The Effect of Rotation Period on Slope Distribution on Asteroid Itokawa

*Masanori Kanamaru[1], Sho Sasaki[1]

1.Osaka University

Asteroids 25143 Itokawa was visited by the spacecraft Hayabusa and its detailed surface was unveiled. Demura et al. (2006) reported that Itokawa surface is divided into rough highlands and smooth low lands. Rough areas are covered with lots of boulders. Meanwhile, there are few boulders in smooth areas. It might be the result of regolith migration by seismic shaking (Miyamoto et al. (2007))

Itokawa has very steep slope areas especially on the neck region. "Slope" is defined as the separation angle of a gravity acceleration vector and a normal vector of a surface facet. Non-spherical body like Itokawa has an asymmetric gravity field. Polyhedron model, which was studied in Werner and Scheeres (1997), is an effective way to calculate such an asymmetric gravity field of a polyhedron with homogeneous density. We calculated the surface gravity field and slope distributions, giving Itokawa shape models, observed rotation period (12.1324 hour) and the bulk density (1.95 grams per cubed centimeters). We found that there are many steep slope areas over 30 degrees in the neck region of Itokawa. Such a steep slope looks like unstable.

Change of rotation period is known as YORP effect by solar radiation. As a rotation period changes, a surface gravity field and a slope distribution also change. This phenomenon makes a strong effect on Itokawa's history of reconfiguration and surface terrain formation in hundreds of thousand years time span. This time, we calculated the slope distribution with different rotation period (4h, 6.5h, 9h, 12.1324h, 18h, 24h). It showed that faster rotation can change surface gravity and reduce slope.

One of possible scenarios for Itokawa formation is that Itokawa rotated much faster before and surface topography was formed then. After that, the spin rate may have been decelerated by YORP effect.

S. C. Lowry et al. (2014) studied that observed light curves of Itokawa and simulation of YORP effect and inferred interior density distribution. We expect to simulate the surface gravity with heterogeneous density and make a restriction on internal structure of Itokawa.

Keywords: Asteroid 25143 Itokawa, Gravity field, Slope, YORP effect