7.04

ASTROMETRIC OBSERVATIONS OF HELENE(SXII), TELESTO(SXIII), AND CALYPSO(SXIV).

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These three moons were discovered in 1980 in ground-based observations made at the ring-plane crossing. Helene(SXII) is the L4 librator in the Dione/Saturn system while Telesto(SXIII) and Calypso(SXIV) are the L4 and L5 librators in the Tethys/Saturn system.

We have observed these satellites during the 1992 apparition of Saturn with the USNO 61-inch astrometric reflector and a CCD. Special techniques were used to refer the faint satellites to the brighter ones and the trail/scale method was used to reduce the observations. The observations are compared to an ephemeris, and the accuracy of the ephemeris, as well as of the observations are discussed.

7.05

Numerical Exploration of the 4:3 Resonance in the Elliptic Restricted Problem

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The orbits of 1071 fictitious asteroids were integrated numerically spanning approximately 85000 years in an effort to investigate the structure of the 4:3 mean motion resonance. The orbits were classified as chaotic or regular based on the largest Lyapunov characteristic exponent. The equations of motion of the planar restricted three body problem were regularized in order to handle close encounters with Jupiter. The initial eccentricity and semimajor axis were chosen to fill a grid between 4.23 and 4.43 A.U. The initial mean motion, and argument of perihelion were set to zero. From the 600 survivors, a limited sample was chosen to study the possible dynamical protection mechanisms present. The libration of the critical argument was observed for most of these objects. The maximum eccentricity of an orbit during the integration is also noted. Based on the estimate of the largest Lyapunov characteristic exponent, the resonance seems to be mostly chaotic. However, longer integration of individual orbits (10^6 years) indicates that large Lyapunov characteristic numbers are not reliable predictors of unbounded motion in the elliptic restricted three body problem.

7.06

Galactic Oscillations can produce Velocity Maps that look Warped

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Velocity maps of disk galaxies almost never look like purely planar, circular flows; other velocity components disturb the symmetries expected of such an idealized system. Traditionally many of these distortions have been interpreted in terms of warped disks, both because of an historical bias against steady-state radial motions and because of the indisputable fact that many disk galaxies are indeed warped—the evidence from edge-on observations alone is sufficient proof of this. However, numerical experiments indicate that galaxies oscillate in normal modes with surprisingly large amplitude. Neutral hydrogen is carried inward and outward by the oscillations. In addition to its usual circular motions, those radial velocities produce velocity signatures similar to those of warped disks. Given this, we investigate the extent to which kinematic observations of disk galaxies can be interpreted in terms of planar disks with a radial flow component, rather than as warped disks with purely circular flows. Some features of observed velocity fields imply unphysical restrictions in the warp picture while they follow naturally in the oscillations picture. We have checked whether these features might be selection effects in the observations and conclude that they are not. Examples of velocity fields driven by oscillations will be shown and compared with observed velocity fields and with velocity fields synthesized from the warp picture.

8.01

The Long Term Motion of Comet P/Swift-Tuttle

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The orbit of P/Swift-Tuttle is investigated by way of a long term integration forward to +2392 and backward to -702. The initial conditions used in the integration are determined from observations obtained at the 1992-93, 1862 and 1737 returns. Two of its previous apparitions in +188 and -68 prior to the telescopic period are identified in Chinese records. No other early observations of P/Swift-Tuttle have been found. Our successful integration is consistent with all the observed returns of the comet. The unobserved returns between 188 and 1737 are easily explained as the comet did not approach the Earth closely enough to allow naked eye visibility. Our integration and the observing conditions at each return suggest that the comet has maintained about the same intrinsic brightness for more than two millennia. Our prediction of the comet's return in 2126 places it well away from the Earth's position at the nodal crossing. The minimum Earth distance in 2126 will be 0.153 AU. This work was supported by NASA Planetary Geology and Geophysics Program.

8.02

The Orbits of the Outer Satellites of Jupiter

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We have integrated the orbits of all eight of the irregular satellites of Jupiter (J8 through J13) for 50,000 years forward and backward in time from the present epoch. The purpose of these integrations was to make the first investigation of the long-term dynamics of these unusual satellites. The existence of eight such satellites is an extremely fortuitous occurrence since they allow us the opportunity to compare and contrast the different orbits. For example, we have found that, among the retrograde satellites, the variable $\nu = \Omega' - \omega' - \Omega - \omega$ librates in the case of Pasiphae (J8) but circulates (in opposite directions!) in the cases of Carme (J11) and Ananke (J12). Here Ω, Ω', ω, and ω' are the longitudes of the ascending node and the arguments of periapse of Jupiter and the satellite, respectively. Sinope (J9) appears to be right at the boundary between these two types of behaviors since, for it, ν alternates between circulation and libration in step with the long-period variations in Jupiter's rate of perihelion precession. The direct satellites display their own, unique variety of locking between their eccentricity and longitude of periapse, relative to Jupiter's longitude of perihelion.