

Interactive comment on “Technical Note: The single particle soot photometer fails to detect PALAS soot nanoparticles” by M. Gysel et al.

Anonymous Referee #2

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This paper furthers current understanding relating to the detection efficiency of the single particle soot photometer, which previously appeared to be well understood (Schwarz et al., 2010). The paper describes the interesting result that spark-generated soot particles are poorly detected by the SP2.

This is clearly important for studies using spark soot as a surrogate for atmospheric BC and although, as the authors note, there is no evidence yet of a similar effect in ambient or other chamber data, it is certainly useful to bear this in mind.

While their conclusions of precisely why they have found this result require some further justification, the poor detection efficiency is still a worthwhile result to publish. The details of the experiments are very clear and the written English is generally very good.

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I recommend this paper is published after addressing the following points.

Specific comments

There are 3 explanations for the apparent lack of incandescence by spark soot particles in the SP2:

- 1) Differences in the chemical structure of spark soot prevent it from incandescing efficiently in the SP2 (this is addressed more fully by the other reviewer)
- 2) Fractal spark soot particles disperse towards the edges of the laser beam, thereby experiencing a lower laser power and scatter but do not incandesce
- 3) The spherules in spark soot do not conduct heat efficiently between one another, and vaporise before they reach incandescence temperatures

The first explanation is possible and could be ruled out by collapsing the fractal structure of the soot, for example by condensation of sulphuric acid, then thermodenuding to leave just the collapsed core, then selecting the same mass of particle.

The second explanation has been identified and the authors have attempted to rule it out, however their conclusion does not appear fully justified- it is possible that the larger spark soot particles scatter enough light to be detected efficiently with the PSD but do not incandesce efficiently, whilst the smaller particles, with their smaller scattering cross section, do not scatter enough light to be detected efficiently even with the PSD.

The authors have concluded the third explanation is the correct one through process of elimination, but in light of the above this does not seem fully justified.

It is also surprising that discussion of detection efficiency has not made any reference to coincidence and the duty cycle of the SP2, both of which can greatly affect the detection efficiency of the instrument. It should be noted how much if at all these affected the results, or if the dilution involved in the sampling made them negligible.

Their conclusion that the SP2 is “essentially unable to detect PALAS soot particles with the incandescence detector” is too strong, figures 2 and 3 show the larger particles

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are detectable by the incandescence detectors, just with low efficiency. The title of the paper is similarly too strongly worded, the SP2 does detect PALAS soot particles, but not well.

Technical corrections

The authors make several references to the fact that their result is “surprising” or “unexpected”. While this may be true, the way in which it is currently phrase make this sound like their opinion, rather than a logical conclusion based on previous literature. They should revise their use of these words to make the statements look more based on verifiable facts than opinions.

4906 line 6 several tenths of a femtogram

4907 line 2 climatic not climate

4907 line 5 not just organic carbon, organic aerosol. May be best to just use “nonrefractory aerosol”

4907 line 7-8 Please rewrite these 2 sentences into 1, replace “few years ago” with “recently”

4907 line 20 Remove “to our knowledge” as this is unnecessary, and sounds like you are speaking for people who are not coauthors of this paper

4907 line 24 “we stumbled across” sounds too informal, please rephrase this sentence

4909 line 4 – 12 Please let the reader know whether or not this is the standard SP2 setup and if not what is different.

Reference Schwarz, J. P., Spackman, J. R., Gao, R. S., Perring, A. E., Cross, E., Onasch, T. B., Ahern, A., Wrobel, W., Davidovits, P., Olfert, J., Dubey, M. K., Mazzoleni, C., and Fahey, D. W.: The Detection Efficiency of the Single Particle Soot Photometer, *Aerosol Science and Technology*, 44, 612-628, 10.1080/02786826.2010.481298, 2010.

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