SPIN STATE AND SHAPE OF (99942) APOPHIS RECONSTRUCTED FROM ITS LIGHT CURVES. J. Ďurech[1], P. Pravec[2], D. Vokrouhlický[1], K. Hornoch[2], P. Kušnirák[2], P. Fatka[2], and H. Kučáková[1,2] [1]Astronomical Institute, Charles University, V Holešovičkách 2, 180 00 Prague 8, Czech Republic, [2]Astronomical Institute of the Czech Academy of Sciences, Fričova 298, 251 65 Ondřejov, Czech Republic.

Introduction: Asteroid Apophis is in an excited rotation state. This "tumbling" non-principal axis rotation state can be described by two periods - rotation and precession. These periods (263 h and 27.38 h, respectively), together with other spin parameters and a convex shape model, were derived by [1] from photometric observations carried out in 2012/13. Radar observations are consistent with the spin state derived from light curves and suggest that the shape of Apophis might be bifurcated [2].

We aim to use the photometric data from 2012/13 and the new observations carried out in 2020/21 to determine Apophis's precise spin state. Due to the long time interval of nine years between observations, the rotation parameters could be determined precisely, which would enable us to (i) predict its orientation before and during the close approach in 2029, and (ii) estimate the change of its spin state caused by the Earth's gravitation torque during the encounter.

New observations: We carried out photometric observations of Apophis between November 2020 and May 2021 with the Danish 1.5m telescope at La Silla, ESO. This data set consists of 1280 calibrated photometric measurements in Cousins R filter distributed over 67 individual nights.

Results: Using the light curve inversion method [3], we aimed at reconstructing a unique spin and shape models from all available photometric data. We obtained results similar to [4]. However, there were more possible spin parameters that provided about the same quality of the fit to the data. This means that the spin parameters are not determined uniquely and the orientation for the 2029 flyby is not known.

When fitted separately, the data from the two apparitions provide slightly different spin parameters, and we were not able to find a satisfactory fit to both data sets simultaneously. The reason might be (i) systematic errors in the data (not likely), (ii) model errors - shadowing effects of a nonconvex shape at high solar phase angles that are not taken into account in our convex shape model, (iii) changed spin parameters between 2012 and 2021 due to external forces (the thermal YORP effect).

Conclusions: The work is still in progress. We will discuss possible reasons why the fit to photometric data is unsatisfactory.

Acknowledgments: This work was supported by the grant 23-04946S of the Czech Science Foundation.

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