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Improved High Frequency Performance of the Green Bank Telescope

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Extended Abstract

Over the last few years the improved performance and instrumentation of the Robert C. Byrd Green Bank Telescope (GBT) has drastically increased the telescope's scientific versatility and productivity. New instruments include ARGUS, a 16-pixel spectral-line camera that covers 75-116 GHz as well as MUSTANG2, a 223-pixel continuum bolometer camera. A consortium of universities and the observatory developed both instruments [1, 2]. Within the last few years, we have also deployed a new CASPER-based spectrometer, VEGAS [3], which has the extended bandwidth, resolution, and versatility that match the requirements for all current spectral-line observations over the telescope's full frequency range (100 MHZ to 116 GHz). Once we finish an upgrade to VEGAS, the GBT will extend its status as the premier pulsar observatory. Because of its extremely high velocity and time resolution, VEGAS is also the spectrometer used by Breakthrough Listen for its search for extraterrestrial intelligence. Another paper from this conference, "The Green Bank Observatory – Current Status" gives an overview of all of the observatory's telescopes and a second paper, "Transformative Science with the Green Bank Observatory" presents the fundamental research areas in which the GBT will make key contributions.

In this paper, we will present recent improvements to the telescope's performance, in particular to its servo performance and surface accuracy. We will report the current pointing and surface characteristics of the GBT as well as low cost plans to improve further the telescope in these areas. One realistic goal is to improve the surface from its current 240 µm accuracy, under good night-time conditions, to 200 µm. The current nighttime tracking error under no winds, 1.3", as well as the telescope's response to winds, could be reduced with modest improvements to the servo system. We will present weather statistics that indicate that over 1000 hrs/year have less than 5-mm of precipitable water. We will also show how we take advantage of good weather with a Dynamical Scheduling System as well as compare the weather conditions under which the DSS schedules the GBT to those scheduled at other high-frequency sites, like ALMA and Owens Valley.

The new cameras, backends, and telescope improvements, along with the telescope's 100m-diameter collecting area, unblocked aperture, access to 85% of the celestial sphere, and over 1000 hrs/year of usable high-frequency weather conditions, provides unequalled sensitivity for a wide range of fundamental research projects.

References

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