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CHIRIKOV DIFFUSION IN THE REGION OF THE (3556) LIXIAOHUA ASTEROID FAMILY

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INTRODUCTION

In recent papers several authors have investigated the dynamics of the asteroids families with the goal of evaluate its age (see [1], [2], [3], [4], [5], [6]). In general, in these studies the authors have considered families located in regions crossed by two-body and three-body mean-motion resonances (MMR). Nesvorný and Morbidelli (1998, 1999) showed that asteroid family dynamics in the three-body mean-motion resonances is governed by stable chaos. In fact, in the Nesvorný-Morbidelli model, these resonances are formed by a multiplet of resonances the components of which have different intensity and overlap themselves. In this case, the overlapping produces the long-term dynamical evolution in eccentricity and inclination, but not in semi-major axis. Cachucho, Cincotta and Ferraz-Mello (2010) using Chirikov (1979) diffusion theory and Nesvorný-Morbidelli model, evaluated the diffusion in eccentricity and semi-major axis of the (490) Veritas asteroid family (see Fig. 1).

METHODOLOGY

Chirikov diffusion theory allows explaining the mechanism that governs the long-period motion of system. Indeed, the long-period diffusion in eccentricity is produced by the contribution of weaker resonances belonging to the multiplet. Fig.1 shows the diffusion coefficient in semi-major axis (top panels) and eccentricity (bottom panels) for (490) Veritas asteroid family obtained using a Hadjidemetriou-type sympletic map for times 10^6, 10^7 and 10^8 Mys, respectively. The brighter regions indicate the higher diffusion values. For 10^8 Myrs the diffusion in semi-major axis is lower than for eccentricity.

In this communication, we evaluate the diffusion in Lixiaohua asteroid family and also estimate its age using Chirikov diffusion theory and Nesvorný-Morbidelli model. Chirikov diffusion theory is applied considering only three-body MMR which are identified in Nesvorny and Morbidelli (1998), and in Novaković et al. (2009b). Moreover, the theoretical diffusion is obtained using the procedure given in Cachucho et al. (2010) such that the diffusion coefficients are

$$D_{ij} = \frac{\epsilon^2}{2\Omega_G^2 T_a} \sum_{\mathbf{m}_D} R_{\mathbf{m}_D} \nu_i(\mathbf{m}_D)\nu_j(\mathbf{m}_D) Q^2_{\mathbf{m}_D} \qquad i,j = 3,\ldots,N. \tag{1}$$

For more details about the parameters of the last equation see Section 2 in Cachucho et al. (2010). The computational code was developed and estimations of diffusion were obtained using the Hadjidemetriou-type sympletic map for times up to 10^8 years.

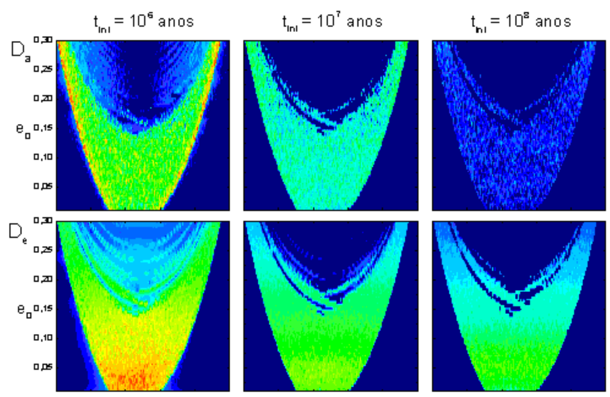

Figura 1. – Semi-major axis (top) and eccentricity (bottom) diffusion coefficents for (490) Veritas family.

CONCLUSIONS

Chirikov's theories provide heuristic tools to understand the diffusion observed in both eccentricity and semi-major axis of asteroids inside the resonance. The multi-dimensional Hamiltonians of the three-body (three orbits) mean-motion resonances may be studied with the theory developed by Chirikov, mainly because of the particular geometry of those resonances in the plane (*a*,*e*). The results obtained in this paper for the three-body mean-motion resonance confirms the role of the resonances as foreseen in Chirikov diffusion theory.

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