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Southern Hemisphere Asteroid Radar Program (SHARP)

Shinji Horiuchi* (1), Jamie Stevens (1), Chris Phillips (1), Philip Edwards (1), Jon Giorgini(2), Lance Benner(2), Ed Kruzins(3), and Guifré Molera Calvés(4)
(1) CSIRO Space and Astronomy, Australia; e-mail: Shinji.Horiuchi@csiro.au
(2) Jet Propulsion Laboratory/California Institute of Technology, USA
(3) University of New South Wales, Australia
(4) University of Tasmania, Australia

Astronomical radar observations have been used to probe surfaces of all the solid planets and many smaller bodies in the solar system. More recently, there has been considerable interest in using radar observations both to characterize near-Earth asteroids (NEAs) and determine their orbits more precisely. The motivation for radar observations of asteroids is three-fold. First, asteroids represent primitive remnants of the early solar system and characterization of their properties such as shape, rotation state and existence of satellites can provide insights into their evolution and parent population(s). Secondly, precise knowledge of their orbits is essential to assess the extent to which they might represent impact hazards to the Earth, and finally, they represent targets for spacecraft, both robotic and crewed (Benner et al. 2015). Over the past years we have successfully developed and demonstrated a Southern Hemisphere radar capability using the Canberra Deep Space Communication Complex (CDSCC) as transmitters and the Parkes 64m Radio Telescope and the Australia Telescope Compact Array (ATCA) as receivers (Benson et al., 2017, Horiuchi et al. 2021). As of December 2022, we've successfully detected 24 Near Earth Asteroids in total since the project started in 2015. Our radar Doppler astrometry results also have contributed to refine orbits of the Near-Earth Asteroids. The key benefits of these observations are further the development of an Australian space radar capability, and contribution to improved understanding of near-earth asteroids and the early solar system. One of remarkable recent achievements is the discovery of the binary system associated with near Earth asteroid 2005 LW3 observed in November 2022 (Figure 1).

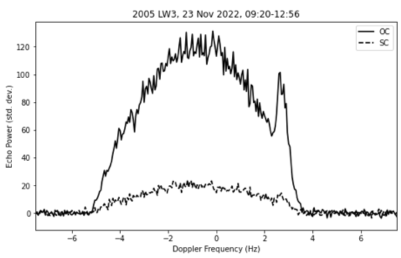

Figure 1. Opposite sense circular polarization (OC) and Same sense circular polarization (SC) echo power spectra for 2005 LW3, observed on 2022 November 23, shown at a frequency resolution of 0.05 Hz. The 0 point of the x-axis is 7159.45 MHz. DSS-43 transmitted circular polarized continuous wave (CW) at Doppler compensated frequency for ATCA to receive echoes centered at 7159.45 MHz. The secondary peak at 2.8 Hz represents an orbiting asteroid around the primary asteroid of the 2005 LW3 binary system.

References

[1] C. Benson, et. al, "First Detection of Two Near-Earth Asteroids With a Southern Hemisphere Planetary Radar System," *Radio Science*, **52**, 11, November 2018, pp. 1344-1351, doi: 10.1002/2017RS00639.

[2] S. Horiuchi, et. al, "Bistatic radar observations of near-earth asteroid (163899) 2003 SD220 from the southern hemisphere," *Icarus*, **357**, March 2021, pp. 114250, doi: 10.1016/j.icarus.2020.114250.