MSc project: Spectropolarimetry of aerosols

Background
Aerosols of natural or human-made sources play an important role in climate, health, and the economy. Aerosols modify the balance of energy by absorbing and scattering solar radiation, they can cause smog and respiratory diseases, or disrupt air traffic. Their effects depend on their size, shape, and composition, which are difficult to measure at large scale.

Recent advances in *spectropolarimetry*, the analysis of frequency and polarization state of light, make possible the development of compact instruments for precise measurements of the most important properties of aerosol particles from a remote sensor on Earth's surface.

Task description
The project seeks to study basic concepts behind the measurement of aerosols properties by analyzing the state of polarization of sunlight scattered by aerosol particles. From this analysis the student will study different configurations of instruments using novel techniques such as polychromatic and spectral modulation polarimetry, which have been successfully demonstrated on research of Earth's and other planets' atmospheres. The thesis will be concluded by building and demonstrating the capability of a prototype to measure spectral aerosol optical depth and parameters of the size distribution of a real-world sample.

The project outcomes have a large potential to be useful on astronomical, atmospheric, biological, and industrial applications. It will open a new and exciting line of research in our group.

Required education and potential course requirements
The student should have basic knowledge and strong interest in the physics of light-matter interaction, spectroscopy, optics, electronics, and programming. This project will offer a good balance between fundamental theory and experimental research. The student should be motivated and target-oriented and have interest in environmental applications of basic science.

Credits
This project will offer 30 or 60 credits, depending on scope of the project, and the balance between model development and experiment, to be discussed with the supervisor.

Starting time
The project can start on 1 March 2021.

Reference literature
Snik, F. et al., An overview of polarimetric sensing techniques and technology with applications to different research fields, Proc. SPIE 9099, Polarization: Measurement, Analysis, and Remote Sensing XI, 90990B, 2014, https://doi.org/10.1117/12.2053245

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