Shape and thermal characterization of a candidate spacecraft target asteroid (175706) 1996 FG_3

L. Yu[1,2], J. Ji[1,2], and S. Wang[1,2]

[1]Purple Mountain Observatory, Chinese Academy of Sciences, Nanjing 210008, China
[2]Key Laboratory of Planetary Sciences, Chinese Academy of Sciences, Nanjing 210008, China

In this work, we have derived a 3D convex shape model for asteroid (175706) 1996 FG_3, which consists of 2040 triangle facets and 1022 vertices, from the known lightcurves. The best-fit orientation of the asteroid's spin axis is determined to be $\lambda = 237.7°$ and $\beta = -83.8°$, and its rotation period is ~ 3.5935 h. Using our shape model, we adopt the thermophysical model to fit three published sets of mid-infrared observations of 1996 FG_3 (Wolters 2011, Walsh 2012) to evaluate its surface properties. Assuming the primary and the secondary have identical shape, albedo, thermal inertia, and surface roughness, the best-fit parameters are obtained from the observations. The geometric albedo and effective diameter of the asteroid are calculated to be $p_v = 0.045 \pm 0.002$, $D_{\rm eff} = 1.69^{+0.05}_{-0.02}$ km. The diameters of the primary and secondary are determined to be $D_1 = 1.63^{+0.04}_{-0.03}$ km and $D_2 = 0.45^{+0.04}_{-0.03}$ km, respectively. The surface thermal inertia Γ is derived to be a low value of 80 ± 40 $\rm Jm^{-2}s^{-0.5}K^{-1}$ with a roughness fraction f_R of $0.8^{+0.2}_{-0.4}$. The results suggest that the primary possibly has a regolith layer on its surface, which is likely to be covered by a mixture of dust, fragmentary rocky debris and sand. The minimum regolith depth is estimated to be $5 \sim 20$ mm from the simulations, indicating that 1996 FG_3 could be a very suitable candidate target for future space mission.

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