Geometry of Retrograde Stable Capture Zones for Tidal Capture of Satellites by Planet Neptune.

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A three-body (sun, planet, planetoid) numerical simulation program is used to determine the two-dimensional extent of retrograde Stable Capture Zones (SCZ) for tidal capture of a triton-like planetoid encountering a neptune-like planet. The mechanism for capture is dissipation of tidal energy within the body of the encountering planetoid. The computer program uses a 4th-order Runge-Kutta integration scheme and has an energy dissipation subroutine which operates within 20 neptune radii (R_n). The major variables in the calculation are (1) the displacement Love number (h) for the planetoid, (2) the specific dissipation factor (Q) for the planetoid, (3) the eccentricity of the planetoid's orbit, (4) the planet anomaly (initial position of the planet in its orbit), and (5) the planetoid anomaly (the initial position of the planetoid relative to the planet). The constant values for this set of calculations are (1) a circular planet orbit, (2) a set of Q values for the planetoid ($Q=1$ for the initial encounter and $Q=10$ for all subsequent encounters), (3) a pericenter radius of 1.10 R_n for the initial encounter of an encounter sequence, (4) an initial distance of separation of 15,000 R_n (well beyond the limits of the Hill sphere for planet neptune), and (5) the h of the planet is 0 (no energy dissipation in the planet).

The only stable capture orientations are when the major axis of the orbit at the time of close encounter is nearly parallel (within a few degrees) to the tangent of the planet's orbit. There are SCZ's for capture from orbits that are both somewhat larger and somewhat smaller than neptune's orbit.