CHU Eclipse Data Collection

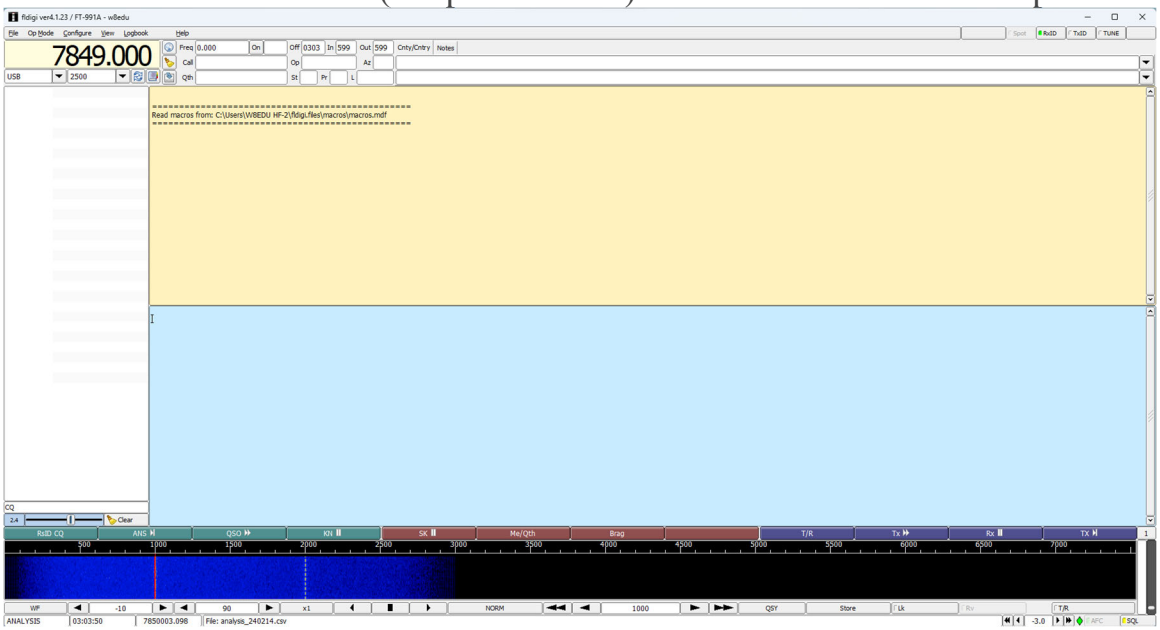
The Case Amateur Radio Club W8EDU is excited to lead citizen science research during the upcoming solar eclipse alongside HamSCI and a network of stations all across North America. We will be monitoring the reception of the Canadian time standard CHU before, during, and after the eclipse to measure the recombination time of the ionosphere. In other words, we know that the ionosphere changes in response to the presence of UV radiation in the sun by ionizing during the day and "de-ionizing" at night (which is why many frequency bands propagate differently during the day and the night). We understand how the ionosphere changes over a normal 24 hour period in response to the relatively slow transition from daytime to night time, but want to learn more about how it changes over a much shorter period (which is what the eclipse provides). **We want you to help!**

We are greatly appreciative of everyone who has volunteered to help us! **If you would like to volunteer, please reach out to eclipse-research@case.edu and we will onboard you.** To assist with the research, please read the instructions below depending on your station classification. **For stations that will record locally with a receiver and Fldigi (EQ stations), please read the instructions below.** Instructions adapted from KD8OXT's instructions for collecting data from WWV:

1. If you have not already, email eclipse-research@case.edu including the following information:
   – Your planned receiving location
   – If you plan on transmitting on the 20m, 40m, and 80m ham bands near the receiver from April 1-15.
   – If you anticipate any time when you will not be able to receive from April 1-15.
   – A brief description of the antenna(s) that you plan to use. If possible, please use an antenna that is directed towards the CHU transmitting station in Ottawa, ON.
   – If you request a USB for mailing data. We estimate that a station recording all three CHU frequencies for two weeks will generate about 60GB of data.
   – The number of receivers that you can run simultaneously and the types of receivers. If possible, please use a GPS-disciplined radio. If possible, to keep the signal as raw as possible, please also disable all filtering such as notch filtering, noise blankers, etc. Please also disable automatic gain control (AGC). If you cannot disable AGC, consult your receiver's instruction manual to set it to be as slow as possible (in other words, the highest delay possible). For example, in the Yaesu Ft-991A below, the AGC is set to the slowest AGC at 4000 milliseconds when used with sideband.

2. We specifically request that you use the open-source software package [fldigi](), **version 4.1.23 or later.** You **must** use a recent version of fldigi, or your data will be overwritten.

3. Download fldigi, install it, verify that it's working correctly. Use John N8OBJ's instructions to calibrate the sound card you will be using with the computer you will be using (pages 1-3). If possible, **please re-calibrate before the data collection period starts and also re-calibrate any time you switch your receiver or computer.**
4. Put your receiver in AM mode, and tune it to the carrier frequency of the CHU signal we assign you to. This will either be 3.330 MHz, 7.850 MHz, or 14.670 MHz (*stated differently,* 3300 kHz, 7850 kHz, or 14,670 kHz). Ensure that you can receive the carrier if you are normally able to.
5. Set your receiver's mode to USB (upper sideband) and tune to a frequency 1 kHz below the carrier. For example, for 7.850 MHz, tune to 7.849 MHz (7849.000 kHz – see image) and listen for the 1000 Hz tones. For 3.330 MHz, tune it to 3.329 MHz and for 14.670 MHz, tune it to 14.669 MHz. Because you are recording a wav file, the "op mode" does not matter.
6. In Fldigi, make sure that the tuned frequency in the upper left-hand corner is the same as your radio's frequency. To change it, click on the top half of a digit to increase it or the bottom half to decrease it (see photo below). Please use the default sample rate of 8000 Hz.



7. In fldigi, select the "File" menu and select "Rx capture" checkbox. This will create a .wav file of the data you will record. The data collection period starts at 1700UTC on Monday, April 1. Starting precisely at 1700UTC is not needed as each .wav file is timestamped.
8. Now, leave fldigi alone. While collecting data, leave your radio alone and make sure your computer is not shut down by an automatic update or sleep settings. If you have an Uninterruptible Power Supply (UPS), now is a good time to leave your equipment on it. However, in the event that your recording is unexpectedly stopped, this is ok. Just please create a new .wav file and keep recording. Submit the multiple .wav files at the end of the data collection period.
9. At the end of your recording period, uncheck "Rx capture". The .wav file you created earlier should be under the directory you saved it in earlier. The data collection period ends at 1700UTC on Monday, April 15. Ending precisely at 1700UTC is not needed as each .wav file is timestamped. **Please name your files using the requested convention:**

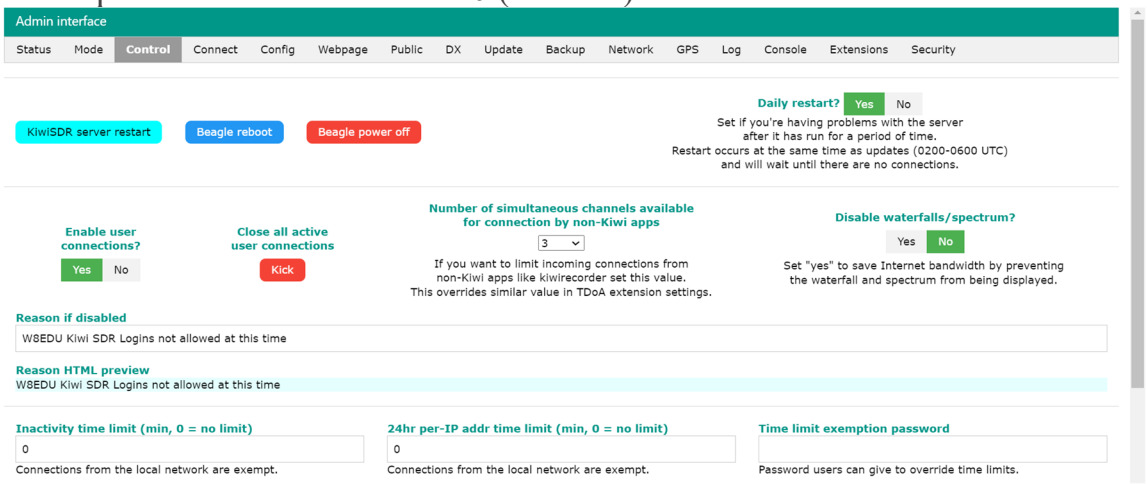
[callsign or name]_[frequency recorded in KHz]_[day of UTC month when the wav file starts]_[day of UTC month when the wav file ends].wav

For example, for a recoding of the 7850 KHz CHU frequency at W8EDU that lasts from April 1 to April 15, you would name the file **w8edu_7850_1_15.wav**

10. Upon completion of the data collection period, we will email you a link to a file transfer server that you can upload your .wav file(s) to and a required survey to share your station data and ensure you receive proper credit for your contributions. However, if you have limited internet, let us know and we will mail you a USB in a SASE that you can use to mail your data.

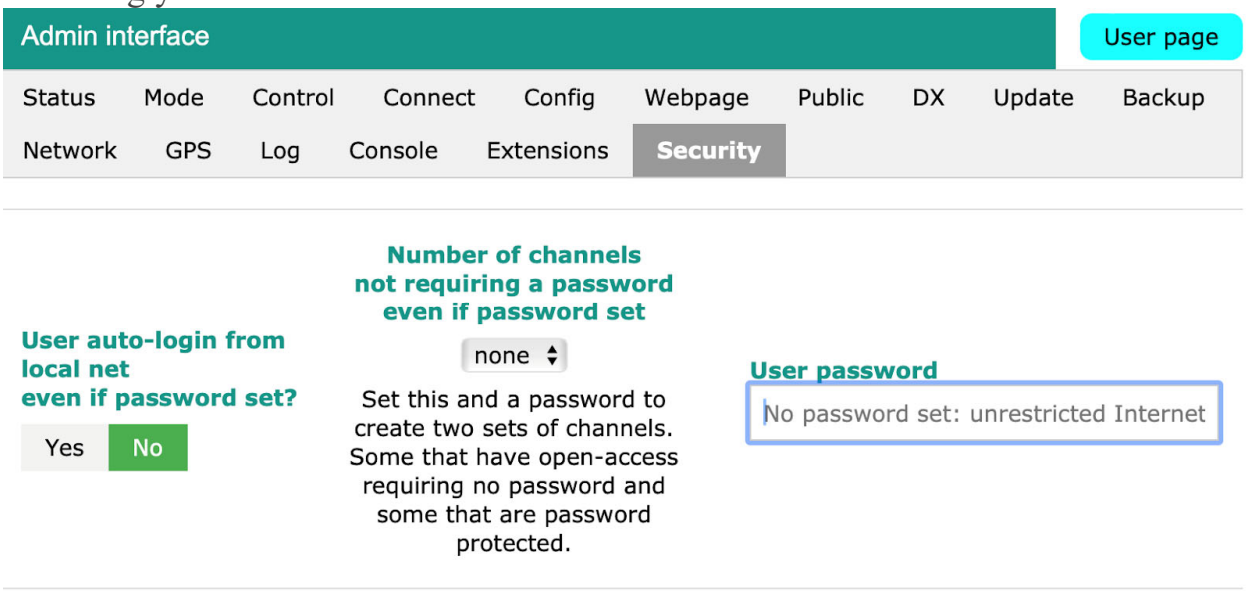
For stations that will stream data using a web-based SDR such as a KiwiSDR (EQ stations), please read the instructions below:

1. If you have not already, email eclipse-research@case.edu with the following information:
   – Your planned receiving location.
   – If you plan on transmitting near the receiver on the 20m, 40m, and 80m ham bands from April 1-15.
   – If you anticipate any time when we will not be able to use the channels from April 1-15
   – A brief description of the antenna that you plan to use. If possible, please use an antenna that is directed towards the CHU transmitting station in Ottawa, ON.
   – How many channels we are allowed to use simultaneously and the password you set (see below).
2. In the Kiwi admin interface, under "control," set:
   -"Enable user connections" to "yes"
   -"Number of simultaneous channels available for connection by non-kiwi apps" to the number of channels you are willing to let us use (i.e if we are able to measure all CHU frequencies, please set this to 3).
   -"Inactivity time limit" to 0 (no limit).
   -"24hr per-IP addr time limit" to 0 (no limit).



3. Find your FPGA mode under the "mode" tab. Please note that 12KHz bandwith per channel is more than enough for the project, so you can run your Kiwi in "more receivers" mode just fine.
4. Navigate to the "security" tab, and:
   -Set the password under "user password"
   -If we are allowed to use three channels: set the "number of channels not requiring a password even if password set" to allow at least 3 channels to be password protected if you are allowing us to use 3. Example: for a kiwi with 8 stations, we request that it would be set to either "none" or 4 or below. This allows us to have priority for three channels and the kiwi operator to have priority access to one channel when running. If you prefer us to only use two or one, set "number of channels not requiring a password even if password set"

accordingly.



5. During the period surrounding the eclipse (April 1-15), we will use a script to scrape the data from the KiwiSDR. Please make sure that your password protected channels are free so we can properly run the script.

For ET stations (that W8EDU is shipping a custom receiver to):
Coming soon! Right now, we recommend scouting out areas with acceptable power, environmental conditions, and space to hang a random wire or loop antenna to up to three receiving units. The receiving units will also need a location to mount a GPS antenna.

The unit you will receiver can operate without a wifi/ethernet connection, but we strongly encourage connecting it to the internet for ease of reliability and troubleshooting. Please reach out to eclipse-research@case.edu for any questions as you make these decisions. We will send a more detailed instructions manual before you receive your receiving units.