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Topic: NEO Characterization

GROUND-BASED PLANETARY RADARS: CURRENT AND FUTURE PROSPECTS

T. Joseph W. Lazio[(1)], Anthony Beasley[(2)], Lance A. M. Benner[(1)], Marina Brozovic[(1)], Philip G. Edwards[(3)], Jon D. Giorgini[(1)], Shinji Horiuchi[(3)], Ed Kruzins[(3,4)], Ronglin R. Liou[(1)], Blake Molyneux[(5)], Shantanu P. Naidu[(1)], Ryan S. Park[(1)], Chris J. Phillips[(3)], Marc Sánchez Net[(1)], Justin Spring[(1)], J. Stevens[(3)], Mark Taylor[(1)], and Victor Vilnrotter[(1)]

[(1)]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr, Pasadena, CA. 91109
[(2)]National Radio Astronomy Observatory, 520 Edgemont Road Charlottesville, VA 22903-2475
[(3)]CSIRO Space & Astronomy, PO Box 76, Epping NSW 1710, Australia (Cnr Vimiera & Pembroke Roads, Marsfield NSW, 2122)
[(4)]UNSW Canberra Space, PO Box 7916, Canberra ACT 2610
[(5)]Australia National University, Canberra ACT 2600 Australia

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ABSTRACT

Radar observations of asteroids provide a powerful means for characterization, providing measurements of their sizes, shapes, rotation states, surface features, satellites, masses, and densities. Radar observations can obtain information about large numbers of asteroids that complement the detailed observations for the small number of asteroids obtained with spacecraft. Moreover, precise orbit determinations achieved with radar observations are integral to planning missions to asteroids and enable decade- to century-long assessments of impact hazard risks.

NASA's Deep Space Network (DSN) enables all-sky coverage for asteroid radar observations, and we summarize the recent and on-going work to conduct asteroid radar observations with its facilities and planned improvements to them. In the northern hemisphere, the Goldstone Solar System Radar (GSSR) is the world's most powerful planetary radar, conducting observations of dozens of asteroids per year. Over the past few years, a new design has been developed and implemented for its klystrons, the vacuum tubes that provide the amplification to achieve the 450 kW of output power. Looking ahead, the design phase is well underway for a complete rebuild of the underlying transmitter system, planned to start in 2025 and intended to replace infrastructure that is as much as 40 years old in some cases. The Southern Hemisphere Asteroid Radar Project (SHARP) uses antennas at the Canberra Deep Space Communications Complex to transmit with antennas of the Australia Telescope National Facility used to receive. While much less sensitive than the GSSR, SHARP observations have complemented those of the GSSR by providing coverage when the GSSR was not available or obtaining initial returns that helped refine the GSSR observations. A recent improvement is that Doppler astrometry is now feasible, with

SHARP observations enabling as much as millennial-long predictions of Earth encounters.

Finally, we illustrate the system design for a future planetary radar capability that is based on an array of smaller antennas and that could recover the capabilities that were lost in the collapse of the Arecibo Observatory in 2020. A planetary radar array would be naturally scalable in capability, but also degrading gracefully. Further, there has been substantial recent progress toward producing large number of antennas with diameters of 15 m to 18 m and demonstrating the feasibility of kilowatt-level solid-state transmitters and amplifiers that could be used in such an array.

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Comments:

Oral presentation