Limitations in the Use of Unipolar Charging for Electrical Mobility Sizing Instruments: A Study of the Fast Mobility Particle Sizer - DTU Orbit (01/01/2019)

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A comparison between three different types of particle sizing instruments (fast mobility particle sizer, FMPS; electrical low pressure impactor, ELPI; and scanning mobility particle sizer, SMPS) and one condensation particle counter (CPC) was made to compare instrument response in terms of size distributions and number concentration. Spherical oil droplets in 39 different sizes, with geometric mean diameter (GMD) ranging from 50nm to 820nm, were used as test particles. Furthermore, a characterization of the FMPS unipolar charger behavior was made to analyze the measured size distributions and number concentrations. The results show that all three sizing-instruments agree well for particle sizes below 200nm, both in terms of size and number concentration, but the FMPS deviates clearly when particle sizes exceed 200nm. Above this, the FMPS underestimates the particle size throughout the remainder of the size range, with an apparent upper limit for GMD of 300nm. It also estimates a higher particle number concentration as compared to the other instruments. Analysis of the 22 FMPS electrometer currents and calculation of average number of charges per particle show a diameter dependence of response of [GRAPHICS] for the FMPS unipolar charger. The resulting calculated electrical mobility showed a minimum in mobility for spherical particles at 577nm, which indicates an interfering range of particles above the measurement range, but below the cut-off of the inlet pre-separator (1 μm). The study concludes that particle distributions with a true GMD above 200nm cannot be measured reliably with the FMPS. Copyright 2015 American Association for Aerosol Research

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