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Some Astrophysical and Instrumental Applications of AIPS++

Joseph P. McMullin, Robert W. Garwood

NRAO, 520 Edgemont Road, Charlottesville, VA 22903

Anthony H. Minter

NRAO, P.O. Box 2, Green Bank, WV 24944

Abstract. We present several applications of the AIPS++ environment as applied to the development of the Green Bank Telescope as well as current astrophysical problems. In particular, we demonstrate the use of AIPS++ in building tools for analyzing data at various points along the data stream, from diagnosing receivers and calibration, to data reduction and scientific modeling.

1. Introduction

AIPS++ (Astronomical Information Processing System, written in the C++ language) is an ambitious project to standardize the processing of (primarily radio) astronomical data, both interferometric and filled aperture. Currently under development by an international consortium of observatories, AIPS++ is now under beta release, with several other 'experimental' releases available to consortium organizations.

In particular, the Green Bank Telescope (GBT) project requires AIPS++ as an analysis environment. To accommodate and facilitate the GBT development, several sets of tools have been fashioned within AIPS++ at several points along the data path, from general calibration routines and data quality assessment to analysis and modeling. The comprehensive suite of mathematical applications available under the beta release offers a facile means of interacting and manipulating data for scientific purposes. In the following section, we detail some of the applications of AIPS++ for the GBT project and point to the future.

2. Current Usage

The following examples illustrate some of the many uses of AIPS++ at NRAO Green Bank. The majority of these examples were written in the Glish language (e.g., Paxson & Saltmarsh 1993; Schiebel & Paxson 1998) which is the main CLI to AIPS++ and allows access to the various libraries and clients within.

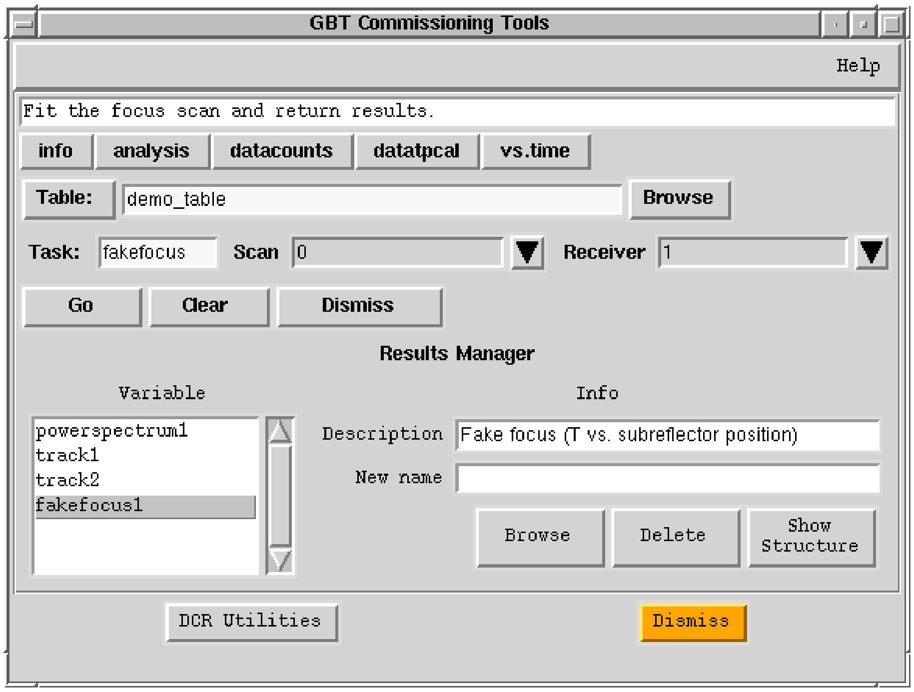

Figure 1. Example Commissioning Tool GUI.

2.1. Data Calibration

A series of tools have been created to aid in understanding and calibrating the equipment involved in taking observations.

gbtlogview A diagnostic tool for engineers to assess and monitor the receivers, and weather stations. It is composed of a GUI interface which allows selection of a series of devices over a selected time range which are subsequently 'filled' to an AIPS++ table. The plotting interface allows multiple columns to be intercompared.

bandpass analysis Several of the GBT backends are first being tested on the NRAO 140-foot telescope. Total power integrations of different continuum calibrators at many frequencies are being obtained for comparison with GBT performance and as diagnostic tests of the hardware. The goal is to be able to quantitatively describe the improvements of an unblocked aperture on the non-random frequency structure of instrumental baselines.

continuum commissioning An in-house commissioning package has been written in Glish using the AIPS++ modules to provide a set of standard tasks for characterization and commissioning of the telescope. Tasks include: T_{sys} calculation, T_{Ant} calculation, τ_{zenith} calculation, focus measurements, pointing measurements, and power spectra calculations. In addition, plotting of all quantities (e.g., individual phase data) is possible. A pointing model module is currently under development.

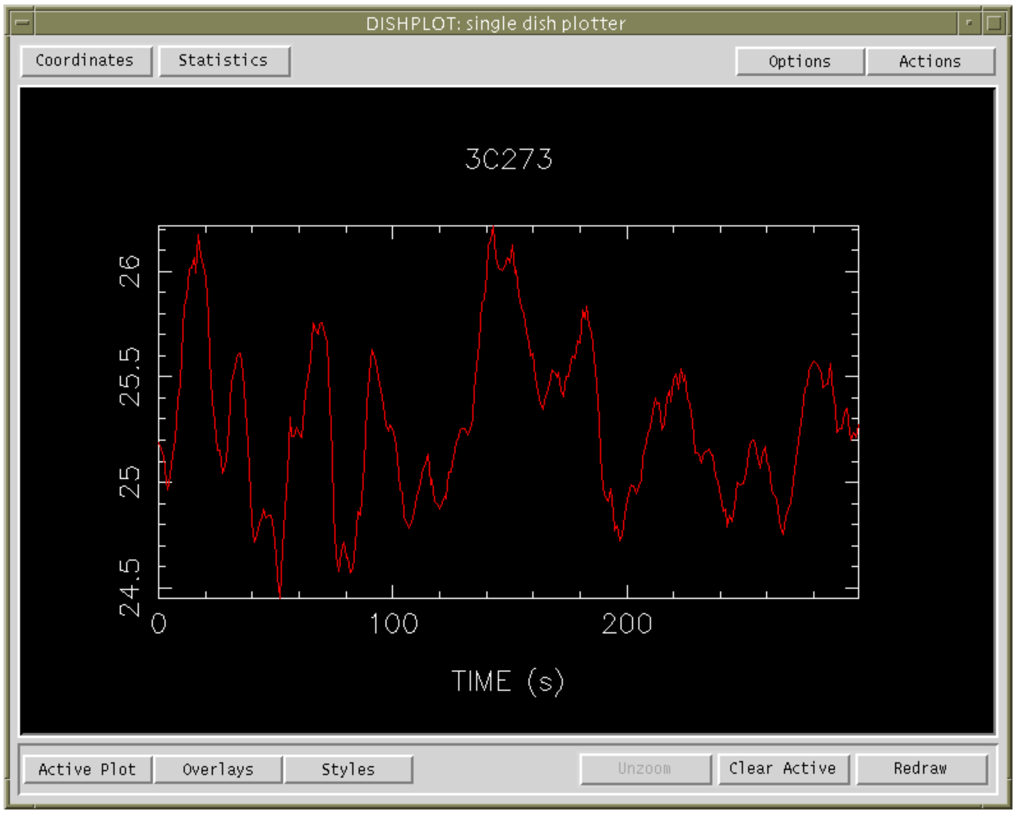

Figure 2. Example Commissioning Tool Plot. Display shows plot of a tracking scan on 3C273.

2.2. Data Quality

Several tasks have been developed for general assessment of data quality during observing.

monitoring radiometer observations An 86 GHz tipping radiometer is installed in Green Bank for monitoring atmospheric conditions. This data is analyzed every hour through execution of an AIPS++ program. The program writes out information in HTML format for updating a web page of information. Current and archived data are available along with an atmospheric transmission curve over a relevant range of frequencies.

monitoring and archiving radio frequency interference Low frequency observations are particularly plagued by radio frequency interference. In response, an archive tool for submitting interference events and allowing table searches to aid identifying these events has been created. The availability of Tk widgets within the Glish programming environment along with sophisticated table querying within AIPS++ make this possible.

2.3. Science

Although AIPS++ is only in Beta testing, the large number of analysis tools allows a fairly high level of analysis. Some examples follow.

DISH The DISH software, a single-dish subset of AIPS++, is also under Beta release. Data from several telescopes have been loaded into the system and reduced (see Garwood & McMullin 1999).

Pulsar Tools Several general tools for pulsar analysis are also under development. These are intended to be generic tools for displaying and calculating basic parameters (e.g., pulse time-of-arrival, dynamic spectra, de-dispersal).

Modeling Gas Structure in the Interstellar Medium The suite of mathematical functions allows simulating a data cube with a Kolmogorov spectrum of turbulence. This data cube can then be used to simulate observations; in particular, a model was used to compare observed properties in Molecular Clouds to discern statistical biases in different types of analysis probing molecular cloud structure. These results are currently in preparation (Minter & McMullin 1997).

3. Future Directions

With the GBT expected to be delivered in late 1999, there will be increased development in the coming year. In particular, we are in the midsts of developing the on-line reduction system for the GBT as well as aiding in the holographic measurements.

References

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