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Enhancing the Radio Astronomy Capabilities at NASA's Deep Space Network

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1 Extended Abstract

NASA's Deep Space Network (DSN) is well known for its role in commanding and communicating with spacecraft across the solar system that produce a steady stream of new discoveries in Astrophysics, Heliophysics, and Planetary Science. Equipped with a number of large antennas distributed across the world, the DSN also has a history of contributing to a number of leading radio astronomical projects. This paper summarizes a number of enhancements that are being implemented currently and that are aimed at increasing its capabilities to engage in a wide range of science observations. These enhancements include

- A dual-beam system operating between 18 and 27 GHz ($\approx$ 1 cm) capable of conducting a variety of molecular line observations, searches for pulsars in the Galactic center, and continuum flux density (photometry) of objects such as nearby protoplanetary disks;
- Enhanced spectroscopy and pulsar processing backends for use around 1.5 GHz (20 cm), 18–27 GHz (1 cm), and 38–50 GHz (0.7 cm);
- The DSN Transient Observatory (DTN), an automated, non-invasive backend for transient searching;
- Larger bandwidths ($\geq$ 0.5 GHz) for pulsar searching and timing; and
- Improved data rates (2048 Mbps) and better instrumental response for very long baseline interferometric (VLBI) observations with the new DSN VLBI processor (DVP), which is providing unprecedented sensitivity for maintenance of the International Celestial Reference Frame (ICRF) and development of future versions.

One of the results of these improvements is that the 70 m Deep Space Station 43 (DSS-43, Tidbinbilla antenna) is now the most sensitive radio antenna in the southern hemisphere. Proposals to use these systems are accepted from the international community.

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