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EXPLORING STABLE AND CHAOTIC REGIONS TO DESIGN A SPACE MISSION AROUND A BODY WITH A LARGE CRATER

Abstract

New information regarding Trans-Neptunian Objects and Centaurs is becoming increasingly common. As a result, many discoveries are made about these objects, such as the case of (307261) 2002 MS4 and the rings around Chariklo. Recent data obtained through stellar occultation technique reveal a large crater on the surface of 2002 MS4, with a depth depression of about 45 km and a linear extent of 322 km. Finding stable and chaotic regions around such objects will allow to design a space mission and also to guide it to find ring particles or small satellites around them. The objective of this work is to study the dynamics around the object (307261) 2002 MS4. The potential acting on the spacecraft is the gravitational potential of a spherical object subtracted the gravitational potential of the crater. Based on the main characteristics of the object we were able to calculate the equivalente radius ($R = 335$ km) and masses, considering density estimatives. We calculated the mass of the crater by determining the mass that was removed from the main body, treating it as a sphere with a radius equals to the depth depression. The system can be fully described by two free parameters: the rotation parameter of the central body (λ), which represents the ratio between the angular velocity and the keplerian frequency, and the parameter μ, which represents the ratio between the mass of the crater and the mass of the spherical body. The dynamics is numerically explored as a function of these two parameters using the Poincaré surface of section technique. As a result resonant configurations, several periodic and quasi periodic orbits located in the range between 2.5 R and 4.5 R were identified along with a chaotic region extending up to 7 R. We will present the evolution of the stable region as a function of λ and μ parameters.