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Supplemental Information

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by

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S1. APM transfer function for the parabolic flow model

In the case of the parabolic flow model, $s_1^{\pm}$ are provided by numerically solving the following equation (Ehara et al. 1996)

$$\lambda\left(s_1^{\pm}\right)=\frac{3}{2}\left[1-\rho^2\left(s_1^{\pm}\right)\right]\ln\left[\frac{\rho\left(s_1^{\pm}\right)\mp 1}{\rho\left(s_1^{\pm}\right)\pm 1}\right]+3\rho\left(s_1^{\pm}\right) \qquad \text{(S1).}$$

In this equation, $\rho(s)$ is defined as

$$\rho\left(s\right)=\frac{1}{\delta}\left(\sqrt{\frac{V_{APM}}{s\omega^2\ln\left(r_{2\_APM}/r_{1\_APM}\right)}}-r_{c\_APM}\right) \qquad \text{(S2).}$$

The APM transfer function $\Omega\left(s\right)$ is represented by

$$\Omega\left(s\right)=\left(\rho_0^h-\rho_0^l\right)\frac{\left[3-\left(\rho_0^h\right)^2-\rho_0^h\rho_0^l-\left(\rho_0^l\right)^2\right]}{4} \qquad \text{(S3).}$$

ρ_0^l and ρ_0^h are calculated using the following equation

$$\zeta=\frac{3}{2\lambda}\left[1-\rho^2\left(s\right)\right]\ln\left[\frac{\rho-\rho\left(s\right)}{\rho_0\left(\rho,\zeta\right)-\rho\left(s\right)}\right]-\frac{3}{4\lambda}\left\{\left[\rho+\rho\left(s\right)\right]^2-\left[\rho_0\left(\rho,\zeta\right)+\rho\left(s\right)\right]^2\right\} \text{(S4).}$$

For the regions B and C, ρ_0^l is calculated using equation S4 by substituting $\{\rho,\zeta\}$={-1,1}. ρ_0^h for the regions C and D are similarly obtained using a parameter set of $\{\rho,\zeta\}$={1,1}. ρ_0^h for the region B is 1, and ρ_0^l is equal to -1 for the region D.

References

Ehara, K., Hagwood, C., and Coakley, K. J. (1996). Novel method to classify aerosol particles according to their mass-to-charge ratio - Aerosol particle mass analyser. *J. Aerosol Sci.* 27:217-234.

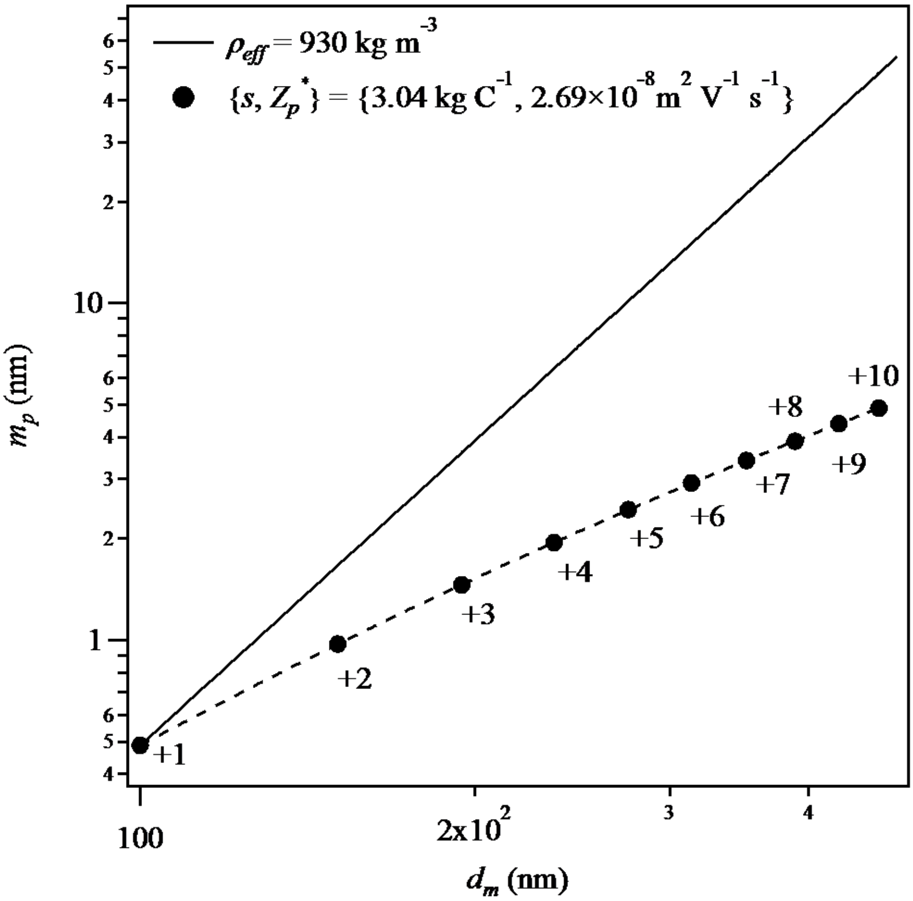

Figure S1. Examples of locations for multiple charged particles. The integers in the figure indicate the number of particle charges. The specific mass *s* and electrical mobility Z_p were fixed at 3.04 kg C^{-1} and 2.69 × 10^{-8} m^2 V^{-1} s^{-1}, respectively. For single charged particles (+1), these values correspond to {m_p , d_c} = {0.49 fg, 100 nm}. The corresponding value of ρ_{eff} for such single charged particles is 930 kg m^{-3}. The distance between the line for ρ_{eff} = 930 kg m^{-3} and the positions of the multiple charged particles tends to be far for highly charged particles. When particles have a narrow population around the line for ρ_{eff} = 930 kg m^{-3}, highly charged particles have a lower chance of being selected by the DMA-APM system due to the longer distance in the $log(m_p)$-$log(d_m)$ space.