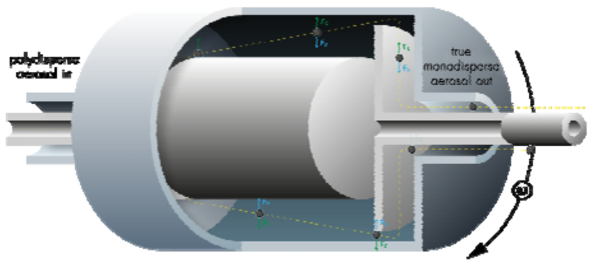
Cite abstract as Author(s) (2017), Title, European Aerosol Conference 2017, Zurich, Abstract T302N56d

Use of the Aerodynamic Aerosol Classifier (AAC) for evaluation of aerosol microphysical and optical properties.

J.D. Allan[1,2], D. Liu[1], M.R. Alfarra[1,2], P.I. Williams[1,2]

[1]School of Earth, Atmospheric & Environmental Sciences, the University of Manchester, M13 9PL, UK
[2]National Centre for Atmospheric Science, the University of Manchester, M13 9PL, UK
Keywords: AAC, photoacoustic, classification, black carbon, optical properties
Presenting author email: james.allan@manchester.ac.uk

The Aerodynamic Aerosol Classifier (AAC) is a new instrument produced by Cambustion Ltd. (Tavakoli et al., 2014). It uses two concentric cylinders and selects particles according to their migration through a particle-free sheath gas in a similar manner to a Differential Mobility Analyser (DMA). However, by rotating the column and using centrifugal rather than electrostatic forces, they are selected according to their aerodynamic, rather than mobility diameter.



A major feature of this instrument is the lack of a requirement for electrostatic charging prior to selection, as is the case with DMAs and mass selectors such as the Centrifugal Particle Mass Analyser (CPMA) and Aerosol Particle Mass analyser (APM). The benefits of this are twofold:

1. Elimination of multiply charged and uncharged particles
2. No reliance on the charging efficiency of the particle size

The use of the instrument in series with another scanning size classification instrument can be used to infer particle microphysical data, as was shown by Tavakoli and Olfert (2014), who used a scanning mobility particle sizer (SMPS). In addition to this, here also show additional methodologies such as using a scanning CPMA with an electrometer as a detector to deliver a similar data product.

One particularly exciting application is the use of this instrument to classify particles prior to measurement of their optical properties, such that size-resolved optical properties can be evaluated. While Liu et al. (2017) evaluated monodisperse NIR properties, visible optical properties were limited to the bulk. Previous experiments using classification by electro-mobility or mass selection have been confounded by the presence of uncharged or multiply charged particles. While methods exist to exclude their influence, it is far more desirable to eliminate these entirely. Furthermore, with photoacoustic instruments employing a single-pass cell such as the DMT Photoacoustic Soot Spectrometer (PASS) (Arnott et al., 1999), signal-to-noise is limited, so it is highly desirable that a classifier delivers as high a throughput as possible.

Here we present our first laboratory test data of AAC classification followed by evaluation by other microphysical and optical instruments, including the CPMA, SMPS, PASS and Aerodyne Cavity Attenuated Phase Shift Particulate Matter Single Scattering Albedo (CAPS PM_{SSA}) (Onasch et al., 2015). Particles tested include atomiser-generated soot analogues and particles from a light duty diesel engine dynamometer rig.

Acknowledgements. This work was supported by the National Centre for Atmospheric Science (NCAS).

References

Arnott, W. P., Moosmuller, H., Rogers, C. F., Jin, T. F., and Bruch, R.: Photoacoustic spectrometer for measuring light absorption by aerosol: instrument description, Atmos. Environ., 33, 2845-2852, 1999.

Liu, D. T., Whitehead, J., Alfarra, M. R., Reyes-Villegas, E., Spracklen, D. V., Reddington, C. L., Kong, S. F., Williams, P. I., Ting, Y. C., Haslett, S., Taylor, J. W., Flynn, M. J., Morgan, W. T., McFiggans, G., Coe, H., and Allan, J. D.: Black-carbon absorption enhancement in the atmosphere determined by particle mixing state, Nat Geosci, 10, 184-188, 10.1038/NGEO2901, 2017.

Onasch, T. B., Massoli, P., Kebabian, P. L., Hills, F. B., Bacon, F. W., and Freedman, A.: Single Scattering Albedo Monitor for Airborne Particulates, Aerosol Sci. Technol., 49, 267-279, 10.1080/02786826.2015.1022248, 2015.

Tavakoli, F., and Olfert, J. S.: Determination of particle mass, effective density, mass-mobility exponent, and dynamic shape factor using an aerodynamic aerosol classifier and a differential mobility analyzer in tandem, J. Aerosol. Sci., 75, 35-42, 10.1016/j.jaerosci.2014.04.010, 2014.

Tavakoli, F., Symonds, J. P. R., and Olfert, J. S.: Generation of a Monodisperse Size-Classified Aerosol Independent of Particle Charge, Aerosol Sci. Technol., 48, I-Iv, 10.1080/02786826.2013.877121, 2014.