Hydrogen Line Galaxy GB 20 Meter Telescope Data Analysis Spreadsheet User Guide

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Introduction

This document is meant to be a companion guide to my Hydrogen Line Galaxy GB 20 Meter Telescope Data Analysis Spreadsheet. It includes an in-depth description of each tab on the sheet, what the various columns do, and how to use them. I hope that this document will make the use of the spreadsheet easier to understand. Each tab in the spreadsheet will be covered in the order in which they appear referred to by the title on the tab.

Purpose of the Spreadsheet

The purpose of the Hydrogen Line Galaxy GB 20 Meter Telescope Data Analysis Spreadsheet is to analyze the data from a single observation session using the Green Bank 20 Meter Telescope via UNC-Chapel Hill's "Skynet" program. This analysis will generate a plot that hopefully reveals a clear spectral profile that matches the spectral profile obtained from professional sources.

Raw Data Tab

The raw data tab is simply named after the galaxy which you are observing (e.g. "m101 data"). This tab contains a direct dump from the text file generated by the Skynet observing session. The filename will have a format similar to this example:

"Skynet_60545_messier_101_10_sec_JLB_120655_70550.A.onoff.cal.txt"

Once you paste in the contents of the text file into the sheet you will need to use excel's built in "text to columns" option to expand the single stream of text into the proper columns for analysis. Select "Data" then "Text to columns" and enable the "fixed width" option. Then click through the dialog boxes till it finishes expanding the data into separate columns.

Analysis Tab

The next tab is also named after the galaxy being observed (e.g "m101 analysis") and it is where the analysis calculations take place. This tab converts the frequency values from the raw data into VLSR corrected doppler velocities in km/s. The Green Bank 20 Meter Telescope is set up to automatically correct for VLSR so the frequency values in the data files don't need to be adjusted, they can simply be converted to velocities using the non-relativistic approximation doppler formula.

Column “A” references the first of two frequency columns labeled “Freq1(MHz)” in the raw data tab and reflects those values on this sheet. The raw data file contains two identical sets of frequency and cross-polarized power value columns due to the fact that the receiver has the option for two different center frequencies for observation. During my observations I set them both to the same band and so the second set is redundant.

Column “B”, labeled “Velocity” converts the frequencies in column “A” to doppler velocities in km/s using the formula:

V = 300,000*(1420.406/Fo – 1)

Columns “C” and “D” reference the first of two sets of cross polarized power value columns labeled “XX1” and “YY1” in the raw data tab and reflects those values on this sheet. Again, the second set of cross polarized power value columns is redundant.

Columns “E” and “G” both contain flattening functions to correct the backgrounds of the profiles contained in the “XX1” and “YY1” columns. These functions are labeled “fitX” and “fitY” and are generated by polynomials defined by coefficients entered into cells in column “K” labeled “2^{nd}”, “1^{st}”, and “0^{th}”. If you don’t want to do any correction just set the coefficients to zero. If you only want to use a linear fit only use the 1^{st} and 0^{th} order coefficients. The idea is to look at the uncorrected “XX1”, “YY1”, “fitX”, and “fitY” plots and adjust the coefficients for each fit function until it follows the curve or slope of the background for it’s respective uncorrected plot. Then look at the “corX” and “corY” plots and make sure they are flat and the backgrounds are at zero.

Columns “F” and “H”, labeled “corX” and “corY” are where the flattening functions are applied to the data sets “XX1” and “YY1” to produce flattened profiles.

Column “I” labeled “combined” simply averages “corX” and “corY” together to get a single composite profile.

Column “J”, labeled “smoothed” applies a 5-point running average to the data in column “I” to smooth out the noise a bit more.

To the right of all these columns is a plot that can display the “XX1”, “YY1”, “fitX”, “fitY”, “corX”, “corY”, and/or “smoothed” column(s) as desired.