

The Green Bank Solar Radio Burst Spectrometer

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Abstract The Solar Radio Burst Spectrometer (SRBS) is a project designed to 1) provide high quality radio dynamic spectra to the wider solar, heliospheric, and space weather communities; 2) serve as a development platform for ultra-wideband feeds and receivers. Dynamic spectroscopy is a powerful tool for observing radio bursts in the Sun's corona. These bursts are associated with solar flares and/or coronal mass ejections and result from coronal shocks (type II radio bursts), electron beams (type III radio bursts), and other forms of energy release in the corona. The community has been hampered by a lack of readily available dynamic spectra in the 12-24 hr UT time range, a shortcoming that has now been remedied. The instrument is located at the Green Bank Site of the National Radio Astronomy Observatory in the National Radio Quiet Zone, where the effects of radio frequency interference are much reduced compared with unprotected sites. The spectrometer is composed of two swept-frequency systems that together support observations from 20-1050 MHz with a time resolution of approximately 1 sec. The low frequency system, operating from 20-70 MHz, is a standalone dipole antenna. The high frequency system, which uses the 13.7 m telescope at Green Bank, will be installed during the summer of 2005 and operate from 70-1050 MHz. The data are available daily through a web-based interface. Both raw and background-subtracted data are available in a variety of formats. Users are encouraged to view and download selected data for research or forecasting purposes.

1 Introduction

Time-resolved radio spectroscopy of solar radio bursts – *dynamic spectroscopy* – has played an important role in identifying, studying, and understanding physical processes in the solar corona for more than fifty years. A resurgence of interest in radio spectroscopy has occurred in recent years as a result of its relevance to, and utility for, space weather studies, especially when used in combination with the wealth of space based instrumentation now available (e.g., SOHO, TRACE, RHESSI, WIND, ACE, and Ulysses), as well as those that soon will be (e.g., STEREO).

Spectroscopic radio observations are used to study radio precursors of coronal mass ejections (CMEs), the coronal and interplanetary shocks produced by blast waves, ejecta, and/or CMEs, particle acceleration in flares and CMEs; and energy release in flares. These studies rely on the availability of broadband spectroscopic records during times of interest. Surprisingly, support of ground based solar radio spectroscopy in western longitudes is sparse (Fig. 1). Available coverage is confined to swept-frequency radio spectrometers by the USAF/RSTN network operating between 25-180 MHz. These data are used for event reporting, but are generally unavailable for analysis.

We have embarked on a project to build high-performance spectrometers to address the need for high-quality broadband dynamic spectroscopy in western longitudes: **The Green Bank Solar Radio Burst Spectrometer**. The project also serves as a development platform for wideband systems needed for the **Frequency Agile Solar Radiotelescope (FASR)**, a project in the planning stages. The work is supported by an MRI grant from the NSF/ATM division.

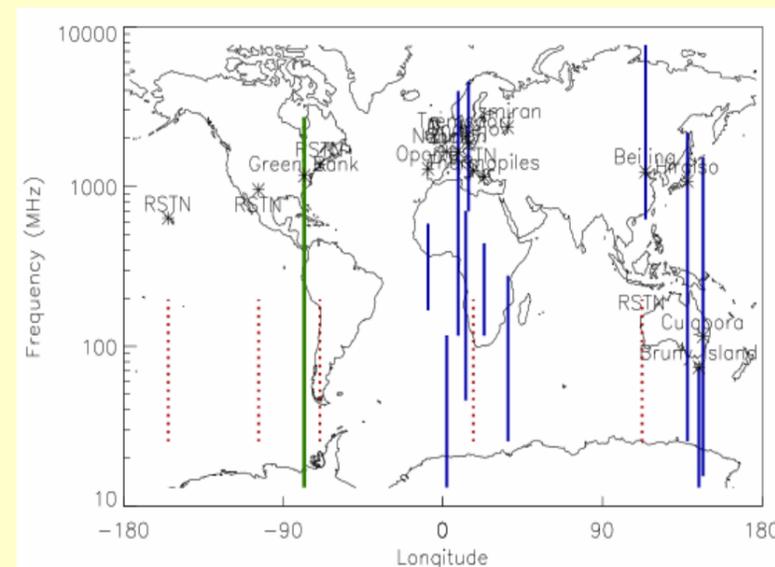


Fig. 1 Graphical summary of the present state of ground based solar-dedicated spectroscopic instrumentation around the world. Asterisks mark the locations of spectrometers. Vertical lines indicate the frequency range supported by a given observatory. Solid blue lines indicate those observatories where data are easily accessible via the web. The dashed red lines indicate those locations where this is not the case. The heavy solid green line indicates the location and eventual frequency range of the Green Bank spectrometers.

2 The Site

The Solar Radio Burst Spectrometer is located at the National Radio Astronomy Observatory (NRAO) site in Green Bank, West Virginia. The Green Bank site ($38^{\circ} 26' N$, $79^{\circ} 49.5' W$) is located in the National Radio Quiet Zone (NRQZ), a land area of approximately 33,000 km² established by the Federal Communications Commission in 1958 to minimize interfering radiation at radio frequencies. All frequency assignments for transmitters in the NRQZ are carefully coordinated and power density thresholds imposed. The Green Bank site therefore offers a benign site for broadband radio spectroscopy from decimeter to decameter wavelengths.



Fig. 2 View of the Erickson dipole (left) and the 13.7 m antenna at Green Bank, WV. The Erickson dipole supports the low frequency system, which operates from 20-70 MHz. A high frequency system is being installed on the 13.7 m telescope during summer, 2005. The low- and high-frequency systems will together operate from 20-1050 MHz. Following future upgrades, GB/SRBS will provide coverage from 10 MHz to several GHz.