A dynamical study of an earth-grazing fireball

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Abstract. Grazing meteors type are meteoroid debris that enter the planetary atmosphere with a near-horizontal path and perigee very high to the ground, having only part of their material being ablated during air interaction so the remaining could return to space at a different orbit after that brief encounter. So, on 1990-13-10 an earth grazing fireball crossed the atmosphere, reaching an abs mag of -6 with a duration of 10 secs, with initial velocity of 41.7 km/s, it was observed above Czechoslovakia and Poland and registered by two Czech stations of the European Fireball Network. During its luminous trajectory it traveled about 409 km . The modified orbit of the remaining material, which went out into interplanetary space with solidified fusion crust on its surface, was calculated using the special method for long trajectory determination of the authors Borovicka and Ceplecha (1992) [1]. Using Rebound Python package [2] we implemented calculations for that grazing type close encounters back and forth in time, before initial conditions (IC) used for the retrograde integration and the after IC for prograde integration, then, the same steps were done running the equation of motions under a 4^{th} order Sympletic Integrator [3,4,5,6,7]. Both results were compared in order to investigate if we can obtain a capture (or a collision) in time (back or forth) simulating the solar system, also to determine the parental body and to predict a future close approach with the Earth.

Keywords: Meteoroids · Grazing Meteors · Fireball · Numerical Integration

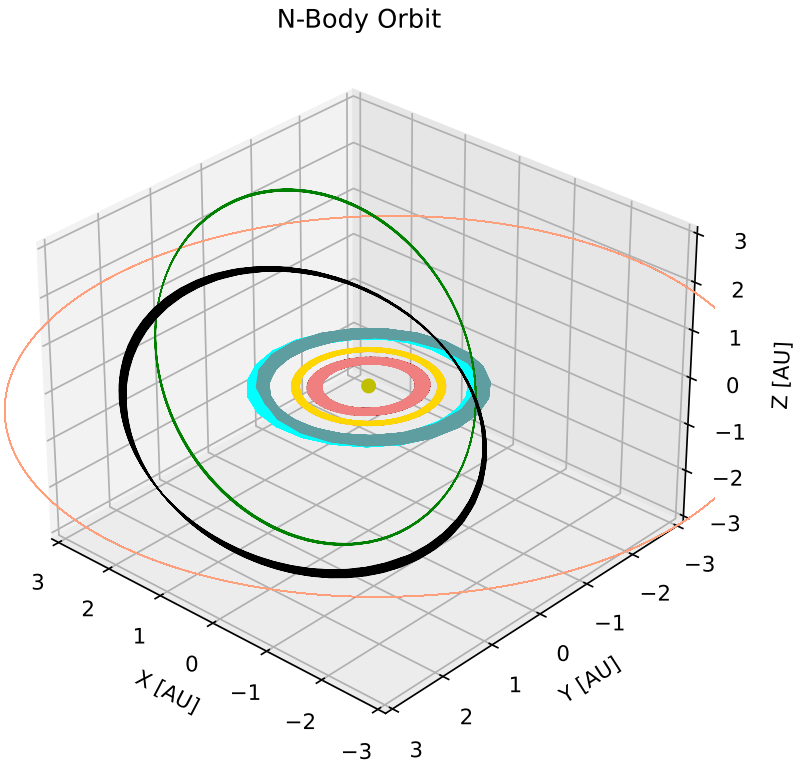

Fig. 1. A Solar System diagram showing grazing meteor orbits forth and back in 100 yrs time, dark green and black line orbits, respectively, using a Sympletic 4^{th} order numerical integration .

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