Planetary Radar Astronomy

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The past six months have been a period of considerable success for planetary radar observations but there have also been some disappointments due to system teething problems. The end of July saw the successful detection of the SOHO spacecraft (a “stop press” item in the last newsletter) with Arecibo operating in a bistatic mode with the 70m Goldstone antenna. The radar echo was surprisingly strong given that the distance to SOHO was 1.5 million kilometers. This is the largest distance that a radar echo has ever been detected from a man made object. The fluctuation power spectrum (Fig. 10) showed that the spacecraft was rotating with a period of 52.87 sec. This, combined with SOHO being where it was predicted to be, greatly reassured the European Space Agency and NASA project teams that SOHO was potentially recoverable. Communication with the spacecraft was re-established shortly afterwards and, as of early November, SOHO was once again fully operational. Assisting with the recovery of SOHO was a little out of the ordinary for the Arecibo and JPL radar groups but none-the-less both interesting and rewarding.

The close approach of Mercury in August was the first opportunity for observations of that planet with the new radar system. John Harmon (NAIC) and Marty Slade (JPL) imaged the north polar region at a resolution of 3 km with the aim of better defining the position and radar backscattering properties of the putative ice deposits in permanently shadowed areas of the floors of impact craters. The resultant images, which are at significantly better resolution than previous ones, very clearly delineate the locations and shapes of the deposits. August also saw the first high resolution imaging of a newly discovered small near earth asteroid, 1998 ML14, by Mike Nolan, Phil Perillat et al. (NAIC), Steve Ostro, Lance Benner et al. (JPL), and Scott Hudson (WSU). A resolution of 30m (200 ns range resolution) was achieved and the resultant modeling of the asteroid’s shape based on delay-Doppler images from both the Arecibo and Goldstone radar systems shows a roughly spherical object with one very large probable impact crater. This is just the first result for what is expected to be a large program devoted to the imaging and study of near earth asteroids.

In early September we suffered the first of what has become a series of failures in the high voltage cable carrying the 2 MW (33 amps at 63 kV) of DC power from the transmitter’s power supply, near the land end of the catwalk to the suspended structure, and the final amplifier in the Dome. Repairs were hampered by the arrival of hurricane Georges on September 21. This resulted in the loss of the first five of eight bistatic (Arecibo transmitting, Goldstone 70m receiving) observations of Titan. However, the final three observations carried out by Don Campbell and Mike Nolan (NAIC), Greg Black (NRAO) and Marty Slade, Ray Jurgens and Steve Ostro (JPL) give an upper 3-sigma limit to Titan’s radar cross section of 8% of its projected area, a significantly smaller value than has been reported for previous observations. Coincident with the Titan runs, successful imaging observations were made by Ostro et al. (JPL) and Nolan et al. (NAIC) of 1036 Ganymed, at a diameter of 41 km the largest known near earth asteroid.

Unfortunately, the HV cable problems reappeared shortly after the Titan and Ganymede observations and have not been resolved. The cable has been spliced (a difficult and expensive task) several times but the problem persists. Several asteroid imaging opportunities have been lost. A new cable with a different insulation is being procured but delivery times are long and we are searching for a temporary fix until a new cable can be installed.