

LUX Day 2026

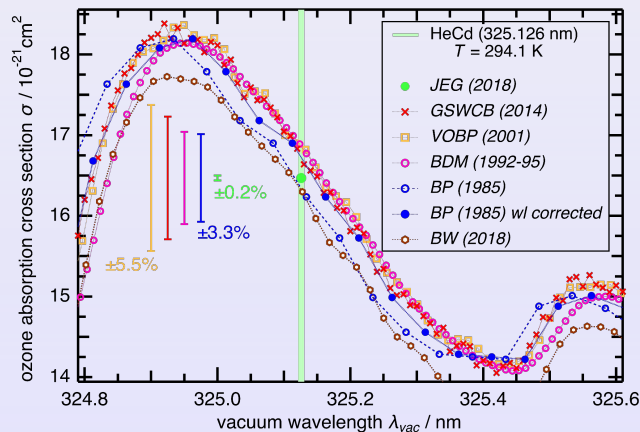
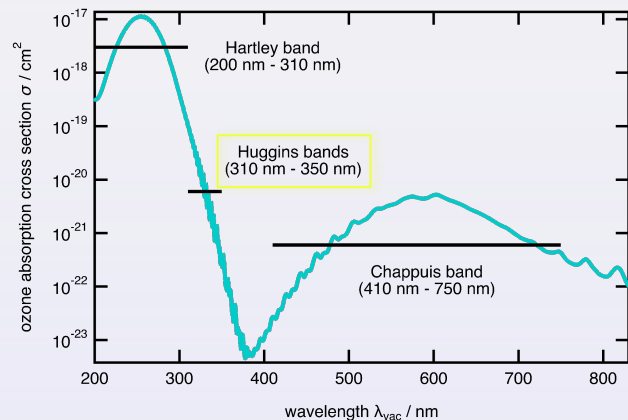
Measurements of ozone's cross section around 308 nm for remote sensing

presented by Coline MAHOB

Team : MIS-PLASMAS

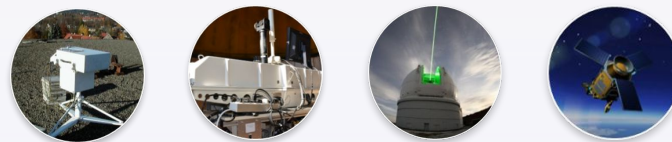
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Why new value of cross section for Ozone are needed ?



Ozone Absorption Cross Sections (310–350 nm):

- Key input for Brewer, Dobson, LiDAR & UV satellite instruments

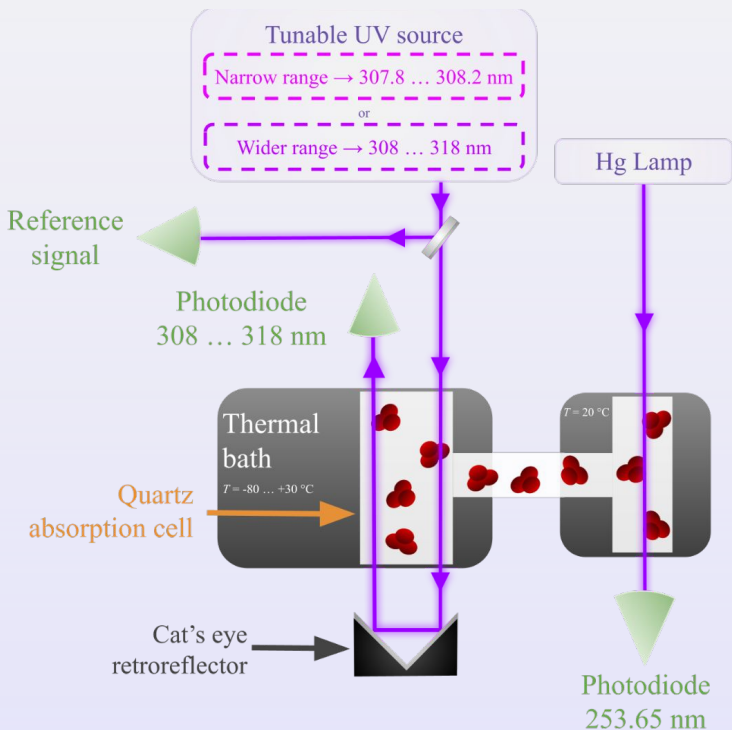


- Current datasets: $>1\%$ uncertainty (systematic biases + measurement uncertainty)
- Biases propagate into ozone trends and climate assessments
- Limitations: broadband lamps, low spectral resolution, weak temperature control, signal to noise

Our approach:

- Continuous-wave laser spectroscopy
- High spectral resolution + better temperature control

Experimental Strategy and Expected Outcomes



Brewer



Dobson

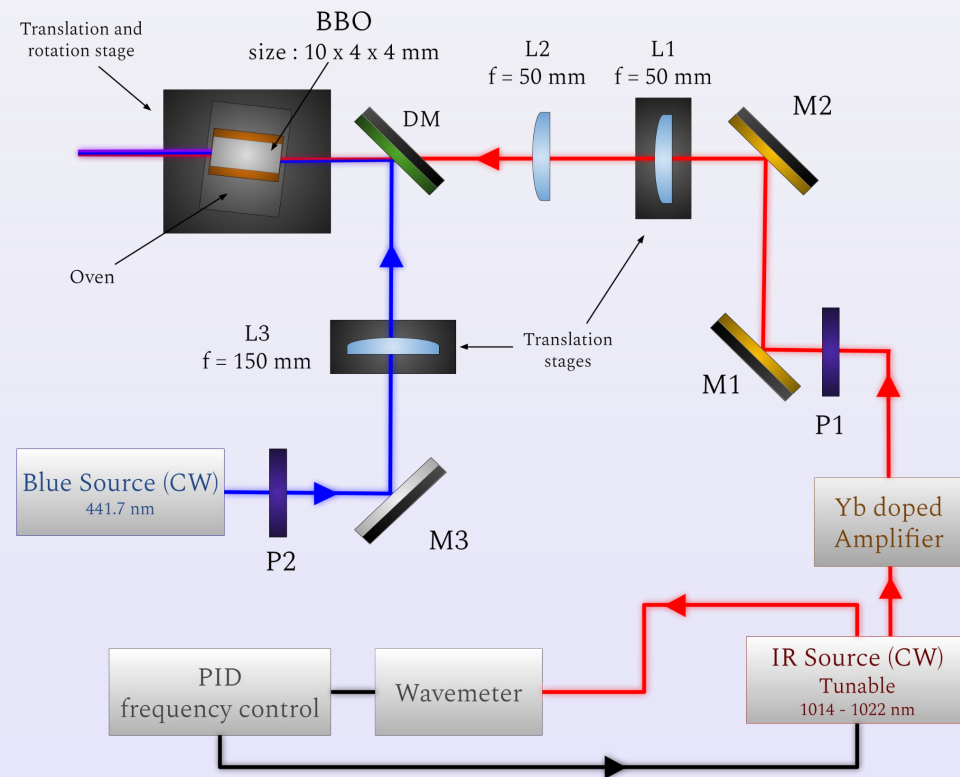


LiDAR

303.2 nm	313.5 nm	305.5 nm	<u>Tropospheric</u>	<u>Stratospheric</u>
306.3 nm	316.8 nm	308.8 nm	289 nm	308 nm
310.0 nm	320.0 nm	311.45 nm	316 nm	355 nm
		317.6 nm		

- Measurement based on Beer Lambert law : $\ln\left(\frac{I_0}{I}\right) = \sigma n l$
- Controlled temperature from -80°C to $+30^{\circ}\text{C}$
- 99.8% purity ozone
- Simultaneous 254 nm calibrated photometer measurements
- Target wavelengths (in bold) match the spectral windows of ozone instruments.
- Target σ uncertainty $\lesssim 0,5\%$

1st laser system : Set Up & Wavelength coverage



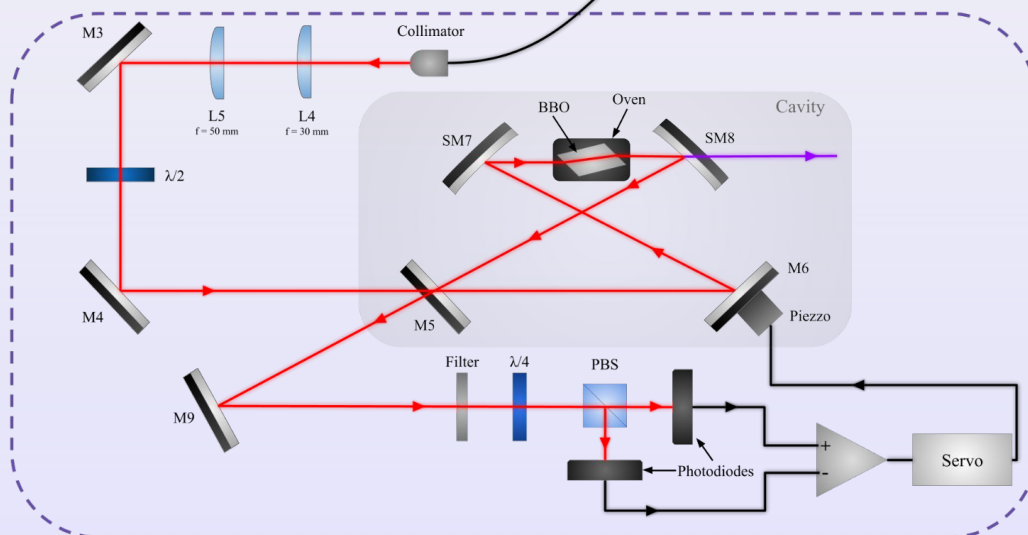
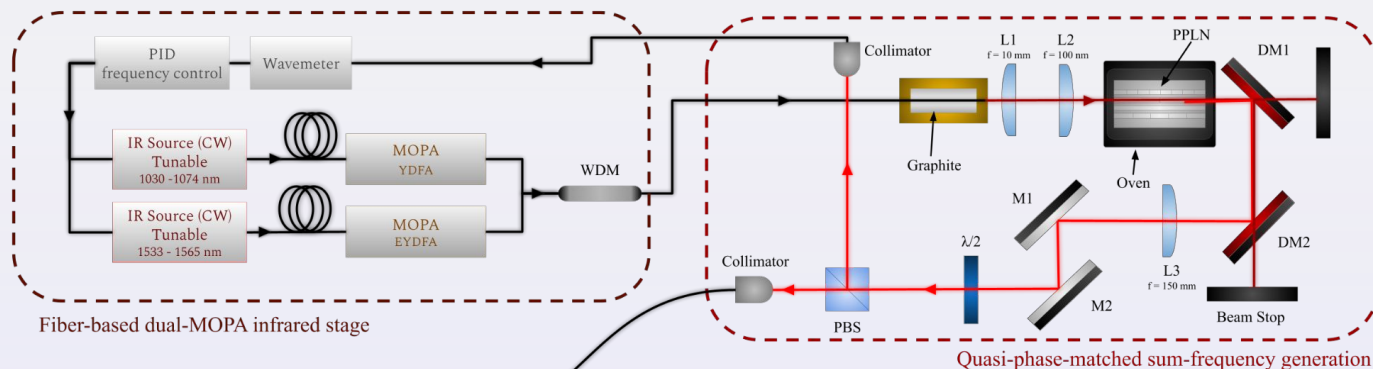
- Targeting stratospheric LiDAR wavelength
- Using non linear optics to achieve UV range : 307.8 ... 308.2 nm

Characterization

- Output UV power : 3.7 μ W
- Frequency stabilization with PID on the IR source

Target λ / nm	Measured λ / nm	$\Delta\lambda$ / 10^{-4} nm
307.83406	307.83406	0.0
307.90108	307.90102	0.6
308.00067	308.00057	0.9
308.13737	308.13736	0.1
308.20308	308.20303	0.4

2nd laser system : Set Up



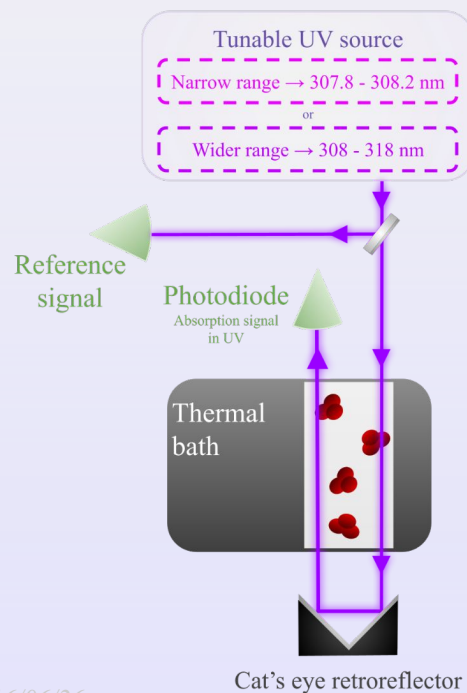
- Brewer, Dobson, and satellite coverage
- UV generation in 2 steps : IR $\rightarrow$ Red $\rightarrow$ UV
- Tunability Red : 616 ... 637 nm
UV : 308 ... 318,5 nm

Characterization

- Output IR max power : 7 W
- Output Red max power : 1W
- Output UV power : $\sim$ 12 mW
- Frequency stabilization with PID

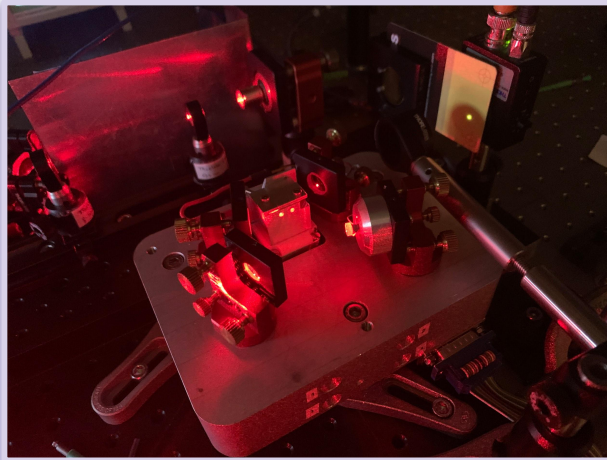
Conclusion

$$\sigma = \frac{A}{nl} = \sigma_{254} \frac{A}{A_{254}} \frac{T}{T_{254}} \frac{l_{254}}{l}$$



	Range	Standard uncertainty / stability	Rel. standard uncertainty u_r	Note / Traceability
Ozone purity / %	≥ 99.8	0.06	$6 \cdot 10^{-4}$	Janssen, C., et al. (2016). DOI: 10.1063/1.3557512
Temperature / °C	-80 ... +30	0.5	$< 2.5 \cdot 10^{-3}$	Pt100 sensor calibration using calibrated SPRT
Temperature / °C	20	0.1	$3 \cdot 10^{-4}$	Pt100 sensor calibration using calibrated SPRT
UV Source 1 / nm	307.8 ... 308.2	$3 \cdot 10^{-5}$	10^{-7}	Calibrated wavelength metre
UV Source 2 / nm	308 ... 318	$3 \cdot 10^{-5}$	10^{-7}	Calibrated wavelength metre
Absorption length / mm	600	0.2	$3 \cdot 10^{-4}$	Calibrated caliper measurement
Reference cell length / mm	10.002	0.003	$3 \cdot 10^{-4}$	Interferometric measurement Elandalousi et al. (2016). DOI: 10.1364/ao.55.001971
Absorbance A_e			$2 \cdot 10^{-3}$	Under evaluation
Absorbance A_e @254 nm	1 ... 2	0.002 ... 0.004	$2 \cdot 10^{-3}$	Janssen, C., et al. (2020). DOI: 10.1016/j.jqsrt.2021.108051
Cross section @254 nm / cm² molecule⁻¹	$1.1329 \cdot 10^{-17}$	$0.0035 \cdot 10^{-17}$	$3.089 \cdot 10^{-3}$	Hodges et al. (2019). DOI: 10.1088/1681-7575/ab0bdd

Thank you for your attention



Thanks to :



Additional references

Images

- Observatoire de Meudon :
<https://static.actu.fr/uploads/2021/06/20210617-101449.jpg>
- Brewer :
<https://th.bing.com/th/id/R.480f52427ddc3a512b08158cd366b0da?rik=L6v93UKu1TrQJw&riu=http%3a%2f%2ftid.uio.no%2foz%2fPics%2fbrewer1.jpg&ehk=PypdDwIsQ39ByBUcZbQDNa6MYd8kkxYbgkeR74er2z0%3d&risl=&pid=ImgRaw&r=0>
- Dobson :
<https://www.univ-reims.fr/gsma/equipements/equipements.9566.17482.html>
- LiDAR :
<https://innolas-laser.com/Applications/LIDAR.html?s=DD0953A5EA7A693A42841CF90B3B892BF030875E>
- Tropomi :
<https://www.tropomi.eu/>