

# RFI observations with the VLBA:

## A guide to data collection and reduction using **redrfi**

Walter Max-Moerbeck  
NRAO

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### Abstract

This is a brief description on how to use a script developed to generate RFI plots with interactive online plots. The script performs the data reduction in AIPS, formatting of the resulting spectra to generate an average spectrum for each site and the generation of the websites with interactive plots for easy exploration by the user. The script is actually a wrapper for several scripts that are briefly discussed at the end of this document, but that do not need to be used directly by the users.

## Taking RFI data on the VLBA

We are currently obtaining RFI data on the VLBA by running one of the standard schedules for each band. Standard schedules currently exist for L-band and S-band for a single polarization, RR in the current versions, but using LL requires a simple modification to the setup files. The code described below has been tested with these standard schedules and is not guaranteed to work for others.

These scripts use geodetic segments to distribute sources around the sky to have good elevation coverage<sup>1</sup>. Since we are mostly interested in RFI coming from the horizon we restrict the elevation to low values using 'geohiel=30'. More details on geodetic segments can be found in the SCHED manual.<sup>2</sup>

The only required configuration for these schedules are the date, experiment and observer information related keywords, which are the beginning of them. A list of keywords you might want to change is given below:

- expcode, year, month, date, start, piname, phone, obsphone, email, corship1

The **stations** keyword can be changed to select a subset of stations for a special experiment. Changing other keywords is not advised, because the reduction script has not been tested with setups not included here. If you still decide to do so, please consider the automatic reduction might not work.

A copy of the standard schedules can be obtained by running '**redrfi --scheds**' on the current directory. See more about using '**redrfi**' below.

We are planning to generate standard schedules for the other bands in the VLBA.

## Using **redrfi**

**redrfi** is a utility that takes idifits files and outputs total power data in csv format and plots for each one of the scans included in the files. It also generates summary total power plots and data sets that are meant for an easy exploration of the statistical properties of the total power data. The output contains mean, rms, minimum and maximum values of the total power versus frequency for the scans contained in the idifits files.

<sup>1</sup>We would like to optimize the azimuth coverage too, but that is not currently possible in SCHED.

<sup>2</sup><http://www.aoc.nrao.edu/software/sched/sched.html>

It also generates a set of webpages with static and interactive plots for a quick exploration of the result by users of the VLBA planning their observations.

To run it, all is needed is to configure the parameters using a `configredrfi.py` file located in the current directory. If no such file is present use `'redrfi --config'` to make a default copy of `configredrfi.py` on the current directory. This default copy needs to be edited with the desired parameters. An example is included below, for most cases the text before the variable might be enough explanation, but longer explanations of the parameters have been added for reference below.

## Installing redrfi

Before running `'redrfi'`, it needs to be installed in a directory of the user choice. To do that follow the steps below:

- Obtain the code from the VLBA SVN repository. This can be done by with  

```
svn co https://svn.aoc.nrao.edu/repos/VLBA/vlba_rfi/redrfi/
```

  
This requires having access to the repository.
- Define the environment variable `'REDRFIPATH'` as the path to the directory containing the code  
For the bash shell this is done by adding this line to `.bashrc`  

```
export REDRFIPATH='full-installation-path-used-above-to-/redrfi/'
```
- Add `'REDRFIPATH'` to the search path for executable files (`'PATH'`).  
For the bash shell this is done by adding this line to `.bashrc`  

```
export PATH=$PATH:$REDRFIPATH
```

## Updating redrfi

To update simply run

```
svn update $REDRFIPATH
```

This requires having access to the repository.

## The configredrfi.py file

There are two groups of keywords in the configuration files. The group of **basic options** needs modification for any project. The group of **advanced options** does not need to be modified.

```
#-----  
# Basic data reduction parameters - Basic options  
#-----  
# Define AIPS input and output files  
aips_input = '/home/inti/Documents/usno-sband-tests-2014-08/ts035b/data/'  
aips_output = 'output/'  
  
# idifits file names. The complete name is form by adding '.idifits' to them  
name_prefixes = ['ts035b0', 'ts035b1']  
  
# AIPS user ID number in in decimal and extended-hexidecimal.  
# Use AIPS EHEX to obtain it  
aips_id = 8888  
aips_ehexid = '6uw'
```

```

# List of antennas to obtain total power spectra
antennas = ['BR', 'FD', 'HN', 'KP', 'LA',
            'MK', 'NL', 'OV', 'PT', 'SC']

# List of polarizations to include, options are 'RR' and 'LL'
stokes = ['RR']

# Version of the flag table to use when saving total power data
# flagver = 0 uses the last flag table
# flagver = -1 ignores the flags
flagver = 0

# Band name and date to display on webpages
band_name = 'S-band'
date = '2014-10-11 15:00:00 UT'

#-----
# Output folder configuration - Advanced options
#-----
# Output folder used by python plotting script
plots_output = 'plots'

# Folder to contain the website
webpage_folder = 'website'

#-----
# Total power plots parameters - Advanced options
#-----
# Normalization for the total power scan
normalize = True

# Normalization type. 'mean' is recommended.
norm_method = 'mean'

# Type of plot. 'envelope' is recommended.
plot_type = 'envelope'

# Make plot for each scan
plot_single_scans = False

#-----

```

## Appendix:

### Brief description of the individual scripts called by redrfi

redrfi runs all the scripts without any user interaction. The description below indicates what each one of the scripts does, and is meant as a help for a user trying to modify the code.

The reduction process is straightforward but somewhat involved by the need to combine steps in AIPS for

the calibration and Python scripts that perform the plotting, data aggregation and generation of the website. The description below provides an overview of the process.

- Run `write_aips_script.py` to create the directory structure to contain the output for the following scripts.
- Run `write_aips_script.py`: This Python script generates the AIPS run files (these can be several, we use `aips_reduction.uid` as a generic name for the description below) that will be used to load the data sets and perform the calibration of the data.

The script is needed because in each observation several setups can be used, and in this way all the reduction scripts can be generated with minimal typing required.

The script will also run the AIPS run files for the user.

- Run `parse_listr_scans.py`: This Python script uses the scan lists created in the step above to generate AIPS scripts (several, generic name `aips_tp.uid`) that output a total power spectrum for each of the scans.

The script also runs the `aips_tp.uid` AIPS run files. These output the total power spectra for each scan. These total power spectra are the basic data for the RFI survey but there are too many of them and we need to reduce their number to obtain averages for the users.

- Run `plot_total_power.py`: This Python script generates total power plots and the average total power spectra for each antenna and polarization. These are ready for user consumption.
- Run `generate_webpages.py`: This Python script generates the webpages along with simplified versions of the total power spectra to be consumed by the limited functionality of the online interactive plotting software .

This generates a folder (`webpage_folder = 'website'` for the `configredrfi.py` file above) with all the files required for the website. This folder can simply be copied in an appropriate place to be visible to users.