STABLE LOW-ALTITUDE ORBITS AROUND GANYMEDE CONSIDERING A DISTURBING BODY IN A CIRCULAR ORBIT

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Some missions are being planned to visit Ganymede like the Europa Jupiter System Mission that is a cooperation between NASA and ESA to insert the spacecraft JGO (Jupiter Ganymede Orbiter) into Ganymedes orbit. This comprehension of the dynamics of these orbits around this planetary satellite is essential for the success of this type of mission. Thus, this work aims to perform a search for low-altitude orbits around Ganymede. An emphasis is given in polar orbits and it can be useful in the planning of space missions to be conducted around, with respect to the stability of orbits of artificial satellites. The study considers orbits of artificial satellites around Ganymede under the influence of the third-body (Jupiter's gravitational attraction) and the polygenic perturbations like those due to non-uniform distribution of mass (J_2 and J_3) of the main body. A simplified dynamic model for these perturbations is used. The Lagrange planetary equations are used to describe the orbital motion of the artificial satellite. The equations of motion are developed in closed form to avoid expansions in eccentricity and inclination. The results show the argument of pericenter circulating. However, low-altitude (100 and 150 km) polar orbits are stable. Another orbital elements behaved variating with small amplitudes. Thus, such orbits are convenient to be applied to future space missions to Ganymede. Acknowledgments: FAPESP (processes n° 2011/05671-5, 2012/12539-9 and 2012/21023-6).

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TIDAL, THERMAL AND MAGNETIC EVOLUTION OF TERRESTRIAL EXOPLANETS IN THE HABITABLE ZONE OF DWARF STARS

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The rotation and thermal evolution of a planet plays a main role in the planetary magnetic field evolution. The rotation period determines properties like the regime of the planetary dynamo and its intensity. This is crucial for a planet to keep its reservoir of volatile material like water, protected against the erosive action of the stellar wind and cosmic rays. Planets orbiting dwarf stars are tidally affected by their host, this determines the final rotation period (resonance) or the tidal locking of the planet, especially during the very first Myr. At the same time this first period of the planet history is the most affected by the magnetic activity of the host star. We calculate the rotation and tidal evolution of planets and combine this with a thermal evolution model to know how this very first stages of the planetary evolution finish with an stable and protective planetary magnetic field or with an unprotected planet.

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IMPROVEMENT OF TNO'S EPHEMERIS IN THE CONTEXT OF STELLAR OCCULTATIONS

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Trans-Neptunian Objects are distant, faint and poorly known solar system objects. Stellar occultations are currently, the only way to precisely determine some physical characteristics of these objects, such as the shape/size, the multiplicity or an eventual atmosphere. The prediction of stellar occultations requires both accurate astrometry of stars and accurate ephemeris.

The current methods of prediction use a constant offset compared to JPL ephemeris. The offset is calculated from the most recent observations as the mean difference between observations and the ephemeris. This method assumes that the offset remains constant over a certain period.

In this study, we perform a new ephemeris with available observations and observations done for offset determination. In this context, we have developed a dynamical model of the motion of asteroids

(NIMA), fitted to observations and determined a new ephemeris.

The difference between NIMA and JPL ephemerides is close to the offset at the date of observations but this difference then varies over time, according to a periodic one-year term and a secular term. For some objects, the offset method may remain accurate when the time between observations and occultation is short or when the offset's variations remain small. For other TNOs, the difference sharply increases making inaccurate predictions in the future. Consequently, new ephemerides should be used to make predictions. Finally, occultations also provide accurate astrometric positions and therefore new constraints on the TNO's motion. We analyze the contribution of previous occultations in the improvement of TNO'S ephemerides.

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SMALL ASTEROID FRAGMENTS IN EARTH-CROSSING ORBITS

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The meteorite that fell in Chelyabinsk, Russia, naturally made many people think it could be a smaller companion of the Asteroid 2012 DA14, which passed close to Earth on that same day. Some asteroid specialists discarded this hypothesis for two main reasons: The meteorite was too far away from the asteroid, because the collision happened sixteen hours before the asteroid passed close to Earth. Moreover, it was not traveling, similarly to asteroid DA14, from south to north. However the possibility of the meteorite being a companion of the Asteroid 2012 DA14 cannot be completely discarded. The Asteroid 2012 DA14, with a diameter of 45 meters, is very small. It can be considered an asteroids fragment, which is usually accompanied by other smaller fragments, scattered in space, practically in the same orbit and possibly being separated from each other by long distances. Assuming that 2012 DA14 is not an isolated asteroid, but the biggest remaining fragment from a previous impact, we developed a model to study the dynamics of an asteroid fragment, similar to DA14, and its companions, the smaller fragments. This dynamically interesting encounter with planet Earth is addressed and the orbital changes that could explain the Chelyabinsk event are discussed. As a result we find that, there could be a collision of a meteorite before, during, or after the Asteroid 2012 DA14 passing by, the same way that happens with meteorite showers, which can last several days. Therefore, it would be very interesting to look for asteroid fragments also, close to the larger fragments, more easily found.

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ATLAS OF THE THREE BODY RESONANCES IN THE SOLAR SYSTEM

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Three body resonances (TBRs) between a massless particle with an arbitrary orbit and two planets P_1 and P_2 in circular coplanar orbits occur when the critical angle $\sigma = k_0\lambda_0 + k_1\lambda_1 + k_2\lambda_2 - (k_0 + k_1 + k_2)\varpi_0$ being k_i integers is oscillating over time. The approximate localization in semimajor axis of the TBRs taking arbitrary pairs of planets is very simple, specially if we ignore the secular motion of the perihelion and nodes of the perturbing planets. When these slow secular motions are taken into account each of the nominal three body resonances split in a family of resonances all them very near the nominal one. The challenge is to obtain the width, strength or whatever that give us the dynamical relevance of these TBRs. We propose an algorithm to numerically estimate the strength of arbitrary TBRs between two planets in circular coplanar orbits and a massless particle in an arbitrary orbit. This algorithm allowed us to obtain an atlas of the TBRs in the Solar System showing where are located and how strong are thousands of TBRs involving all the planets from 0 to 1000 au. Relevant results for the population of asteroids and transneptunian objects will be presented.

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DYNAMICAL EVOLUTION OF DIFFERENTIATED ASTEROID FAMILIES

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