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Optical reflectance polarimetry of Saturn's satellites Tethys, Dione, Rhea, Iapetus, and Titan.

I.Kulyk(1), K.Jockers(2)

(1) Main astronomical obsevatory, NAS of Ukraine, (2) Max-Planck-Institute for Solar System research [leda@mao.kiev.ua]

The opposition effects of brightness and polarization observed in atmosphereless solar system bodies have recently found increased attention from the point of view of light scattering in random media and the possibility to derive properties of the regolith presented on these bodies. Of particular interest is the appearance of a second narrow minimum of polarization, so far observed only in very few bodies, at phase angles $< 1ˆ{\circ}$ besides of a broad minimum of negative polarization at larger angles. The two minima may be related to the size and average distance of scatterers located on an otherwise rather smooth surface. In order to enlarge the amount of observational material of brightness and polarization of atmosphereless solar system bodies observed at small phase angles we present here observations of the icy Saturnian satellites Tethys, Dione, Rhea, and the dark side of Iapetus. For comparison we also observed Titan's atmosphere.

The observations were made on 5-14 January 2005 in the phase angle range from 0.7 to 0.03$ˆ{\circ}$. The 2-m RCC telescope at Rozhen observatory (Bulgarian Academy of Science) with two-channel Focal Reducer was used. A Wollaston prism was introduced into the optical path to split the incoming light in two beams with parallel and perpendicular polarization. The Stokes parameters Q and I were measured. A coronagraph setup with Lyot stop reduced the bright glory of Saturn and its rings. In order to study the opposition effect in a wide wavelength range, filters with effective wavelengths 431 nm, 669 nm, and 889 nm (methane absorption band) were used. In the red filter the satellite Iapetus shows a narrow polarization minimum of -0.5 ± 0.2 \%. We did not find significant negative polarization near the opposition for the icy satellites Tethys, Dione and Rhea. Instead their phase curves of polarization are similar to laboratory measurements of different kinds of snowy surfaces.