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Session: NEO Characterization

Southern Hemisphere Asteroid Radar Program (SHARP)

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Astronomical radar observations have been used to probe surfaces of all the solid planets and many smaller bodies in the solar system. This led to a growing interest in the use of radar to characterize near-Earth asteroids (NEAs) and determine their orbits more precisely. There is a three-fold motivation for performing radar observations of asteroids. 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 populations. Secondly, precise knowledge of asteroid orbits is essential to assess the extent that they might represent impact hazards to the Earth, and finally, they represent targets for spacecraft. Historically, Goldstone and Arecibo planetary radar capabilities have made significant contributions to tracking many asteroids. However, their coverage has been limited to the northern hemisphere sky and consequently have missed a fraction of NEAs during Earth flybys. To fill the gap, in recent years we have developed and demonstrated a Southern Hemisphere radar capability using the Canberra Deep Space Communication Complex (CDSCC), part of the NASA Deep Space Network (DSN), as transmitters and the Australia Telescope Compact Array (ATCA) and Murriyang, the Parkes 64m Radio Telescope, and more recently University of Tasmania radio telescopes such as Ceduna 30-m dish as receivers. From the start of the project in 2015 to the end of 2024, we have detected a total of 40 near-Earth asteroids. SHARP also provides the option for

observing on dates and times when Goldstone can't, which is going to be even more important during the Goldstone downtime from 2026-2028.

In 2029, Apophis will encounter Earth within 4.9 radii from the Earth surface. Apophis will approach from the south at a declination of about -30 deg, rapidly move past Earth, and then recede at a declination of +17. Apophis will be observed extensively by the Deep Space Network radars at Goldstone and Canberra. Also, SKA-mid will be operational in South Africa by then and be able to receive radar echo from Apophis and contribute to dramatically enhancing asteroid charactering capability.

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Comments: *Oral is preferred*

(Alternative session **Apophis: T-4 Years***)*