***Supplemental Information***

**Development of a toroidal-shaped differential mobility analyzer for effective measurements of airborne particles: Experiment and modeling**

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**Figure S1.** Real picture of the toroidal Hy-DMA and TSI standard long-DMA for size comparison.



**Figure S2.** Positioning of injected particles at the injection line with the different number of segments (*k*) and particles (*Nin*).

In Figure S2, an individual red point indicates a particle. There are two things to recognize on the particle placement at the injection line. First, due to the low flow velocity near the walls, i.e., no-slip boundary condition at the wall, less particles are placed near the walls, i.e., near 0 and 3 mm of the injection distance, compared to the center. Second, due to the highest velocity estimated at around 1.0 mm from the injection starting point (Figure 4a in the original manuscript), resulting in the higher flow rate, it appears that more particles are placed between 0 and 1.5 mm compared to the region between 1.5 and 3.0 mm. This can be seen clearly when there are statistically enough particles at the injection line, e.g., *Nin*=500.



**Figure S3.** Comparison of applied voltages to the toroidal Hy-DMA and the TSI standard long-DMA to classify the same-sized particles.

Since we used the TSI long-DMA to scan the output from the toroidal Hy-DMA, we can compare the applied voltages for classifying central particle sizes. The relation between two voltages are shown in Figure S3. Using the voltage relation we can obtain the particle sizes corresponding to the applied voltages on the Hy-DMA.

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**Figure S4.** Normalized particle concentrations of the toroidal Hy-DMA as a function of (a,b) particle diameter and (c,d) normalized electrical mobility for different sheath-to-aerosol flow rates.