(130) Elektra – dynamical analyses on the region of the third moonlet

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Abstract. (130) Elektra is the first known asteroid quadruple system [1]. The system is composed of a central body (Alpha) and three moonlets (Beta, Gamma, and Delta). Beta is the larger and outer satellite, Gamma has an intermediate size, while Delta was the last body to be discovered and also the inner and smaller satellite. The aim of our study is to understand the dynamics of the region where Delta is supposed to be. It was reported a range of the semi-major axis of 339-449 km, 0.28-0.38 for eccentricities, and inclinations of 19-57° for the Delta [1]. It was also emphasized a lot of uncertainties still remain regarding the Delta's orbit due to their data set, the data processing, and the halo removal process. In order to model the dynamical system, we derived the mass of each moonlet by considering them as spherical bodies and assumed they all have the same density as Alpha. For Alpha, we consider three scenarios: as a spherical body, with spherical harmonics (J_2 and C_{22}) and with its irregular polyhedral shape model. Given the uncertainties of the orbital elements data, we made a set of numerical simulations considering a range of the semi-major axis (250-450 km), eccentricities (0-0.5), and inclinations (19-57°) for test particles in the region of Delta. Then, we create a stability map to verify if the region where the third moonlet is supposed to exit is stable or not. We identified that in the expected region of the fourth body, there is a larger and stable region when Alpha is considered as a spherical body. However, there is no stability when the polyhedral shape model of Alpha is considered. Thus, the Delta moonlet could not remain in this region or there are problems with the determination of the orbital elements since the irregular shape model of Alpha was not considered. We also simulated some cases considering Delta as a massive body but the stability of the region does not change. Hence, a new set of orbital elements could be searched for the third satellite considering the stable regions found.

Keywords: Celestial mechanics · Dynamical stability · Asteroid: (130) Elektra.

References

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