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Possibility of a Nonmetallic M-type Asteroid for 65803 Didymos

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Japan Aerospace Exploration Agency (JAXA), Institute of Space and Astronautical Science (ISAS) has been planning the next generation minor body exploration in succession to HAYABUSA (MUSES-C) mission. 65803 Didymos (1996 GT) is a potentially hazardous asteroid nearly approaching the Earth and one of the candidates for the target due to the accessibility by spacecraft. We present the results of photometric observations of the object using the K.3T and the Schmidt telescope at Kiso Observatory in November and December 2003.

Didymos has a complex lightcurve consisting of two independent components: the continuous periodic wave with double peaks and the intermittent deeper attenuation of brightness. It suggests that the two bodies system as asynchronous binary displaying the mutual eclipse/occultation by the satellite. From the lightcurve analysis, the following physical parameters of Didymos's binary system were obtained: the primary's rotational period is *P*rot = 2.26 ± 0.01 h, the secondary's orbital period is P_{rot} = 11.90 ± 0.01 h, the secondary-to-primary mean diameter ratio is d_s/d_p = 0.34±0.05, the ratio between semi-major axis of the mutual orbit and primary's mean diameter is a/d_p = 1.33 ± 0.08, and the both bulk density is ½ = 1.4 ± 0.3 g/cm^3.

In the multi-band photometry with UBVRI bands the color indices of Didymos indicates as follows: $(U - B)$ = 0.039 ± 0.081, $(B - V)$ = 0.130 ± 0.023, $(V - R)$ = 0.087±0.011, $(V - I)$ = 0.108±0.012, which are consistent with the taxonomic X-type (including E,M,P-type). In addition, the slope parameter of Didymos were obtained as G = 0.19 ± 0.02 from H-G magnitude system. This indicates the asteroid would be an M-type asteroid among the X-type. Considering that an M-type asteroid is composed of iron, Didymos would be highly porous body due to the value of bulk density. This might be capable of the interpretation that Didymos is composed of the materials like enstatite chondrite having low albedo by space weathering.

Keywords: M-type asteroid; binary; porosity