<box orange |**Under Construction**> VE7HZF is editing this section, please do not edit it until this notice is taken down. </box>

Polarization

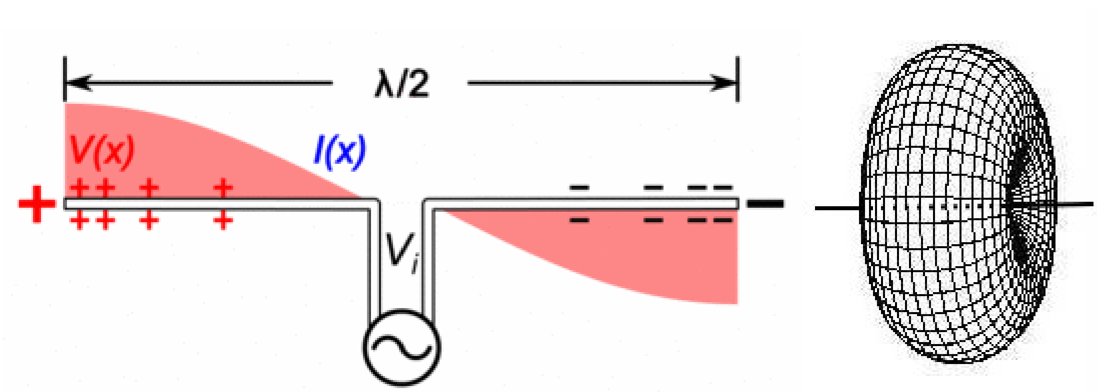
How To Make A Radio Wave

Back on the Intro Page, we introduced to the idea of frequency and saw that

> A Hertz (Hz) is a measure of how fast something vibrates [...]
>
> Just seeing "Hz" doesn't tell you anything about what it is that's oscillating in the same way that seeing "°C" doesn't tell you anything about what it is that has temperature. "Hz" is a unit of measure, not a thing itself.
>
> Without going into too much detail (yet), radio waves are created by oscillating electric currents. How many times this current oscillates per second is called the frequency, which is measured in Hz (or kHz, MHz, GHz).

It's now time to add a few more details. Here is a basic recipe for making a radio wave:

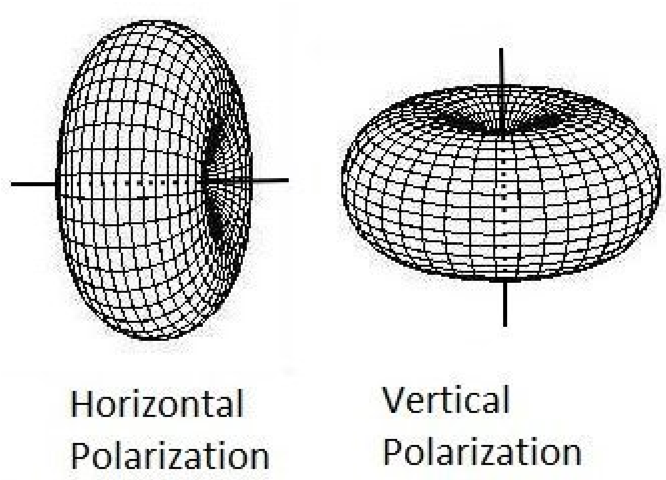
1. Get a length of conducting wire and lay it in a straight line.
2. Cut it in half right in the middle and bend both ends at right angle.
3. Connect the two middle ends to each side of an alternating current generator.



Voila! Assuming that the length of the antenna (the two pieces of wires) match the frequency of the current generator (more of this later), and that the antenna is high enough above the ground, you've created a radio wave.[1] As electrons move up and down the length of the wires, they create varying electric and magnetic fields that couple together according to Maxwell's Equations and propagate outward in a doughnut shape.[2]

Horizontal vs Vertical Polarization

Here's the critical part though: In the same way that an alternating current through an antenna creates a radio wave, a radio wave hitting an antenna induces an alternating current through it **if the radio wave hitting the antenna is in the same "direction" as the antenna**.



This "direction" is called polarization.

Effect on Communication

In practice, polarization is more important for VHF and UHF communication because signals go directly from the transmitting station to the receiving one.

For skywave HF communications, the ionosphere can change the polarization of the signal from moment to moment as the radio wave refracts, reflects, or goes through magnetic fields in the atmosphere. As such polarization of the antennas on HF frequency doesn't matter much.

Scattering

On the previous page, we saw that radio waves can reflect, refract. Now we'll discuss how they can also be scattered.

Scattering occurs when an EM wave hits a bunch of "small particles"[3] that in turn re-radiate the wave in all direction. Here are a few examples[4] in the visible light spectrum:

The first picture shows a laser beam shinning at the wall. In the second picture water is sprayed into the path of the laser beam.

The reason the beam is invisible in the first picture is that all the light from the laser travels toward the wall (an none toward the camera). But in the second picture, the water vapour scatters some of that light in random directions, allowing some of it to reach the camera. In the same way, we also normally can't see light rays from light bulbs that don't go toward us. What I mean is this:

- Look at the light bulb in the room you're in.
- Now look at an object that the light bulb illuminates.
- Now imagine a straight line between the light bulb and that object.

Just like in the first picture, you don't see any light along *that* line. If you did, the entire room would be glowing white from all the different lines that the light bulb emits. In fact, it can happen on a foggy day when it's also sunny. Or on a foggy evening with the high beam of a car.

Now back to radio waves...

Troposphere

On the previous page, we discussed how the Ionosphere (the region of our atmosphere between 50km and 400km altitude) can, reflect and refract radio waves, let them pass straight through, or absorbed them completely mostly due to the sun's ionization of the gas in these layers.

Here we discuss how the troposphere (the lowest region of our atmosphere below 20km altitude) can also affect radio waves.

Next

- Tropospheric bending on 2m
- Ducting
- Sporatic E
- Auroral propagation
- Scatter
- Meteor Scatter

See Radio_propagation

Questions:

- B-007-007-002 → B-007-008-011

Questions

- B-007-004-007
- B-007-004-010

[1] GIF from Wikipedia Dipole Antenna

[2] Picture modified from Wikipedia Dipole Antenna

3) The “small particles” can be single atoms, molecules, dust, or pockets of gas with a different index of refraction. They can also be bigger objects like meteors or small planes! The size of the “particle” is always relative to the wavelength of the EM wave. To a 160m radio wave, a meteor is small, but to a laser beam (≈500nm), a dust particle is very big.

4) The laser pictures were taken by Patrick, VE7HZF with help from Justine. The picture of the forest is from: https://www.souvenirpixels.com/Photo-blog/i-cZgCHvZ