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Comment

## ***Interactive comment on “Electrodynamic balance measurements of thermodynamic, kinetic, and optical aerosol properties inaccessible to bulk methods” by S. S. Steimer et al.***

### **Anonymous Referee #2**

Received and published: 23 March 2015

This manuscript does a nice job of explaining the measurement method and required data analysis to retrieve thermodynamic and some kinetic properties (water diffusivity) from EDB experiments on single levitated particles. They use four different methods to observe changes in the droplet’s size, and refractive index. The high resolution Mie resonance spectroscopy is a nice addition, though it is constrained over a quite small wavelength range, compared to say the cavity resonance enhanced Raman spectrum obtained from aerosol optical tweezers measurements. The data and analysis presented is quite detailed and the method is thorough. The implications and novelty of the measurements obtained from this method and analysis could be made signifi-

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cantly more clear, and this would increase the impact of this paper. While much focus was placed on the final retrieval of the water diffusivity, the obtained results were then barely discussed or put into much context. Measurement of aerosol thermodynamic and kinetic/mass transport properties is certainly of interest to the readers of AMT. I recommend this manuscript for publication after the following questions and comments have been addressed.

I didn't see the vapor pressure or Henry's Law constant of shikimic acid stated in the paper. It should be clear that it has sufficiently low volatility such that evaporation of the organic component is not a large concern here. It would also be good to bring in some discussion of the very nice new method for retrieving organic component volatility and hygroscopicity from aerosol optical tweezers experiments recently described by Cai et al. (2014, 2015).

I felt it wasn't clearly stated that at low RH ("dry") the organic acid/water particle does effloresce, at least I assume that is what is going on. Was a phase change observed, and is this what explains the observed hysteresis? This aspect was not clear in the paper.

Where was RH measured in the system? You could validate the RH probe's measurements this from hygroscopic growth measurement of known salt droplets – use changes in droplet size and refractive index to retrieve water activity and thus RH – have you?

Sect. 3.2: The assumption that  $K$  is a constant. What magnitude of uncertainty does this introduce?

Sect. 3.4.2: Is the value for the diffusivity of water in the pure solute required? If so how did you obtain or deal with this? This aspect was confusing to me.

Sect 3.4.2: This section on the retrieval of water diffusivity just seemed to end in a rather unsatisfactory way. This is a shame as "direct" measurements of water diffusivity

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in particles are rare and valuable. There was virtually no discussion of the actual properties obtained from your analysis, and almost no discussion of the data plotted in Fig. 9. While this is a technical paper focused on the method, some discussion of what the obtained data means and if it is reasonable would certainly help here. Are there any other experimental measurements of water diffusivity in this or related systems to compare to? Or estimates of diffusivity, perhaps from viscosity data and Koop's framework [Koop et al., 2011]?

Figure 9: Adding a second y-axis that estimates equilibration timescale for a given particle size for that value of water diffusivity would be a valuable addition to this figure. Again, the measured water diffusivity values are put into almost no context. What is there significance? This figure is barely discussed in the text.

There seemed to be little discussion of how accurately this technique could measure the desired properties, and a comparison to the abilities of other techniques. See for example the paper by Mason et al. (2012). Please add more discussion of the accuracy/uncertainties in the measured properties using your methods, and how these compare to other methods.

Page 695, line17: typo, "being"

Page 697, line 7: typo, "were"

Page 702, line 6: missing word, "This mainly"

#### Cited References

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 689, 2015.

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