Estimation of Impact Conditions for a Possible Collision Between Apophis Asteroid and the Earth: Numerical Modeling for a Circular Crater. J. C. Echaurren, Bilbao 796, Casa N° 28, Calama, Chile, jechaurren@gmail.com.

Introduction: In this work the center of attention is the asteroid 99942 Apophis than will make a close approach to Earth on April 13, 2029, passing at a distance of only 36700 ± 9000 km (or 5.7 ± 1.4 Earth radii), closer than geosynchronous satellites [1].

The models used here are based on some equations postulated by Holsapple (crater depth) [2]; scaling; polynomial analysis; and an adaptation of quantum formalism for the mathematical representation of the energy pulse generated in the impact point, in where besides, is used one solution (soliton type) of the Korteweg-DeVries’s equation [3]. The results obtained are due only to estimates based on equations that use data associated with the average target rock at the point of impact on Earth, as well as data linked to the diameter of the apophis asteroid, or its possible density, in order to make more representative corrections.

Results obtained with the models: The development of this impact event is realized in 4 stages [4], in which are specified the variables of impact more common, as follows: a) Contact/Compression Stage: In this stage the diameter of the crater circular generated is estimated in ~ 7.00 km [4], the velocity of impact is ~ 18.19 km/s, the impact angle is ~ 46.81° (circular crater), the density of impactor is ~ 2.38 g/cm³, the crater depth is estimated in ~ 2.03 km [2], the maximum melt volume is ~ 8.66 km³ (~8.66×10⁶ m³), the total energy of impact is estimated in ~ 8.83×10³⁵ Erg (~ 2.10×10¹⁵ megatons), pressure to 1 km of the impact point is ~ 1.39 Gpa, and the seismic shock–wave magnitude is ~ 9.43 according to Gutenberg–Richter’s law (1956). b) Modification/Excavation Stage: In this stage the diameter of transient crater is ~ 3.19 km, the number of ejected fragments is ~ 1.08×10⁷, the average size of the macroscopic fragments is ~ 18.32 m, the average density of fragments is ~ 2.51 g/cm³, the minimal distance of ejection of the fragments is ~ 323.44 km, the velocity of ejection is ~ 3.30 km/s, the minimal angle of ejection is ~ 8.49°, and the minimum height of ejection is ~ 12.07 km. c) Collapse/Modification Stage: In this stage the pressure toward the final crater rim decrease to ~ 0.11 Gpa. d) Final Crater Stage: The relation between the transient crater and the final crater is ~ 0.5, value that is in accordance with the specification realized by Bevan French [4], the time of creation for the final crater can be estimated in ~ 15.13 seconds according to Schmidt and Housen [2].

Discussion: In this model the total impact energy, is the sum between the energy of radiated friction (in the atmosphere of the Earth), and the kinetic energy of the asteroid on a collision path with the Earth’s surface. This energy behaves like a pulse consisting of a fundamental transient, followed by a train of permanent soliton waves, which move radially from the point of impact towards the edge of the crater. A more detailed analysis of how this energy pulse behaves, will be addressed in future work.