

Characterisation of antennas used in Radio Astronomy

1 Goal of the experiment

An antenna is the primary detector of radio waves. Radio astronomy employs a variety of antennas for observation of radio sources. Apart from their resolving power, these antennas differ in their sensitivity and nature of polarization. The aim of this simple hands-on experiment is to familiarize the participants with the diverse variety of antenna and study the beam pattern of these antenna in comparison with what is expected from theory.

2 Procedure for the experiment

1. Antenna trainer kit consists of receiving table, transmitting table, radio frequency (RF) generator, RF detector, different types of antennas and connecting cables with appropriate connectors.
2. Take out the kits from the suitcase.
3. Place transmitting table and receiving table at some distance (Make sure the distance is about 1 m).
4. Take out connecting cables from the suitcase (connecting cable has BNC connectors on both sides).
5. Switch on RF generator and set its gain to 75 μA . After that switch off the RF generator.
6. Pick out folded dipole antenna with one element and fix it to the receiving table.

7. Pick out the antenna for which you want to study the power pattern. Connect it to the transmitting table.
8. Connect transmitting end of the antenna and the RF generator through the given cable.
9. Connect receiving end of the antenna and the RF detector through another cable.
10. Connect the power cord of the receiver to power and switch it on.
11. After all things are done again switch on the power of the RF generator. Before this make sure both the antennas are facing each other. Also make sure the position of the transmitter antenna is on zero degree (Note: Position values for the transmitter antenna are given at the end of holding rod of antenna).
12. Now start taking readings for each position of transmitting antenna at certain intervals of angle from zero to 360 degrees (at about 10 degree intervals).
13. Note down all the values in the log sheet (**Important note: Once you started the experiment don't disturb the setup throughout experiment. (i.e) Do not change the distance between the two antennas. Do not change the gain of both RF generator and detector**).
14. During the experiment, for each position of the transmitting antenna you may have to wait for 1 minute in order to get the stable reading from RF detector.
15. After you are done with one antenna then redo the procedure from 7 to 14 for different antennas.

2.1 Observation Log

2.2 Analysis Procedure and Log

1. Make a Polar plot of readings for each antenna
2. Estimate FWHP from the polar plot for each antenna

3 Results and Discussion

The estimate of FWHM are as follows –

1. Simple dipole : Deg.
2. Yagi-Uda : Deg.
3. Parabolic reflector : Deg.
4. Helical : Deg.

Compare the above with expected FWHM. In which situation, each of the above antennas is best suited for Radio Astronomy ?

The sources of error in my experiment are as follows –

Type of antenna	
RF Generator Setting	
RF Detector reading (0 deg)	
Position of transmitter Table	Detector Reading
170	
160	
150	
140	
130	
120	
110	
100	
90	
80	
70	
60	
50	
40	
30	
20	
10	
0	
-10	
-20	
-30	
-40	
-50	
-60	
-70	
-80	
-90	
-100	
-110	
-120	
-130	
-140	
-150	
-160	
-170	