Design and Performance of a Wideband Radio Telescope

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The Goldstone Apple Valley Radio Telescope (GAVRT) outreach project is a partnership involving NASA, the Jet Propulsion Laboratory (JPL), the Lewis Center for Educational Research (LCER), and the Apple Valley Unified School District., located east of Los Angles near the NASA Goldstone deep space communication complex. This educational program currently uses a 34-meter antenna, DSS12, at Goldstone for classroom radio astronomy observations via the Internet. The GAVRT program introduces students in elementary, middle, and high school to the process of science with the goal of improving science literacy among American students. The current program utilizes DSS12 in two narrow frequency bands around S-band (2.3 GHz) and X-band (8.45 GHz) and is used by a training program involving a large number of secondary school teachers and their classrooms. To expand the program, a joint JPL/LCER project was started in mid 2006 to retrofit an additional existing 34-meter beam-waveguide antenna, DSS28, with wide band feeds and receivers to cover the 1.2 to 14 GHz frequency bands.

The 34-meter antenna was retrofitted with a tertiary offset mirror placed at the apex of the main reflector. The tertiary mirror can be rotated to use two feeds that cover the 1.2 to 14 GHz band. The feed for 4.0 to 14.0 GHz is a cryogenically cooled commercially available open boundary Quadridge horn from ETS-Lindgren. Coverage from 1.2 to 4.0 GHz is provided by an un-cooled scaled version of the same feed. The computed performance is greater than 40% over most of the band and greater than 55%from 6 to 13.5 GHz. Measured data will be provided at the conference. This paper will describe the wideband radiometric receiver front end with emphasis on the feed and optical system.