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Atmospheric Measurement Techniques Discussions
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Interactive comment on "A DMA-train for precision measurement of sub 10-nm aerosol dynamics" *by* Dominik Stolzenburg et al.

Anonymous Referee #1

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First, I wish to congratulate the authors for putting together such a complicated battery of state-of-the-art aerosol instrumentation, and also for being able to operate it successfully. The instrument certainly is unique in the field of aerosol research and instrumentation, and deserves to be published in AMT. Prior to publication I have couple of general concerns and a few more technical concerns here and there regarding the manuscript, which need to be addressed.

General:

- The authors claim that high time resolution is the advantage of the current DMA train method to study sub 10 nm particle dynamics, and that existing methods are not sufficiently fast to do the same job. However, based on the manuscript it is not clear what is sufficient time resolution and why, to study the sub 10 nm particles. The time resolu-

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tion of the DMA train itself has not been studied but still the authors make such claims. 1 s mentioned in the text, what is this value based on? Response time is normally measured so that the particle concentration of the sample flow at the instrument inlet rapidly increases from zero to constant value, or similarly decreases from constant value to zero, and from there the 95% values are taken from the CPC readings. If response time of a CPC is $\sim$1 s (3776 and 3788 can be a little faster), I don't believe that the response time of the whole DMA train is 1 s, at least without shown data, due to the sampling lines and the DMA upstream of the CPCs. I am happy to be proven wrong. Also, the introduction severely lacks references prior literature on fast aerosol sizing methods. Clarity on these need to be significantly improved to give the reader the possibility to put the new instrument into context.

- P8-9, what is missing from the instrument characterization is a figure, in which the x-axis is the particle diameter, and y-axis is the "total transmission" or "total detection efficiency" of the DMA train, i.e. all sampling losses, charging efficiency, DMA transmission efficiency and CPC calibration curves combined. With this the reader can appreciate the performance of the instrument and its suitability in various environments with various particle concentrations. Jiang et al. 2011 (45:510–521, AST), Fig2 is a nice example.

Minor:

- P1 l11-13, which gap? PSM-NAIS-DMPS cover size range from 1 nm to 1 um.

- P2 l1-2, aerosol growth is well studied phenomena, please check for example Ehn et al., 2014 and Tröstl et al. 2016, Nature, and lots of other research on the subject.

- P2 l18-19 and l24-25, not strictly true since the calibration always relies on DMA techniques

- P2 l20-21, not true again at least in the case of DMA, see eg. Tröstl et al. 2015 JAS, or Shah et al. 2005 AST, and certainly some other references

- P2 l20-21, what is sufficient time resolution, and why?

- P2 l21-22, this is the case for the DMA train too

- P2 l24-26, the composition dependency is not due to the supersaturation scanning technique but property of heterogeneous nucleation! It is exactly the same case as in using DMA-CPC system if measuring close to the CPC cutoff diameters, which is always the case below 2.5 nm. The difference is just that the single cutoff of the CPC is uncertain, while in the PSM method the range of cutoffs have uncertainties. This of course provides uncertainty in the DMA-CPC method only in the sizes < 2.5 nm, where particle activation cannot be assumed to be 100% for all compositions

- P8 l5-7, (same as above) exactly, however in the sub 2.5 nm size it cannot be done with DEG, which requires a small discussion somewhere in the manuscript.

- P2 l31, please refrain from citing conference abstracts since they rarely available

- P5 l14, please refrain from citing to unpublished work

- P7 eq5, what is diameter offset?

- P7 l26-29, what is the particle composition the manufacturer uses to calibrate the PSM? As shown in Kangasluoma et al. 2013 (AST), silver shows higher cutoff compared to the other test aerosols, so can the deviation from the manufacturer number be due to different particle chemical composition?

- P10 l14-17, it is mentioned that by following the particle growth, the DMA train can follow the growing mode by changing DMA channels. Is it done automatically or manually? Also, Fig9 shows 13 measured size bins but there are only 6 DMAs. P9 l14-18 mention something about linear interpolation. What are the real measured channels with the DMAs and what are interpolated?

- P10 l2-3, this can be observed from the DMPS data too

- P10 l4, concentration agreement is impossible to judge from the given figure.

- P10 l10, to my understanding switching off the electric field do not start ozonolysis

- P10 l21, how do you know that the counts are not background counts? What is the background count rate of the DMA train, especially with the PSMs?

- P11 l4-7, the experiment did not demonstrate 1 s time resolution

- P11 l11, do you mean increase the sensitivity?

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