Interactive comment on “Characterization of an aerodynamic lens for transmitting particles > 1 micrometer in diameter into the Aerodyne aerosol mass spectrometer” by L. R. Williams et al.

Anonymous Referee #1

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In their manuscript “Characterization of an aerodynamic lens for transmitting particles > 1 micrometer in diameter into the Aerodyne aerosol mass spectrometer” Williams and coworkers describe the development and characterization of a new aerodynamic lens and aerosol inlet system for the Aerodyne aerosol mass spectrometer (AMS). The Aerodyne AMS has developed into a standard instrument for chemical aerosol analysis within the last decade. However, still one of the major limitations of this instrument is the limited particle size range that can be measured with the standard aerosol inlet setup. Especially the cut-off for particles larger than ~700 nm inhibits the measurement of true PM1 aerosol composition. After many years of development of an aerosol inlet system that enables the AMS to measure particles up to sizes significantly larger than one micrometer, here finally such an inlet system and its characterization are presented. Since the measurement of aerosol particles up to more than one micrometer with the AMS enables not only the true PM1-size range measurement with this instrument but also a measurement of other particle types like a large fraction of biological aerosol particles and in addition allows the measurement of the whole accumulation mode without truncating the larger particle size tail, this development is a very relevant innovation for the whole aerosol measurement community. The manuscript is written very clearly and easy to follow without lengthy passages or incomprehensively short passages. The measurements as well as the results are clearly presented. Besides several minor details I find only one major shortcoming in the manuscript: It is known – and this is also indicated in the text - that work on such a “high pressure lens” for the AMS was ongoing for many years with several copies of the assembly working rather well and others not performing as desired. In their manuscript Williams and coworkers describe in the “Machining the high pressure lens” section how they improved the machining process in order to better reproduce the production of well-working lenses. Still they have to admit that out of five copies of the lens only two generate a satisfactory deposition pattern, i.e. focus all particles into the same direction. This shows that machining is still an issue. Therefore it would be desirable that the authors present data that show that “good” lenses (i.e. the two out of the five) are able to reproduce the transmission properties as shown in Figure 5 for one single copy of the lens. Only if the reader can be convinced that it is reliably possible to produce aerodynamic lenses with all the desired features reproducibly this advancement becomes really relevant to the large number of potential users of this device. Therefore after including this information and taking care of the other very minor issues I suggest publishing this manuscript in Atmospheric Measurement Techniques.

Specific comments: P5035L3/4: “…that transmits particles between 80 nm and more than 3 μm in diameter.” This was also true for the standard AMS lens, however with very little efficiency. It would be desirable if a statement would be added how well
particles were transmitted.
P5035L15: Here are several references to papers from the same or almost the same
P5035L22-25: The logic of the sentence is not completely correct. The collection
P5036L3: Indicate how efficient the standard lens transmits particles in this size range.
P5036L18: "microns": slang
P5036L1921: The introduction of a relaxation chamber behind the critical orifice was
P5037L4/5: The Stokes number is the ratio of particle stopping distance to a character-
P5038L3ff: It would be desirable if the process how the authors came to the current
P5039L2: “This inlet distribution . . . “: please be more specific of which variable is
P5040L17: “. . . residence time in lens system . . . “ → “. . . residence time in the lens
P5041L8/9: Are the continuum assumptions implicit in the CFD software not “strictly
P5042L23: Shouldn’t it be “effective particle density” instead of “material density”?
P5043L18: The lower limit of 100 nm for particles to be detectable with an ion burst
P5045L7: “Experimental particle velocities were determined . . . “: Laboratory slang
P5046L21: “. . . can select larger dm’s than . . . “: Laboratory slang
P5046L28: Why is the uncertainty of the AMS ion count (+/- 500 Hz) a constant number
P5048L13-22: The order the information is presented in this paragraph is somewhat
C1767
P5049L11: It would be helpful in this context if at any place the SN of the lens which was used for the measurements presented in Fig. 5 would be provided.

P5049L24: Was the SN10 Lens re-aimed for every particle size individually or was it necessary to re-aim it just once? Please be more specific.

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