Ejecta plume resulting from an oblique impact on (596) Scheila. M. Ishiguro[1], H. Hanayama[2], S. Hasegawa[3], Y. Sarugaku[3], J. Watanabe[2], H. Fujiwara[2], H. Terada[2], H. H. Hsieh[4], J. J. Vaubaillon[5], N. Kawai[6], K. Yanagisawa[2], D. Kuroda[2], T. Miyaji[2], K. Ohta[7], H. Fukushima[2], H. Hamanowa[8], J. Kim[1], J. Pyo[9], A. M. Nakamura[10], [1] Seoul National University, [2] National Astronomical Observatory of Japan, [3] Institute of Space and Astronautical Science, [4] University of Hawaii, [5] Observatoire de Paris, [6] Tokyo Institute of Technology, [7] Kyoto University, [8] Hamanowa Astronomical Observatory, [9] Korea Astronomy and Space Science, [10] Kobe University

Introduction: Outer main-belt asteroid, (596) Scheila, was discovered in 1906, and was found to exhibit comet-like activity on 2010 December 11 [1]. Scheila is relatively large main-belt asteroid with a diameter of 113-120 km [2-3]. It is classified as a T- or D-type asteroid; asteroids of this type have dark and moderately red spectra [4-5]. No gases were detected by Swift UV-optical observations, suggesting that the outburst was not triggered by the sublimation of ice [6]. Given these findings and other physical evidence[7-9], it is likely that an asteroid collided with Scheila recently, and that its activity is unlikely produced by sublimation. In this presentation, we report our observations and model to reconstruct the observed images[10-11]. In addition, we describe our new results from the multiband lightcurve.

Observations and their Results: We made imaging observations of Scheila on 2010 December 12 to 2011 March 1 by the Ishigaki-jima Astronomical observatory 1.0-m telescope, the Subaru 8.2-m telescope and the University of Hawaii 2.2-m telescope. In the 2011 December's images, there were three components, that is, the northern jet, the southern jet, and westward tail. The northern jet was the most prominent structure, and both northern and southern jets were smoothly curved in the western direction. These components faded out rapidly, and finally became undetectable after early 2011 February. Instead, a faint linear tail remained after 2011 February.

We found that the orientation of the linear tail after 2011 February coincided with the locus of the dust particles ejected with zero velocity (what we call, synchorone) on December 3.5±1.0. It is thus likely that dust particles were ejected impulsively rather than continuously on the day. Since the faint linear tail was connected to Scheila on 2011 March 1, large dust particles (>100 μm) as well as sub-micron particles must be ejected.

Morphological Fitting: To explain the formation of Scheila's triple dust tails, we conducted a model simulation of Scheila's dust emission on 2010 December 3. Our simulation was based on information gained through impact experiments. In general, two prominent features are generated by an oblique impact. One feature, a downrange plume, appears in a direction downrange from the impact site and results from the fragmentation or sometimes evaporation of the object that impacted another. A second feature occurs during the physical destruction of the impacted object; a shock wave spreads from the impact site, scoops out materials (conical impact ejecta), and forms an impact crater. The axis of the cone of ejecta is roughly perpendicular to the surface at the impact site. We reasoned that these two processes caused the ejection of Scheila's dust particles and that sunlight pushed them away from the asteroid. After performing a number of computer simulations under different conditions, we succeeded in duplicate their observed images when an object struck Scheila's surface from behind (Figures 1).

We conclude that peculiar three tails were thus impact–driven ejecta plume that appeared soon after a single impact; such a momentary plume was identified on an asteroid for the first time.

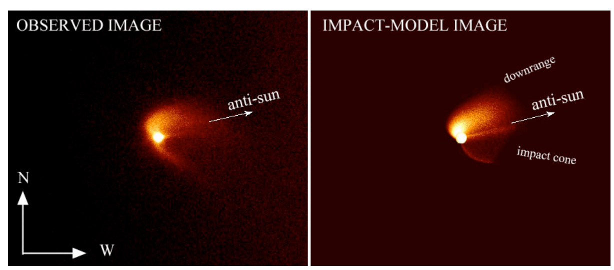

Figure 1. Comparison between the observed image on 2010 December 12 (left) and model image (right). In this model, we considered dust ejecta which consist of impact cone and downrange ejecta.

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