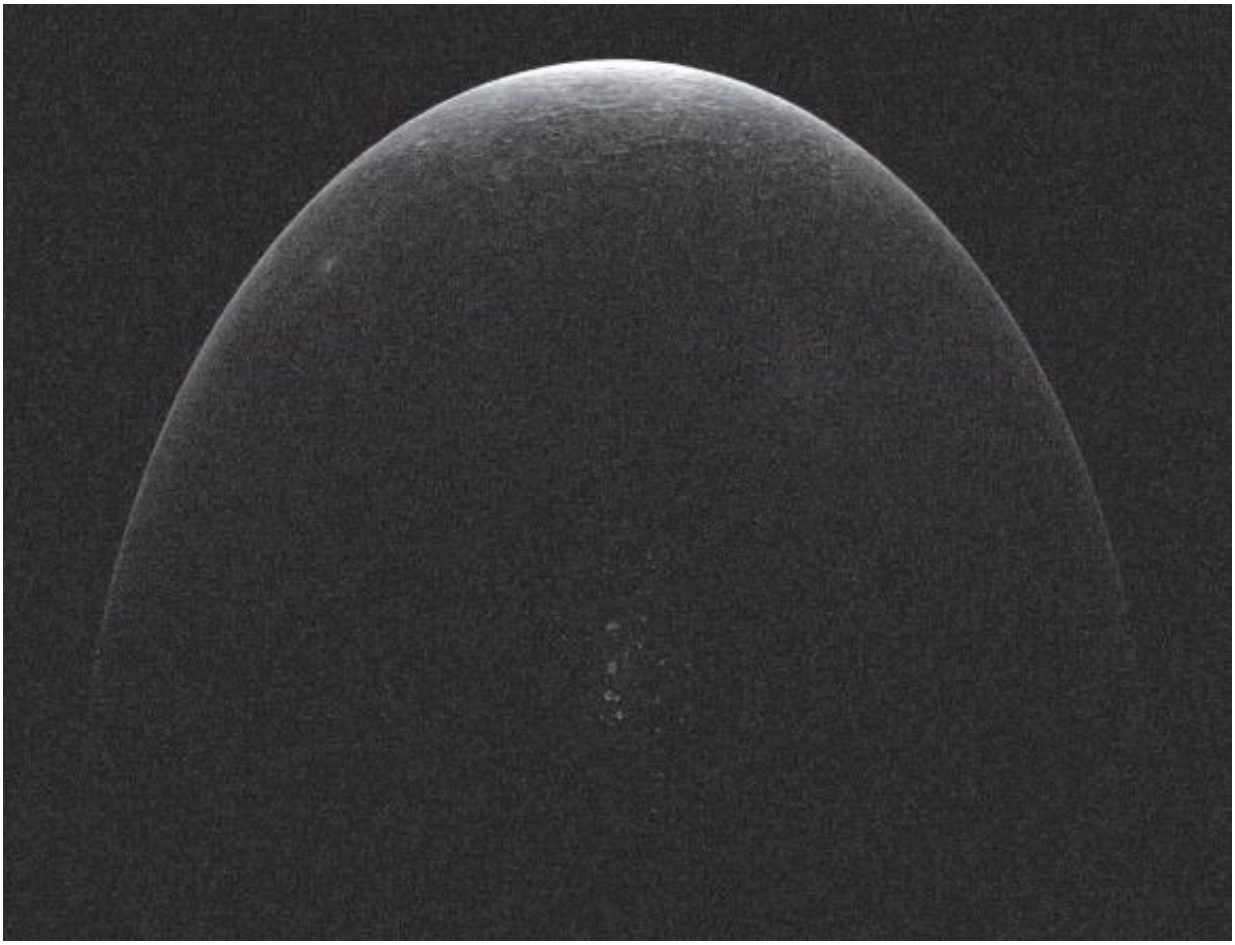
There are deposits of ice at Mercury's poles, too

March 21 2022, by Brian Koberlein

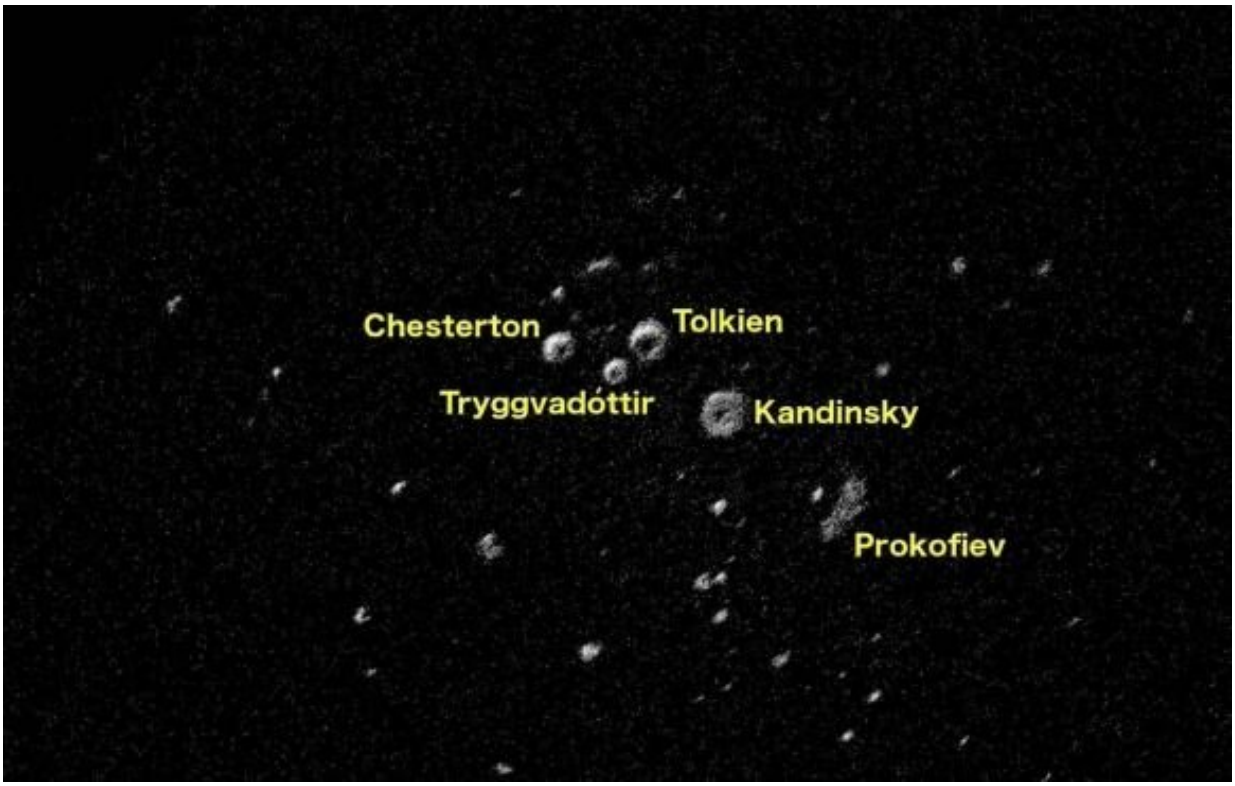


A radar map of Mercury showing pockets of ice (center). Credit: Rivera-Valentín et al

Although the Arecibo radio telescope is no more, it continues to deliver scientific discoveries. There is a wealth of Arecibo data astronomers continue to mine for new discoveries, and one of them is thanks to an astronomical technique known as planetary radar.

You're probably familiar with radar as it's used in weather forecasts, or when you're caught speeding on the highway. Radar works by beaming a radio signal at an object. Some of the radio light bounces back, and from the return signal, you can tell things such as how distant an object is and where it is moving. Planetary radar involves beaming a radio signal at a planet, then picking up the scattered signal with a sensitive radio telescope. The technique was first used in the 1960s to measure the orbits of Venus and Mercury.

Over the years, radar astronomy has gotten more powerful. In the past several decades the method could be used not only to map the surface of a planet but also to identify surface composition. In the 1990s planetary radar was used to map the surface of Mercury, and it surprisingly found pockets of ice near the planet's poles. The radar maps weren't precise enough to determine exactly where the ice was located, but astronomers figured it must be hidden within the shadowed regions of polar craters where sunlight never reaches. Further studies in 2012 confirmed the presence of crater ice.



A detailed map of Mercury's polar ice. Credit: Rivera-Valentín et al

Then in 2019, Arecibo beamed a powerful radio signal toward Mercury. The scattered signal was recaptured by the Arecibo receiver, allowing astronomers to make a detailed radio map of Mercury, including polar regions where there are ice pockets. In this latest study, this data was combined with data from the Messenger spacecraft, which orbited Mercury from 2011 to 2015.

The Messenger spacecraft used laser mapping to distinguish bright regions of ice from darker regolith regions. By combining the data, the team was able to better interpret data from the radar map. Although ice typically reflects more radio light than regolith, making icy regions appear bright on a radar map, regions can also appear bright for other

reasons, such as scattering off a surface angled just so. The team was able to confirm that the radio bright regions of Mercury generally indicated ice. They could even get a handle on the purity of Mercury's ice pockets.

In addition to further confirming Mercury's polar ice, the study also lays the groundwork for radar maps of other worlds. For example, there is a great deal of interest in the location of water ice on the moon, which would be extremely useful for future lunar astronauts. Refined radar maps of the moon will be able to determine not only the position of lunar ice pockets but also the size and purity of these pockets. And if you are going to build a base on the moon, it would be very helpful to have a bit of ice on the rocks nearby.

More information: Edgard G. Rivera-Valentín et al, Arecibo S-band Radar Characterization of Local-scale Heterogeneities within Mercury's North Polar Deposits, *The Planetary Science Journal* (2022). DOI: 10.3847/PSJ/ac54a0

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