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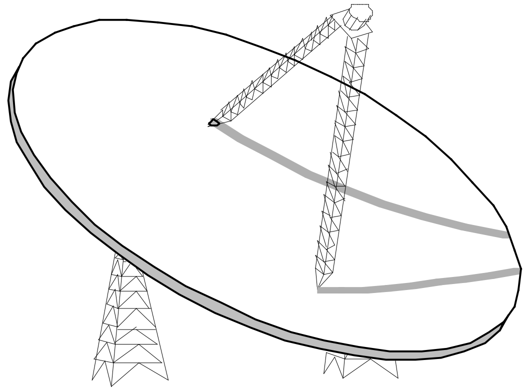


Chippewa Valley Astronomical Society star party introduces the Little Bitty Telescope™ Version 2 and LBT Experiment No. 1

The fall star party of the CVAS group in Fall Creek, WI provided a good time to introduce the LBT 2 radio telescope. The CVAS group has been working on their own 5 meter dish for radio astronomy experiments.

Ten miles east of Eau Claire, Wisconsin, there are hundreds of acres of upland woods, roadside prairies and river bottom forests. The beauty of this region is enhanced by a gently flowing river, sandy beaches, rocky falls, clear cool streams and a multitude of birds, wildlife, and native flowers.

In the heart of this natural setting lies the Beaver Creek Reserve, an environmental center dedicated to maintaining this beautiful area for the enjoyment and appreciation of all who visit. The Reserve encompasses 360 acres of diverse habitats and includes 3 different facilities: The Eau Claire County Youth Camp, the Wise Nature Center, and the Hobbs Observatory. It also includes miles of groomed hiking/ski trails that inner-twine along the Beaver and Deinheimer Creeks within the Reserve.

The youth camp is complete with dorms and cafeteria. This provides an excellent natural setting for optical and radio astronomy. It also provides a source of young people that have the opportunity to experience both optical and radio astronomy as part of their nature outing.

The Hobb's observatory includes two optical telescopes and a nice auditorium with audio/visual facilities. Also in the site at the Nature Center are additional high quality meeting facilities.

The best part of the site is all the nice people that come to the star party. The CVAS members give a warm welcome new visitors and readily accept new ideas for astronomy. They also are very good at digital astro-photography.

Here's a photo of the Fall 2001 group, I'm there, but on the other side of the camera:

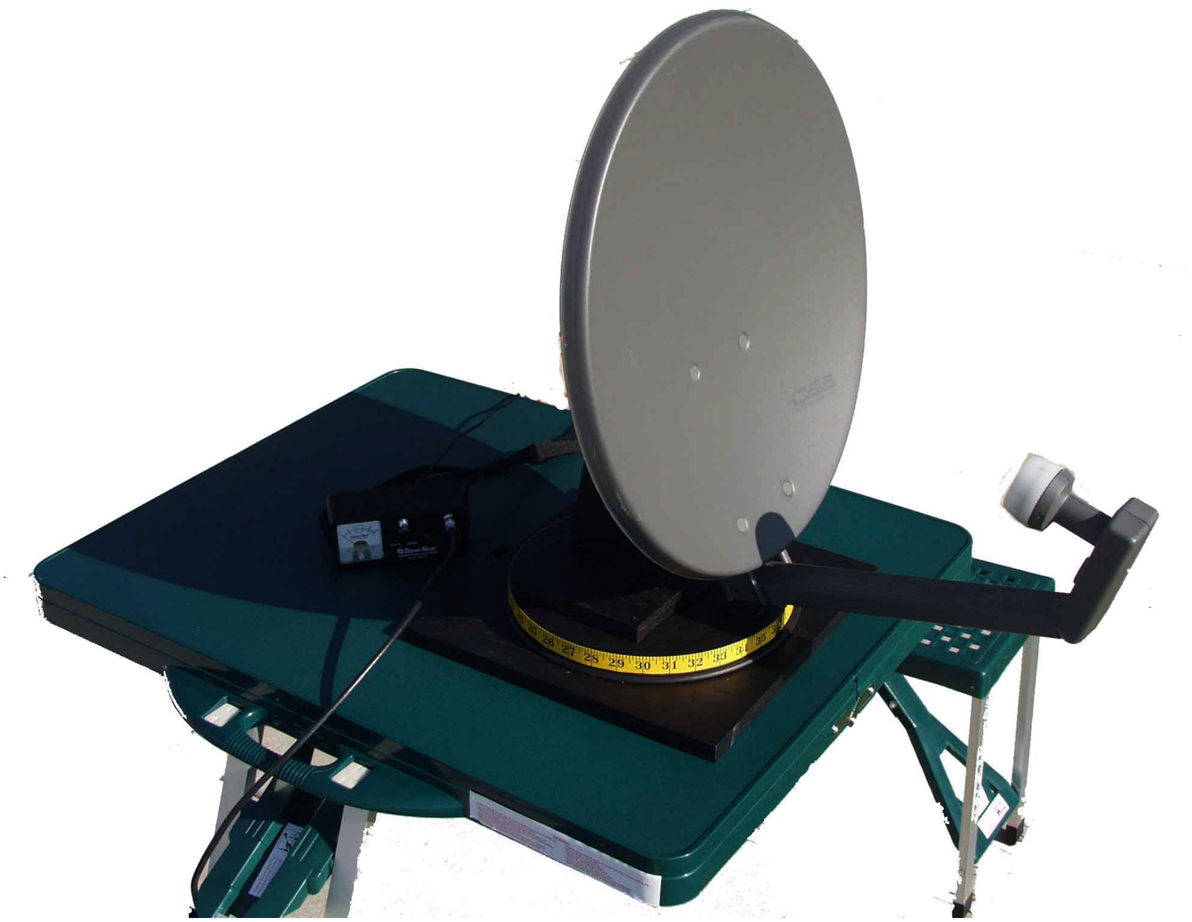
The 5 meter dish is installed but electronics need to be completed and given a test run:

In order to spur a little more interest I introduced the LBT2, a 12,000 MHz radio astronomy telescope you can build for less than $200. Here two star party members, Jacki Lavaque and Daniel Blomquist experiment with the neat little radio telescope:

The dish and LNB have no problem detecting the difference between 3K cold sky, the Sun, warm bricks or a person's body.

I have been building the units, but not spending the required time using the units. This system is NOT a radio astronomy system to be used for serious sky surveys, but it is a tremendous starter unit to give you the excitement of detecting the Sun, your own body radiation or just 300 deg. K tree branches.

The unit works great! With zero on the meter for a cold sky, it is full scale on the Sun and about 1/2 scale for a human or 300 deg. K.



A simple RF/IF/Detector unit is a Channel Master Model 1004IFD tuning meter that includes an **audible tuning indicator**.

The Channel Master Model 1004IFD tuning meter as shown below is available from http://www.mjsales.net/dsstune.htm for $76 plus shipping.

Other sources of similar units are:
http://home.inreach.com/hanseung/Signalmeter.htm (Thanks Malcolm!)

What else do you need?

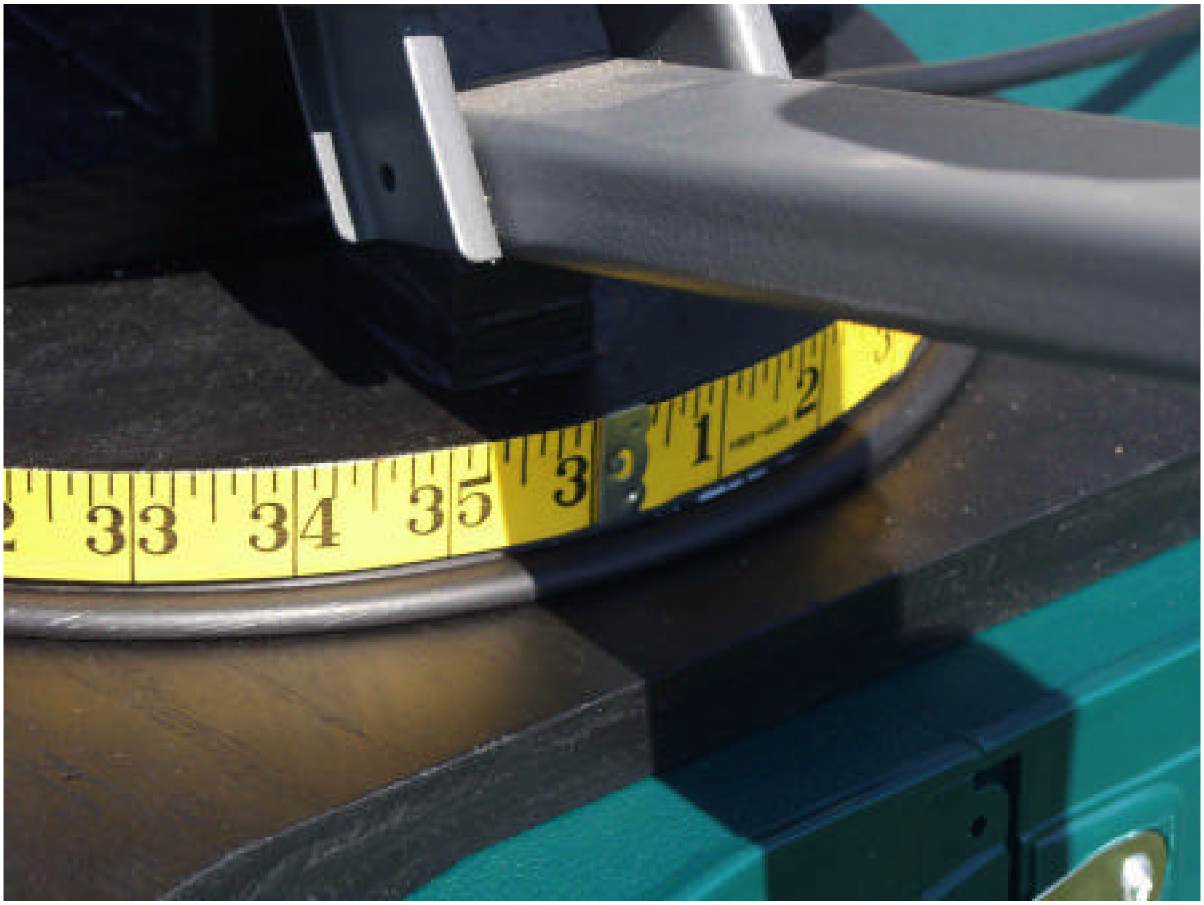
The unit normally gets 15 vdc from the satellite receiver in the house via the coax center pin. Put a RF choke of about any value in series with your positive power lead and feed it into the SAT RX terminal. Don't forget the ground or negative connection. The unit will work fine on 12 vdc, but 15-16 vdc is better.

Connect a section of CATV coax also from Radio Shack between the LNB connection on the tuning meter and the output of the LNB on the dish unit.

The output of the tuning meter can be fed into your computer. It's been noted that the coil in the meter movement would generate voltages if the meter is moved, so you may want to replace the meter with a resistor that can be switched in and out of the circuit.

In the above photo you can see where I input the 12-15 vdc and output the voltage from the meter to the recording device. The toggle switch connects the output to either the meter or a 10,000 ohm resistor . The binding posts make the output across the resistor available for logging.

If you cut a circle out of 3/4 inch plywood that is 11-5/8" in diameter it will have a circumference of just over 36 inches. This is just right to glue a seamstress tape measure to the edge of the disk and have a nice azimuth readout. The disk mounts on the base with a swivel stool or lazy susan bearing available at your local building store. (use the larger diameter unit, about 8 inch diameter bearing raceway)



A $6.00 rotary protractor at the builders store provides the elevation readout.

The readout will not be accurate, but the experiment below will help you determine the correction factor. Hot plastic glue holds the protractor to the dish just fine.

Note the white plastic or teflon sheet at the hinge point of the dish. This makes adjusting elevation a smoother affair.

The small wood block at the base of the dish prevents the dish from cutting the coax in low elevation settings.

What's next?

One of my dish and tuning meters was donated to the Space Place in Madison, WI to provide a demo radio telescope to use along with observations of sunspots. You could do the same!

Kerry Smith, a member of SARA, has detected the moon with his 4-foot dish.

LBT Experiment No. 1

Measuring Dish Gain and Antenna Aiming Accuracy

This experiment is designed to measure the horizontal beam width in degrees for your dish antenna and at the same time determine how accurately you can aim your antenna.

If you have improvements to this experiment, please let me know and I will publish your information.

There are two items you must have to do this experiment. The first is a clock or watch set to within 5 seconds of correct time. The next is an accurate location for the antenna using a GPS locator or maps with Latitude and Longitude coordinates. Both of these items can be obtained using a hand held GPS unit. The latitude and longitude do not have to be obtained prior to the experiment.

Record your "given" conditions:

Day of test: _________________ (mm/dd/yr)
Local time at start of experiment: ______ hours: ______ minutes
GMT time at start of experiment: ______ hours: ______ minutes
UTC time at start of experiment: ______ hours: ______ minutes
Latitude: _____ degrees _____ minutes _____ seconds _____ (N or S)
Longitude: _____ degrees _____ minutes _____ seconds _____ (E or W)

Checking the antenna beam width:

The process involves letting the earth's rotation act as a rotator to move the dish past the sun at a known rate (degrees per hour) and then measure the time for the sun to enter and leave the beam of the dish.

The earth rotates __360__ degrees in 24 hours local time. This results in a rotation rate of __15__ degrees per hour or __0.25__ degrees per minute. If the dish takes __8__ minutes to enter and leave the sun's path the maximum beam width of the dish is __2__ degrees.

Normally we state the antenna beam width as the number of degrees to go from 3dB before the peak to 3 dB after the peak signal level. (dB is decibels, more on that later).

Gathering Data: (for those North of the equator)

First set the dish up to point due south. If the dish can be rotated in the azimuth direction wait until the sun is at about 160 degrees and aim the dish at the sun. Adjust the elevation of the dish so the sun passes directly through the center beam of the antenna (the point of maximum signal reception). At this time check that the sun noise does not overload the receiver or output device. As you pass through the peak output of the sun the output indicator on your system should reach a peak value, ideally about 2/3 of maximum reading and go back down again to a minimum level.

Next, leave the dish at the same vertical elevation and move the dish horizontally to due south or 180 degrees. If you have a polar mount versus azimuth-elevation (Az-El) adjust the dish in declination and hour angle to accomplish the same task. Do not change the aiming of the dish from this point on.

As the sun just enters the beam of the antenna, the output of your signal detector will start to respond. Record the output in volts, dB, S-units or any unit your system reports signal (or noise) strength. Make a recording every 30 seconds. Do not change the dish position.

Time Hr:Min:Sec	Signal Strength (__________ units)
_____:_____:0	_______
_____:_____:30	_______
_____:_____:0	_______
_____:_____:30	_______
_____:_____:0	_______
_____:_____:30	_______
_____:_____:0	_______
_____:_____:30	_______
_____:_____:0	_______

Time Hr:Min:Sec	Signal Strength (__________ units)
______:______:0	________
______:______:30	________
______:______:0	________
______:______:30	________
______:______:0	________
______:______:30	________
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______:______:30	________
______:______:0	________
______:______:30	________
______:______:0	________
______:______:30	________

At this point move the antenna to a point in the sky where you get minimum output. There is a great area in the sky that produces minimum output. Make sure you are aimed above trees and buildings, avoid satellites if you are using a satellite receiving system.

Record the output value in this position of minimum signal _______.

Now aim the antenna directly at the trees and/or ground and record the output value in this position _______.

We will use these values later.

Next make a chart and plot the time on the bottom (X axis) and signal strength on the vertical (Y axis). You should see a curve that looks a lot like a bell shape but slightly more of a peak at the top.

Now we would like to find out the number of degrees between –3 dB points on either side of the peak output, this is the 3 dB beam width of our antenna. This is also known as the 1/2 power beam width.

The question is what output value is 3 dB down?

Finding –3 dB the technical way:

If you have access to a 3 dB attenuator you can aim the dish back to the sun and get a peak reading similar to the peak value recorded above. Do not adjust the gain or controls on your receiving system. Insert the 3 dB attenuator in the coax between the LNB and the receiver. It can be inserted at the receiver or just after the LNB, whichever is the simplest for you. Again aim the dish at the sun for peak value and note the output value, this is the –3 dB level. Remove the 3 dB attenuator and measure the peak output of the sun, it should be the same value at the first measurement. (This method will not work for satellite dish systems since the DC power is flowing on the center conductor of the coax cable. You will put

12-15 vdc on your attenuator and probably burn out the attenuator or power supply)

Finding –3 dB by estimation:

If the noise output on your system is being detected by a diode and the output is a DC voltage then this method may be accurate enough for your needs. If you put 1.0 volts across a 1.0 ohm resistor, Ohms law says there is 1.0 watts of heat generated in the resistor. If we reduce the voltage across the resistor to 0.707 volts the watts of heat generated in the resistor is 0.5 watts or 1/2 power. Now you know what % reduction in the output level meter equals –3 dB.

If an audio output meter measures your noise output, use the dB output scale on the meter to note the –3 dB points.

Want to be real scientific?   Measure using all three methods and find out how much they differ.

Back to our recorded data:

At this point you can calculate how many percent (%) reduction in signal output equals –3 dB for your system at these particular control settings. Use this percentage value and calculate where the –3 dB points are on the data you recorded during the pass of the sun. Now calculate the minutes between the –3 dB points and convert to degrees of earth rotation.

This is the –3 dB or 1/2 power bean width of your antenna or dish in degrees.

Calculating the gain of your dish or antenna:

In another experiment we will use the above data to calculate the gain of the antenna.

Checking the aiming of your dish or antenna:

Using the “given” information plus the recorded information and a good computer program, you can compare the time that the sun passed what you believed to be due south and what the computer program predicted. Assuming your computer program is correct, you can determine the aiming error on the azimuth of your dish or antenna.

Do the same for your elevation or declination indicator.

Using the correction factors, repeat the experiment tomorrow and see if you have achieved improved aiming accuracy.

Other experiments:

Without changing the sensitivity or gain controls on your system measure the peak output of the sun from day to day. See if that compares to solar flux data.

Plot the magnitude of peak sun output during the daylight hours. Does the sun output change or does the heat of the day affect your system output signal.

If you aim your system to a “cold” point in the sky, does the signal output of your system seem to rise or fall as the daily temperature increases or decreases?

If you physically rotate your dish or antenna past the sun is there only a single peak in output or do you get additional smaller peaks on either side of the main peak?

What does this mean?

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