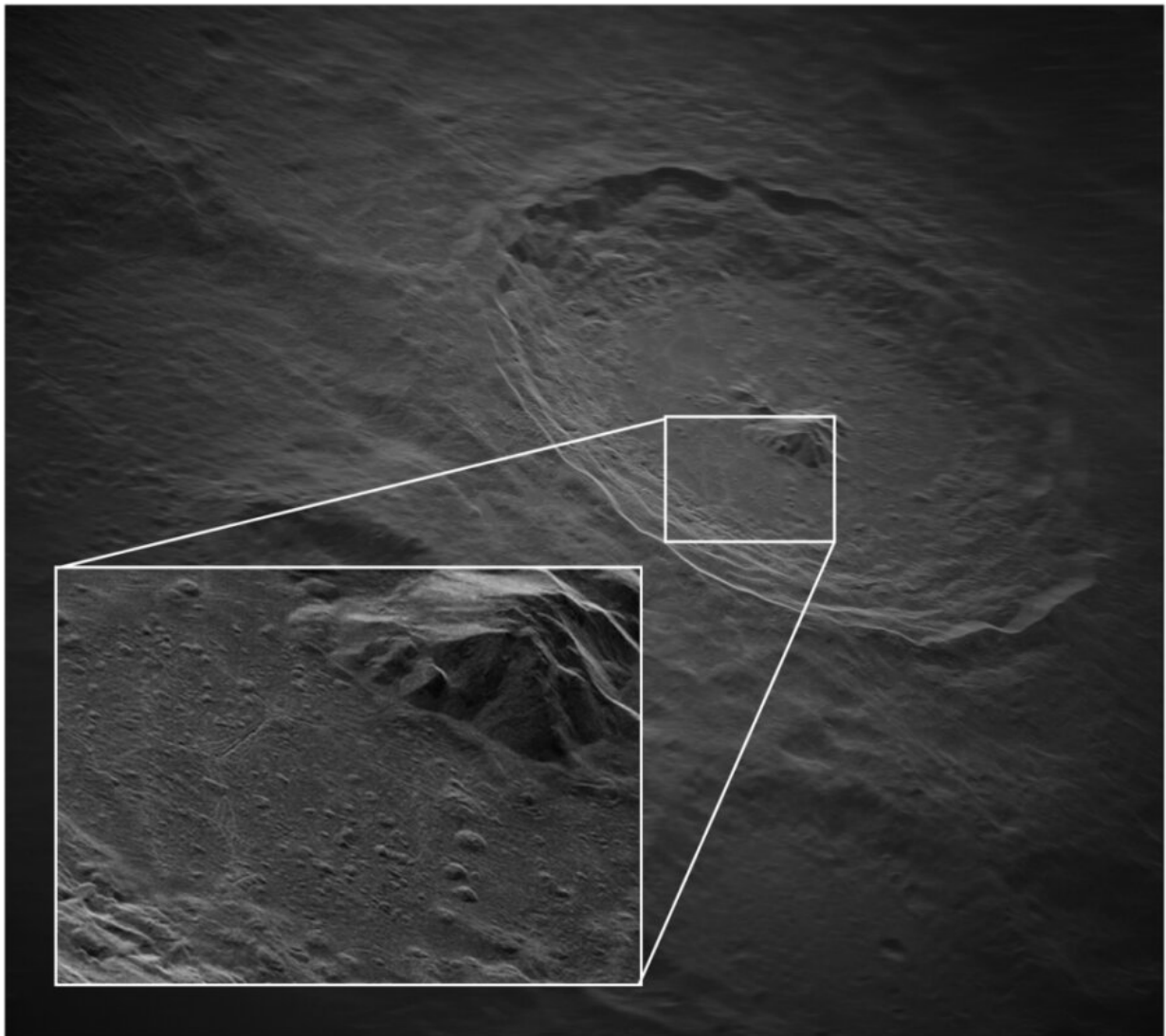


Planetary defense and science to advance with new radar on a powerful telescope

January 10 2023, by Jill Malusky



A Synthetic Aperture Radar image of the Moon's Tycho Crater, showing 5-meter resolution detail. Credit: Raytheon Technologies

With a transmitter less powerful than a microwave oven, a team of scientists and engineers has used the National Science Foundation's Green Bank Telescope (GBT) and Very Long Baseline Array (VLBA) to make the highest-resolution radar images of the moon ever collected from the ground, paving the way for a next-generation radar system to study planets, moons, and asteroids in the solar system.

The National Radio Astronomy Observatory (NRAO), Green Bank Observatory (GBO), and Raytheon Intelligence & Space (RIS) are designing a high-power, next generation planetary radar system for the GBT, the world's largest fully steerable radio [telescope](#). The prototype of this system produced some of the highest resolution planetary radar images ever captured from Earth.

A low-power radar transmitter, with up to 700 watts of output power at 13.9 GHz, designed by RIS was tested on the GBT, aimed at the moon's surface, and radar echoes were received with NRAO's ten 25-meter VLBA antennas. An image of the Tycho crater was captured with 5-meter resolution, showing unprecedented detail of the moon's surface from Earth. "It's pretty amazing what we've been able to capture so far, using less power than a common household appliance," emphasizes Patrick Taylor, radar division head for GBO and NRAO.

Design work continues for the flagship system, a 500 kilowatt, Ku-band (13.7 GHz) planetary radar for the GBT using the VLBA and the future Next Generation Very Large Array (ngVLA) as receivers. This high-power system would have nearly 1000 times the [output power](#) and several times the waveform bandwidth (up to 600 MHz) allowing for even higher resolution imaging.



The Green Bank Telescope. Credit: Jay Young

A system like this will serve in the frontline of planetary defense, able to detect, track, and characterize potentially hazardous objects that may be on a crash course with Earth.

"In our tests, we were able to zero in on an asteroid 2.1 million kilometers away from us—more than 5 times the distance from the Earth to the moon. The asteroid is about a kilometer in size, which is large enough to cause global devastation should there be an impact," adds Taylor, "With the high-power system, we could study more objects much further away. When it comes to developing strategies for possible impacts, having more warning time is everything."

These capabilities recently came in handy to support NASA's Double Asteroid Redirection Test (DART) mission, with GBT data confirming that the impact of NASA's DART spacecraft with an asteroid had indeed altered its course in the first demonstration of asteroid deflection technology.

Astronomers also will find this tool useful for astrometry, imaging, and physical and dynamical characterization of solar system objects for planetary science. In the near term, integration of a medium-power, Ku-band [transmitter](#) (of at least 10 kW) would develop an end-to-end system at GBO/NRAO for real-time radar observations and lay the foundation for the flagship high-power system.

The GBT's new radar capabilities will introduce a tool that astronomy has not had before, collecting data at higher resolutions and at wavelengths not previously available. NRAO and GBO are also developing advanced data reduction and analysis tools that have not been available before. Taylor notes, "At NRAO and GBO, we have a long history of participation in planetary radar studies, and we look forward to adding new capabilities to the GBT and VLBA to produce a next-generation [radar](#) system that will serve as valuable tool for researchers in [planetary science](#) and planetary defense."

Provided by Green Bank Observatory

Citation: Planetary defense and science to advance with new radar on a powerful telescope (2023, January 10) retrieved 5 May 2024 from <https://phys.org/news/2023-01-planetary-defense-science-advance-radar.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--