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Galileo PPR Polarimetric Phase Curves for the Galilean Satellites

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Abstract:

The Galileo Photopolarimeter Radiometer (PPR) has made polarimetric observations of the Galilean satellites to 130° phase angle. Earth-based observations are limited to phase angles $< 12^\circ$.

We present preliminary polarization vs phase curves for the four satellites, along with unpublished data from the Pioneer 10 and 11 Imaging Photopolarimeter and Earth-based data. Observations of the Moon obtained during the 1990-92 Galileo Earth encounters serve for validation and comparison.

At 678 nm, Ganymede and Callisto show phase curves similar to the Moon, but with a maximum near 90° phase of 4-5%. Europa's maximum polarization is less than 2% with a negative branch at $90-100^\circ$ phase. Io is particularly interesting, with $< 1\%$ positive polarization near 20° , negative 1% polarization near 45° , increasing positive polarization beyond 60° , with a maximum of 3% at 130° .

PPR measurements at 410 and 945 nm wavelength show only weak wavelength dependence of the polarization. There is a trend towards larger polarization for the 410 nm band, where albedos are lower than at 678 nm.

The Galilean satellite surfaces are very heterogeneous in albedo and terrain types. The PPR data varies in spatial resolution from disk-integrated observations used to sample some phases, to 100 km and better resolution "maps" acquired by sweeping the PPR for over a portion of the disk during targeted encounters. This initial phase curve study is the first step of an iterative process attempting to establish the phase angle dependence of the polarization of the varied terrains on the Galilean satellites. Future work will analyze the spatially resolved PPR data to assess the degree of variation between terrains at specific phase angles.