

# Temperature dependence of the SO<sub>2</sub> absorption cross sections in the UV-visible region

ULB

Christian Hermans  
christh@oma.be

Ann Carine Vandaele  
annc@oma.be

Sébastien Dubois  
sedubois@ulb.ac.be

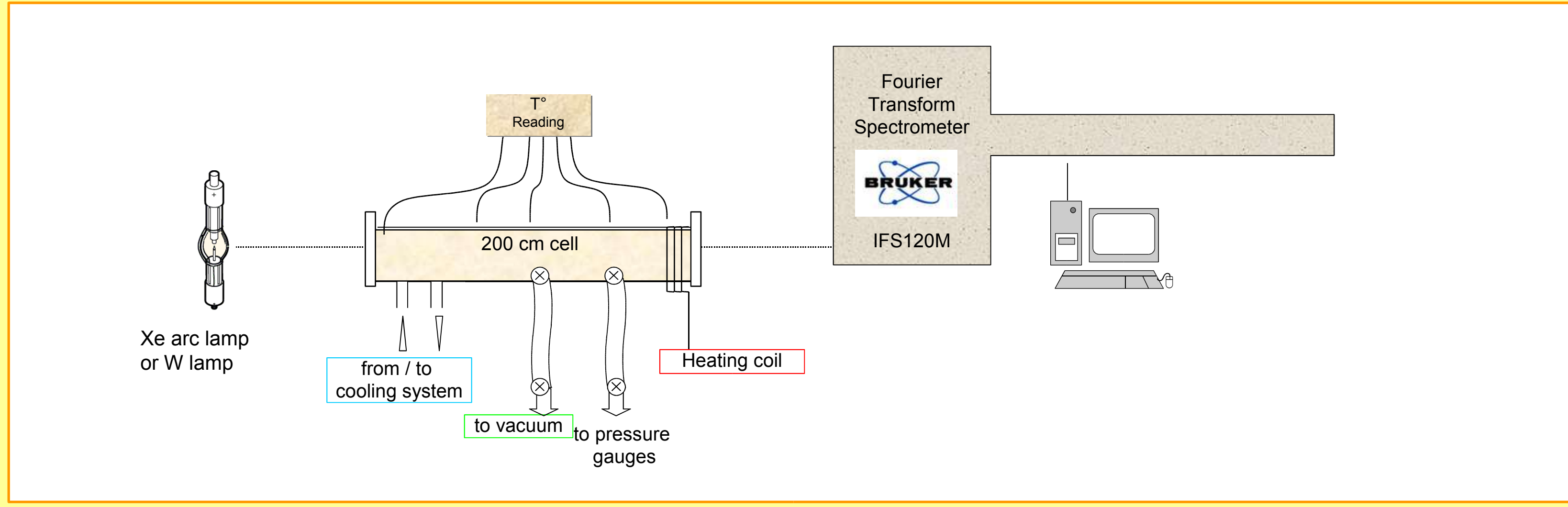
Sophie Fally  
sfally@ulb.ac.be



**The problem ?** ✓ Large disagreements exist between published absorption cross sections  
 ✓ Literature data were recorded @ low resolutions & mostly @ room T°

**Aims ?** ✓ Produce new, i.e. high resolution, laboratory abs. cross-sections measurements  
 ✓ Study the high Temperature effect in support of atmospheric & astrophysics studies

## EXPERIMENTAL



**Experimental conditions**

Spectral range	23500-44500 cm <sup>-1</sup>
Resolution	0.042 - 2.0 cm <sup>-1</sup>
Absorption path length	200 cm
Temperature	298, 318, 338, 358 K

- Empty cell
- Pure gas @ P1
- Pure gas @ P2
- ....
- Empty cell

✓ Sequence repeated at least twice for each T°

Experimental conditions @ resolution 2 cm<sup>-1</sup>

T(K)	Lamp-Detector	Nb of different pressures	Pressure range (Torr)	Nb blocks x nb scans
298	W - GaP	10	31-130	40 x 128
	Xe - GaP	5	0.4-66.2	40 x 128
	Xe - PM	11	0.03-1.03	8 x 512 (48 x 512)
318	W - GaP	11	31-150	40 x 128
	Xe - GaP	5	0.4-63.7	40 x 128
	Xe - PM	9	0.05-3.24	8 x 512 (38 x 512)
338	W - GaP	14	20-175	40 x 128
	Xe - GaP	5	0.5-68.4	40 x 128
	Xe - PM	10	0.04-4.65	8 x 512 (40 x 512)
358	W - GaP	15	30-265	40 x 128
	Xe - GaP	5	0.6-73.0	40 x 128
	Xe - PM	8	0.05-5.11	8 x 512 (40 x 512)

Experimental conditions @ high resolution

298 K	Nb of different pressures	Pressure range (Torr)	Nb blocks x nb scans
W - GaP (0.042 cm <sup>-1</sup> )	4	156-199	(81-102) x 128
Xe - PM (0.044 cm <sup>-1</sup> )	5	0.18-0.26	(6-48) x 128

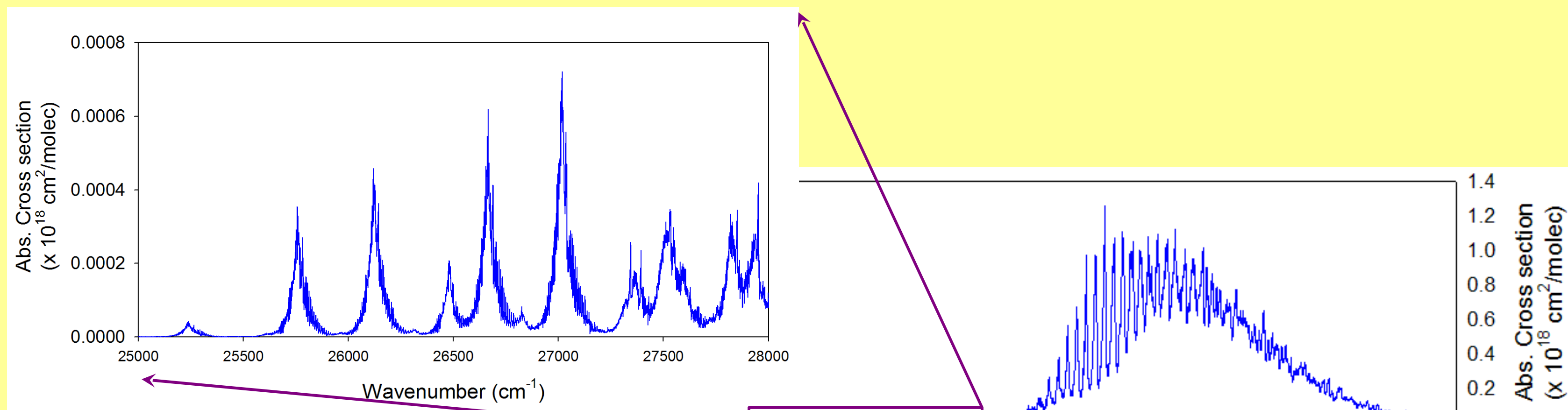
## ABSORPTION CROSS SECTIONS

✓ Cross sections calculated using

$$\sigma(\nu) = \frac{1}{n_{SO_2} l} \times \ln \left( \frac{(B_{before}(\nu) + B_{after}(\nu)) / 2}{I(\nu)} \right)$$

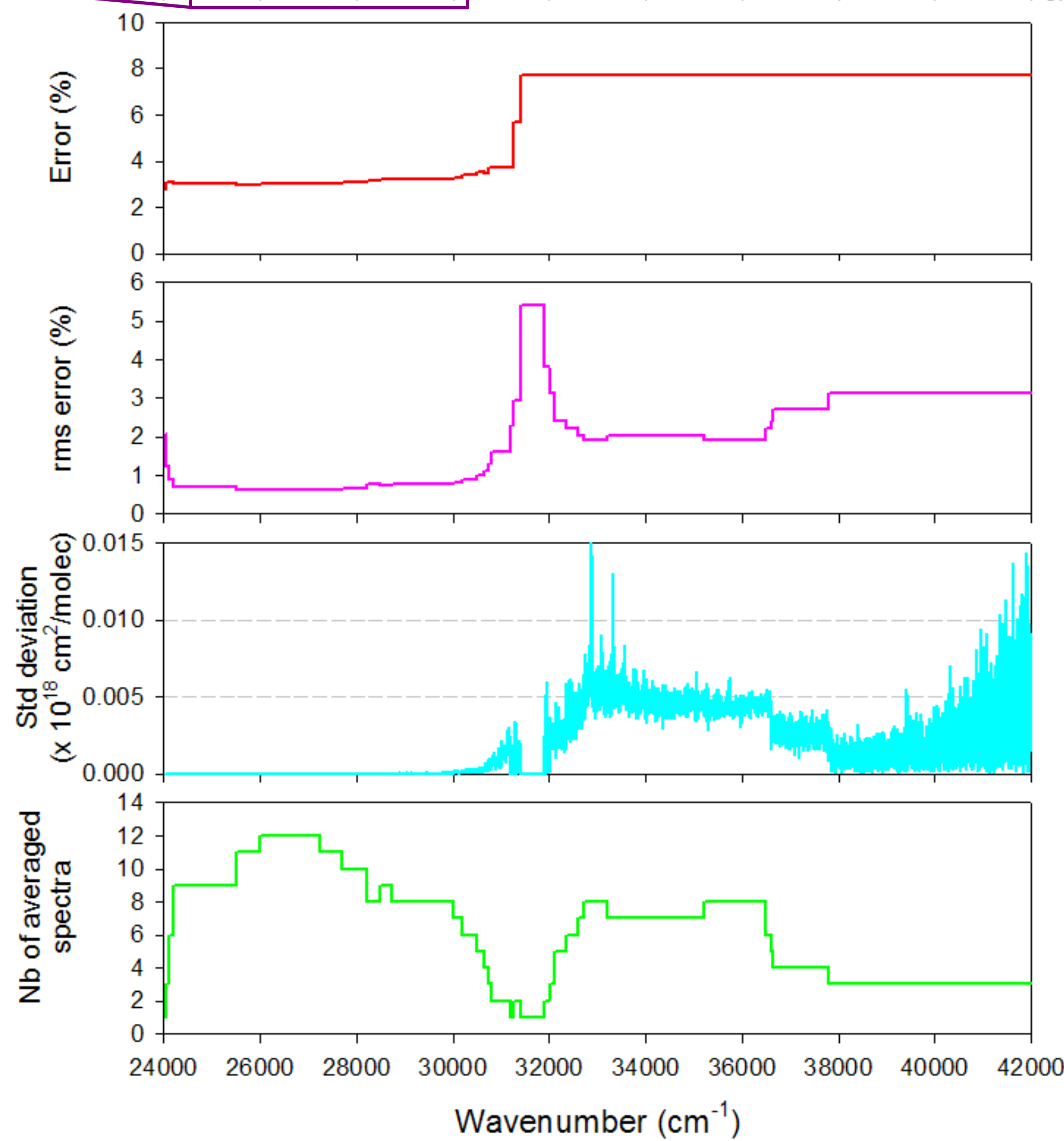
✓ Averages of available data @ 1T° on optimized spectral intervals → better SNR

✓ Error estimates : A (1% Xe-GaP, 2% W-GaP, 5% Xe-PM), P (0.1%), T(0.4%), I(0.2%), lamp variation (0.1% W, 2.0 Xe)

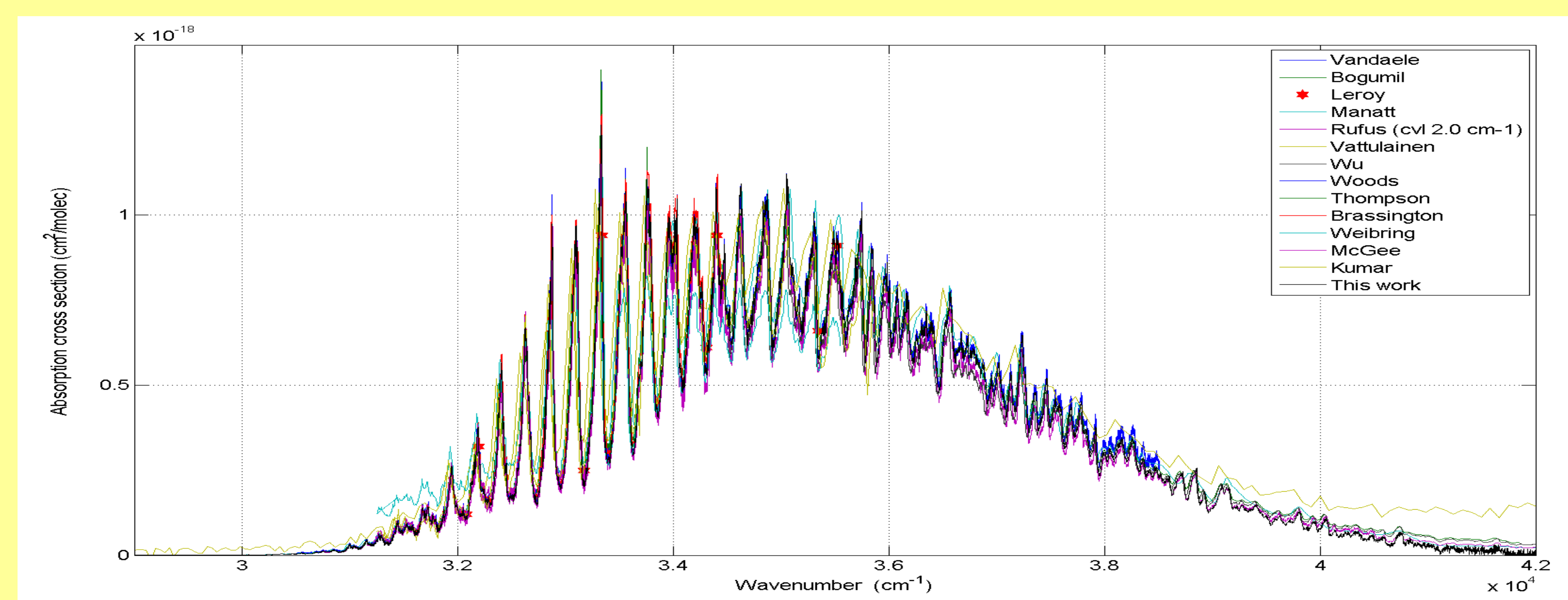
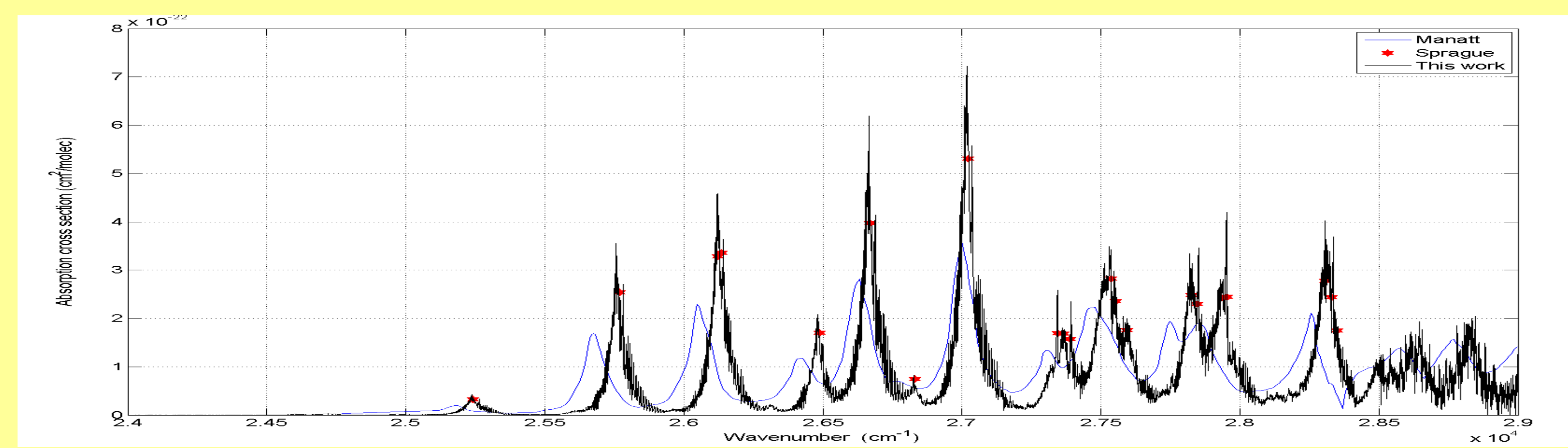


$$error(\%) = \frac{\delta A}{A} + \frac{\delta p}{p} + \frac{\delta t}{t} + \frac{\delta l}{l} + \frac{\delta lamp}{lamp}$$

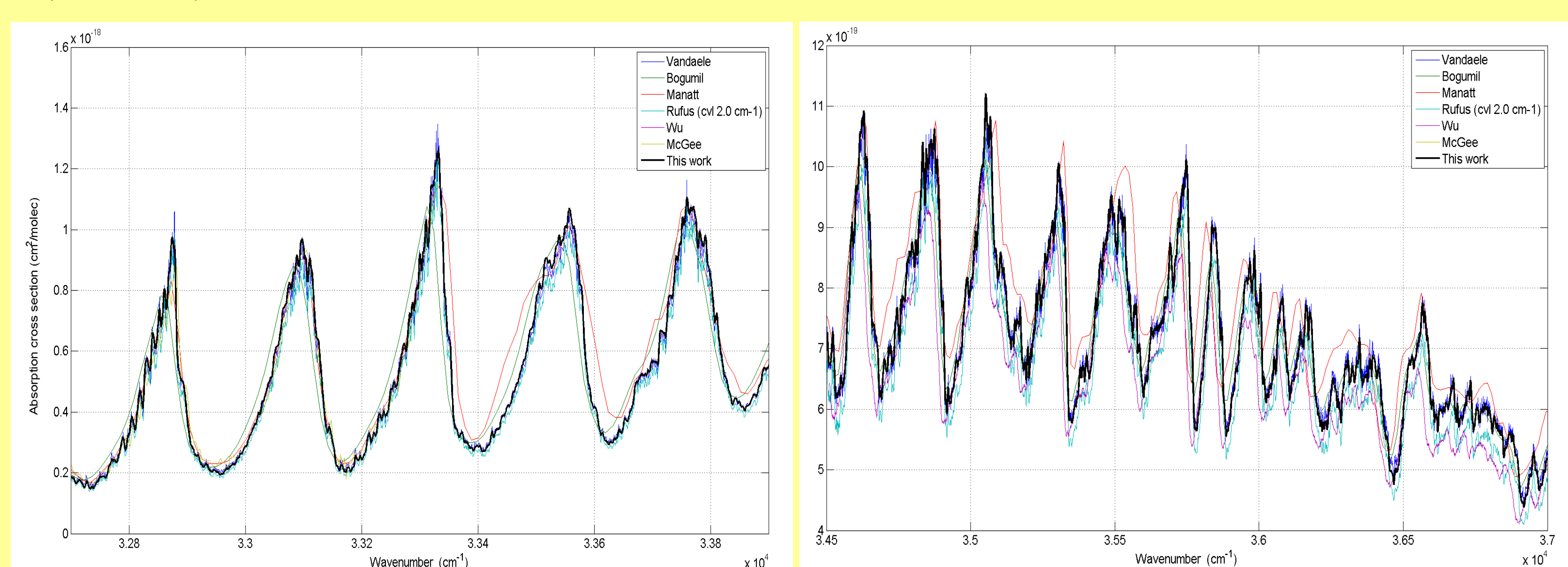
$$rms\ error(\%) = \sqrt{\left(\frac{\delta A}{A}\right)^2 + \left(\frac{\delta p}{p}\right)^2 + \left(\frac{\delta t}{t}\right)^2 + \left(\frac{\delta l}{l}\right)^2 + \left(\frac{\delta lamp}{lamp}\right)^2}$$



## COMPARISON OF CROSS-SECTIONS WITH THE LITERATURE



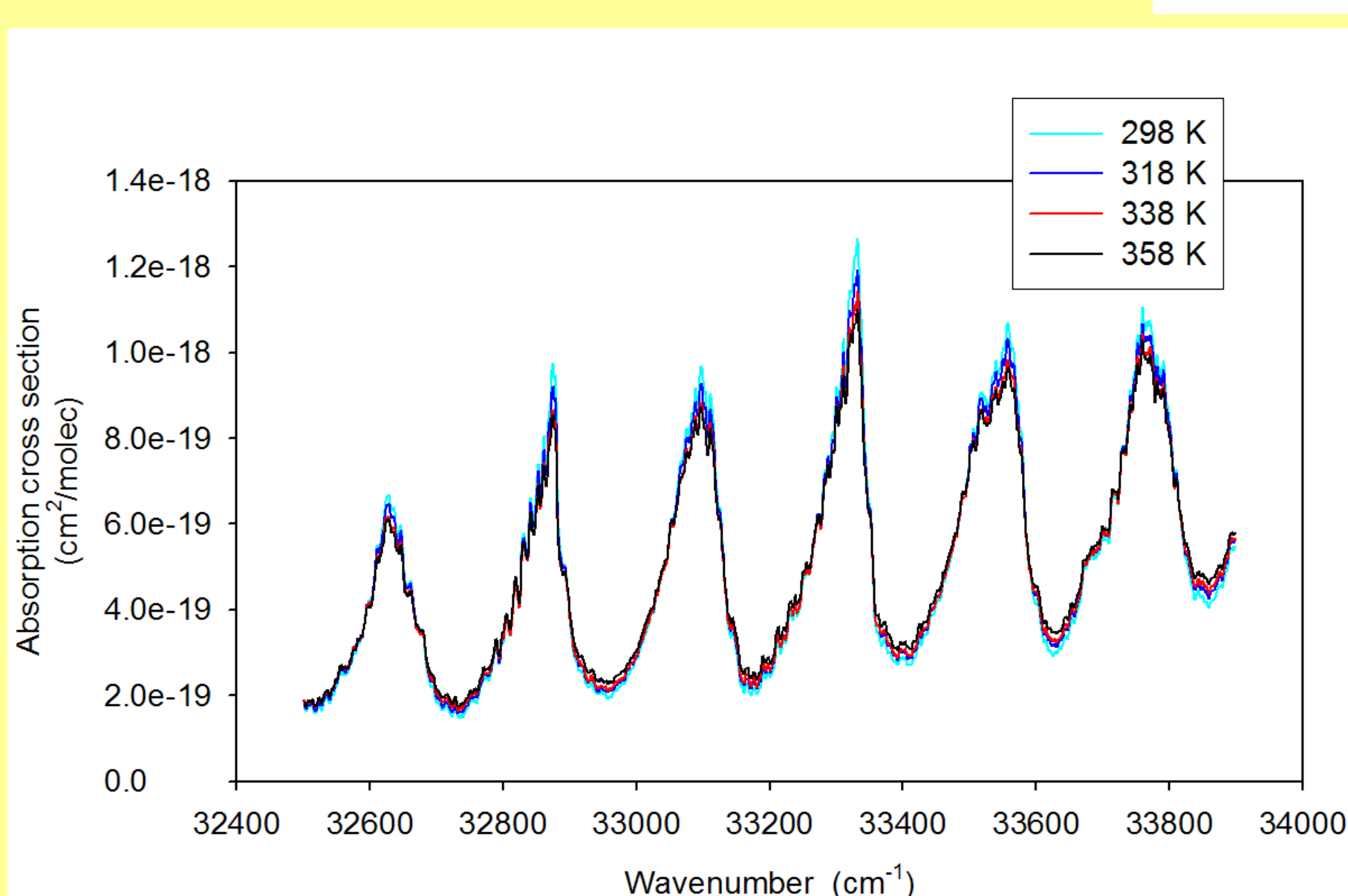
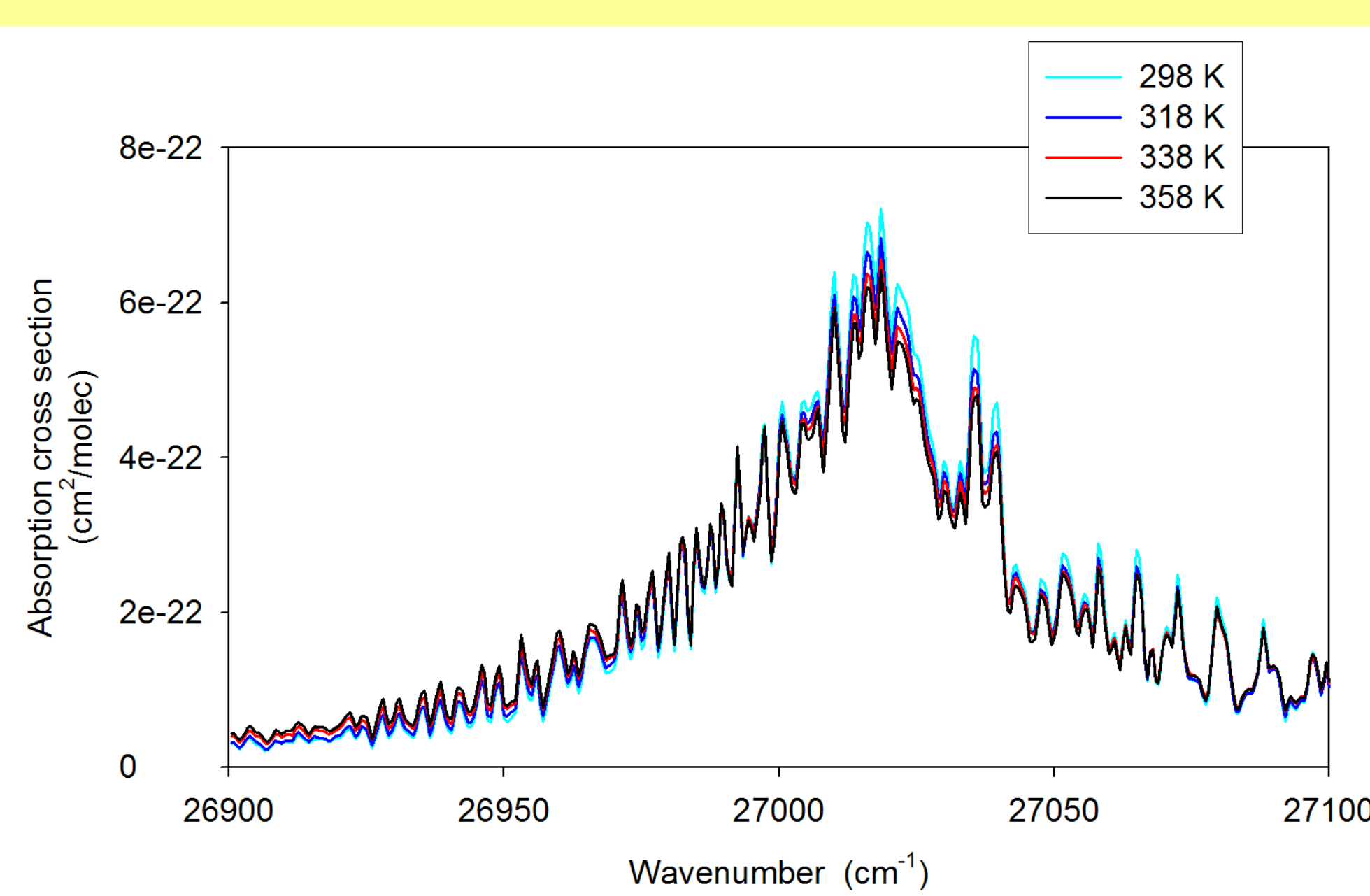
Comparison only with recent data @ room T



## TEMPERATURE EFFECT

Below 29000 cm<sup>-1</sup>

- ✓ Right from peak intensities ↑ when T° ↓
- ✓ Left from peak intensities ↓ when T° ↓



Above 29000 cm<sup>-1</sup>

- ✓ Peak intensities ↑ when T° ↓
- ✓ Trough intensities ↓ when T° ↓

## SUMMARY & CONCLUSIONS

- ✓ FTS spectra of pure SO<sub>2</sub> were recorded
  - ✓ in the range 23500-42000 cm<sup>-1</sup> (225-425 nm)
  - ✓ at 2 cm<sup>-1</sup> and 0.042 cm<sup>-1</sup> resolution
  - ✓ @ 4 T° : 298, 318, 338, and 358 K
- ✓ Error estimates are of the order of 8% above 30000 cm<sup>-1</sup> (5% if rms) - 3% (1%) below
- ✓ T° effect is the largest at the peaks
- ✓ Comparison with recent data from the literature → good agreement
- ✓ Data downloadable [soon](http://www.aeronomie.be/spectrolab/) @ <http://www.aeronomie.be/spectrolab/>
- ✓ Useful for remote sensing applications

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