CHARACTERIZATION OF THE SURFACE PROPERTIES OF MUSES-C/HAYABUSA SPACECRAFT TARGET ASTEROID 25143 ITOKAWA (1998 SF36). S. M. Lederer[1,2] and D. L. Domingue[3], F. Vilas[2], M. Abe[4], T. L. Farnham[5], K. S. Jarvis[6], S. C. Lowry[7,8], Y.Ohba[4], P. R. Weissman[7], L. M. French[9], H. Fukai[4], S. Hasegawa[4], M. Ishiguro[4], S. M. Larson[10], Y. Takagi[11], [1]CSUSB/NASA JSC (Dept of Physics CSUSB, 5500 University Parkway, San Bernardino, CA 92407, slederer@csusb.edu), [2]NASA JSC, [3]JHUAPL, [4]ISAS, [5] U Maryland, [6]Lockheed-Martin, [7]JPL, [8]Queens U., [9]Wesleyn U, [10] LPL UA, [11]Toho Gakuen U.

Introduction: Several spacecraft missions have recently targeted asteroids to study their morphologies and physical properties (e.g. Galileo, NEAR Shoemaker), and more are planned. MUSES-C is a Japanese mission designed to rendezvous with a near-Earth asteroid (NEA). The MUSES-C spacecraft, Hayabusa, was launched successfully in May 2003. It will rendezvous with its target asteroid in 2005, and return samples to the Earth in 2007.

Its target, 25143 Itokawa (1998 SF36), made a close approach to the Earth in 2001. We collected an extensive ground-based database of broadband photometry obtained during this time, which maximized the phase angle coverage, to characterize this target in preparation for the mission. Our project was designed to capitalize on the broadband UBVRI photometric observations taken with a series of telescopes, instrumentation, and observers. Photometry and spectrophotometry of Itokawa were acquired at Lowell, McDonald, Steward, Palomar, Table Mountain and Kiso Observatories.

The photometric data sets were combined to calculate Hapke model parameters of the surface material of Itokawa, and examine the solar-corrected broadband color characteristics of the asteroid. Broadband photometry of an object can be used to: (1) determine its colors and thereby contribute to the understanding of its surface composition and taxonomic class, and (2) infer global physical surface properties of the target body. We present both colors from UBVRI observations of the MUSES-C target Itokawa, and physical properties derived by applying a Hapke model to the broadband BVRI photometry.

Hapke Model: A Hapke model was applied to the resultant data to estimate the surface roughness, single particle scattering albedo, and geometric and bond albedos. The geometric albedo, A_g, (or physical albedo) is the disk-integrated reflectance of a surface at solar phase angle α=0 relative to a same-size Lambert disk under the same observing conditions. This is one method for measuring how closely the surface resembles a diffuse scattering surface. The Bond albedo (or spherical albedo) is the fraction of incident light scattered in all directions by the surface. Model results indicate a large geometric albedo, which suggests a rocky, smoother surface, consistent with other smaller near-Earth asteroids. The Bond albedo and phase integral are much lower than corresponding values for other S-class asteroid objects, even though the geometric albedo is much higher. This implies that the surface of Itokawa is a less diffuse scatterer than typical S-type asteroids.

These calculations show that Itokawa appears significantly brighter than the general main-belt S-class asteroids, in agreement with the results of other observers; however, since this asteroid had not present a viewing geometry at low solar phase angle since being chosen as the MUSES-C target, and the Hapke modeling results are all based on an assumed opposition surge behavior, the high geometric albedo may reflect inaccurate assumptions. Observations within the opposition effect regime are planned for late January 2004 to address this question.

Broadband Colors: We have also calculated the broadband colors U-B, B-V, V-R and V-I. For asteroids, the U-B color generally represents a measure of the presence and strength of the Fe^{3+} UV/blue intervalence charge transfer transition (IVCT) absorption. Here, the U-B colors for Itokawa indicate an even stronger IVCT absorption than exhibited by the S-class asteroids, indicating another departure from a 'typical' S-class asteroid. Examination of the broadband colors in the context of the populations of the main-belt asteroids and near-Earth asteroids show that Itokawa - a small-diameter NEA - has the spectral characteristics of a "space weathered", larger-diameter S-class asteroid.

Conclusions: Multiple photometric data sets have been combined here to calculate the Hapke parameters of the surface material of near-Earth asteroid Itokawa, and examine the solar-corrected broadband color characteristics of the asteroid. These calculations show that Itokawa appears significantly brighter than the general main-belt S-class asteroids. The mean geometric albedo is high for an S-class asteroid, which is consistent with the results of other observers. Our calculated V-magnitude geometric albedo is = 0.53 ± 0.04. Examination of the broadband colors in the context of the populations of the main-belt asteroids and near-Earth asteroids show that Itokawa – a small-diameter NEA – has the spectral characteristics of a "space

weathered", larger-diameter atypical S-class asteroid. The results neither support nor eliminate the possibility of Hayabusa discovering blocks and boulders on its surface. The larger geometric albedo, however, suggests a rocky, smoother surface consistent with other smaller, near-Earth asteroids. Hayabusa may discover a target with topography such as peaks and valleys, and albedo variations. The single particle scattering characteristics are very different and allude to a surface with interesting regolith properties. The characteristics of Itokawa remain enigmatic, and await spacecraft examination.

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