THE "SWARM" MODEL FOR THE AZIMUTHAL BRIGHTNESS VARIATIONS IN SATURN'S RING A

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Abstract

A number of researchers have observed asymmetric azimuthal variations in Saturn's ring A not seen in any other portion of the rings. In order to explore this effect, photometric observations of the ring system at four ring tilts (B (TURNEQ) 6(DEGREES), 11.5(DEGREES), 16.5(DEGREES), 26 (DEGREES)), four colors (red, green, blue, UV) and a range of phase angles (0.1(DEGREES) < (alpha) < 4(DEGREES)), are presented and analysed. These images are calibrated, converted in ring plane coordinates, and corrected for smearing. The azimuthal effect appears to reach a maximum 40% peak-to-peak variation at a tilt angle near B = 11.5 (DEGREES), with a minimum brightness occuring at an orbital phase angle of (theta)(,0) = 66(DEGREES) (+OR-) 2(DEGREES). Phase curves for the rings, and major axis ring profiles are also presented. The azimuthal variations are modelled by ellipsoidal swarms caused by gravitational interactions between ring particles. Monte Carlo routines are developed to handle the light scattering properties of triaxial ellipsoids, both for surface (e.g. asteroidal) scattering, and interior scattering. The contribution of backscattered light from the swarms, and from an interswarm medium are separated, and model ellipsoids are compared to the data. The best matches appear to occur for optically thick ellipsoids with axial ratios greater than 4.5, and a relatively high single scattering albedo, (omega) (,0) = 0.8. The optical thickness of the interswarm medium is about (tau) (,0) = 0.40 (+OR-) 0.05. The ring particles are assumed to scatter like Lambert spheres. As seen from above, the swarms cover 30-40% of the surface area of the inner ring A.^

Subject Area

Physics, Astronomy and Astrophysics