

20 Meter Telescope User's Handout

Websites:

Here is where you log in with your username and password: skynet.unc.edu

Lots of info here including more advice: www.gb.nrao.edu/20m

Username: _____ **Password** _____ -

For new users of the Skynet 20-meter radio telescope, here are some simple investigations and observing set-ups to try.

Is it a radio source?

What does it look like in radio: making radio images

What can we learn about our Milky Way by measuring Hydrogen?

1. Is an object a radio source? How powerful is it?

What question are you trying to answer? The most basic one is "does this object produce radio waves?" And if it does emit radio waves, how strong are they?

Here is how to find out.

When you use an optical telescope on Skynet to make an image of an object, you usually track the object. That is, you point the telescope at one position and follows your object for the length of time you specify. Light falls on all of the different pixels of your CCD camera, and you get a nice image. But this is usually not a useful observing method with a radio telescope (with one exception we'll get to later), and here's why.

The 20 Meter telescope only has one pixel, and it's "big". The telescope sees a field of view that is often much larger than the angular size of the object, so the radiation detected by the telescope comes both from the object of interest and from the surrounding background and foreground. How much radiation is from the object, and how much from the background? With a "track" scan, you cannot tell.

To find out what is coming from the object itself you need to observe both the object and the nearby surroundings, using either a "daisy" scan, "map scan" or an "on/off" scan.

Daisy Scan

The daisy scan will scan the telescope across the object several times. If the object is detected, you will see a bump in the graph every time the telescope scans across the object.

If you have set up a "daisy" scan with 4 petals, you should see 4 bumps in the graph. The height of those bumps tells you how much radiation is detected from the object. If there are no bumps, then the object has not been detected, and maybe does not emit radio waves at all.

After you click "Radio Observing" and "Add New Observation" Here is a prescription for making a daisy scan:

- Type in an object in "Target Lookup", or click on an object in the SkyViewer
- select "low resolution mode" (This is analogous to using a "clear" filter, so that you can get the maximum signal through to the detector)
- select "daisy" as the path type.
- set the radius to 120 arcminutes (X-band 60)
- set the number of petals to 4
- set the integration time to 0.3 (This is analogous to exposure duration in a way)
- set the duration to 80 seconds (20 seconds per petal).

Look at the observation plots on the 20-meter web page. Look at the plot of power vs time. How much are the bumps above the baseline? That gives you the power in units of Kelvin.

Making Maps, i.e., radio images

Maps are the way to make an image of an object. For a Map to make sense, your object needs to be big- that is it needs to take up a lot of room in the sky. Most of the objects you are observing with the optical telescopes are only a few arc minutes across. The 20 Meter Telescope can't see any detail in these objects! You need something much larger in angular size-- like parts of our Milky Way, if you want to make a good map.

Maps should be at least 6 degrees on a side (for 21 cm observations) to make a good map. (X band 1.5 - 2 degrees)

Measuring Hydrogen Clouds in the Galaxy.

With the radio telescope you can find out if our Milky Way Galaxy (and others) contain hydrogen atoms. Hydrogen atoms undergo an energy transition that produces energy in the form of radio waves that have a wavelength of 21cm, or a frequency of 1420.41 MHz.

These are hydrogen ATOMS mind you, not ionized hydrogen or plasma like you find in stars. These atoms reside in clouds of cold gas that will one day coalesce into stars.

To see if parts of our Milky Way contains cold hydrogen atoms, try this: click on a location near the red line on the Skyviewer. The red line is the Milky Way's equator.

Type in a name for your observation

- set the minimum elevation to 20 degrees
- select "high resolution spectral/continuum mode" select "track"
- set the duration to 60 seconds
- everything else can stay the default values.