Paper ID: 14969
oral
student

ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (2) (7)

Author: Mr. Xiaodong Liu
Tsinghua University, China, liu-xd08@mails.tsinghua.edu.cn

Dr. Xingrui Ma
China Aerospace Science and Technology Corporation (CASC), China, maxr@spacechina.com

AVERAGED MODEL TO ANALYZE THE LONG-TERM ORBITAL EVOLUTION OF THE BINARY ASTEROID

Abstract

The investigation of binary asteroids has been of special interest since its first discovery. In the current study, a simple averaged model is used to analyze the long-term orbital evolution of binary asteroids. The secondary is assumed to be a particle with negligible mass, and the solar tidal force and the nonspherical effect from the primary are considered. The disturbing function due to the solar tidal force is expanded in terms of Legendre polynomials up to the second order. The nonspherical primary is approximated by a triaxial ellipsoid, and then expanded in the form of the spherical harmonics up to the fourth degree and order. Taking the orbital plane of the primary as the reference plane, the disturbing function due to the nonspherical effect is first averaged over the orbital period of the secondary around the primary, and second averaged over the spin period of the primary. The disturbing function due to the solar tidal force is first averaged over the orbital period of the secondary around the primary, and second averaged over the orbital period of the primary around the Sun. By abundant numerical simulations, it is found that argument of pericentre rotates rapidly and circulates due to the small value of eccentricity. Thus, the disturbing function is further averaged with respect to argument of pericentre. The final averaged Hamiltonian is time-independent, so the averaged Hamiltonian represents the energy of the averaged system. This averaged model is applied to several binary asteroids. The results of this averaged model show a good agreement with those of the unaveraged model. The secondary would neither escape from the binary system nor impact on the primary over a long time. It is found that these binary cases all lie close to extreme points of the Hamiltonian. It is also noted that the mean orbital plane of the secondary, the equatorial plane of the primary, and the orbital plane of the primary around the Sun share a common intersection line, which is an interesting phenomenon.