Reviewer's comments

A High Speed Particle Phase Discriminator (PPD-HS) for the classification of airborne particles, as tested in a continuous flow diffusion chamber by Mahrt et al. [**AMT-2019-36**]

Page and line numbers refer to submitted manuscript (22 February 2019)

General comments:

The authors present a new method to characterise the particle phase of hydrometeors using a novel light scattering instrument and machine learning algorithm. This represents a promising advance in studying mixed phase cloud microphysics since particle phase can be determined from scattering parameters independent of the particle size. The utility of the method is demonstrated using different conditions in a CFDC to generate liquid droplets, ice crystals, and mixtures.

The manuscript is very well written and scientifically sound. I recommend that it is suitable for publication in its present form, however I have a few minor suggestions for the authors to consider, listed below. I think there is great potential for more detailed investigations of cloud microphysics with this technique, and look forward to (hopefully) future measurements of mixed phase clouds in the atmosphere. I would also like to commend the authors on the excellent documentation, data, and explanations of their methodologies and measurements provided.

Specific comments:

P5 Fig1: I would suggest clarifying that the light orange and brown shading denote *detected* light from the trigger and image laser beam.

P6 L9: Can you provide an estimate of the azimuthal angle range of detected light?

P6 L6-9: What is the purpose of L4-L5?

P6 L11-12: Was saturation of the CMOS arrays ever problematic

P9 L1-4: Since $\varDelta TBC$ is later determined to be a key value, perhaps it is worth mentioning it here.

P11 L3-4: Where/how were temperature and relative humidity measured?

P14 Fig5: I believe the minimum value on the x-axis should be 1μm instead of 0.1 μm.

P16 L22-23: Can you comment on why the machine learning algorithm would classify particles as aspherical (e.g. Fig8 39,46,74) with lower TBC and AIC values than particles classified as spherical (e.g. Fig8 29, 57, 41)?

P17 L34: Can you offer an explanation for the trimodal appearance of the AIC values for the 243K NH_4NO_3 case (Fig 10d)?

SI P4 FigS4: It would be helpful to have *RTe* and *RAWe* defined in the caption (presumably real-time electronics board and raw sampling electronics?).

SI P6 FigS6: "*2 μm*" instead of "*2 mum*"

SI TableS1: A minor suggestion, it would be helpful to have the data sets used in FigS12 highlighted by bold or coloured font.