

**PHYSICAL MODEL AND TAXONOMIC TYPE OF 1998 SF36, THE TARGET ASTEROID OF SAMPLE RETURN MISSION, MUSES-C.** M. Abe<sup>1</sup>, Y. Ohba<sup>2,3</sup>, M. Ishiguro<sup>3</sup>, S. Hasegawa<sup>3</sup>, T. Fuse<sup>4</sup>, K. Aoki<sup>4</sup>, Y. Ohyama<sup>4</sup>, N. Kashikawa<sup>4</sup>, FOCAS team, A. Tokunaga<sup>5</sup>, M. Goto<sup>4,5</sup>, T. Usuda<sup>4</sup>, H. Terada<sup>4</sup>, N. Kobayashi<sup>4</sup>, IRCS team, and A. Fujiwara<sup>3</sup>. <sup>1</sup>Institute of Space and Astronautical Science (abe@planeta.sci.isas.ac.jp), <sup>2</sup>University of Tokyo, <sup>3</sup>Institute of Space and Astronautical Science, <sup>4</sup>National Astronomical Observatory of Japan, <sup>5</sup>University of Hawaii.

**Introduction:** Near-earth asteroid (25143) 1998 SF36 is a target body of Japanese sample return MUSES-C mission. This asteroid made a close approach to the earth at the end of March in 2001. The observing campaign for this asteroid was performed during this period. The kinds of observations were visible to near infrared spectroscopy, visible to thermal infrared colorimetry, light variation, and radar observation. Here we report the pole orientation and axis ratio of this asteroid obtained from light variation data, taxonomic type obtained from colorimetric and spectroscopic data, and its absolute size and geometric albedo estimated from thermal colorimetric data and model fitting.

**Our observational data:** We observed this object on 30 December 2000 using the 8-m SUBARU telescope with FOCAS (Faint Object Camera and Spectrograph for the Subaru Telescope; [1] Kashikawa et al., 2000) and obtained 0.45-0.90 micron spectroscopic data. On March 10 and 11 in 2001, we obtained J,H,K,L', and M' band photometric data and L' band spectroscopic data using SUBARU telescope with IRCS (Infrared Camera and Spectrograph for the Subaru Telescope; [2] Kobayashi et al., 2000). During 26 March and 1 April 2001 and during 21 and 26 August 2001, we obtained B,V,R and I band photometric data and light curve data using 1.05-m Kiso schmidt telescope with 2KCCD.

**Additional data obtained by other observers:** Some observers have reported in the rotational period of this asteroid (12.15 $\pm$  0.03 h; [3] Kwiatkowski 2001, 12.13  $\pm$  0.02 h; [4] Budi et al. 2001, 12.13 h; [5] Yoshikawa et al. 2001). A first approximation to the asteroid's shape is an ellipsoid 630  $\pm$  60 m long and 250  $\pm$  30 m wide obtained by radar observation [6] (Ostro et al., 2001). The result of this observation also suggested two preliminary pole solutions: either (320  $\pm$  30, -75  $\pm$  15) or (230  $\pm$  15, -5  $\pm$  15) deg. N-band photometry was performed using ESO 3.6 m telescope with TIMMI2 on March 14 by Sekiguchi et al. [7] and reported mean diameter is 360  $\pm$  20m and geometric albedo is 0.32  $\pm$  0.04 assuming absolute magnitude is 19.1 and standard thermal model. Visible and near infrared spectroscopy were performed by Binzel et al., 2001 [8], Vilas et al., 2001 [9] and other observers.

**Result of colorimetric observation:** Our visible photometry using Kiso schmidt telescope shows that B-V = 0.17  $\pm$  0.04, V-R = 0.15  $\pm$  0.06, and V-I = 0.02  $\pm$  0.03 mag (solar color subtracted). These results are consistent with the spectral slope  $S'_{6000} = 8.0 \pm 0.7$  %/100nm derived from SUBARU/FOCAS spectroscopic data. The result of near infrared photometry using SUBARU/IRCS shows J-H = 0.49  $\pm$  0.04 and H-K = 0.02  $\pm$  0.04. These results were compared with color diagrams of known taxonomic type asteroids and we can conclude this asteroid is S-type. This result is consistent with other observers' spectroscopic data. We also observed the color variation during the rotational period and cannot detect a color variation of more than 0.01 magnitudes.

**Result of light curve analysis:** We used our Kiso data obtained in March-April and August, Mitaka data obtained on March 13 and 15, and Pic de Midi data obtained on February 20-26.

To estimate its pole orientation we used A-method and E-method in Magnusson, 1986 [10]. The obtained solution is 320  $\pm$  30 deg in ecliptic longitude and -75  $\pm$  12 deg in ecliptic latitude. From A-method we can estimate the aspect ratio of three axis of ellipsoid. Estimated aspect ratio is a : b : c = 1 : 0.47( $\pm$ 0.09) : 0.29( $\pm$ 0.06). These results are close to that obtained by radar observation. We can also estimate slope parameter (G = 0.21  $\pm$  0.10) and absolute magnitude in V-band (H<sub>v</sub> = 19.73  $\pm$  0.17), using the light curve simulator constructed by Ohba, 2002 [11] and calculating the mean magnitude at 90 deg of aspect angle.

**Result of thermal model fitting:** Referring light curve of Mitaka data and light curve simulator, we combined our L' and M' photometric data to N band photometric data obtained by Sekiguchi et al. [7]. Using the free beaming parameter thermal model which is the minor change of the NEATM [12] of Hasegawa and Abe, 2001 [13], derived absolute sizes of this asteroid are a = 620  $\pm$  120 m, b = 260  $\pm$  60 m, and c = 170  $\pm$  30 m, and geometric albedo in V-band is 0.37  $\pm$  0.11. Hasegawa's thermal model can estimate beaming parameter of this asteroid. 1998 SF36's beaming parameter is estimated 1.4  $\pm$  0.1.

**Discussion and Summary:** From our observation and using additional data we could construct the physical model of 1998 SF36. Obtained results are summa-

rized as following. 1) Taxonomic type is S type. 2) Surface color seems to be homogeneous. 3) Spin is retrograde. 4) Pole orientation is almost perpendicular to the ecliptic plane. 5) Shape is elongated. 6) Diameter is about 300 m. 7) Albedo is high among S-type asteroids. 8) Surface thermal inertia seems to be higher than general asteroids (c.f. Hasegawa and Abe, 2000 [12]).

**References:** [1] Kashikawa et al. (2000) SPIE 4008, 104. [2] Kobayashi et al. (2000) SPIE 4008, 1056. [3] Kwiatkowski (2001) pers. comm. [4] Budi et al. (2001) Master thesis of Univ. of Tokyo, [5] Yoshikawa et al. (2001)

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