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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of particle size and shape on the backscattering linear depolarisation ratio of small ice crystals – cloud chamber measurements in the context of contrail and cirrus microphysics" *by* M. Schnaiter et al.

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General comments:

The polarization lidar technique is largely used to investigate characteristics of atmospheric aerosols and ice clouds. That technique is well suited to distinguish layers of spherical and non-spherical particles. Moreover, it can be used to separate profiles of different types of particles (see, e.g., [1]). At the same time, the interpretation of lidar data depends on the used a priory values of the depolarization ratio. Thus, measure-

ments of the depolarization ratio are of particular importance when they are performed under controlled laboratory conditions and accompanied by a set of other experimental data.

The discussion paper is well structured and written. In my opinion, it would be a good example to follow (an example of a paper devoted to measurement techniques) if estimations of uncertainties were provided. The experimental setup, the calibration procedures, and the employed devices are rigorously described.

The obtained results are of importance and can be used in atmospheric implications.

I recommend that the paper be published in ACP after minor revisions.

Specific comments:

1) Please, provide estimations of uncertainties or relative uncertainties (at least of the backscattering signals and the depolarization ratio) using the standard "JCGM 100:2008" [2, Ch.5].

2) Figure 5.

It is difficult to understand why the random noise is so large (about ± 0.03) in the most favorable conditions of measurements (signals from a special scattering target).

It could be hypothesized that the coherence length of the laser light is so large that an interference pattern (speckle structure) affected the measurements. If this is the case then the light source (Sapphire 488LP) should be replaced in the future because the same level of the random noise is seen in Figs. 8 – 10. For example, high-power multimode laser-diodes are compact and have good operating characteristics.

3) Page 15464, lines 16 - 18.

The ratio S22/S11 can be deduced from SIMONE measurements. Please, underscore that it is deduced for the scattering angle of 178.2° (not of 180°).

4) Page 15469, Figures 6 and 8.

The residual depolarization ratio of 0.02 - 0.03 for the cases of a supercooled liquid cloud and cloud droplets give impression of a systematic bias that also affects the other reported experimental data. This leaves some doubts about the accuracy of the modeling and the values of the actual detection angles because, generally speaking, systematic biases may affect crucially retrieval results when an inverse problem is ill-posed.

5) Page 15469, line 2. Please, provide the definition of the term “scattering ratio”, which is largely used in the text and the figures.

6) Panel (f) in figures 9 - 10. There are time intervals where the modeled depolarization ratios are largely different from the measured absolute values.

The extinction spectroscopy (FTIR retrievals) is mainly sensitive to the spectral dependence of the refractive index and to the averaged projection area of particles. Variations of the exact shape of particles, the roughness of their surface, and internal inclusions practically do not affect FTIR data.

To the contrary, phase functions and polarization parameters are very sensitive to the listed above characteristics. I believe that AIDA retrievals can be improved in the future by using more sophisticated algorithms like [3] when experimental data from different types of sensors are taken into account.

References.

1. Tesche, M., Ansmann, A., Müller, D., Althausen, D., Engelmann, R., Freudenthaler, V., and Groß, S.: Vertically resolved separation of dust and smoke over Cape Verde using multiwavelength Raman and polarization lidars during Saharan Mineral Dust Experiment 2008, J. Geophys. Res., 114, D13202, doi:10.1029/2009JD011862, 2009b.

2. JCGM 100:2008. Evaluation of measurement data âĂŤ Guide to the expression of uncertainty in measurement. (see URL:

http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf last access: July 2012)

3. Dubovik, O., A. Sinyuk,T. Lapyonok, B. N. Holben, M. Mishchenko, P. Yang, T. F. Eck, H. Volten, O. Muñoz, B. Veihelmann, W. J. van der Zande, J-F Leon, M. Sorokin, and I. Slutsker: Application of spheroid models to account for aerosol particle nonsphericity in remote sensing of desert dust, J. Geophys. Res., 111, D11208, doi:10.1029/2005JD006619, 2006.

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