

Investigation of the effects of humidity and volatile coatings on the photothermal interferometry signal

B. Visser¹, J. Röhrbein¹, L. Drinovec², M. Wipf¹, P. Steigmeier¹, G. Močnik² and E. Weingartner¹

¹Institute for Sensors and Electronics, University of Applied Sciences Northwestern Switzerland, Windisch, 5210, Switzerland

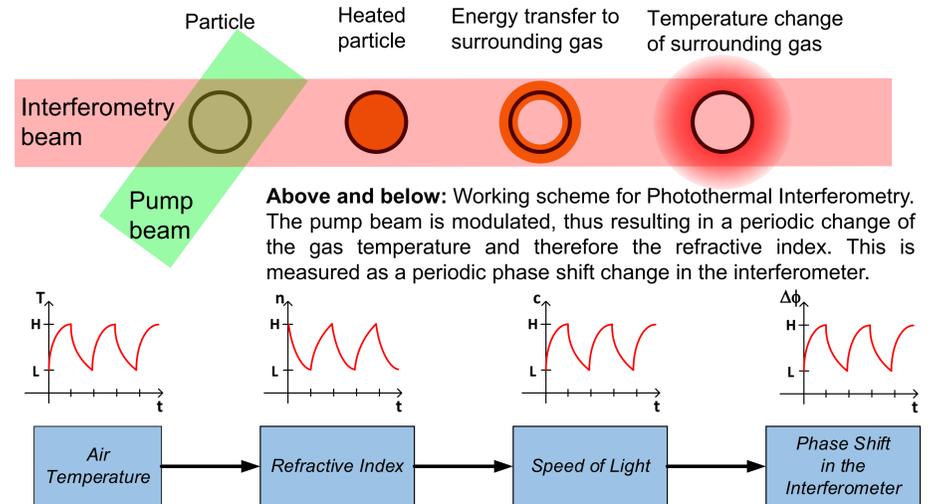
²Jozef Stefan Institute, 1000 Ljubljana, Slovenia

bradley.visser@fhnw.ch, ernest.weingartner@fhnw.ch

Why is PTI interesting?

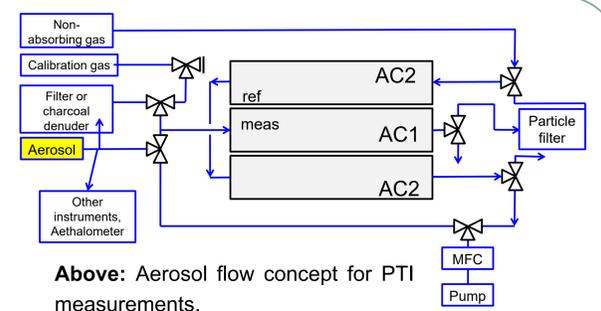
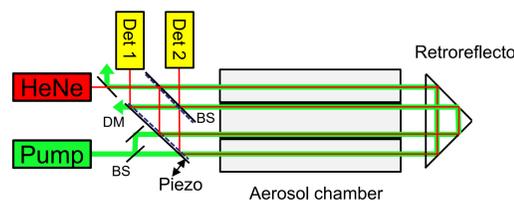
- Carbonaceous aerosols (CA) in the atmosphere affect health, visibility and climate
- Carbonaceous particles are difficult to detect specifically, especially in mixed aerosols
- Established measurements of light absorption by CA are performed *ex situ* (i.e. particles are deposited into filters)
- These methods suffer from large systematic errors caused by the modification of particle properties due to deposition of particles into the filter
- In situ* absorption measurements are free of these artefacts

PTI absorption technique



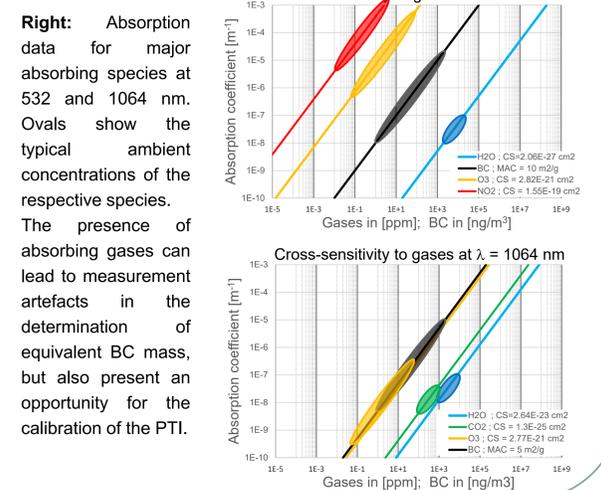
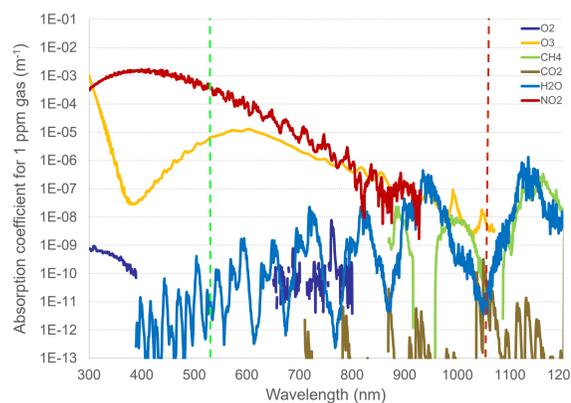
Experiment

- We are currently working on a PTI instrument for the measurement of CA
- Using the PTI technique allows the correction of measurement artefacts, for example light absorption by gases, by incorporating a reference path without CA
- As the measurement is non-resonant, it is possible to extract extra information about the CA from the shape of the heating curves (see below)

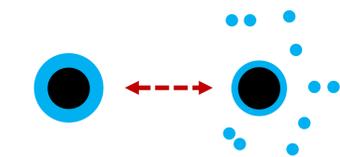


Background gas absorption

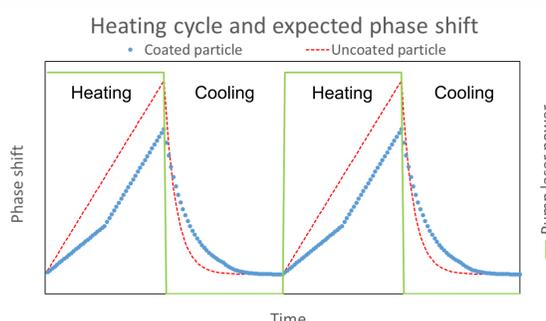
- In addition to CA particles, naturally occurring gases can contribute significantly to light absorption measurements
- The gases must either be removed before the measurement or the light absorption of the gas measured without the CA particles
- As the gases absorb light, they can be used to calibrate the instrument response
- Absorption features of gases are very specific, i.e. there is a large wavelength dependence to the absorption magnitude
- As these absorption magnitudes are well known, PTI has the potential for primary calibration with a gas standard



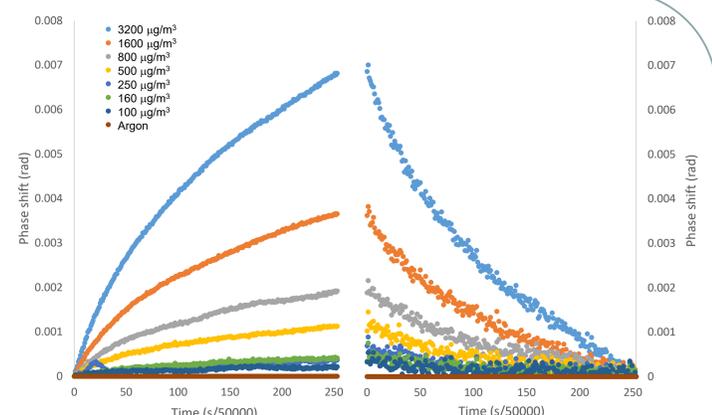
Volatiles and latent heat



Right: The evaporation and condensation cycle changes the phase of the energy release of the aerosol to the surrounding gas. This effect could possibly be measured in PTI measurements by examining the heating and cooling rates at high light intensities.



Heating and cooling cycles



Conclusions

- In situ* absorption measurements of CA can be affected by artefacts arising from light absorption by gases and the evaporation of volatiles
- The gas absorption artefact can be mitigated by careful experimental design
- The shape of the time resolved PTI signal can be used to determine the influence of volatile coatings in *in situ* absorption measurements

References

- HITRANonline database, www.hitran.org, accessed 29.06.2017;
- J. A. Davidson *et al.*, JGR, 93, D6, 7105 (1988);
- J. B. Burkholder and R. K. Talukdar, Geophys. Res. Lett., 21, 7, 581 (1994)

Acknowledgements

