

TM
SpectraCyber I / II

**SpectraCyber I/II™
1420 MHz Hydrogen Line
Spectrometer**

**Installation and Operation Manual
No. SC1/2-2006**



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SpectraCyber™ – WARNINGS and CAUTIONS

CAUTION

BEFORE HOOKING UP YOUR SYSTEM, CONNECT THE POWER CABLE TO THE +12 VDC OUTPUT, LOCATED ON THE SPECTROMETER REAR PANEL. APPLY POWER (110 VAC or 220 VAC) AND CONFIRM THAT +12 VDC IS PRESENT AT THE END OF THE POWER CABLE (NOT SUPPLIED).

AFTER CONFIRMATION, CAREFULLY CONNECT THE POWER CABLE TO THE LOW NOISE AMPLIFIER (LNA).

WARNING

THESE MODULES UTILIZE GASFET AND HEMT DEVICES, USE CAUTION WHEN CONNECTING THE SIGNAL CABLES, AS NOT TO INDUCE ANY STATIC CHARGE.

WARNING

THIS SPECTROMETER HAS BEEN CONFIGURED FOR OPERATION AT 110 VAC or 220 VAC (European). *IT IS STRONGLY SUGGESTED THAT THAT THE UNIT NOT BE OPENED DURING OPERATION. SHOCK OR BODILY INJURY MAY BE INCURRED IF CONTACT WITH THE POWER SUPPLY. IN ADDITION, REMOVE ANY JEWELRY FROM YOUR BODY WHICH MIGHT HANG DOWN OR COME IN CONTACT WITH THE VOLTAGE SUPPLY.*

USE EXTREME CAUTION WHEN WORKING WITH VOLTAGE/CURRENT POTENTIALS!

Jeffrey M. Lichtman/Radio Astronomy Supplies (RAS) and associates, will assume no liability for operation of this radio telescope in any unsafe manner. This product has been engineered and tested to insure that the operation is safe and that the product does what it is was built and designed for. The radio telescope is guaranteed for 90 days from the time of delivery. **Opening or modifying will void the warranty** unless prior permission is received from Radio Astronomy Supplies. In the event of any malfunction, RAS should be notified. Authorization for return and repair will be given. **No attempt should be made to open or repair.**

This system is a highly sensitive research grade system. Please adhere to the enclosed directions, to insure proper operation.

SpectraCyber™ – Introduction

The Radio Telescope is composed of a frontend unit which includes, the low noise preamp and a cylindrical feed horn for 1420 MHz. The frontend is connected to the backend rack unit by user supplied low loss coax cable with type "N" connectors. In addition, 18 Gauge, four conductor (shielded) power wire is recommended for external LNA power.

NOTE 1: The difference between the SpectraCyber I and II, is a 70 MHz In/Out Loop on the rear panel.

NOTE 2: We recommend a "very low loss" cable such as, LMR-400 flexible cable or a Type 200 (9913 type replacement) derivative at the very least. This cable should have a loss of 6 dB or less at 1420 MHz.

Depending on the length of cable run, it may be necessary to add an additional low noise preamp in the line. Extremely low loss hard line such as Heliax, will allow runs of over 100 feet with no additional preamp needed.

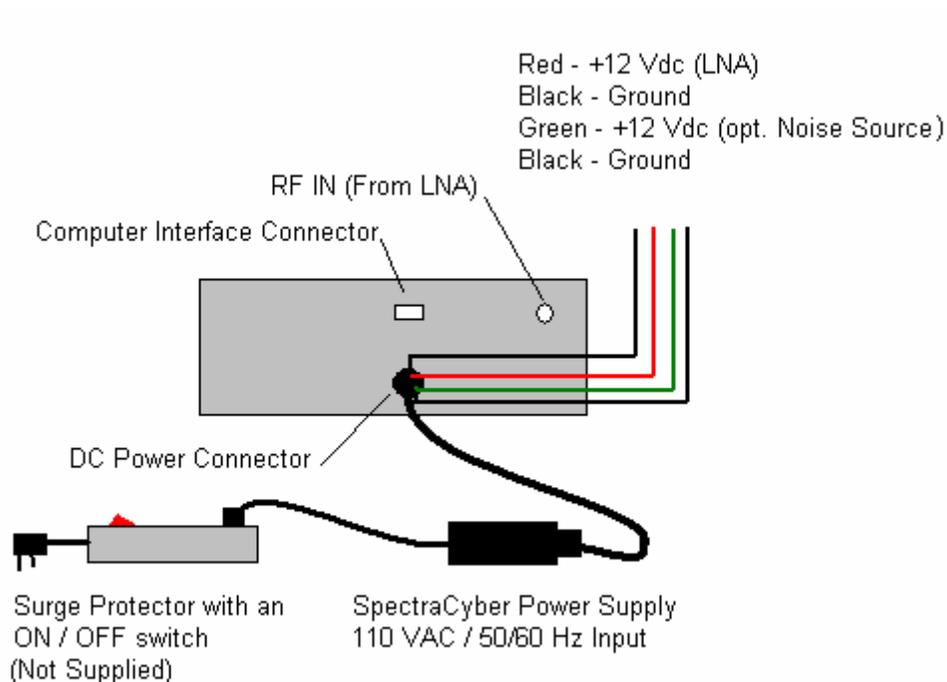
It can not be stressed enough that this feed line is most important to the successful operation of the telescope. Please do not skimp on the purchase of this material. Price certainly reflects quality and durability. Expect to pay at least \$1.00 per foot for good material. It would also be a wise investment to purchase this cable with type "N" connectors already installed. If you are not familiar with installing these then you run the risk of water damage to the cable due to infiltration. A small fee will be charged by the cable supplier to install these correctly. An excellent source for coaxial cable is the Wireman: <http://www.thewireman.com>

Backend:

The feedline carries the low noise amplified signals to the telescope backend. The backend electronics are enclosed in a standard 19" instrument rack which should rest on a table top or be enclosed in a rack mount chassis. It is important to maintain the rack in as temperature stable environment as possible. This will keep electronics gain drift to a minimum. The back end is powered by a 110/220 VAC supply which produces a nominal +/- 12.5 VDC for the electronics in the rack as well as a rear panel output to power the preamp and an optional noise source. The instrument communicates with an IBM compatible CPU via an RS-232 dB9 connector. The 1420 MHz signal from the frontend (LNA) enters the rear panel (Receiver Backend) and is fed to a 1420 to 70 MHz dual conversion (Internal) down converter. This converter has approximately 3 dB = 8 MHz bandwidth with the Hydrogen rest frequency at 70.0 MHz. This 3 dB = 8 MHz wide IF signal is passed through a programmable gain IF amplifier and then split between the continuum square law detector and the spectrometer third conversion mixer. The programmable gain IF amp is used to compensate for feedline losses and to place the signal in optimum range for the square law detectors.

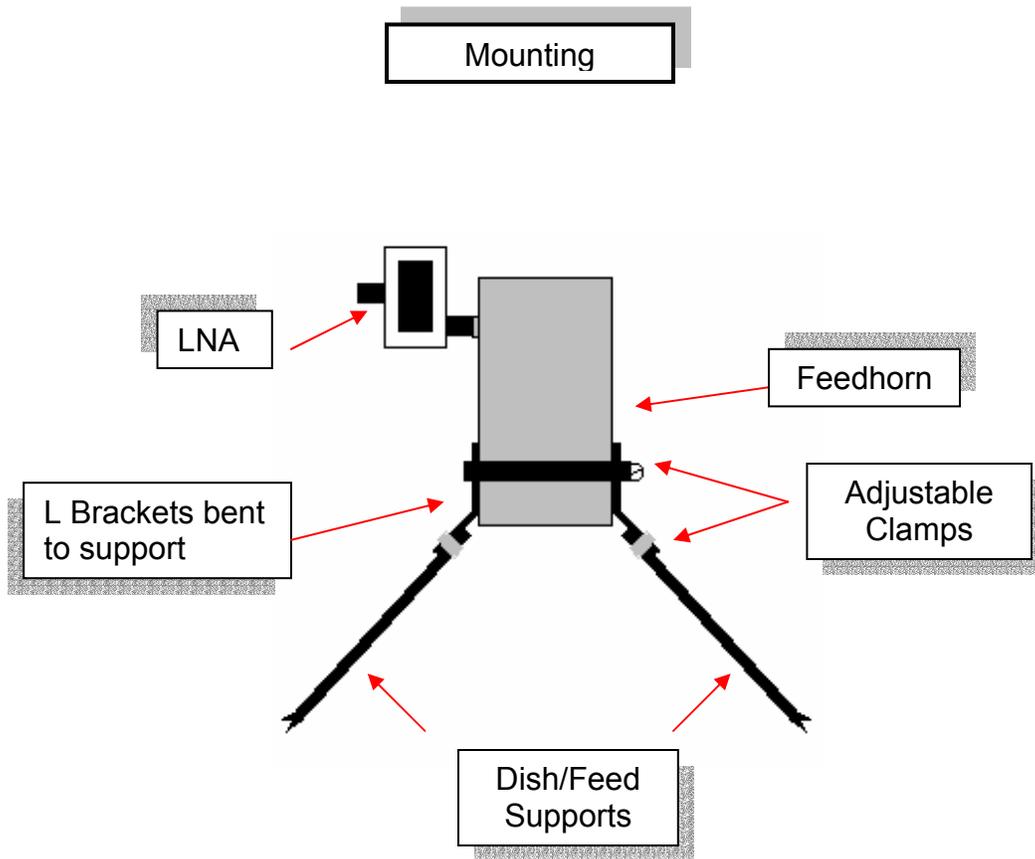
SpectraCyber™ - Setup Procedure

The following Setup diagram should be followed for installing the SpectraCyber™. In addition, information on Feedhorn and LNA mounting is also supplied.



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Feedhorn / Choke (optional) / LNA Mounting:



SpectraCyber™ I / II - Software Documentation

Introduction:

This is a software product development of the The Jupiter Space Station Group for the SpectraCyber™ Spectrometer... Copyright 2000... All rights reserved.

(A CD with the current software is provided with your SpectraCyber).

The software has been designed and tested on Intel 486 equipment or better, running Windows 95 – 2000, XP and ME; and a SVGA (800 x 600) monitor.

The software provides a control and hardware setting interface to the SpectraCyber spectrometer. In addition, the software includes features, which enables the user to play data movies of hundreds of scans at a time, select time coordinate systems for the data files, set the computer clock to within 500 milliseconds of WWV via the internet, and change graphical features such as background or the amplitude axis on the data plot. Final modifications in this version include a rapid scan rate mode, frequency shifting for equipment that can shift frequencies around 1420.406 to a 70 MHz IF, and Km/sec displayed on the X axis.

Also the user can also run a single scan and save it to produce the bmp. The 13k bmp which can be converted to a 6 k gif file with almost any graphic software package. This bmp or gif graphics file can be used in desktop publishing or in creating an animated gif, for an internet series of data plots.

The software can be completely exercised and tested in an offline mode using real Sagittarius data, along with files to play data movies.

Coming features include JAVA internet control of a spectrometer, NTP time protocol clock setting, and audio toning on antenna alignment. However these features are being developed for the new SpectraCyber II.

This software does not link with the Windows Registry.

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Software Implementation:

To install the software simply follow these steps:

1. Insert the CD into your drive and select that drive. Click on the unzip icon. The program will automatically install
2. Choose a temporary folder to deposit the download file.
3. After downloading, double click on the SpectraCyberUnzip.exe
4. The Unzip gives you the option of installing in a folder named SpectraCyber or a folder of your choice.
5. Under the folder you choose, three sub-folders are created... please do not change the names or relocate these sub-folders.
6. You could at this point drag the SpectraCyber.exe to the desktop to create a shortcut from the desktop. You could also drag the JSSatomicTime.exe to the desktop for setting your computer clock to NIST atomic time via the internet.
7. Help files within the product give full software and hardware documentation.
8. You may now delete the download file... Installation complete.

NOTE: The COM port must be set to - 2400 baud, 8 bit data, No Parity, Flow Control = None.

Software Information and Commands:

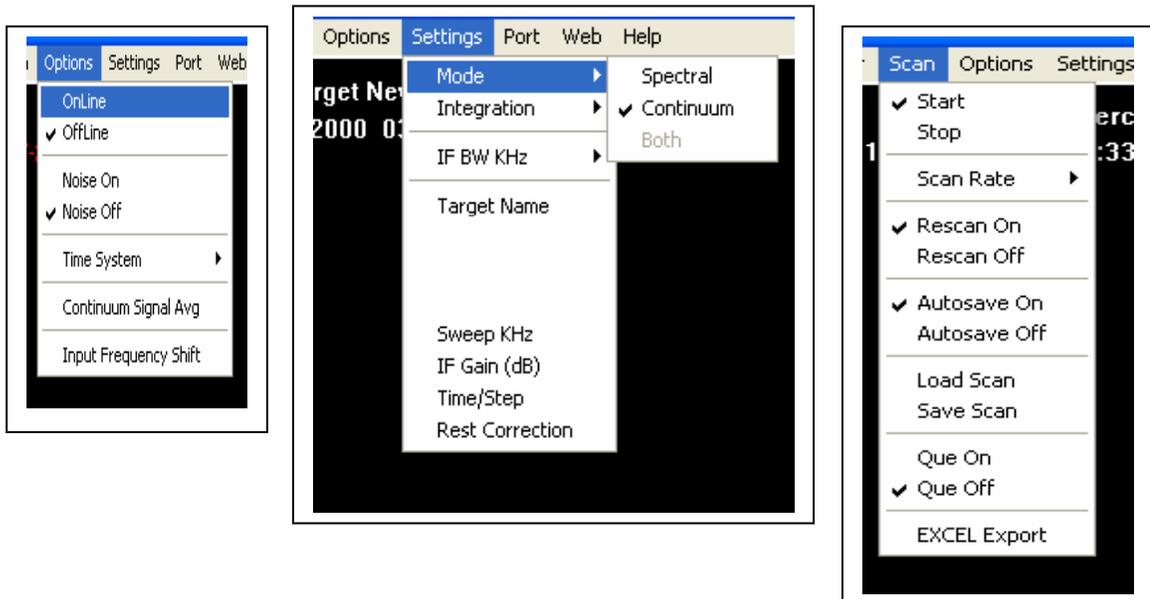
The spectrometer software is written in Visual C++. This is Windows based software and does require Windows to operate. The compiled version of this program is SpectraCyber.exe. Follow the Readme file instructions to properly load the software on your computer and review the computer hardware requirements. From your chosen folder simply click SpectraCyber.exe. This will start the spectrometer program. You can also create a desktop shortcut by dragging this .exe to the desktop... if you wish. There is also a JSSatomicTime.exe which connects to the internet and updates your system clock to the nearest second, you could also drag this to the desktop if you wanted an icon for it.

The product comes up in Offline mode. Go to Options and choose Online and the product will query the SpectraCyber spectrometer. Once two way communications has been verified then the main Status Box will display Online Status. At the upper left the present date/time will constantly be displayed in UTC or LAST (Local Apparent Sidereal Time) depending upon the Time coordinate selection described later. At the top are the control and function choices which may be selected by the mouse. A left button click will select most of the choices however there are several selections which open a separate dialog box.

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Menu Selection

When the Windows version software starts it is in a demo mode and requires you to select **Online** mode by clicking the options tab and selecting **Online**. If the port is set correctly and is connected you should see the red status bar switch to online. The cpu is now talking to the receiver. Click the settings tab and select mode then select **Continuum mode or Spectral**. In addition, you can select **Target Name and other settings such as Gain etc.**. You may now select **Rescan On** and **Autosave ON** then **Start** scan (or view the included help file on the software operation).



System:

Click on Favorites and choose Load Favorites to reset the settings on the the software or click on System and then Reset (This is primarily an error recovery command). Click on System and then Exit to shutdown the program and return to Windows.

Favorites - Load, Save, and Default:

The next item on the menu bar is the Favorite item. This permits the user to save a favorite configuration for a target under study. One could save a favorite under a target name and then come back to it later. To pull up a previous favorite simply click on the Load menu item. If you want to have a standard default configuration you would save the current configuration to the filename: Default.fav, which is what the program loads on initialization.

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Screen:

By clicking on Black or White the user can set the background of the main window, which may be useful for clean and clear Screen Prints or for the Plot Capture option which drops a .bmp file to be included in publication documents or an animated gif of the data. Left click the mouse on Screen and choose Clear to clear the present data from the screen. An X axis feature permits you to use either KHz or Km/sec on the axis. Here you will find the Plot Zoom feature. Upon clicking this feature a dialog box comes up capturing the upper and lower Y-axis limits you wish to zoom too. The only restriction is that the lower limit cannot exceed the upper limit. Another feature permits the user to use either dots or connected lines for the plotting. The final feature is Plot Capturing. This feature permits the user to specify whether or not a bmp graph file is created on each save of the scan. This does not drop a bmp for each AutoSave during the scanning process; the user must load the scans they like, re-save them, and the bmp. is created if the Plot Capture feature is on. The user can also ran a single scan and save it to produce the bmp. The 13k bmp can be converted to a 6 k gif file with almost any graphic software package. This bmp or gif graphics file can be used in desktop publishing or in creating an animated gif for the internet of a series of data plots. Finally, the bmp or gif file can be printed from any number of graphic packages.

Player:

Data which has been stored on disk can be played back in a "movie". Each screen of data is pulled from the disk one at a time and rapidly drawn on the Screen. The previous screen is erased and the next file in sequence is displayed. This presents a fluid motion of time and is very insightful in the display of doppler data as the sky sweeps the dish. This is a unique method of displaying the doppler data and gives a "third dimension" to an otherwise standard.

Graph:

When you left click Pick Starting File bar a dialog box will guide you asking for the path and file prefix name to play. The files to play should have been previously stored on the hard disk by the Autosave command (described later). The filename prefix could be something like C:\YourDir\Data\Orion.1 The C: represents your hard disk or perhaps a floppy disk drive. The name of the files to display is Orion. After clicking select Pick Ending File to specify an ending file extension in the data series. The file extension is the suffix after the period in a file name. The Autosave command will automatically increment this number for each scan saved. In the hypothetical case above the first file extension would be 1. On your hard disk there would be files Orion.1 Orion.2 Orion.3 etc. The start # is the first file in your data movie. After entering a number for the start press Tab and you will be asked for an ending #. This is the last data file to display in your movie. A movie can be up to 999 scans long. After entering the ending # press TAB. Next you will be asked for a delay. This represents the delay in seconds or fractions of seconds to pause between each screen of data. A short delay of .2 seconds runs the movie quickly while a long delay of 1 second per frame moves more slowly. This allows close examination of small changes in the graphs. Just enter the desired delay in seconds and press TAB.

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You will then select Single or Continuous play of the movie. In single play the movie runs once and then returns to the command state, in continuous play the movie is automatically started over at it's end. Simply enter S or C followed by a clicking on OK. The movie should start and display the file name and the date it was recorded at the upper portion of the screen. To start the movie click On... To stop the movie click Off.

Scan:

This Start and Stop menu bar will start or stop scanning as well as kill a movie which is in progress. Plotting will indicate when a scan is in progress and will cease when scanning is stopped.

A Scan Rate feature permits you to speed up the scans by a factor of up to 4x. Basically this changes the between point scans from either 5 or 10 KHz (depending on your upper/lower limits) to as much as 4x or 20 - 40 KHz.

A selection of Rescan On or Rescan Off toggles the screen rescan on or off. This simply means that at the end of a screen full of data if rescan is on then the old data will be erased and a new scan will start automatically.

Autosave On or Autosave Off clicked automatically saves plots of data when they are full. When clicked the Status Box changes to Autosave On. The Target name is used for the filename and the data is stored in the Data folder. This path helps to better organize things as it is a good idea to use sub-folders. Again an example could be C:\DATA\ORION the program will automatically place the period and append an extension # when each file is saved. There can be a maximum of 999 files which would save on the C: drive in the DATA subdirectory. As an example: ORION.1 THRU ORION.999 The path and file prefix will be shown in the plot area at the upper portion of the screen. As each file is saved it's path, name and extension # will be displayed. Click on the Start bar to begin data collection. The consecutively saved files can later be viewed as a movie with the player command.

Load and Save feature bars permit individual scans to be loaded for viewing or stored for later analysis.

Next comes a powerful operations feature: Que. The software has the ability to start data collection at a point which is chosen in the future. When the Que bar is left clicked you will get a dialog box which prompts you to enter the countdown time until data collection. An example could be 15 hours 21 minutes. After entering this time press TAB and you will be asked for the lapse time to run the observation using the spectrometer data collection. The times must be in 24 hour format. Click OK when done. The data would be stored under the Target name as the Autosave saves the file. As an example it could be C:\YourDir\Data\Orion. This will save files named Orion.* on drive C in the DATA subdirectory. If you wish to abort this Que operation, simply click Que Off.

There are two powerful features at work here: first, a Que.fav file is saved to be retrieved when the countdown kicks the job on, and second, the user can use the spectrometer and software during the countdown period.

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Options:

By clicking Online a dialog box of settings comes up for you to initialize the spectrometer settings. When completed with filling out the settings values the spectrometer moves to Online if the communications channel is open. In Offline mode the spectrometer can be completely exercised using a dummy Sagittarius data set.

The backend unit is equipped with a relay to supply +12Vdc @100 Ma to an external noise source if required. The noise source is turned on or off by clicking the Noise On/Off bar. Each click toggles the relay on or off. This command may be used during the scan acquisition to record a reference power level.

Audio On/Off is a toggle which produces an audio tone proportional to the amplitude of the current point on the plot. This may assist in antenna tuning/alignment. This feature may be **implemented in a later version.**

Time System... the user may select either a UTC or LAST (Local Apparent Sidereal Time) time coordinate system for data file stamps. Each time LAST is selected the user may enter the local latitude and longitude coordinates which will become the default for all sessions thereafter; also one would note that the current Julian Day is also displayed in this dialog box. Some users like LAST displayed so that they can easily estimate when the target comes up on their local meridian.

The next option, Priority, permits the user to jack up the priority of the software tasks in the Windows operating system. This should be used sparingly. This may be helpful when running on an older Intel machine to give SpectraCyber the machine cycles it needs to interface with the instrument. At "Realtime" priority Windows will basically roll over and play dead (like the old DOS days... dangerous though). The last option is the Input Frequency Shift. This brings up a dialog box which wants to know how much (in KHz) you want to shift the the x axis values.

Settings:

The backend unit is a dual model spectrometer and continuum receiver. A left click on this bar will open it for. The choices are Spec Mode which is spectrometer only, Cont Mode which is continuum only mode.

NOTE: If you have been operating in the SPEC mode and you change to CONT mode, and then go back to SPEC mode, you may have to re-enter the + and – scan parameters (example: +600 and -600).

Integration acts like a capacitor charging up with signal and then is tapped at intervals specified by Time/step (DT). Standard integration values for Spectral mode are .3, .5, and 1.0 seconds; Continuum mode are .3, 1.0, and 10 seconds.

A few units have the option of either 15 or 30 KHz IF bandwidth. The default is 7.5 KHz. Target permits the user to set a target/filename for data and for the title line on the plot... If the user does not specify anything then the words SPEC or CONT are used along with date stamping to indicate target information.

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The Scan or Sweep limits are used to set the upper and lower scan limits of the spectrometer.

The backend is capable of scanning +/- 2 Mhz from the hydrogen rest frequency. The lower limit is usually a negative value and ranges from 0 to -1000 KHz. This corresponds to red shifted doppler signals. Enter a limit and then press the TAB key. Next the program will move over for an upper scan limit in KHz. This corresponds to blue shifted doppler signals. Enter a value from 0 to 1000 KHz and press TAB. Keep in mind that the spectrometer moves in 5/10 KHz steps so these values should be integer multiples of 5/10. An entry such as 183 KHz would be invalid, however 185 would be fine. The program selects -600 and +600 for the limits at start up (unless you modified them in your favorite file). Most signals observable with a smaller dish will be in this range. Both upper and lower limits will reside somewhere on the x axis. Just remember that the lower limit must lie to the left of the upper limit.

A final note about the x axis values: depending on your upper and lower limits there are 4 possible ranges: -2000 to 2000 (10 KHz steps), -1000 to 1000 (5 KHz steps), 0 to -2000 (5 KHz steps), and 0 to 2000 (5 KHz steps). Above we described a Scan Rate feature which speeds up scanning by jumping steps 2x to 4x.

The Time/Step or DT bar allows a change in the "Delta Time" or simply the time between sample data points. In Spec mode this is usually 1 second or less, in continuum mode you can choose as long as you wish however 60 seconds is a reasonable upper limit. The source could pass through the beam of the dish without being sampled if the delay is too long. Below 1 second the resolution is .05 seconds. If you enter 0 seconds it will be "rounded up" to .2 seconds. Above 1 second values are rounded to the nearest whole second. Continuum only mode stores 360 data points per screen while Spec mode has 400 data points per screen.

Finally, Rest Frequency Correction permits the user to tune the spectrometer so that the hydrogen rest frequency will be precisely 0 MHz on the Doppler x axis scale. Typically the units come from the factory with a correction factor of .5 and 2.0 seconds, located on the front panel.

Port:

The Port selection permits the user to designate COM1 or COM2 as the computer port interface to the spectrometer.

Web:

The Web selection permits the user to go directly onto the internet, to set the computer clock to within 1 second of NIST time. Go to the support site to pick up new releases of SpectraCyber and the documentation, or jump to the SpectraCyber sales site for information on new and radio astronomy equipment.

Help:

This Web selection permits the user to select software or hardware help on this product as well review the Readme file for installation instructions. Information about the Development Team can be found in the Help About SpectraCyber selection.

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