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Ground-based radar observations of Mercury

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Radar observations of Mercury from both Goldstone, California and Arecibo Observatory, Puerto Rico, have a long history, including ranging observations of ever-increasing precision for topographic profiles and testing of theories of Gravity. In 1991, Goldstone/VLA direct radar imaging unexpectedly revealed radar-bright features in the North Polar region of Mercury (Slade et al., 1992), quickly confirmed by data from Arecibo that such features exist at both Poles (Harmon et al., 1992). Not only were these features radar-bright, but they also showed the characteristic that the expected "mirror" sense of reflection is weaker than the "unexpected" polarization reflections - a characteristic shared only by the South Residual Ice Cap on Mars and the icy Galilean satellites. Thermal models led to the conclusion that water ice is unstable to evaporation even at the poles, unless the ice is in permanently shadowed regions (like crater bottoms) and also covered by a layer of dust/regolith to protect it from H Lyman-alpha radiation from the Very Local Interstellar Medium. The emphasis on Mercury observations subsequently switched to imaging of the polar regions. A 1994 paper showed clearly the correlation with craters in the Mariner-10 imaged parts of Mercury (Harmon et al., 1994). Early results with the upgraded Arecibo S-band radar gave the delay-Doppler imaging of the north polar ice features at 1.5-km resolution (Harmon et al., 2001), which showed high-quality images with terraced crater bottoms, radar shadows of crater central peaks, including craters not imaged by Mariner-10. With the advent of 3.5-cm receive capability at Arecibo, the opportunity exists to directly compare two-wavelength crater radar albedoes for the purpose of measuring the thickness of the "dust" cover of the ice, which has important implications for the needed "footprint" of MESSENGER's neutron spectrometer to confirm the water ice hypothesis. A proof-of-concept experiment with Goldstone transmitting to Arecibo was performed successfully in 2003. In April 2005, we hope to interleave 13-cm and 3.5-cm imaging of the South Pole, with similar studies hoped for in July 2005 for the North polar regions.

Keywords: Arecibo; Goldstone; craters; Poles.

References

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