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Radar Studies in the Solar System I. I. Shapiro

We have actively engaged in observations of asteroids and comets, both as systematically planned targets and as "targets of opportunity." The most recent example of the latter is asteroid 1991 AQ, which was discovered optically on 1991 January 14 and found to be rapidly nearing the Earth. Due, in part, to our previous success in obtaining useful radar data on short notice, we and our colleagues were able to schedule time on the Arecibo radar on January 28-31, when the asteroid was within the Arecibo declination window. Each day during that period, a fresh ephemeris was made including all available data, both optical and (after the first day) radar. The first two of these were transmitted electronically to Arecibo for use on subsequent observations, but including even a single radar datum along with the optical data proved to be sufficient for predicting ephemerides for the rest of the observing run. Each day yielded a strong detection of the asteroid. With further processing, the results of the observations are expected to include detailed two-dimensional images of the asteroid, and information on its surface properties, size, shape, and spin.

The observing program also covered two other asteroids besides 1991 AQ, two of the four Galilean satellites of Jupiter, the satellites of Mars, and the planet Mercury. We are gaining understanding of the surfaces of both rocky and icy bodies from analysis of these results. Also, analysis of newly available radar observations of Venus has led to a refinement of the spin vector of that planet and has thereby provided a coordinate basis for the Magellan spacecraft mapping mission.