COMET RADAR EXPLORER. E. Asphaug[1] and the CORE Science Team, [1]Arizona State University, Tempe

Introduction: Missions to cometary nuclei have revealed major geological surprises: (1) Global scale layers – do these persist through to the interior? Are they a record of their formation? (2) Smooth regions – are they landslides originating on the surface? Are they cryovolcanic? (3) Pits – are they impact craters or sublimation pits, or rooted in the interior?

The spectacular successes of the Rosetta mission are ongoing and add to the overall state of wonder about comets. The deeper questions persist: How do primitive bodies accrete? What is the interior compositional distribution? What drives cometary activity and evolution? CORE can also tell us the answer to a more practical question: Where do we go to collect the best samples, and what is their context related to the global interior? Briefly stated, our goals are to find out *what's inside*, *what makes it work*, and *how it formed*.

Comet nucleus: The Comet Radar Explorer (CORE) mission uses a Mars-heritage radar to image the detailed internal structure of the nucleus of 10P/Tempel 2. This ~16×8 km prolate Jupiter Family Comet (JFC), or its parent body, originated in the outer planets region possibly millions of years before planet formation. Several times the diameter of Rosetta target 67P/Churyumov-Gerasimenko, the target of our investigation is perhaps more closely akin to the ~20-40 km diameter targets of the 2019 post-Pluto New Horizons flyby. It is a weakly producing comet, but is slowing by 20 seconds per perihelion, indicating regular repeated activity or shifting of moment of inertia.

Radar imager: CORE arrives post-perihelion and observes the comet's waning activity from safe distance. Once the nucleus is effectively dormant, the spacecraft enters a ~20-km dedicated Radar Mapping Orbit (RMO) and begins using the powerful Radar Refection Imager (RRI), a JPL/ASI collaboration.

The exacting design of the RRI experiment and the precise navigation of RMO will achieve a highly focused 3D radar reflection image of internal structure, to 30 m range resolution, and tomographic images of velocity and attenuation to a few hundred meters resolution, tied to the gravity model and shape.

Science and navigation camera: The color camera to be built by DLR will produce maps of the surface morphology, albedo, color, texture, and photometric response, and images for navigation and shape determination. It will also monitor the structure and dynamics of the coma, and its dusty jets, allowing their correlation in 3D with deep interior structures and surface features.

Thermal imager: A broadband thermal imager to be built at ASU will obtain repeated high-resolution temperature maps to probe the near-surface layers heated by the Sun. Maps of thermal inertia will be correlated with the radar boundary response, and photometry and texture, probing surface materials attainable by future robotic excavation missions. Thermal images will reveal areas of sublimation cooling around vents and pits, and the secular response of the outer meters as the nucleus moves farther from the Sun.

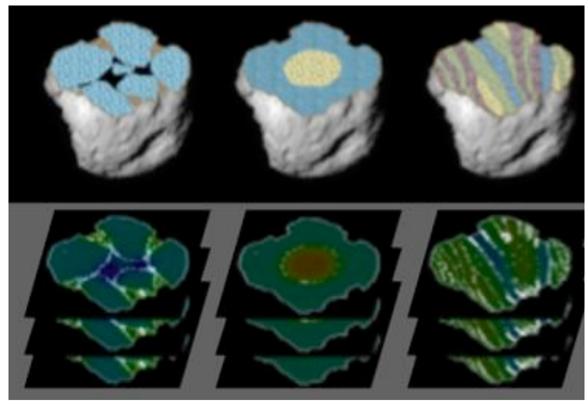

Figure 1. Schematic representation of hypothesis discrimination using radar imaging and tomography.

Figure 2. CORE acquires a dense network of radar echoes from polar orbit to obtain a 3D 'CAT scan' of the comet nucleus. It utilizes mature techniques of planetary radar, in a 3D geometry that leads to high definition migration imaging and tomography.