

GROUND-BASED LIGHTCURVE OBSERVATION OF (25143) ITOKAWA, 2001-2004. S. Nishihara^{1,2}, M. Abe¹, S. Hasegawa¹, M. Ishiguro³, K. Kitazato^{1,2}, N. Miura⁴, H. Nonaka^{1,2}, Y. Ohba⁵, M. Okyudo⁶, T. Ozawa⁷, Y. Sarugaku^{1,2}, and M. Ueno⁸. ¹Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, 3-1-1 Yoshinodai, Sagami-hara, Kanagawa 229-8501, Japan (nishihara@planeta.sci.isas.jaxa.jp), ²Graduate School of Science, The University of Tokyo, ³Institute for Astronomy, University of Hawaii, ⁴College of Liberal Arts, University of Tokyo, ⁵Accenture Japan Ltd., ⁶Student Center for Independent Research in the Sciences, Wakayama University, ⁷Misato Observatory, ⁸Graduate School of Arts and Sciences, University of Tokyo

Introduction: The asteroid of (25143) Itokawa, 1998SF36, is a target object of the Japanese sample return mission, HAYABUSA. This asteroid made close approach to the Earth in 2001 and 2004, during which we intermittently continued observations of Itokawa in optical wavelength. Here we report the rotational period, the absolute magnitude, and the slope parameter of this asteroid derived from our long-term observational dataset.

Our observational data set: During 2001 apparition, we performed optical observations using the 1.05-m Kiso Schmidt telescope with 2KCCD; [1] Abe et al., 2002, [2] Ohba et al., 2003. While during the recent apparition in 2004, we used the University of Hawaii 2.24-m telescope with 8K mosaic CCD, the Misato observatory 1.05-m telescope with ST-9 CCD, and also the Kiso observatory telescope again. The observational conditions are summarized in Table 1.

Date (UT)	r (AU)	Δ (AU)	α (deg.)	Site	Filter
2001 Mar 26	1.018	0.040	59.4	Kiso	B, V, R, I
2001 Mar 29	1.009	0.038	78.4	Kiso	B, V, R, I
2001 Mar 31	1.003	0.039	83.2	Kiso	B, V, R, I
2001 Apr 01	1.000	0.040	87.6	Kiso	B, V, R, I
2001 Aug 22	1.305	0.319	20.3	Kiso	R
2001 Aug 23	1.309	0.321	19.1	Kiso	R
2001 Aug 24	1.313	0.323	18.0	Kiso	R
2001 Aug 25	1.317	0.325	16.8	Kiso	R
2003 Dec 01	1.528	0.786	34.5	Kiso	R
2003 Dec 02	1.525	0.776	34.3	Kiso	R
2003 Dec 03	1.522	0.765	34.0	Kiso	R
2003 Dec 04	1.519	0.755	33.8	Kiso	R
2004 Jan 15	1.369	0.396	11.3	Kiso	R
2004 Jan 19	1.353	0.375	7.8	Kiso	R
2004 Jan 20	1.348	0.368	6.9	Kiso	R
2004 Apr 10	1.019	0.250	79.1	Kiso	R
2004 Apr 11	1.016	0.248	79.9	Kiso	R
2004 Apr 12	1.012	0.246	80.7	Kiso	R
2004 Sep 06	1.304	0.348	27.3	Hawaii	R
2004 Sep 07	1.309	0.356	27.7	Hawaii	R
2004 Sep 08	1.313	0.363	28.1	Hawaii	R
2004 Sep 09	1.317	0.371	28.5	Hawaii	R
2004 Sep 12	1.330	0.395	29.6	Misato	R
2004 Oct 16	1.461	0.707	37.4	Hawaii	R
2004 Oct 17	1.464	0.717	37.5	Hawaii	R
2004 Oct 18	1.468	0.727	37.6	Hawaii	R

r : Heliocentric distance of this asteroid.
 Δ : Geocentric distance of this asteroid.
 α : Phase angle (Sun-Asteroid-Observer).

Table 1: Observational conditions of (25143) Itokawa.

Results and Discussion: By modulating the rotational period for phase over 3 years, we derived its rotational period, 12.1324 +/- 0.0001 hours. In the process, the solar angle bisector (PAB), the bisector of the direction toward the observer and the Sun, were

corrected; that is, we assumed the obliquity of spin axis was perpendicular to the ecliptic plane and uniformed the astrocentric longitude of PAB. Fig.1 shows the interpolation of lightcurve from the epoch 2001 August to 2004 September, assuming 12.1324 +/- 0.0001 hours. This result is more accurate than the result only derived from observational dataset during 2001 apparition (12.132 +/- 0.0005 hours; [3] Kaasalainen et al., 2003).

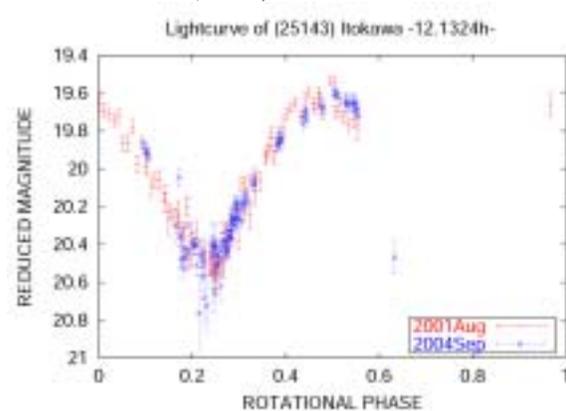


Figure 1: Composite lightcurve assumed 12.1324 hours.

To obtain its absolute magnitude and slope parameter, we used H, G magnitude system in Bowell et al., 1989 [4]. A phase angle of this asteroid is shown in Fig. 2 with exception of a dataset obtained in October 2004. By fitting of this phase curve, we can also estimate its absolute magnitude in R-band ($H_R(0)_{\max}=18.61 \pm 0.48$, $H_R(0)_{\min}=19.42 \pm 0.21$) and slope parameter ($G=0.25 \pm 0.05$). Here, G is the average of G_{\max} and G_{\min} . Since our data set covered a much wider range of solar phase angle, 6.9 to 87.6 deg., our obtained slope parameter G is more reliable than the values estimated in previous studies ($G=0.29 \pm 0.14$; [5] Dermawan et al., 2002, $G=0.21 \pm 0.10$; Abe et al., 2002).

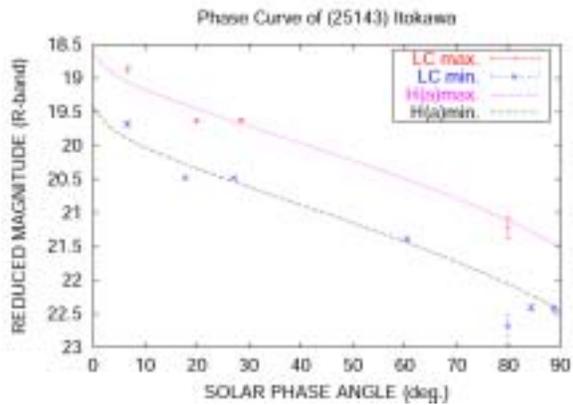


Figure 2: Phase curve of (25143) Itokawa. The lightcurve maximum (LC max) and minimum (LC min) of each observational sequence with error bars, respectively. The dashed lines are fitted by the least-squares analyses.

References: [1] Abe et al. (2002) Lunar & Planetary Science XXXIII, abstract #1666. [2] Ohba et al. (2003) EPS, 55, 341. [3] Kaasalainen et al. (2003) A&A, 405. [4] Bowell et al. (1989) Asteroid II, 524. [5] Dermawan et al. (2002) PASJ, 54, 635.