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Atmospheric Measurement Techniques Discussions

Interactive comment on "A single-beam photothermal interferometer for in-situ measurements of aerosol light absorption" *by* Bradley Visser et al.

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The authors thank the reviewers for their time in reviewing the manuscript and their constructive questions and comments. The manuscript will most certainly be improved by implementing the suggested changes. On a personal level, the authors also very much enjoyed the high level discussion of our instrument and PTI in general.

Addressing the specific comments and questions of Anonymous Reviewer #2:

1) The authors acknowledge that the introduction is a little lengthy. It will be reworked slightly for brevity.

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Discussion paper

2) This is indeed a very important requirement for use of the instrument in ambient measurements. Recent tests have shown that the instrument can be operated for more than 24 hours without issue and the future instrument should be durable enough to measure for months on end to fulfil its function as an ambient monitoring instrument. A sentence will be added to the introduction of the manuscript to stress this point.

3) Yes, the authors have investigated the splitting ratio of the beam splitter for various polarisations of the incoming laser beam and have seen a significant dependence of the splitting ratio on the polarisation. This was measured both using a power meter and by determining the contrast of the interferometer. We cannot comment on the wavelength dependence of the beam splitter as all of the measurements were performed at a single wavelength. Subsequent testing has shown that the splitting ratio and polarisation insensitivity is much improved for the 532 nm laser line beam splitter as compared with the broad-band version.

4) The maximum power of the laser is 450 mW. The power employed in the study was 200 mW as at the time the cooling was insufficient to run the laser at higher powers for extended periods. The laser power employed in the study will be added to the experimental section of the manuscript.

5) Thank you for the reference. It will be added to the introduction of the manuscript.

6) Equation 3 is correct. It shows how the differential phase is calculated from the difference of intensities at the detectors divided by the total light intensity.

7) Thank you. The manuscript will be changed for this improved phrasing.

8) Yes, the absolute filter is HEPA grade. The manuscript will be updated to reflect this.

9) The authors accept the recommendation and the lines in question will be moved to the end of the experimental section.

10) The authors intended to bring across the message that the heating curves were not observed to be linear, including for measurements made with heating periods in the

so-called linear range seen in Figure 8. The shapes of the heating curves remained constantly non-linear in this range, however, thus leading to the linear relationship between the PTI signal and the heating time in this range. This section of text will be updated for clarity. Please see also replies to Anonymous Reviewer 1.

11) Filter photometers are calibrated using the mass attenuation cross-section (Gundel et al., 1984). The mass attenuation cross-section is a product of the mass absorption cross-section and the filter multiple-scattering parameter, using the parameterization of Weingartner et al. (2003). Drinovec et al. (2015) have determined the C for the AE33 filter (at that time) relative to the value from Weingartner et al. (2003). Filter photometer response to a complex sample with a high SSA is more complicated (Lee, 2019) – the scattering of the sample affects the measurements (Weingartner et al., 2003; Arnott et al., 2005) and this cross-sensitivity to scattering affects the measurement. This is often measured as a change in the effective (apparent) multiple-scattering parameter, that is the slope between the reference absorption measurement and the filter photometer. We do not observe this effect as the SSA of our aerosol samples is very low.

References: Gundel, L. et al., The relationship between optical attenuation and black carbon concentration for ambient and source particles, Sci. Total Environ., 1984, 36, 197 Weingartner, E. et al., Absorption of light by soot particles: determination of the absorption coefficient by means of aethalometers, J. Aerosol Sci., 2003, 34(10), 1445 Arnott, W. P., et al., Towards Aerosol Light-Absorption Measurements with a 7-Wavelength Aethalometer: Evaluation with a Photoacoustic Instrument and 3-Wavelength Nephelometer, Aerosol Sci. Tech., 2005, 39(1), 17 Drinovec, L. et al., The "dual-spot" Aethalometer: an improved measurement of aerosol black carbon with real-time loading compensation, Atmos. Meas. Tech., 2015, 8(5), 1965

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