HOW PRECISE IS APOPHIS ORBIT AND WHAT IS AHEAD AFTER 2029? V. A. Shor[1], O. M. Kochetova[1], Yu. A. Chernetenko[1]. [1]Institute of Applied Astronomy of RAS, nab. Kutuzova, 10, St. Petersburg 191187, Russia 0, St. Petersburg 191187, Russia

Orbit of potentially hazard Potentially hazardous asteroid (99942) Apophis has unusually small MOID (minimum orbit intersection distance) with respect to the Earth orbit equal to 0.00027 A.U. This determines possibility of very close approaches of the asteroid with the Earth which take place when the Earth crosses the node line of the asteroid orbit on ecliptic approximately simultaneously with the asteroid being in ascending node. The nearest in time close approach will happen 13 April 2029 when the minimum distance of the asteroid from the Earth center will be as small as 38000 km. Such close approach will result in substantial perturbations of the asteroid orbit which will be transformed from Aten into Apollo type orbit with semimajor axis greater than 1 A.U. and revolution period longer than one year. The perturbations critically depend on minimum distance attained during the flyby. Among possible transformations are those which lead to new dangerous approaches with the Earth and even to collisions with it starting from 2036. Dimension of Apophis (~270 m) and peculiarities of its orbit are such that there is little sense in counting on new ground base observations before 2011. At the moment there are 989 optical and 7 radar observations made at the time interval from 15.03.2004 to 16.08.2006. Radar observations are more informative as compared with optical and they can substantially improve precision of the orbit determination even if their number is small. At present at least four solutions are known for the Apophis orbit which are obtained using all radar and most of available optical observations [1, 2, 3, 4]. In all instances the orbital parameters were found by the weighed least square fitting. At least in three cases the sets of improving parameters were different. The equinoctial elements, the rectangular coordinates and velocities, the comet orbit elements (T, q, e) were used as such. In addition, in all cases the procedures of assigning weights to different observations were distinct. Besides, the model of motion varied to some extent in different solutions. A comparison between found values of parameters and estimations of their precision is of great interest. The more so as small variations in initial values of orbital parameters affect Apophis motion and lead to different estimation of collision probabilities in 2036 and in subsequent period. In the paper an attempt is made to estimate how close to each other are found solutions and their mean errors and what differences in prediction of collisions stem from distinctions of models and neglected factors nonetheless exerting some actions.

References: [1] http://newton.dm.unipi.it/neodys/epoch/ 99942.eq1. [2] http://ssd.jpl.nasa.gov/sbdb.cgi?sstr=99942 [3] Vinogradova T. A. et al. (2008) *Astron. Vest.*, N 3, 1 – 10. [4] http://neo.jpl.nasa.gov/apophis/Apophis_CORRECTED_PREPRINT.pdf