Autumn

The Aero Aerial

The Newsletter of the Aero Amateur Radio Club
Middle River, MD
Volume 12, Issue 11
November 2015

Editor Georgeann Vleck KB3PGN

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		Contests	Bob Venanzi ND3D

Website: http://w3pga.org
Facebook: https://www.facebook.com/pages/Aero-Amateur-Radio-Club/719248141439348

About the Aero Amateur Radio Club

Meetings

The Aero Amateur Radio Club meets on the first and third Wednesdays of the month at Essex SkyPark, 1401 Diffendall Road, Essex. Meetings begin at 7:30 p.m. local time. Meetings are canceled if Baltimore County Public Schools are closed or dismiss early.

Repeaters

W3PGA	**2 M :**	INPUT : 147.84 MHz, OUTPUT : 147.24 MHz
W3PGA	**70 Cm:**	INPUT : 444.575 MHz, OUTPUT : 449.575 MHz
W3JEH	**1.25 M:**	INPUT : 222.24 MHz, OUTPUT : 223.84 MHz

Club Nets

Second Wednesday Net – 10 Meters (28.445 MHz) @ 8 p.m. Local Time
Fourth Wednesday Net – 2 Meters (147.24 MHz Repeater) @ 8 p.m. Local Time
Fifth Wednesday Net – 70 Centimeters (449.575 MHz Repeater) @ 8 p.m. Local Time

Radio License Exams

The Aero Amateur Radio Club sponsors Amateur Radio License Exams with the ARRL VEC. Examination sessions are throughout the year. Walk-ins are welcome.

2015 Examination Schedule

Where:	White Marsh Branch Baltimore County Public Library 8133 Sandpiper Circle, White Marsh, Md. 21236
Time:	1 p.m.
Dates:	November 14
Contact:	Patricia Stone AC3F, email: ac3f@juno.com, landline: 410-687-7209

LOCAL AREA NETS

Day	Time	Freq. (MHz)	Net Name
Daily	9 – 10 am	145.330	Oriole Net
Daily	6 pm	3.820	Maryland Emergency Phone Net
Daily	6:30 – 7 pm	145.330 no PL	Baltimore Traffic Net (b/u 146.670 PL 107.2)
Daily	7 pm & 10 pm	3.643	MD/DC/DE Traffic Net
2nd Tue	7:30 pm	146.670	Baltimore County RACES Net
2nd Wed	8 pm	28.445	Aero ARC Net
4th Wed	8 pm	147.240	Aero ARC Net
5th Wed	8 pm	449.575	Aero ARC Net
When activated by NOAA		147.030	SkyWarn (primary)

NET REPORTS

10-14-15: 28.445MHz, 20:00 to 20:32 local.

W3PGA Joe (NCS) Essex, W3JEH Ron Perry Hall, KB3PGN Georgeann Essex, KA3SNY Dave Essex, KC3FBL Jim Parkville, KC3FRH Chuck Parkville, N3VBJ Jerry Dundalk, KC3FNN Rob Middle River

Jerry N3VBJ reported that he has received the Fusion 440 repeater. He plans to install it next Tuesday the 20th.

10-28-15: [2m net] 449.575, 20:00 to 21:02 local.

Because of receiver problems on the 2 meter repeater, the regular 2 meter net was held on 449.575r.

W3PGA Joe (NCS) Essex, KB3FBL Jim Parkville, KB3FRJ Steve Parkville, KB3JVP Ken Middle River, N3VBJ Jerry Dundalk, N3EKO Ron Parkville, K3TEL Arnold Towson

N.B. DST to EST this weekend!
Also, got an email about the grid squid designator, I went back and checked each station by call, and it appears that QRZ has changed some of the prefix small letters. I will make these corrections in the next roster update in November.
Joe M

STATION ACTIVITIES

Joe Miko WB3FMT gave a presentation on Antennas after the business meeting on October 28. He generously provided his notes to the membership, a condensed version of which is included below. Thanks to Joe for an interesting and useful lecture.

Upcoming Second Wednesday Presentations

These presentations will be given at the Essex SkyPark FBO building after the business meeting.

Date	*Topic*	*Presenter*
TBD	Contest Logging with N1MM	Bob V
TBD	ISS Sighting and Contacting	

Any questions call Joe Miko at 443-956-0197.

Presenters who wish to submit a description of their talk may email it to Georgeann at KB3PGN@reagan.com for inclusion in the Aerial.

VE CORNER

by Pat Stone, AC3F

The AERO VE Team held its September 26th, 2015 session at the White Marsh Library. Congratulations to new Techs Chuck Walter KC3FRH and Steve Lawhon KC3FRJ and new Genera l Brent DeFatta KC3FRI.

A very special thanks to N3VBJ, KB3VAE, WB3FMT, KB3KRV, AB3QK & N3VEJ for assisting me with this session.

Thanks again to all who have volunteered to join our VE Team. A special thinks to Jerry and Rich who served their first (of many, I hope) session.

Unfortunately, due to changes in the library reservation system, we are only able to reserve the library meeting room once every 2 months. We will post the test schedule as we are able to reserve the meeting room.

Our next test session is scheduled for November 14th, 2015 at White Marsh Library.

UPCOMING HAMFESTS and EVENTS

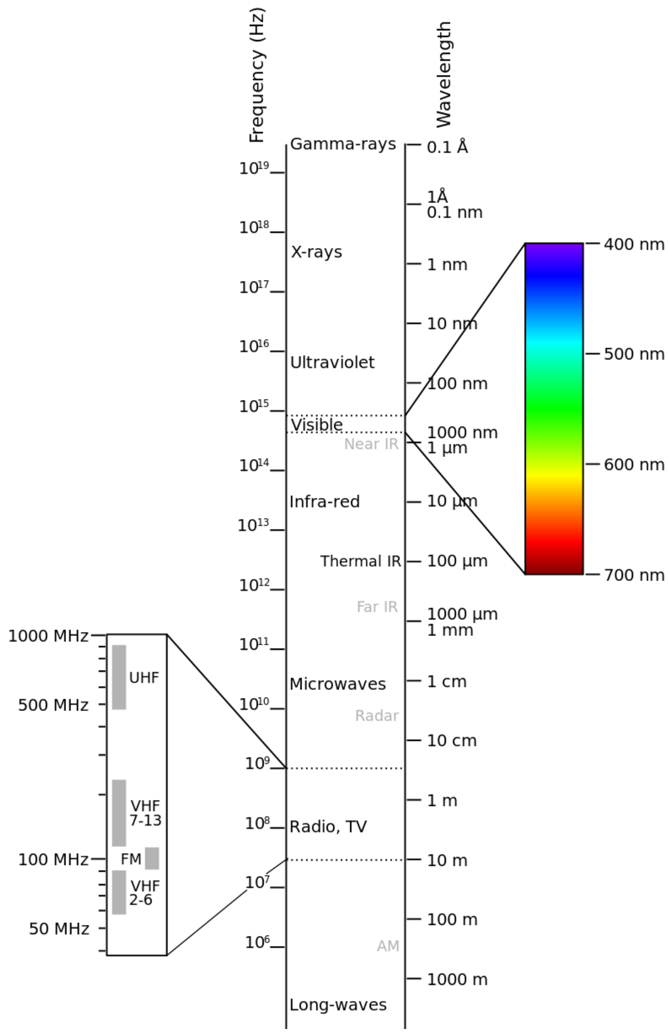
Saturday, April 16, 2016: Delaware State Convention (Delmarva AR & Electronics EXPO) – Rescheduled

Sussex Technical High School, 17099 County Seat Hwy., Georgetown, DE 19947. Website: <www.radioelectronicsexpo.com>
Sponsor: Sussex Amateur Radio Association. Talk-In: 147.090 (PL 156.7)
Contact: Herb Quick, KF3BT, PO Box 1431, Seaford, DE 19973
Phone: 302-629-4949, E-mail: <herb@hamiltongraphics.com>

PUBLIC SERVICE OPPORTUNITIES

Antennas and Stuff – A Primer

What does an antenna do? It allows us to utilize part of the electromagnetic spectrum that we cannot see.

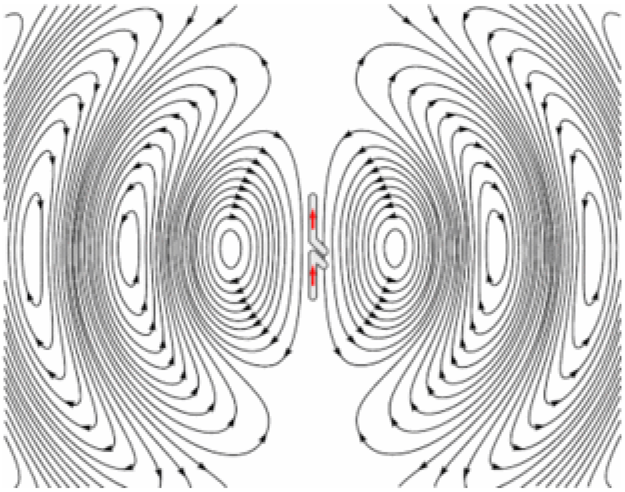


It not magical, it does not increase your transmitter's power! It focus the output power/receiving capability of you transmitter. It focuses the transmitted / receive signal into a smaller area! 100w = 100w = 100w …..

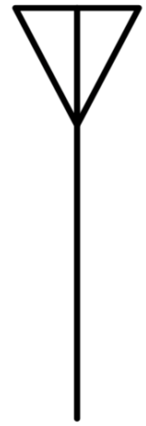
Think of an antenna as a 60w light bulb (550 nm or 579^{THz}), in the middle of a room. Light is radiated evenly in all directions except the base. To increase the light onto one of the walls you need to put more light on it. You either move the light bulb, or use a reflector (like in a flashlight or a lens to focus it). The output of the light bulb remains the same! It's the same whether you are transmitting or receiving.

What is an antenna?

An **antenna** (plural **antennae** or **antennas**), or **aerial**, is an electrical device which converts electric power into radio waves, and vice versa. It is usually used with a radio transmitter or radio receiver. In transmission, a radio transmitter supplies an electric current oscillating at radio frequency (i.e. a high frequency alternating current (AC)) to the antenna's terminals, and the antenna radiates the energy from the current as electromagnetic waves (radio waves). In reception, an antenna intercepts some of the power of an electromagnetic wave in order to produce a tiny voltage at its terminals, that is applied to a receiver to be amplified. (Wikipedia)



Radiation pattern from a dipole antenna.



Antenna symbol

Think of dropping a stone in the water, a wave is a wave!

Parts of an antenna

Typically an antenna consists of an arrangement of metallic conductors (elements), electrically connected (often through a transmission line) to the receiver or transmitter. An oscillating current of electrons forced through the antenna by a transmitter will create an oscillating magnetic field around the antenna elements, while the charge of the electrons also creates an oscillating electric field along the elements. These time-varying fields radiate away from the antenna into space as a moving transverse electromagnetic field wave. Conversely, during reception, the oscillating electric and magnetic fields of an incoming radio wave exert force on the electrons in the antenna elements, causing them to move back and forth, creating oscillating currents in the antenna.

Types of Antennas

According to their applications and technology available, antennas generally fall in one of two categories: **Omnidirectional** or only weakly directional antennas which receive or radiate more or less in all directions. These are employed when the relative position of the other station is unknown or arbitrary. They are also used at lower frequencies where a directional antenna would be too large, or simply to cut costs in applications where a directional antenna isn't required. **Directional** or ***beam*** antennas which are intended to preferentially radiate or receive in a particular direction or directional pattern.

In common usage "omnidirectional" usually refers to all horizontal directions, typically with reduced performance in the direction of the sky or the ground (a truly isotropic radiator is not even possible). A "directional" antenna usually is intended to maximize its coupling to the electromagnetic field in the direction of the other station, or sometimes to cover a particular sector such as a 120° horizontal fan pattern in the case of a panel antenna at a cell phone site.

Examples of Antenna Types:

Omnidirectional:

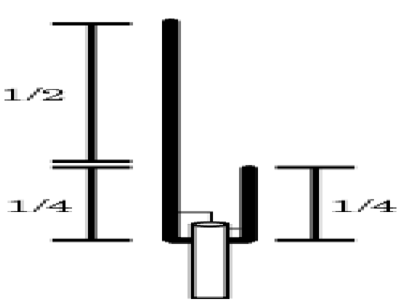
Vertical Antenna single or multi band .

Photo of the 10/40 meter vertical (80 meter coil missing).

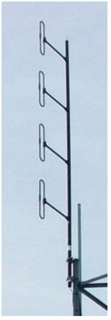
Whip antennas

AM Broadcast Car antenna, Tethered whip on a Military Jeep

Rubber Ducks
Use an Inductor Loading coil to shorten the length of the antenna? The loading coil is integrated with the antenna itself by making the whip out of a narrow helix spring wire.



J-Poles The **J-pole antenna**, also called the **Zepp' antenna** (short for Zeppelin), and more properly known as the **J antenna**, was first invented by the Germans for use in their lighter-than-air balloons. Trailed behind the airship, it consisted of a single element, one half wavelength long radiator with a quarter wave parallel feedline tuning stub.



Collinear Antenna - In telecommunications, a **collinear antenna array** is an array of dipole antennas mounted in such a manner that the corresponding elements of each antenna are parallel and collinear, that is they are located along a common line or axis. The purpose of stacking multiple dipoles in a vertical collinear array is to increase the power radiated in horizontal directions and reduce the power radiated into the sky or down toward the earth, where it is wasted.

Random wire - This describes the typical antenna used to receive shortwave radio, consisting of a random length of wire.

Beverage (not Soda Cans) - Simplest unidirectional traveling wave antenna. Consists of a straight wire one to several wavelengths long, suspended near the ground, one end connected to the receiver at one end and terminated by a resistor equal to its characteristic impedance, 400 to 800Ω at the other end.

Directional Antennas (Beams)

Dipole Antenna. The radiation pattern of a dipole is the long side of the dipole, making it a 2 sided beam, very little at the end points. If you placed a dipole horizontally in the North/ south orientation, your signal would radiate and receive in the East/West direction. If erected in a vertical configuration it would become an omnidirectional antenna.

Beam antenna Yagi type

Photo of the World Famous Aero ARC 2 element, 20 meter beam (2014FD)

Yagi Beam 15 element

TV antenna Yagi type

Log-periodic antenna 140 – 470 MHz

Satellite type antennas

NASA Deep Space Network

Satellite Antennas are normally large parabolic dish antennas, running 3 – 100 feet wide, transmitting or reflecting the signal to a receiving antenna at the focus of the dish. It's like a big satellite dish used to receive satellite TV. Multiple antennas can be linked together to make a Very Large Array or big ear, or eye.

NASA Spacecraft Communications (Cross-polarization)

Helical Antenna - Consists of a wire in the shape of a helix mounted above a reflecting screen. It radiates circularly polarized waves in a beam off the end, with a typical gain of 15 dBi. It is used at VHF and UHF frequencies for communication with satellites and animal tracking transmitters, which use circular polarization because it is insensitive to the relative orientation of the antennas.

Skywave or Skip

In radio communication, **skywave** or **skip** refers to the propagation of radio waves reflected or refracted back toward Earth from the ionosphere, an electrically charged layer of the upper atmosphere.

Skywaves are not limited by the curvature of the Earth; skywave propagation can be used to communicate beyond the horizon, at intercontinental distances. It is mostly used in the shortwave frequency bands.

Skywave propagation is distinct from: **Groundwave** propagation, where radio waves travel near Earth's surface without being reflected or refracted by the atmosphere—the dominant propagation mode at lower frequencies. **Line-of-sight** propagation, in which radio waves travel in a straight line, UHF and microwave communications.

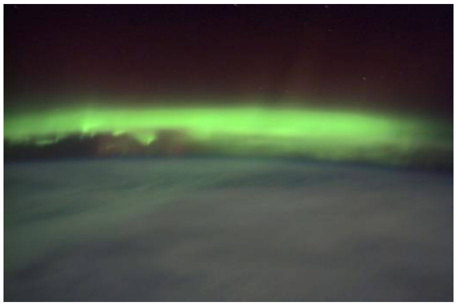
Ionosphere

In the old days the Earth atmosphere was divided into 4 layers; Troposphere, Stratosphere, Ionosphere and Exosphere. With invention of Space/Weather satellites, the atmosphere was subdivided in to additional layers. The Ionosphere is now part of the Thermosphere.

Earth's atmosphere is now divided into five main layers. Excluding the exosphere, Earth has four primary layers, which are the troposphere, stratosphere, mesosphere, and thermosphere. From highest to lowest, the five main layers are:

- Exosphere: 700 to 10,000 km (440 to 6,200 miles) - Edge of Space
- Thermosphere: 80 to 700 km (50 to 440 miles - Highest temperature 2,700 F
- **Ionosphere 50 – 1,000 km (31 – 621 miles) -** Part of the Mesosphere
- Mesosphere: 50 to 80 km (31 to 50 miles) - Lowest Temp -120F, Noctilucent clouds, meteors burn up
- Stratosphere: 12 to 50 km (7 to 31 miles) - Jet aircraft, contrails, Cirrus clouds
- Troposphere: 0 to 12 km (0 to 7 miles) - Most of Earth weather occurs, Thunderstorm Cloud tops can reach 70,000 feet (13+ miles).

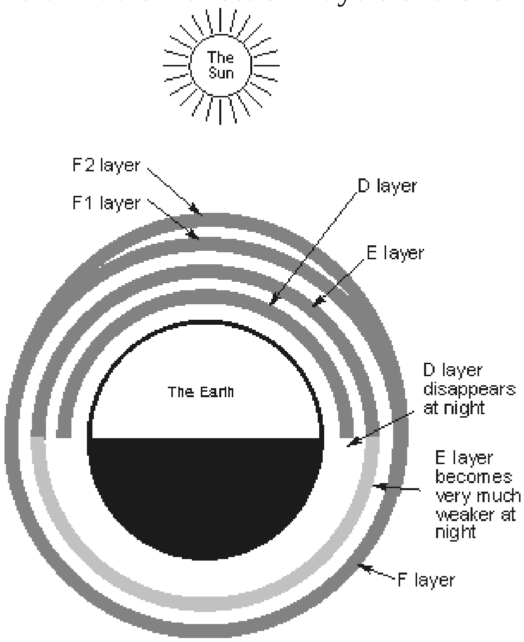
The ionosphere is a region of the atmosphere that is ionized by solar radiation. It is responsible for auroras. During daytime hours, it stretches from 50 to 1,000 km (31 to 621) miles and includes the mesosphere, thermosphere, and parts of the exosphere. However, ionization in the mesosphere largely ceases during the night, so auroras are normally seen only in the thermosphere and lower exosphere. The ionosphere forms the inner edge of the magnetosphere. It has practical importance because it influences, for example, radio propagation on Earth.



Aurora seen by the ISS, caused by geomagnetic storms.

The Earth's surface reflects the incoming wave back towards the ionosphere. Consequently, like a rock "skipping" across water, the signal may effectively "bounce" or "skip" between the earth and ionosphere, multiple times.

Earth Radio Reflection Layers of the Ionosphere are divided into layers from D to F2. These radio regions are affected by the Sun and its solar activity effects location and performance of the ionosphere regions



D Region

The D region is the lowest of the regions within the ionosphere that affects radio communications signals to any degree. It is present at altitudes between about 37 – 56 miles (60 and 90 km). It is only present during the day, it dissipated during dusk and stops at night.

E Region

The E region exists at altitudes between about 62 – 78 miles (100 and 125 km). This layer refracts them where they are returned to earth. Like the D region, It is only present during the day, it dissipated during dusk and stops at night.

F Region

The most important region in the ionosphere for long distance HF radio communications is the F region. During the daytime when radiation is being received from the Sun, it often splits into two, the lower one being the F1 lower region and F2 the higher one. Of these the F1 layer generally only exists in the summer.

Typically the F1 layer is found at around an altitude of 186 miles (300 km with the F2 layer above it at around 248 mi (400 km). The F layers acts as a "reflector" of signals in the HF portion of the radio spectrum enabling worldwide radio communications to be established. It is the main region associated with HF signal propagation.

Radio Propagation by Band

The F layer is mostly responsible for the refraction of radio waves back to Earth, preventing them from escaping to space. The other layers interact in other ways. During the day, the D layer forms, and the F layer splits into F1 and F2 layers.

The D layer is present during the day and is a good absorber of radio waves, increasing losses. Higher frequencies are absorbed less, so higher bands (20m to 10m or so) tend to perform better. Above the critical frequency, the ionosphere is unable to refract the signal back to Earth and it escapes to space. The critical frequency during the day is in the neighborhood of 6m: depending on the space weather, 6m way work for skywave, or it may not.

During the night we need not contend with D layer absorption, but the critical frequency is lower, so higher frequencies cannot support skywave propagation.

Popular Bands by eham.net

So what are the bands that most Radio Amateurs use? The table below shows bands that are relatively common and how and when they are in use. Again your license will determine which bands and what portions you are eligible to use.

	Band (meter)	MHz	Use*
HF	160	1.8 - 2.0	night
	80	3.5 - 4.0	night and local day
	40	7.0 - 7.3	night and local day
	30	10.1 - 10.15	CW and digital
	20	14.0 - 14.350	world wide day and night
	17	18.068 - 18.168	world wide day and night
	15	21.0 - 21.450	primarily a daytime band
	12	24.890 - 24.990	primarily a daytime band
	10	28.0 - 29.70	daytime during sunspot highs
VHF	6	50 - 54	local to world-wide
	2	144 - 148	local and medium distance
UHF	70 cm	430 - 440	local

20m works both day and night. Lower frequency bands work best at night. Higher frequency bands work best during the day. The farther from 20m you get in either direction, the more pronounced these effects are.

During a sunspot high cycle conditions are best for the higher HF frequencies and during a low the low frequencies are often in demand with all kinds of variation in between. Magazines such as QST and CQ Amateur Radio publish charts monthly that predict the best propagation to different areas of the world. Space Weather including Sunspot information can be found at spaceweather.com.

Simple antennas

A simple antenna is one designed to operate on a single frequency. This is done using a monopole or dipole. The monopole antenna is also known as the Marconi antenna, invented in 1895. One side of the antenna feedline is attached to the lower end of the monopole, and the other side is attached to the ground plane, which is often the Earth.

AM Broadcast tower

VHF ground plane

Dipole Antennas

Dipole antennas are antennas consisting of two equal parts of wire. Some dipoles use unequal sided such as Windom. A simple dipole cut for a specific frequency if using RG8 as a feel line will have a 50 ohm impendence, and not require a tuner.

Dipole Dimensions for Amateur Bands (ARRL Field Book w/ 5% added for coated wire)

Here is a handy chart for determining 1/4 wave verticals, 1/2 wave dipoles, and full wave loop lengths. All antenna lengths in the information below are in feet and are the results based on the standard formula of 468 / MHz = total length in feet.

Antenna lengths should be cut longer than formula results and then folded back and only trimmed when you get the desired frequency and best SWR. It's easier to cut than to add! A rule of thumb is to add an additional 5% of wire.

Freq. MHz	Freq Meters	Overall Length ft / in	Leg Length ft / in	Length Length inches	Leg w/5% ft/in	Leg w5% inches
3.6	80	130'	65'	780	68' 3"	819"
7.1	40	65' 10"	32' 11"	395"	34' 6 ¾"	414 ¾"
10.1	30	46' 4"	23' 2"	278	24' 3.9"	291.9"
14.1	20	33' 2"	16' 7"	199	17' 4.95"	208.95"
18.1	17	25' 10"	12' 11"	155'	13' 6.75"	162.75"
21.1	15	22' 2"	11' 1"	133	11' 7.65"	139.65"
28.4	10	16' 6"	8' 3"	99"	8' 7.95"	103.95"

Dipoles such a G5RV (British amateur SK) requires a balun or matching transformer to match the impedance between the antenna and feed line.

What is a BALUN?

A balun is a device that joins a balanced line (one that has two conductors, with equal currents in opposite directions, such as a twisted pair cable) to an unbalanced line (one that has just one conductor and a ground, such as a coaxial cable). A balun is a type of transformer: it's used to convert an unbalanced signal to a balanced one or vice versa. It's a device to connect different types of antennas to various feed lines.

300 ohm to 75 ohm balun

4:1 1.8 – 30 MHz

Beam Antennas

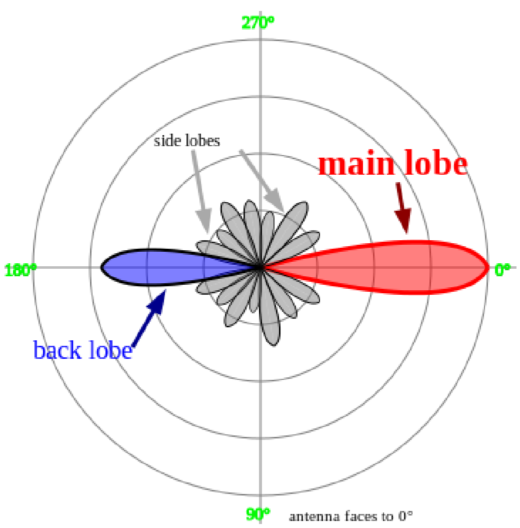
The other types of antenna systems are directional antennas also known at beams. The simplest beam is a dipole. The effective beam is pointed perpendicular to the dipole run. If the dipole runs North and South, the effective beam equally faces East and West. Other type of beams focuses most energy towards a central point. Directional or *beam* antennas which are intended to preferentially radiate or receive in a particular direction or directional pattern.

A beam can have as few as 2 elements or a many as practical based on boom length. The military had a beam with a boom length of 120 feet. That's 6.6 row homes at 18 feet wide.

Beam antennas consist of the following parts: reflector, driven element and director(s). The driven element in a Yagi beam is cut to the transmitting frequency, the reflector is cut 5% longer than the driven element, and the directors are 5% shorter than the driven element. Typical spacing's between elements vary from about 1/10 to 1/4 of a wavelength, depending on the specific design. The lengths of the directors are slightly shorter than that of the driven element, while the reflector(s) are slightly longer. The directors are placed between $1/10^{th}$ to ½ wavelengths. The numbers of directors is dependent on the size of boom.

The radiation pattern is unidirectional (fount and back), with the main lobe along the axis perpendicular to the elements in the plane of the elements. The gain of a beam can be increased by adding reflectors and directors. Adding directors does more to improve performance than adding additional reflectors. The more directors that are added make the beam width narrower.

History Note: The Yagi beam was invented in 1926 by Shintaro Uda and Hidetsusgu Yagi, Tojoku University in Japan. The Yagi was first widely used during World War II for airborne radar sets, because of its simplicity and directionality. Despite its being invented in Japan, many Japanese radar engineers were unaware of the design until very late in the war, partly due to rivalry between the Army and Navy. The Japanese military authorities first became aware of this technology after the Battle of Singapore (February 1942) when they captured the notes of a British radar technician that mentioned "yagi antenna".



The receive or transmit part of the antenna faces 0°,

The antenna's radiation pattern, or polar plot as it is sometimes called, plays a major role in the overall performance of the Yagi antenna. The directional gain, front-to-back ratio, beamwidth, sidelobes combine to form the overall radiation pattern. The antenna's radiation pattern bandwidth is the range of designed frequencies where the pattern remains consistent.

Log-periodic Beams

A **log-periodic antenna** (**LP**), also known as a **log-periodic array**, is a multi-element, directional, narrow-beam antenna that operates over a wide band of frequencies, a broad bandwidth. An LP antenna consists of a number of half-wave dipole driven elements of gradually increasing length, each consisting of a pair of metal rods. The dipoles are mounted close together in a line, connected in parallel to the feedline with alternating phase. The log periodic antenna was invented by Dwight E. Isbell and Raymond DuHamel at the University of Illinois in 1958.

The LP normally consists of a series of dipoles known as "elements" positioned along a support boom lying along the antenna axis. The elements are spaced at intervals following a logarithmic function of the frequency. Every element in the LP design is "active", that is, connected electrically to the feedline along with the other elements.

The Yagi and the LP designs look very similar at first glance, as both consist of a number of dipole elements spaced out along a support boom. The Yagi has a single dipole connected to the transmission line. The other dipoles (directors) on the boom are passive.

From the Skies over Mt. Essex

SKY Events for *November* 2015 rev

Nov 1st -- Daylight Saving Time Ends starts 3/13/2016.

Nov 2nd -- Mars < 1° from Venus in Dawn sky.

Nov 3rd -- Last Quarter Moon.

Nov 7th -- Moon is < 2° from Venus and Mars.

Nov 8th – Edmond Halley (Halley's Comet) born in 1656.

Nov 11th -- New Moon .

Nov 12th – Voyager 1 flies past Saturn in 1980.

Nov 18th -- Leonid meteor shower morning sky, approx 20 meteors/hr. Comet 55P/ Temple-Tuttle, Moon is FQ..

Nov 19th-- *First* Quarter Moon.

Nov 20th – Edwin Hubble born 1889, in 1920's discovered the Milky Way was not the only galaxy.

Nov 22th – Uranus is 0.9° S of the Moon AT 19UT (14 EST)

Nov 25th - *Full Moon* "Snow" for the English Medieval and the "Beaver " for the Colonial American.

Nov 26th – Aldebaran in Taurus is 0.7° S of the Moon 10 UT (05 EST).

Planet Lookout at mid-Month
Sunrise 06:49 EST and Sunset 16:51 EST

Mercury Hidden in Sun's glare all month.

Venus High at Dawn rises 03:01 EST, magnitude -4.3 and 20 arc seconds.

Mars High at Dawn rises 02:30 EST, magnitude +1.6, size 4.5 arc seconds.

Jupiter Dawn, rises 01:30 EST, Magnitude -1.9, size 34.1 arc seconds.

Saturn Dusk sets at 17:39 EST**,** Magnitude +0.0, size 15.2 arc seconds.

Uranus – Evening sky, rises about 15:09 EST, Magnitude 5.7, size 3.5 arc seconds.

Neptune Evening sky, rises at 13:33 EST. Magnitude +7.9, size 2.4 arc seconds.

Transit vs. Eclipse Spot across the Sun!

A transit describes from the viewers point of view when one celestial body passes in front of another. And eclipse is when the shadow of a celestial body is cast onto another. For the enhabinents of Earth an eclipse is when either the Sun's light is blocked by the Moon, a Solar Eclipse or when the Earth blocks the Sun light for the Moon, a Lunar Eclipse. The planets Mercury and Venus make a transit when crossing in a direct line between the Earth and the Sun.

On May 9, 2016 and Nov. 11, 2019 the planet Mercury will transit the Sun. All transits of Mercury fall within several days in May and November. Mercury's orbit is inclined 7° to the Earth orbit; it intersects the ecliptic at two points on those dates. If Mercury passes through an inferior conjunction at that time a transit will occur. Mercury has several transits per century the next ones through 2050 are: 11/11/19, 11/13/32, 11/07/39 and 5/7/49.

The next transits of the planet Venus will occur on December 11, 2117 and December 8, 2125.

Mercury Transit info for 5/9/16 for Baltimore, MD.

Sun rise 05:58 EDT for Baltimore, MD
First Contact 07:12 EDT
Second Contact 07:15 EDT
Greatest Mid-Point 10:57 EDT
Third Contact 14:39 EDT
Forth Contact 14:42 EDT

The Sun's diameter is 1,902 arc seconds (31.7 arc minutes) Mercury diameter is only 12 arc seconds. The May's transit of Mercury will approach the Sun from its Eastern limb (left side of the Sun) just south of the Sun's equator and exits the Sun on the Western limb (right side). The entire transit will transverse the southern half of the Sun. The transit will last 7 hrs and 30 minutes. Mercury will appear to move across the face of the Sun 4.23 arc seconds per minute. This means it will take almost 2 minutes and 50 seconds for Mercury to move 1 planet diameter.

What do I need to see the transit:

1. Clear Skies
2. Low Eastern Horizon it starts 1 1/2hrs hrs after sunrise.
3. Proper Solar Filter No 14 Arc-Welder's filter or better.
4. A small telescope will work with the proper objective filter, or eyepiece projection method. **Don't use an eyepiece filter**.
5. You can use image projection. The image can be safely projected on paper or a wall without the need of a solar filter.