Green Bank Telescope Observing Efficiencies

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File: DYNAMIC SCHEDULING
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Abstract

The Green Bank staff have been preparing for the complete adoption of a significantly improved and more efficient dynamic scheduling system (DSS) for all GBT telescope time. This includes delivery of all the tools necessary to make dynamic scheduling possible. While developing these deliverables, we will strive to keep ease of use high for observers, investigators, and support staff.

As part of these preparations we have been analyzing the weather conditions recorded at the site over the past three years. This analysis has lead to definitions of minimal observing efficiencies and observing 'stringency'. Definitions of efficiency and stringency as applied by the dynamic scheduling team may be found in the project notes web page, linked to the DSS homepage at www.gb.nrao.edu/DSS.

History

6.0 Original Draft (Author)

1 Stringency

A brief description of stringency is, the reciprocal of the fraction of time that both the efficiency and tracking-error limits for the observation are satisfied. Tracking errors are predominately due to wind effects physically shifting the telescope off-source while overall efficiency is a function of the atmospheric efficiency and surface efficiency, sensitive to heating effects and important during, for example, the transition from night to day. All of these factors are naturally functions of the observing frequency and so some effects may be far more important for some observations than others. Full considerations of these factors and their effects are again described in the DSS project notes.
As stringency is the reciprocal of the fraction of time that is considered 'observable', a high stringency reflects a low probability that an observation is possible. A plot of stringency vs. frequency for the GBT is shown in Fig.1

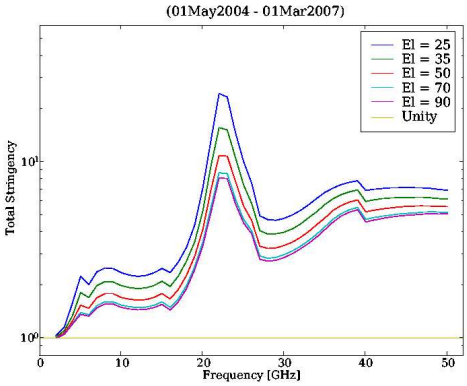

Figure 1: Plot of total stringency vs. frequency. Plot courtesy D.Balser

A plot of observing efficiency vs. frequency is shown in Fig.2. This plot shows the line empirically derived from historical data over the period 1 May 2004 - 1 Mar 2007. The observing efficiency and tracking-error limits were calculated every hour over this period and the atmospheric opacity and system temperature data were derived from vertical weather profiles supplied by NOAA. 'Minimum' observing efficiency is chosen empirically to be slightly lower than the average observing efficiency as determined and described in the Dynamic Scheduling Project Note 5.

This line represents the observing efficiency that one can expect when observing with the GBT, the integration time required to reach a given signal-to-noise ratio is inversely proportional to the observing efficiency. Hence, if you can only expect an observing efficiency of 50% then you should expect to double the integration time required to reach the noise level expected given the radiometer equation. This observing efficiency is not yet taken into account with the GBT exposure calculator available at http://wwwlocal.gb.nrao.edu/GBT/setups/senscalc.html and so we ask that potential observers scale their requests for time using the given information on observing efficiency.

2 Scheduled Time at Each Band

The number of hours approved for observations at each band are listed in Table.1. In addition, the wind speeds associated with 'good' weather conditions are listed. In this table, 'L' band incorporates observations made at longer wavelengths, e.g. using the prime focus receivers operating from 290 MHz to 1.23 GHz. The values for

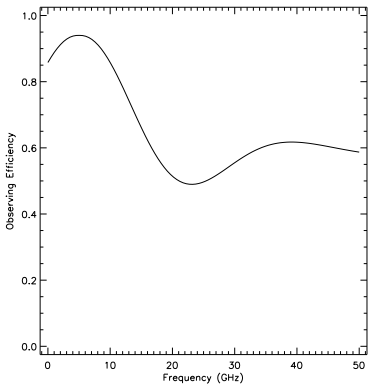

Figure 2: Plot of minimum observing efficiency vs. frequency.

Table 1: Hours Scheduled and Observational Wind Limits.

Frequency Band	Actual Hours Approved	Percentage Approved	Wind Limit (m/s) Day	Night
L	3942	45	21.3	21.3
S	438	5	17.4	17.4
C	876	10	11.5	11.5
X	438	5	8.4	8.4
Ku	438	5	6.7	6.8
K	876	10	5.0	5.2
Ka	876	10	3.7	4.0
Q	876	10	1.4	2.8
Total	8760	100		

wind speed are those above which r.m.s. flux errors exceed %10 as calculated from criteria defined in Dynamic Scheduling Project Note 5. Values of frequency (beamwidth) are mean values averaged over the range of each receiver.

3 Further Information

A full treatment of all ranking considerations in the proposed dynamic scheduling system can be found in 'Dynamic Scheduling Algorithms, Metrics and Simulations', Dynamic Scheduling Project Note 5.