OPPOSITION EFFECT ON ITOKAWA: PRELIMINARY REPORT FROM HAYABUSA IMAGES. Y. Yokota[1], M. Ishiguro[2], A. M. Nakamura[3], R. Nakamura[4], D. Tholen[5], P. Smith[6], J. Saito[1], T. Kubota[1], and T. Hashimoto[1], [1]Institute of Space and Astronautical Science (ISAS), Japan Aerospace Exploration Agency (JAXA), Sagamihara, Kanagawa 229-8510, JAPAN (yokota@planeta.sci.isas.jaxa.jp), [2]School of Earth Environmental Sciences College of Natural Sciences, Seoul National University, Seoul 151-742, KOREA, [3]*** Kobe University, JAPAN, [4]National Insititute of Advances Industrial Science and Technology (AIST), Tsukuba Central 1, Ibaraki 305-8561, JAPAN, [5]Institute for Astronomy, 2680 Woodlawn Drive, Honolulu, HI 96822, USA, [6]Lunar and Planetary Lab, University of Arizona, 1415 N. Sixth Ave. Tucson, AZ 85721, USA.

Introduction: Opposition surge of the air-less body surface is thought as a useful tool to investigate the property of the regolith [1].

The Hayabusa spacecraft rendezvoused with a S-type asteroid (25143) Itokawa on September 12, 2005 [2]. Hayabusa has three Optical Navigation Cameras (ONC-T: Narrow angle Telescopic camera; ONC-W1,W2: Wide angle cameras) [3]. ONC-T, which has a filter wheel for multi-color observation, is also called Asteroid Multi-band Imaging CAmera (AMICA) when used for scientific observations [4]. ONC-W1 and AMICA obtained images that suited for photometric study. We will present current status of the analysis of ONC-W1 data.

Observations: During two months observation periods after the arrival to Itokawa, AMICA obtained disk-resolved images of Itokawa under various solar phase angles (0-35degrees) [4]. In November 2005, Hayabusa have made a few times decent to the asteroid, including two times touch down for sampling. At each trial of the approach, ONC-W1 obtained many JPEG images for optical navigation. From the viewpoint of photometric study, these images have two notable features. (1) Due to the wide FOV (~60 degrees) of the camera, solar phase angle varies widely in one image. (2) Due to the attitude control requirement of the operation (e.g. Data communication, solar buttery), a direction that opposite to the Sun (i.e. phase angle 0) was always within the FOV of ONC-W1. Thus, when the spacecraft went close the asteroid, the opposition point was always observable by this camera. these two features allow us to evaluate disk-resolved phase curves of the asteroid surface from some selected image of ONC-W1.

Effect of JPEG Compression: Although ONC-W1 images were usually downloaded to Earth by using JPEG compression, a pair of a loss-less compression image (12bits) and a JPEG compression image (8bits, Quality factor 100) has been obtained at the touchdown operation. Both images were generated from same raw image onboard. After reducing the loss-less data to 8bits, we compared these images to estimate effect of the JPEG compression. It was appeared that 92% of JPEG data have same DN value as loss-less data. 4% of the JPEG data has +1 lager value, and also 4% of the data has -1 smaller value. No data has been different larger than 2 DN.

Data processing: To derive a phase curve from one ONC-W1 image, it is required to assume homogeneity of albedo and texture in the analysis area. The area was selected by humans eye, and designated to the processing program as a color-painted region in the copy of original image.

Smear correction was applied to the data as same as AMICA data processing [5]. Preflight test data were used for flat field correction.

A bright spot of the opposition surge and spacecraft shadow that cast on the asteroid surface can be used to specify the opposition point in an image. Phase angle was calculated from the angular distance from this point. Orbit data of spacecraft was not used in this analysis. No correction about incidence and emission angles was applied to the data.

Results: Figure 1 shows opposition surge at phase angle ranging from ~0 to 15 degrees. Data is normalized at phase angle 5 degrees. "Muses-Sea" is a representative place of smooth plain, and "Rough terrain" exhibits rough topography [1]. One notable result is existence of opposition surge at the rough terrain. Although existence of regolith is not clear in this area, it exhibits opposition surge comparative to smooth plain. Difference of opposition surge between these two terrain types is not clear. From ground observation, average value of intensity ratio $I(0.3^{O})/I(5^{O})$ of S-type asteroids ranges 1.40 - 1.48 [6]. From extrapolation of Figure 1, Itokawa's value might be slightly smaller than average S-type. Additional data is required for detailed discussion.

Ongoing Work: (1) We are investigating distortion of the camera using pre-flight data, for much precise calculation of phase angle. (2) We will increase number of the images for much detailed discussion. (3) We plan to process AMICA data to check ONC-W1 results. (4) AMICA data will also provide us information of wavelength dependency and albedo dependency.

References: [1] Honda T. et al. (2006) *LPS XXXVI*, this issue. [2] Fujiwara A. et al. (2006) *LPS XXXVI*, this issue. [3] Kubota T. et al, (2003) Acta Astronautica **52**, 125. [4] Saito J. et al. (2006) *Science* (submitted). [5] Ishiguro et al. (2006) *LPS XXXVI*, this issue. [6] Belskaya and Shevchenko (2000), *Icarus* **147**. 94.

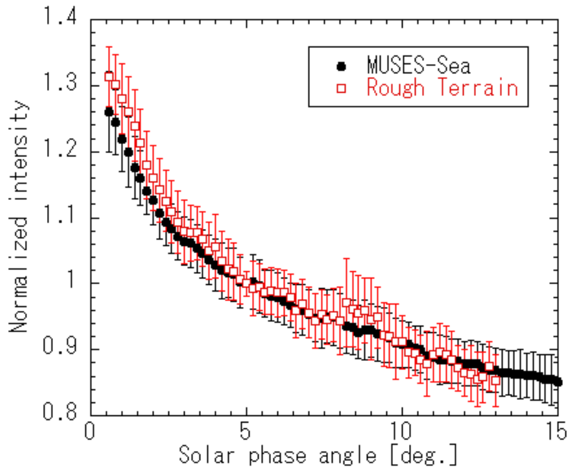

Figure 1. Disk-resolved phase curve of Itokawa. Data are normalized at phase angle 5 degrees. ONC-W1 images SW1_2563322681 and SW1_2539215961 were used.