Space Science Seminar
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10:30 a.m.
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Geophysical Structure of Top-Shaped Rubble-Pile Asteroids

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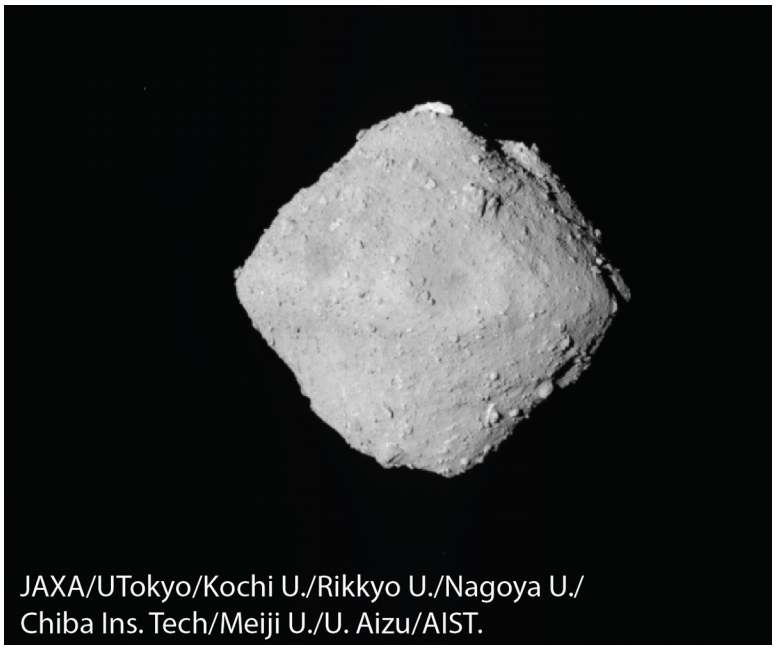
Host: Dr. Caleb Fassett (sponsored by ST13)

Studies have shown that asteroids are rubble piles with irregular shapes. While the irregular shapes of large asteroids may be attributed to collisional events, those of small asteroids may result not only from impact events but also from rotationally-induced deformation processes, a long-term consequence of small torques, for example, caused by solar radiation pressure. A typical asteroid shape that would be affected by such torques may be a round shape with a unique equatorial ridge, which is a so-called top-shape (see the figure).



Observations have identified many top-shaped objects in Near Earth Asteroids (NEAs). A better understanding of the shape evolution of such asteroids allows us to give constraints on the evolution process of NEAs. Here, we use a finite-element model (FEM) technique to analyze the failure modes and conditions of a top-shaped asteroid that was observed at high resolution by ground radar or

asteroid exploration missions. Assuming that the material distribution is uniform, we investigate how a top-shaped asteroid would fail structurally at fast rotation. Our FEM simulations describe the detailed deformation mode at a fast spin. Critical structural failure consists of a vertical mode that makes the shape more oblate and a horizontal mode that pushes material outward in the radial direction. Our analysis suggests that if the material distribution is homogeneous, the internal deformation mode may be part of a contributor to the formation of the equatorial ridge of a top-shaped asteroid. This presentation will discuss analysis results given observational data.

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