.278cm ⁻¹

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

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

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

Speed correction

y trans. energy of NO

	E_{total}	$E_{\text{bond}}(\text{O}-\text{NO})^4$	$E_{\text{int.}}(\text{NO})$
Peak 1 464.484nm	43 058.49cm ⁻¹	25 128.57cm ⁻¹	5814.033cm ⁻¹
Peak 2 464.114nm	43 092.81cm ⁻¹		5965.969cm ⁻¹
Peak 3 460.875nm	43 395.69cm ⁻¹		6239.696cm ⁻¹
Peak 4 456.659nm	43 796.34cm ⁻¹		8004.278cm ⁻¹

Rot. energy level⁵

Simulated data generated by PGOPHER⁶.

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

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

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

Speed correction

y trans. energy of NO

$E_{\text{int.}}(^7\text{O})$	$E_{\text{trans}}(\text{total}) \approx 2.875464 E_{\text{trans}}(\text{NO})$ $= E_{\text{total}} - E_{\text{bond}}(\text{O}-\text{NO}) - E_{\text{int.}}(\text{O}) - E_{\text{int.}}(\text{NO})$	$E_{\text{trans}}(\text{NO})$ $= \frac{1}{2} m(\text{NO}) v^2(\text{NO})$
3P_2	11081.356cm ⁻¹	1923.847cm ⁻¹
	10964.609cm ⁻¹	1903.578cm ⁻¹
	10794.143cm ⁻¹	1873.983cm ⁻¹
(0cm ⁻¹)	9398.766cm ⁻¹	1631.730cm ⁻¹
3P_1	10922.731cm ⁻¹	1896.308cm ⁻¹
	10805.984cm ⁻¹	1876.039cm ⁻¹
	10635.518cm ⁻¹	1846.444cm ⁻¹
(158.625cm ⁻¹)	9240.141cm ⁻¹	1604.191cm ⁻¹
3P_0	10854.379cm ⁻¹	1884.441cm ⁻¹
	10737.632cm ⁻¹	1864.172cm ⁻¹
	10567.166cm ⁻¹	1834.577cm ⁻¹
(226.977cm ⁻¹)	9171.789cm ⁻¹	1592.324cm ⁻¹

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

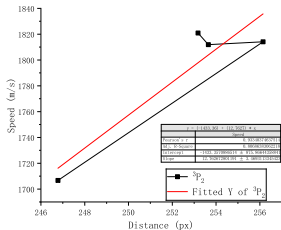
Speed correction

y Trans. speed of NO

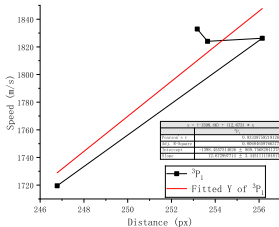
$E_{\text{int.}}(\text{O})$	$v(\text{NO}) = \sqrt{\frac{2E_{\text{trans}}(\text{NO})}{m(\text{NO})}}$	Δy
3P_2 (0cm^{-1})	1832.932m s^{-1}	253.177
	1824.013m s^{-1}	253.650
	1826.228m s^{-1}	256.147
	1719.564m s^{-1}	246.776
3P_1 (158.625cm^{-1})	1820.893m s^{-1}	253.177
	1811.916m s^{-1}	253.650
	1814.145m s^{-1}	256.148
	1706.726m s^{-1}	246.776
3P_0 (226.977cm^{-1})	1815.681m s^{-1}	253.177
	1806.678m s^{-1}	253.650
	1808.914m s^{-1}	256.147
	1701.165m s^{-1}	246.776

Speed correction

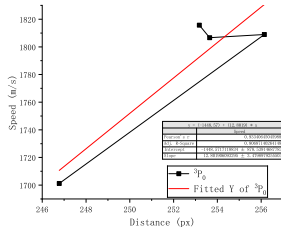
y Trans. speed of NO



$12.76 \text{ m s}^{-1} / \text{px} @ {}^3P_2$



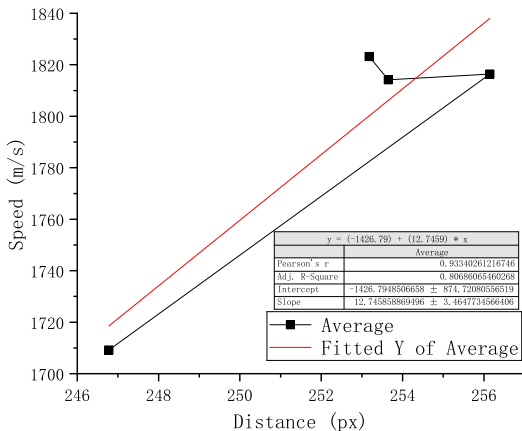
$12.67 \text{ m s}^{-1} / \text{px} @ {}^3P_1$



$12.80 \text{ m s}^{-1} / \text{px} @ {}^3P_0$

Speed correction

y Trans. speed of NO




$$\frac{dv}{dpx} = 12.75 \text{ m s}^{-1} / \text{px @ Average}$$

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

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