Orbital Motion in Outer Solar System

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Motion of a point mass in gravitational fields of the Sun and of the galactic disk is studied. Fundamental features of the motion are found by investigating the time-averaged differential equations for orbital evolution. Several types of possible orbits are mathematically exactly derived in a strictly analytical way. The relation $a^3\,P^2 = f(e_0, i_0, \omega_0)$ between semimajor axis a and period P of the change of osculating orbital elements is found (the index 0 denotes initial values of the quantities).

Due to conservation of energy in potential fields a is a constant. Moreover, the component of angular momentum perpendicular to the galactic plane is conserved. Due to these facts the system of equations reduces to two equations for either (e, ω), or (i, ω) (the length of the ascending node does not enter the equations for a, e, i, ω and is not solved here).