Polarimetry as a tool for studying planets and their atmospheres

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While the direct light of a star like the Sun can be assumed to be unpolarized (integrated over the disk), starlight that is scattered by gases and aerosol particles in a planetary atmosphere or that is reflected by a planetary surface is generally polarized. The degree and direction of polarization of the scattered and reflected starlight depends, besides on the illumination and viewing geometry, on the optical properties of the atmospheric constituents, on the reflection properties of the planetary surface, and on the wavelength of the light. In particular, the polarization appears to be much more sensitive to the microphysical properties of the atmospheric aerosol particles than the commonly measured flux is. The "power of polarimetry" for remote-sensing of planets has been recognized decades ago, e.g. with the accurate determination of the composition and sizes of Venus' cloud particles (Hansen&Hovenier, 1974). Polarimetry is, however, still not routinely added to planetary missions, probably mainly because people are unfamiliar with it. In this presentation, we will (1) present the "power of polarimetry", using examples for various planets, including exoplanets, (2) describe polarization measurement methods and achievable accuracies, (3) briefly discuss the errors in fluxes that are measured with polarization-sensitive instrumentation, and (4) show our plans for a polarimeter for studying Martian dust from orbit.