Detecting oriented dust with novel polarization lidar

Alexandra Tsekeri[a,*], Josef Gasteiger[b], Volker Freudenthaler[c], Joseph Ullanowski [d], Michael Kottas[a], Vasiliki Daskalopoulou[a,e], and Vassilis Amiridis[a]

[a]*Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Athens, Greece*
[b]*Faculty of Physics, University of Vienna, Vienna, Austria*
[c]*Fakultät für Physik, Meteorologisches Institut, Ludwig-Maximilians-Universität, Theresienstrasse 37, 80333 Munich, Germany*
[d]*School of Physics Astronomy and Mathematics, University of Hertfordshire, Hatfield AL10 9AB, UK*
[e]*Department of Physics, Faculty of Astrophysics and Space Physics, University of Crete, Greece*

[*]*Presenting author (atsekeri@noa.gr)*

Dust orientation is an ongoing investigation in recent years [1]. Its potential proof will be a paradigm shift for dust remote sensing, invalidating the currently used simplifications of randomly-oriented particles. Dust orientation can be directly measured with a polarization lidar designed to target the off-diagonal elements of the backscattering matrix which are non-zero only when the particles are oriented [2]. Scattering calculations of realistic-shaped oriented dust particles are needed for designing this novel polarization lidar and further utilizing its measurements in advanced oriented-dust microphysical property retrievals. Currently there is no complete solution for calculating the scattering properties of the whole range of dust sizes, shapes and refractive indices. The Amsterdam Discrete Dipole Approximation (ADDA) [3] has been proven to adequately reproduce the backscattering properties for irregular-shaped dust particles with size parameters smaller than 20 [4]. For larger sizes ADDA calculations are challenging, due to high computational cost [3].

We present the preliminary design of our novel polarization lidar system based on first results of ADDA scattering calculations for irregular-shaped oriented dust particles with size parameters up to 50.

References

[1] Ulanowski, Z., J. Bailey, P. W. Lucas, *et al.*, 2007: Alignment of atmospheric mineral dust due to electric field. *Atmos. Chem. Phys.* **7**, 6161–6173.

[2] Geier, M., and M. Arienti, 2014: Detection of preferential particle orientation in the atmosphere: development of an alternative polarization lidar system. *J. Quant. Spectrosc. Radiat. Transfer* **149**, 16–32.

[3] Yurkin, M. A., and A. G. Hoekstra, 2011: The discrete-dipole-approximation code ADDA: capabilities and known limitations. *J. Quant. Spectrosc. Radiat. Transfer* **112**, 2234–2247.

[4] Gasteiger, J., M. Wiegner, S. Groß, *et al.*, 2011: Modeling lidar-relevant optical properties of complex mineral dust aerosols. *Tellus B* **63**, 725–741.

Preferred mode of presentation: Oral/Poster