Atmos. Meas. Tech. Discuss., 4, C3031–C3034, 2012
www.atmos-meas-tech-discuss.net/4/C3031/2012/

Atmospheric Measurement Techniques Discussions

Interactive comment on "The mathematical principles and design of the NAIS – a spectrometer for the measurement of cluster ion and nanometer aerosol size distributions" *by* S. Mirme and A. Mirme

Anonymous Referee #4

Received and published: 14 November 2012

Interactive comment on "The mathematical principles and design of the NAIS – a spectrometer for the measurement of cluster ion and nanometer aerosol size distributions"

by S. Mirme and A. Mirme

General recommendation:

The authors introduced an instrument for measuring nucleation mode aerosol particles. The Nanometer aerosol and Air Ion Spectrometer (NAIS), as the authors call the

instrument, is already widely used in atmospheric measurements. Therefore, this paper is really needed. I recommend publication in AMT. Nevertheless, there are some issues to be resolved, mainly related to updating citations and providing more details, which help understanding of the instrument for the users.

General comments:

-It should be mentioned more clearly what is the size and time resolution of the NAIS? -How are the transfer functions in comparison to other mobility spectrometers? -What are the main advantages and disadvantages of the NAIS? -How are multiply charged particles taken into account in the mathematical model? -What kind of limitations does it cause to the NAIS spectra that the >40 nm size range is not measured? -Is the charging efficiency the same for the both polarities? Which polarity is plotted in Fig. 3? How would the plot look like for the other polarity? -The problematics of the particle mode spectra in the sub-2 nm size range is not really addresed at all. Asmi et al. (2009) and Manninen et al. (2011) reported that the lower detection limit of the NAIS is $\sim$2 nm.

Spesific comments:

Abstract: Why did you change the name of an instrument which is widely already used and several publications are written? The Neutral cluster and Air Ion Spectrometer (NAIS) is already established name for the instrument. In my opinion, changing that name for this instrument is not correct.

Introduction: Page 7406, lines 15 onwards: Citations should be updated when summarizing the current status of sub-3 nm aerosol particle measurements. There are alternative methods nowadays to measure also the size distirbution at sub-3 nm size range e.g. a scanning Particle Size Magnifier (PSM, Vanhanen et al. 2011) and e.g. sudies reported by Jiang et al. (2011a,b) and Kulmala et al. (2012 and reference therein).

Page 7406, line 26: reference to Wiedensohler et al. (2012) paper should be added when the SMPS and DMPS measurements are mentioned. The authors should also notice the importance of this paper as motivation to their work. Wiedensohler et al. (2012) showed that the disagreement between standard mobility spectrometers below 20 nm is significant. Thus, alternative method to measure nucleation mode is needed, such as the NAIS.

Page 7407, lines 4-7: Perhaps you could consider citing a paper by Hirsikko et al. (2011) when talking about different ion measurement. They are well reviewed in that paper. Hirsikko et al. paper should be also mentioned in the last chapter of the results and discussion when talked about ambient measurements with the NAIS.

Methods: Page 7408, line 19: “There are more than ten NAIS instruments in use today.” Please update if needed? Page 7415, line 19: Define what is ARMA?

Calibration methods: Page 7419, line 26-28: Why are the particle losses of the inlet tract not a measurable parameter in the calibration?

References:

Hirsikko, A., Nieminen, T., Gagné, S., Lehtipalo, K., Manninen, H. E., Ehn, M., Hõrrak, U., Kerminen, V.-M., Laakso, L., McMurry, P. H., Mirme, A., Mirme, S., Petäjä, T., Tammet, H., Vakkari, V., Vana, M., and Kulmala, M.: Atmospheric ions and nucleation: a review of observations, Atmos. Chem. Phys., 11, 767-798, doi:10.5194/acp-11-767-2011, 2011.

Jiang, J. K., Chen, M. D., Kuang, C. A., Attoui, M., and McMurry, P. H.: Electrical Mobility Spectrometer Using a Diethylene Glycol Condensation Particle Counter for Measurement of Aerosol Size Distributions Down to 1 nm, Aerosol Sci. Technol., 45, 510–521, 2011a.

Jiang, J. K., Zhao, J., Chen, M. D., Eisele, F. L., Scheckman, J., Williams, B. J., Kuang, C. A., and McMurry, P. H.: First Measurements of Neutral Atmospheric Cluster and 1-2

nm Particle Number Size Distributions During Nucleation Events, Aerosol Sci. Technol., 45, II-V, 2011b.

Kulmala, M., Petäjä, T., Nieminen, T., Sipilä, M., Manninen, H.E., Lehtipalo, K., Dal-Maso, M., Aalto, P.P., Junninen, H., Paasonen, P., Riipinen, I., Lehtinen, K.E.J., Laaksonen, A. and Kulmala, M. (2012) Measurement of the nucleation of atmospheric aerosol particles, Nature Protocols 7, 1651-1667, doi:10.1038/nprot.2012.091.

Manninen, H. E., Franchin, A., Schobesberger, S., Hirsikko, A., Hakala, J., Skromulis, A., Kangasluoma, J., Ehn, M., Junninen, H., Mirme, A., Mirme, S., Sipilä, M., Petäjä, T., Worsnop, D. R., and Kulmala, M.: Characterisation of corona-generated ions used in a Neutral cluster and Air Ion Spectrometer (NAIS), Atmos. Meas. Tech., 4, 2767-2776 , doi:10.5194/amt-4-2767-2011, 2011.

J. Vanhanen, J. Mikkilä, K. Lehtipalo, M. Sipilä, H. E. Manninen, E. Siivola, T. Petäjä & M. Kulmala (2011): Particle Size Magnifier for Nano-CN Detection, Aerosol Science and Technology, 45:4, 533-542.

Wiedensohler, A., Birmili, W., Nowak, A., Sonntag, A., Weinhold, K., Merkel, M., Wehner, B., Tuch, T., Pfeifer, S., Fiebig, M., Fjäraa, A. M., Asmi, E., Sellegri, K., Depuy, R., Venzac, H., Villani, P., Laj, P., Aalto, P., Ogren, J. A., Swietlicki, E., Williams, P., Roldin, P., Quincey, P., Hüglin, C., Fierz-Schmidhauser, R., Gysel, M., Weingartner, E., Riccobono, F., Santos, S., Grüning, C., Faloon, K., Beddows, D., Harrison, R., Monahan, C., Jennings, S. G., O’Dowd, C. D., Marinoni, A., Horn, H.-G., Keck, L., Jiang, J., Scheckman, J., McMurry, P. H., Deng, Z., Zhao, C. S., Moerman, M., Henzing, B., de Leeuw, G., Löschau, G., and Bastian, S.: Mobility particle size spectrometers: harmonization of technical standards and data structure to facilitate high quality long-term observations of atmospheric particle number size distributions, Atmos. Meas. Tech., 5, 657-685, doi:10.5194/amt-5-657-2012, 2012.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 7405, 2011.