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Polarisation measurements with Voyager and Cassini

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The Voyager 1 and 2 missions to the outer planets carried a Photopolarimeter instrument, and the Cassini Imaging Science Subsystem includes linear polarisers to make polarisation images of Jupiter, Saturn, and its moons and rings. The Voyager 1 Photopolarimeter instrument failed before Jupiter encounter but the Voyager 2 instrument returned polarimetry data from Jupiter, Saturn, Titan, Uranus and Neptune at two wavelengths (240 nm and 750 nm), extending previous Pioneer polarisation measurements in wavelength and scattering angle. Its most important contribution to polarisation science came at Titan. The combined polarisation information from the Pioneer 11 IPP instrument, Voyager 2 PPS, and photometry from the Voyager cameras, led to the conclusion that the haze particles in Titan's atmosphere are aggregates of much smaller particles ($\sim$60 nm radius). This idea is now the paradigm for the morphology of the Titan haze particles. Observations by the Cassini ISS extended this finding to the polar haze of Saturn which is also highly polarizing, as is Jupiter's polar haze. An auroral mechanism is implicated. The Cassini polarisation measurements can be combined with passband filters to sample from the near-UV to the near-IR, including the narrow methane absorption bands. Outside of the polar regions, for both Jupiter and Saturn, the polarisation of the upper tropospheric clouds is quite low as expected from ice crystals larger than the wavelength. Polarisation measurements in those regions help define cloud altitudes from the signature of the overlying Rayleigh scattering by gas molecules. The Cassini polarisation images of icy satellites show correlation with surface albedo as expected if multiple scattering in surface grains is damped out for absorbing surfaces. This abstract was prepared by the Jet Propulsion Laboratory, California Institute of Technology.