

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2021-436

Anonymous Referee #2

Referee comment on "Characterization of tandem aerosol classifiers for selecting particles: implication for eliminating the multiple charging effect" by Yao Song et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-436-RC2>, 2022

Comments on "Characterization of tandem aerosol classifiers for selecting particles: implication for eliminating multiple charging effect"

This study looks at the potential effects of multiply-charged particles in tandem aerosol instruments such as DMA-CPMA and DMA-AAC systems. The results show that the ability of DMA-CPMA system to resolve multiply-charged particles mainly depends on mass-mobility exponent of fractal aggregates as well as the operational conditions of the instruments. Resolving multiply-charged particles with DMA-AAC system mainly depends on the resolution of instruments. The paper showed that the DMA-CPMA setup is more sensitive to multiple charging effect when particles are smaller or have a lower mass-mobility exponent.

General comments:

Overall, the paper is written well and the methodology used is sound. It is also a timely addition to the literature as various classifiers, such as DMA, AAC, and CPMA, are used in tandem to characterize aerosol particles. The text needs some improvement in terms of English language, grammar, and readability and I recommend that the entire text be checked for these issues. I have some minor comments (see below) that must be addressed adequately before the paper can be accepted for publication.

Specific comments:

- Line 88, Eq. (3): The equation for the transfer function of the DMA in non-diffusing case is not given in the general form. Eq. (3) is only correct when aerosol inlet and aerosol

sampling flow rates are equal (i.e. the DMA is operated in balanced flow mode), leading to $\delta = 0$ in the general form of DMA transfer function [Eq. (7) in Stolzenburg and McMurry (2008)]. This information should be noted in the paper.

- Line 139: The primary reference for the miniature inverted soot generator is as follows, which should be cited in the text: Kazemimanesh, M., Moallemi, A., Thomson, K., Smallwood, G., Lobo, P. and Olfert, J.S., 2019. A novel miniature inverted-flame burner for the generation of soot nanoparticles. *Aerosol Science and Technology*, 53(2), pp.184-195.

- Line 138-140: To reproduce the experiments in this study, it is necessary to give details of propane and air flow rates used in the soot generator.
- Lines 145-155: For one or two mobility-selected particles, please add representative plots for the measured spectral density of mass ($dN/d\log m_p$) and aerodynamic diameter ($dN/d\log d_{ae}$), either in the paper or in the supplementary material.
- Lines 198-199: It states that the ability of DMA-CPMA to eliminate multiply charged particles depends on the resolutions of both DMA and CPMA; however, dependence on the resolution of CPMA is not obvious from Eq. (25). Can the authors clarify this?
- Line 201: The sentence states that a larger β is necessary to reduce the potential of multiply-charged particles, but it seems that Eq. (25) shows the opposite. Can the authors double-check this?
- Line 303: In Fig. 5c and all related figures, the unit used incorrectly for absorption cross section is Mm^{-1} , which is the unit for absorption coefficient (length^{-1}). The correct unit for absorption cross section should be $m^2 \text{ particle}^{-1}$ (derived from absorption coefficient/particle number concentration).
- Lines 306-310: It is not very clear to me why multiple charging effects due to the use of DMA-CPMA would affect the MAC or DRF of soot particles. As far as I understand, global climate models consider a specific (mostly constant) MAC value for black carbon particles to estimate their DRF, without regard for multiple charging. Unless the authors are claiming that the MAC values used in current climate models are grossly incorrect.
- Introduction and discussion section: There are a few recent studies that have looked at tandem measurements of mobility diameter, mass, and aerodynamic diameter to study the effective density and shape factor of spherical and non-spherical particles. These studies have used a combination of DMA, AAC, and APM or CPMA and, in my view, are relevant to this paper and should be mentioned in the introduction and their results discussed where necessary:

- Yao, Q., Asa-Awuku, A., Zangmeister, C.D. and Radney, J.G., 2020. Comparison of three essential sub-micrometer aerosol measurements: Mass, size and shape. *Aerosol Science and Technology*, 54(10), pp.1197-1209.
- Kazemimanesh, M., Rahman, M.M., Duca, D., Johnson, T.J., Addad, A., Giannopoulos, G., Focsa, C. and Boies, A.M., 2022. A comparative study on effective density, shape factor, and volatile mixing of non-spherical particles using tandem aerodynamic diameter, mobility diameter, and mass measurements. *Journal of Aerosol Science*, 161, p.105930.

Editorial and technical corrections (sentences that need to be corrected grammatically):

- Line 41-44.
- Line 49.
- Line 88, Eq. (3): Use the tilde over letter "Z" only, not over "Zp". Correct this in all subsequent occurrences.
- Line 103-104.
- Line 105.
- Line 107: radical à radial
- Line 272: I cannot find Eq. (30) in the paper.
- Lines 279-280: Fig. S2(a) and S2 (b) refer to 100-nm particles. The data for 150-nm particles are shown in Fig. S2(d) and S2(e).
- Line 300: Change to "The method to calculate $PNSD_{ve}$ is described in section S1 of the Supplementary Material."
- Line 301: Change the sentence to "Subsequently, absorption cross section, σ_{abs} , was derived using the absorption coefficient and total number concentration of particles with different charging states."
- Lines 308-310: This sentence is written very poorly (huge amount? huge error?). Please rephrase this sentence and avoid ambiguous adjectives.
- Line 312: Reference to Table 3 should be given in the earlier paragraph (perhaps in line 302).
- Line 318: Severe à noticeable, significant. Leded to à lead to
- Line 324: ... but the method can suffer from multiple charging when decreasing the ...
- Caption of Fig. 2: Subscripts and superscripts in this caption are not typed correctly.