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Interactive comment on “Estimating collision efficiencies from contact freezing experiments” by B. Nagare et al.

Anonymous Referee #3

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The authors describe a novel experimental approach to measure the collection efficiency of aerosol particles by falling droplets. By using silver iodide particles, which are potent ice nuclei, it is assumed that at low enough temperatures, collection of a single aerosol particle leads to contact freezing with a probability of unity. From the observed frozen fraction of droplets, the authors deduce the collection efficiency under the given geometrical constraints. Under the geometrical constraints of their setup and for a given droplet and particle diameter, they find an collection efficiency which is almost one order of magnitude above the various theoretical formulations that are used for comparison. From this finding the authors conclude that the collision efficiency between droplets and aerosols, which is crucial for contact freezing and aerosol scavenging may be underestimated in current models

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I consider these skillful experiments to be a clever and novel approach to tackle the notoriously difficult problem of measuring collection efficiencies between droplets and aerosol particles. The presentation is very good and the work fits very well in the scope of ACP. The conclusions seem somewhat premature however, as the current theoretical descriptions of aerosol scavenging are proven and tested over many years. They should not be dismissed by a single experiment without assessing all possible experimental issues with care. In this respect, I feel the manuscript falls short and I like to ask the authors to improve it.

The most manifest (list may not be exhaustive) issues that come to my mind are: 1. Are all particles silver iodide? What about potassium nitrate contaminations or coatings? If a fraction of the particles were poor ice nuclei the analysis would have to be modified considerably.

2. What is the geometry of the silver iodide particles (is their effective density lower than bulk density?) Electron microscopy of collected particle samples may answer both questions. 3. Droplets are falling in the wake of the previous droplets, which may have depleted the aerosols on their track. 4. Droplet charge is crucial here. From the description of how it was measured, it might be that the voltage of the deflection plates induces charges on the droplets which might not have been there during the experiment. It would be very important to measure the charge on the droplets during the experiment. (This might be possible using an induction –tube)

Additional points that should be addressed: It would be very desirable having measurements at more aerosol particle sizes. In my understanding this would mean only to set the DMA to a different voltage? Has this been done, what are the results? Why is the discussion centered around a temperature of 261K if the experimental data are derived from measurements at $T < 245\text{K}$?

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 12167, 2015.

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