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The Astronomer's Integrated Desktop: A Unified Suite of Applications for Scheduling-Block Based Observing with the GBT

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Abstract. Since 2003, the monitor and control software systems for the Robert C. Byrd Green Bank Telescope (GBT) have been redesigned to make the telescope easier to use. The result is the release of the Astronomer's integrated desktop (Astrid), an observation management platform used to create and submit scheduling blocks, monitor their progress on the telescope, and provide a real time, quick look data display. Using Astrid, the astronomer launches one application and has access to all of the software, documentation, and feedback facilities that are required to conduct an interactive observing session. These systems together provide a common look and feel for GBT software applications, enable offline observation preparation, and facilitate dynamic scheduling and remote observing.

1. Introduction

The Scheduling Block (SB) based observing system[1] now in place at the Robert C. Byrd Green Bank Telescope (GBT) is typically accessed through the Astronomer's integrated desktop (Astrid)[2]. This is a single, unified workspace that incorporates, but does not replace, the suite of applications that can be used by GBT astronomers. Astrid provides astronomers with easy access to the Observation Management application, the quick look Data Display, online documentation, and other utilities. The applications are predominantly written in Python.

2. Capabilities and Benefits

The capabilities and benefits of Astrid are many. In particular, Astrid:

- Gives access to all standard Python commands within the SBs;
- Provides access to predefined source catalogs and provides users with the ability to readily create and use their own;
- Facilitates remote observing;

[1] `http://wiki.gb.nrao.edu/bin/view/Software/ObservingTools`

[2] `http://wiki.gb.nrao.edu/bin/view/Software/AstronomersIntegratedDesktop`

- Supports secure observations with multiple investigators by providing three access modes: online (full control of the telescope), monitor (monitor telescope operations), and offline (no connection to the telescope);
- Allows observers to prepare and check SBs in advance of scheduled telescope time, significantly increasing the efficiency of telescope use;
- Provides seamless support for standard observers, expert observers, software engineers, and commissioners through one code base;
- Supports fully interactive use of the telescope;
- Supports non-interactive use of the telescope, allowing GBT to further improve its dynamic scheduling processes.

In addition, astronomers now only need to know one command to launch all the software to observe with the GBT, as opposed to the multitude of commands necessary in previous years. All GBT Standard Observing Modes[3] are now observed via Scheduling Blocks (SBs). This includes basic continuum and spectral line observations, mapping, pulsar, planetary, comet and VLBI observations.

3. Observing with Astrid

To observe on the GBT using Astrid, two main steps are necessary:

Step 1: Up-front Preparation.

- Write SBs using the text editor provided with Astrid, or your favorite editor.
- Validate SBs using the Astrid validate feature. Once it is syntactically valid, SBs will be stored into the Observation Management Database.
- SBs are now available for observations.

Step 2: Observe with the GBT.

- Within Astrid, choose the observing project and decide on the first SB.
- Promote SB to the Run Queue.
- Monitor SB's progress in the Log area (the bottom panel in the Astrid screen).
- Use the Astrid Command Console if your observation requires flexibility outside the bounds of a SB (e.g. balancing the IF power levels while data is being taken).
- Monitor telescope status on the status panel.
- Take a quick look at your incoming data on the Data Display panel.

4. Application Architecture and Scheduling Block Structure

Astrid is a container application that manages smaller applications, called application components. The two primary application components for observing on the GBT are Observation Management, and the quick look Data Display. Application components may consist of one or more plugins, which handle specific cases required by the application. As a concrete example, the data display includes one plugin for each type of data that must be analyzed (e.g. pointing,

[3] `http://wiki.gb.nrao.edu/bin/view/Observing/StandardObservingModes`

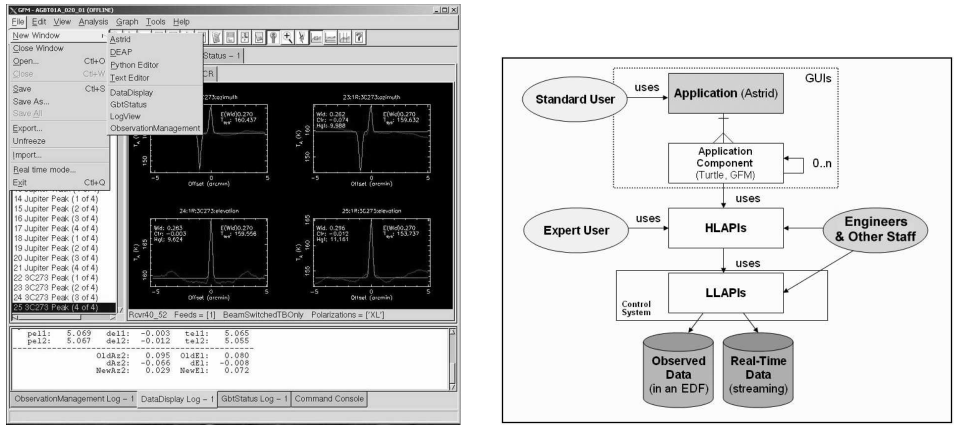

Figure 1. Astrid provides access to GBT applications, monitor information, and interactivity through the Command Console. The Astrid screen is shown on the left and its schematic on the right.

focus, spectral line). A screen shot and application architecture are shown in Figure 1.

When a SB is executed, the SB Executor interprets its contents, using the GBT High Level APIs to convert them to commands understandable to the control system. Those commands are then executed using a low-level API to the telescope, a Simple Object Access Protocol(SOAP) interface which brokers transactions for runtime optimization.

A SB consists of observational metadata and an observing script, which uses observing directives and scan types as described in Table 1. The SB itself is a logical entity in the Observation Management database; observational metadata is stored separately from the observing script.

5. Lessons Learned and Future Development

Astrid establishes standards for application design, layout, and look and feel. Because of these standards, adding new observing capabilities is now a much more streamlined process for the GBT than it has been in the past.

Several lessons have been learned, for example:

1. There should be a simple, straightforward interface to the control system.
2. There must be a way to accommodate expected operational issues, such as temporary weather shutdowns. For example, if a large map is being generated, and the telescope is shut down for wind, it is prudent to be able to pick back up at the same position you were in when the shutdown occurred without having to restart the SB.
3. If "hands-on" observing is a mode of operation, interjecting commands in the middle of a SB's execution is sometimes necessary, and the software must be able to accommodate it.
4. Breakpoints are useful within a scheduling block, and can remind the observer to take actions or perform certain checks during an observation.

Table 1. SBs are constructed using Observing Directives and Scan Types.

Directive	All	Expert	Description
#	×		Add comments into a SB
Annotation	×		Add comments into raw data FITS files
Balance	×		Idealize power levels of GBT hardware
Break	×		Pause the execution of the SB
Catalog	×		Access standard or custom source catalogs
Comment	×		Add a comment to the monitor log
Configure	×		Use predefined or custom telescope setups
DefineScan		×	Load a user-defined antenna pattern
ScanTypes	×		Use predefined antenna patterns (e.g. OnOff, Peak)
execfile		×	Define variables or ancillary procedures
GetValue		×	Retrieve parameter from control system
SetSourceVelocity		×	Set source velocity of LO directly
SetValues		×	Directly set control system parameters

5. Validation apriori is critical.

Additional future work is planned for this system. For example, we plan to establish and encourage best practices. There is an element of art to writing an optimized SB; techniques such as choosing the optimal length for the SB or balancing appropriately can all impact the success of an observation. Development is planned in 2006 to enable observers to manage the logical interconnections between SBs that define a Science Program. Additional application components or plugins will also be adapted into Astrid as new observing capabilities dictate; pulsar observing has recently been integrated. Improved tools to access the Observation Management Database are being reviewed. We have also considered expanding offline validation capabilities, and creating templates for SBs that employ common observing strategies. Some users have suggested that it should be possible to create a SB graphically, by clicking buttons and filling in fields.

Acknowledgments. It would not have been possible to transition these new observing processes, and associated software applications, to the user community without the dedicated work of the staff support scientists in Green Bank providing requirements, learning the system and training observers. Many thanks to Bill Saxton of NRAO for graphic design and layout of the poster displayed at the conference.

References

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