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Abrupt Alteration of Apophis' Spin State Redux

Daniel J. Scheeres^{a,1,*}, Conor Benson^{a,2}, Marina Brozovic^{b,3}, Steve Chesley^{b,4}, Petr Pravec^{c,5}, Peter Scheirich^{c,6}

^aUniversity of Colorado Boulder, UCB 429, Boulder, Colorado, 80309, USA, 720-544-1260

^bJet Propulsion Laboratory, Pasadena, California, USA

^cFricova 298, Ondrejov, CZ 25165, Czech Republic

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On April 13, 2029 the asteroid Apophis will make a close approach to the Earth, coming within 6 Earth radii. This flyby offers many opportunities for remote and in situ observations, and is an event that will drive much planning and analysis over the next decade. The close approach will have a significant impact on two aspects of Apophis' dynamic state, its orbit and its rotation. In this paper we revisit a detailed analysis we performed over a decade ago in 2005 that studied the range of possible spin states the asteroid could have following its close approach flyby [1]. In our current analysis we will take advantage of the many observations of this object that have occurred since that time to develop a more precise range of predictions of what effect the flyby will have on the Apophis spin state and any related geophysical perturbations that may arise from it. Specifically, we will draw from a much richer knowledge of its rotation state that was published in 2014 [2]. In addition, recent radar measurements have also enabled improved understanding of its shape model [3]. The addition of these important items greatly improves the modeling of the effects of its closest approach to the Earth, and will provide a realistic range of post-flyby situations that may be expected.

*Corresponding author

Email addresses: scheeres@colorado.edu (Daniel J. Scheeres), conor.benson@colorado.edu (Conor Benson), Marina.Brozovic@jpl.nasa.gov (Marina Brozovic), Steven.Chesley@jpl.nasa.gov (Steve Chesley), petr.pravec@asu.cas.cz (Petr Pravec), petr.scheirich@gmail.com (Peter Scheirich)

¹Distinguished Professor, Smead Aerospace Engineering Sciences Department

²PhD Candidate, Smead Aerospace Engineering Sciences Department

³Research Scientist, Solar System Dynamics Group

⁴Research Scientist, Solar System Dynamics Group

⁵Leading Scientist, Astronomical Institute of the Academy of Sciences of the Czech Republic

⁶Research Scientist, Astronomical Institute of the Academy of Sciences of the Czech Republic

This analysis supports two important scientific aspects. First, these results we will be able to predict the range of surface accelerations and global stresses that will be placed across the body during its closest approach. These predictions may enable for more precise designs of any measurements that may be performed by visiting spacecraft. Second, assuming further improvements in its shape and spin state, the flyby will also provide some insight into the moments of inertia of the body based on the observed changes in its rotation state through the flyby.

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