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Programa y Libro de Resúmenes

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3.3 Chaos and instability in the three-body problem

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In this work we present a numerical study of application of the Shannon entropy on the stability analyses of a non-restricted three-body problem. We investigate the changes in the measure of the Shannon entropy S inside the phase space defined by the orbital elements o the HD 20003 planetary system. In this technique, the measure of the growth of S is used to estimate the diffusion coefficient associated to the dynamical evolution of the system. We were able to estimate the diffusion coefficient for several initial contidions (ICs) of the phase space. The diffusion coefficient (D_S) can be directly related to the disruption time (τ_{esc}), a (estimated) measure of the system lifetime as a bound system. We applied the entropy to predict the escape times for a set of ICs of this system, and compared the results with times of escape obtained from direct N-body simulations. A very good agreement was found between the results. We used these estimated values of times of escape τ_{esc} to study the empirical power law $\tau_{esc} \sim T_L^b$, where T_L is the Lyapunov time, given as the inverse of the Lyapunov exponent, and which is associated to the time scale of exponential divergence of close trajectories in the phase space.

3.4 Análisis de la composición y estructura química de posibles impactitas

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En los últimos años se ha especulado sobre los efectos de eventos de impacto de hipervelocidad de pequeños asteroides. Se han estudiado residuos terrestres del impacto, formaciones debidas al metamorfismo de impacto, que generan vidrios y otras formaciones inusuales como los vidrios Dakleh (Osinsky et al, 2008), con presencia de Lechatelierita y otras especies químicas ajenas a las formaciones usuales de vidrios e inclusiones de esférulas. Estudios realizados sobre vidrios hallados en el desierto de Libia (Greshake et al. 2017), muestran la presencia de incrustaciones de Mullita, Cristobalita y Rutilo. Estos vidrios conocidos como LDG, presentan un alto contenido de SiO2, con presencia de Mullita. El origen y los mecanismos de formación de estos vidrios es aún muy debatido, entre tormentas de rayos del periodo Cenozoico o impactos de cometas o meteoritos. En este trabajo se presentan resultados preliminares de con apariencia de metamorfismo de impacto procedentes de las costas oceánicas uruguayas y argentinas. Se analizaron propiedades físicas como la densidad y tenacidad. Estos resultados muestran que al igual que en los LDG, hay una alta composición de SiO2 principalmente bajo la forma de cuarzo y la presencia de Mullita, que estaría indicada por la detección de Al y minoritariamente los otros metales. Las condiciones de formación de la Mullita suponen la existencia de altas temperaturas, que serían compatibles con las alcanzadas en un evento de impacto a hipervelocidad.

3.5 Trajectory Analysis of 04/2019 Meteor in Costa Rica

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On 4/24/2019 3:07 AM UTC a meteor was detected in Costa Rica. The object fragments found showed to be a relatively unusual CM2 carbonaceous type. Through surveillance cameras at Marina Pez Vela in Quepos and TV Turrialba we were able to analyze the meteor's trajectory. Through numerical integration, considering the atmospheric drag, and fragments with masses from 1g to 100kg, we obtained a probable fall area, where meteorites were later located. Performing the reverse integration, up to 1000 km of altitude, we find the position and speed of entry of the meteoroid into the atmosphere. Based on these data, we proceed with the reverse integration, considering from this moment on, the gravitational forces of the Sun-Earth-Moon system, up to the point where the meteoroid would have crossed the Earth's sphere of influence. At this point, we determine, in the heliocentric coordinate system, the values of the meteorite's orbital elements, such as

1.290718 au for the semi-major axis, 0.225 for eccentricity and 0.8534 degrees for inclination. This being an NEA type Apollo. We found, through a profound integration, that the object would collide with Earth even without the influence of the Moon.

3.6 A step forward to understand the equilibrium shape of big TNOs

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Global fluid behavior is usually assumed in the study of the equilibrium shapes, and therefore properties, of trans-Neptunian objects (TNOs). However, recent results indicate that this simplification is not always valid. TNOs are composed of a mixture of ice and rock, the properties of these mixtures not only allow the existence of states with residual global stress, but also a gamma of equilibrium shapes different of those assumed by a fluid (i.e. Maclaurin and Jacobi ellipsoids). Therefore, it is necessary to use geological criteria to obtain better estimations of the global properties of these bodies. This allows correlations between parameters associated with the resistance of the materials and the application of forces, such as the ones related to spin and gravitational interactions. When using the spin velocity and the tridimensional shape, it is possible to infer parameters such as density and internal angle of friction, amongst others, that can be used as a base for assumptions regarding composition and internal layering and. In order to do that, the method proposed by Holsapple, 2004 was applied for high precision data (obtained from stellar occultations) of the TNOs Haumea, Quaoar, 2003 VS2, and the asteroids Ceres and Lutetia. Results will be presented and the implications to the study of these class of objects will be discussed.

3.7 Asteroides interactuando con las RMM 2:3 y 3:4 con Marte

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Las resonancias son un fenómeno natural importante en el sistema solar cuyos efectos son, en muchos casos, apreciables a simple vista. En general, las resonancias con Júpiter y Saturno suelen ser las que más afectan la evolución dinámica de los cuerpos del cinturón principal de asteroides. Sin embargo, en el caso de los Hungarias estudios recientes muestran que es Marte quien modula de la dinámica de estos objetos (Correa & Cañada-Assandri 2018). A pesar de la alta inclinación de los Hungarias, la excentricidad del cuarto planeta termina afectando la dinámica de los objetos en la región (Cuk & Nesvorny 2018). En el presente trabajo analizamos del comportamiento dinámico de los Hungarias próximos a las MMR 2:3 y 3:4 con Marte, mediante la integración numérica de 1000 asteroides por un lapso 10.000 años. Nuestros resultados indican 80 objetos resonantes, de los cuales se presentan algunos de los casos más interesantes.

3.8 Study of Options to deflect an asteroid on a collision course with Earth

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This research aims to study options to deflect of an asteroid in a collision course with Earth. This is a very current research topic. It is related to planetary defense, and has been receiving the attention of researchers worldwide. Several tasks are needed, such as characterizing these celestial bodies, determining their trajectory, size, shape, mass, and other parameters that help to measure the consequences of this potential impact. After this step it is necessary to plan and implement measures to divert them from this collision course. There are currently two main forms to make this deflection: (i) the impact of a high-speed object with the asteroid, which may be a spacecraft or a minor asteroid diverted; ii) the use of a gravitational "tractor", which would consist of placing an object (another asteroid or part of a misaligned asteroid) close to the approaching body of the Earth, so that this gravitational interference can divert it from their trajectory. The work to be developed intends to evaluate in more detail these two possibilities, taking into account specific aspects of each of them using the Mercury integrator package.