# RADIOACTIVITIES

**NEWSLETTER OF THE ARGONNE AMATEUR RADIO CLUB**

W9ANL

**Volume XLIX, Number 3** **March 2008**

## Club Meeting

Unless otherwise noted, AARC general meetings are the second Tuesday of the month at the Argonne cafeteria at a table on the north end of the room. Any club member is welcome. To arrange for a gate pass contact Bruce Epperson at epperson@aps.anl.gov phone 630-252-3495 or Chuck Doose at doose@aps.anl.gov phone 630-252-6037.

## The Treasurer's Report

by Chuck KB9UMF

Nothing Received.

## REMINDERS

CLUB BREAKFAST: Always the 2nd Saturday of each month, 8:30 AM at:

*Old◆Country Buffet◆*

**59th Street and LaGrange Road in LaGrange**

CLUB NETS: Thru our Club Repeater 145.19.
SKYWARN NET: Mondays in season at 7 PM with Deni, W9DS.
THE CLUB'S 9PM NET: every Monday with Jack WA9FVP.
THE NIGHT PATROL: every night at 10:30 PM with Paul, W9FNM.
THE BREAKFAST CLUB: every morning at 8 AM.
THE NOONTIME NET: every weekday at noon.

## Mil's Corner for November

Nothing Received.

## Quad The Best Aerial I Ever Used

by Deni W9DS

I used a Radio Shack beam on ten meters with 3 elements wide spaced. That was the best aerial on ten I ever used, but for 20 and 15 meters. Many hams use 3 to 4 element quads. They hear DX before the pack gets there because of gain and capture area. But, quads have a tendency to come down in stormy weather, and after the hams 3rd or 4th time putting them back up they give up and get a 6 element beam and stack them 60' apart and switch between them. Even so, storms can bring these down.

I consider the advice of N2NQ many moons ago. We chatted and I bought a 2 element quad from Maco that was made in Illinois now but out of business. The 2-element will handle all of the storms depending on severity. The wires and fiberglass arms can be replaced most easily. Quads hear a little better than 3-element beams. I have beaten Yagis out in pile ups because they don't hear the DX as well. I have worked all countries except Scarboro Reef and was heard, but I changed my frequency using old faithful FT101B with analog tuning couldn't get it on the right frequency again. OH2BH called me until he faded out. It was my mistake. Stay where you are don't jump around frequencies like I did it was the last day OH2BH faded out in 5 minutes he was gone here in my receiver.

I picked up Bill Orr, W6SAI quad book bought at Newark Radio parts store $2.85. I lived in the family house on Clarendon Hills Rd. ten acre farm the copyright is MCMLIX First Edition I believe that's 1959 my first year as a ham.

After reading the book, it was my dream to build one of those quads in the book. It never happened. I stayed with my Windom and Gonthum throughout the 1960s. I moved in with my stepmother in Lemont and put up a triangle aerial for all bands especially 160 meters. Shortly I moved to Burr Ridge and in the 80s got tired of all the other aerials and bought the Maco Quad, which I use to this day.

The quad was born in South America about 1939 brainchild of W9LZX, in overcoming a Madrid of troubles of aerial design for tropical shortwave broadcasting station The Cubex Corporation supplied quads for every one for years. Clarence C. Moore, W9LZX, must have been chairman of the corporation.

The aerial appeared in Radio Engineer Journals. As the story goes, it is given fantastic gain, unbelievable front-to-back ratio and a magic which no other aerial can lay claim to. It was hailed as the greatest aerial of the age

and damned as the greatest hoax, but truth lies in between these violent extremes.

The story began in Ecuado high in the mountains Quito lies. Invented for a 10,000 watt 25 meter short wave mission of HCJB to listeners of the gospel to the northern hemisphere. The engineers first put up a 4-element beam aimed at the heartland of America.

After a few days in the high mountains, tremendous corona charges leaped full blown from tips of the driven and director elements. Burning with hiss and crackle, the heavy industrial tubing glowed with heat from the arcs and lit up the tips. Molten chunks dropped as fire slowly ate up the beam. The scene was heard a quarter mile away.

The evangelistic effort hinged on solution. W9LZX says the "Quad idea slowly unfolded by divine inspiration." He scoured through 100 pounds of engineering books and worked hours on basic design and the vision of a quad shape came from concept of a pulled open folded dipole, a loop with no ends to the elements was invented. It had high transmitting impedance and high gain. He built one with a reflector and replaced the 4-element beam. The corona problem solved.

When Moor returned to the USA, he applied for a patent and the fact that this aerial radiated perpendicular to the plane of the loop was deemed sufficient new engineering idea to support a patent, and W9LZX patent covers the cubical quad aerial. Mr. Moore was in business selling to South America radio stations and ham radio operators the world over. Amen!

The two element quad has quiet reception less fuss from rain static, occupies less space than 3 element beam, and has gain like a 3 element beam, simple to assemble, fed by coax or open line, lighter than a 3 element beam uses wire elements, and cheap to build. The power gain of 5db (0.9db via a single element) comes from directivity by the upper and lower sections, which are in phase.

They are in face stacked one above the other 2 ½ dipoles with end feeding, thus they are two horizontal dipoles vertically stacked, but 0.1db loss because of the ends bent towards each other to form this loop. The lazy hand aerial, sterba curtain are cousins to the simple square loop quad.

Adding a parasitic element adds gain. Gain is a function of spacing and tuning of the parasitic as either director with more forward gain or reflector behind driven element with a little less gain. However, a billboard screen reflector low Q gives 3db gain, but a wire high Q parasitic reflector can give gain close to 6db. The maximum theoretical power gain is the sum of loop gain and parasitic gain is 5.9db equal to a 2 element parasitic beam.

The radiation resistance of the aerial does not affect gain.

Aerial directivity is a function of radiation ability to send signals in a particular direction. However, a non radiator called an isotropic aerial myth exists only in a mathematical myth concept. How it can radiate uniformly in all directions including its ends like a sphere uniformly is a myth to me, but manufacturers use it to mislead the public with gain figures so that the public buys their aerials, only comparing gain figures adding the isotropic gain to their aerials. The Steppir Company does not.

Well, I opened Pandora's Box of the aerial manufacturers, so lets look at gain measurements.

It has been common practice getting gain figures via field strength meter readings at a remote spot. Comparing 2 aerials by field strength on a ground path is subject to big meaningless figures due to ground reflections and the effects of objects nearby. Thus, test aerial and field strength meter are put many wavelengths above ground. The ground effect will throw off every measurement.

A meaningful system includes: plotting radiation pattern and finding gain pattern, and rotating aerial 360 degrees recording changes in relative field strength at a point ten wave lengths or more away. Thus, E and H field planes can produce 3 dimensional view of pattern showing unwanted lobes and back radiation. The actual gain may be found by formulas.

Relationships between power gain, effective aperture, beam width gain, and aperture figures found from the E and H plane beam widths are placed on graph which assumes spurious aerial lobes are down 10db or more below the straight of main lobe. Only half power beam widths in E and H planes are needed for the measurement. A good signal generator with attenuator for calibrating field strength meter is used. A half wave dipole has a gain 1.64db.

Best spacing of ⅛ wavelength is 0.12λ for the 2 elements. Maximum radiation is 5.7db. At a height of ¼ wavelength, the dipole is useless because radiation is straight up. The quad at the same height has a main lobe at 40 degrees. For more forward gain by adding one

director for most gain can obtain only 1.4db more. Not worth it. Now comes the X quad.

The expanded quad is likened to a lazy H aerial it has 5.5db gain. The expanded quad only 4db. Using 4 ½ wave sections open top center held open by an insulator, but the bottom feed point impedance is 2,000 to 4,500 ohms a slight problem. Adding a reflector requires a longer than ¼ λ wire used to tune the element for highest forward gain. Maximum element spacing is 0.125 wavelengths, and shows 22db front to back ratio. Adding a director you can expect 10db forward gain.

An expanded quad was placed in 73 Magazine May 1967 authored by WA5Kxy, Don Harris. Well, poor Don gave up construction of Bill Orr's 2 wave length XQ, but he found an XQ quad of 1 ½ wave lengths worked and the feed point at center of bottom has an impedance near 50 ohms. So, Don's 1 ½ wave XQ aerial using 2 separate wires worked using 52 ohm coax line on 15 and 10 meters. The 2 band aerial gain is very close to Bill Orr's XQ. Don's XQ impedance was between 40 and 75 ohms at the feed point.

The top ends of Don's XQ are out of phase, thus must be separated by insulation. The expected gain on Don's 2 element beam is pegged at 7db.

Element lengths are the same length for driven and reflector. 14.3 100', 21.4 67', lastly adding a 3rd element 29MHz 49' 6" use stubs or coils for tuning. Boom length 10' electrical aluminum 1 ¼ or 1 ½ inch pipe size or 2 inch OD stiff aluminum tube can be used. The boom is lengthened at each end with 6' lengths of ⅝" or ¾" OD tubing to serve as terminals for connection of the cross bracing.

Assembly. Attach boom to tilting mast so as to allow rotation for access to spreaders. Spreaders attach to boom with spiders. 4 front spreaders should be 17' 9", center ones 17' 9", and back ones 18' 8" long. They should be stiff made of fiberglass-plastics.

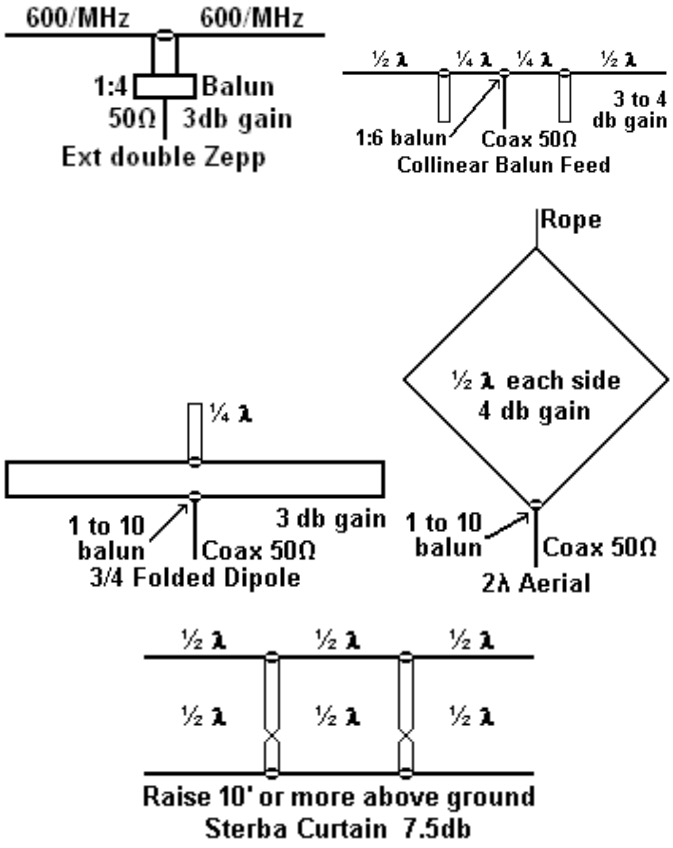
The driven elements were adjusted to 14.3MHz 21.4MHz and 29MHz. Small tuning coils 2 ½ inches diameter and having a length of wire of about 4% of the element were used to adjust the reflector frequencies to 13.6MHz, 20.4MHz, and 28MHz tuning stubs can be used if preferred. RG8U connected feed line to the aerials. Happy building.

Some other aerials: Extended double zepp with balun feed has a formula for wire either side of center insulator is 600/MHz feed line to a 1 to 4 balun the feed line insulator to balun length is 103/MHz then use 500 ohm coax. 3db gain can be achieved.

The ¾ λ dipole has its main radiation at right angles to the line of the wire, and has 3 to 4 db gain. This aerial may be simpler to build than the double zepp aerial since the 1 to 6 balun may be connected at the center of the aerial. Phase reversal stubs between ½ wave elements are made of 300 ohm twin lead shorted at the far end.

How about a 2 band folded dipole by using a stub. The overall length is ¾ wave long at the lowest frequency band used. For single band cancel stub. But if you use a ¼ λ stub use a switch at lowest frequency band. On next harmonically related band, stub acts as short circuit because it becomes ½ λ long and allows aerial flattop to resonate. Either way, feed via 1:10 balun.

A large loop called super loop is a small example of curtain array including types as sterba, bruce arrays, etc. Gain gets real if you have space to extend them one or two wave lengths. In our case the broad side array radiates with 7.5db in both directions. Aerial fed at bottom center requires 1 to 6 balun. The phasing is 300Ω between upper and lower set of elements using a simple twist.



## W6SAI Expanded Quad

by Deni W9DS

Here is an enormous quad two waves long. Which has considerable more gain and directivity than a one-wave loop quad. Don Harris WA5KXY built one his way that appeared in May 67 73 Magazine. The Orr (W6SAI) XQ quad was his idea, but Harris tried to build one and ran into trouble. His version of HQ quad had structural weakness and because the high impedance (2 to 3000 ohms) at the feed point made matching too difficult.

The modified XQ became a 1 ½ wave quad fed at the center bottom has 50 ohm impedance. So, one was constructed and results were better than just using a one-wave length quad. Using the 1 ½ wave 3 element Don's version has 9 to 10 db gain. That's a lot of wire up there in the windy city. A two-element version should have near 7 db with driven and reflective constructed elements of fiberglass.

Loop sizes are as follows (parenthesis are inches per element)

| Frequency | Director | Driver | Reflector | MHz |
|---|---|---|---|---|
| 14.3 | 96 (14.9) | 100' (14.3) | 100' | 13.6 |
| 21.4 | 64' 3" (22.4) | 67' (21.4) | 67' | 20.4 |
| 29.0 | 47' 6" (30.3) | 49' 6" (29.0) | 49.5' | 28.0 |

Note: Reflectors are same size as drive elements to minimize spreader length. Then stubs or coils can be used for tuning.

Start with spreaders 20' long. You figure out the boom; an engineering feat. Stabilizers are made of 150lb nylon. Each element is adjusted for frequency using grid dip meter. Exact frequency was found by picking up frequency on a receiver. Frequencies mentioned earlier. The RG8U coax is connected to all three antennas. This aerial is difficult to construct let alone keeping it up over a nice distance above ground 60' at center. It should perform well at 40'. This should be sufficient.

This is not the end of the story. An article appeared in World Radio, which shows another way to use the full 2 wave dimensions with high gain using a compaction method via a folding technique.

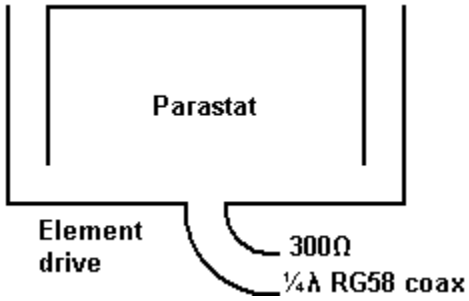
## Pakastat Aerial

by Deni W9DS

The U failed as an antenna, so a second element upside down was placed to the bottom U opposite in phase driven electrostatically in parasitic mode, hence the name coined for this radiator is called parastat. This 2 dipole setup lowers the frequency. Both dipoles cut to length at one frequency.

Due to proximity of elements an LC relationship exists and "pulling" occurs so that each must be pruned to the same frequency. Once reached, the aerial shows an increase of directivity, broadside null, and noise greatly reduced. Dimensions are 18% shorter than formula for a single dipole. Field strength meter shows an elongated figure 8 making a sharp directional pattern now surpassing receiving reference dipole masked signals under noise are readable. This test aerial was 1 foot above ground.

This aerial fits apartment dwellers or aerial restricted areas. Its broadside black hole can be helpful in working around competition. It can be used for direction finding mode in that the null won't spin out upon closure to a strong signal source.




Use ¼ wave open 300Ω line connect coax.

## RF on the Line

by Deni W9DS

Aerial construction brings confusion. Which measurements getting answers that change and don't seem to make sense because the outer shield of coax transmission line becomes part of the aerial system.

Yes, Jerry, the outer shield composite load made an aerial. Thus it was radiating too. A very good ground helps. The solution became obvious. Wrap a portion of the transmission line into an RF choke, 5 turns, about 6 inches in diameter, and placed at the bottom of the aerial. Addition of the coaxial choke cured both problems.

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**From Mike Kiley, WA9ZPM:** I tried to contact Gary Myers, K9CZB, last Sunday [Feb 24..ed.] and his wife informed me he has been so overtaken by multiple sclerosis that he is no longer able to walk or even use his hands. Please keep him in your prayers. Gary worked in the former OHS (Occupational Health and Safety) division and was a past president and main starter of the AARC.

ARGONNE AMATEUR RADIO CLUB
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MEMBERSHIP is open to all who are interested in amateur radio. This club is sponsored by Argonne National Laboratory. Employees of ANL or DOE-Chicago are eligible for full membership. Auxiliary membership is available to non-employees.

W9ANL/R is an open repeater, coordinated on 145.19 MHz (-600 input). The AARC repeater has been in operation on this frequency pair continuously since February 5, 1982.

CLUB NETS: 2 meter fm 1) Regular, every Monday evening at 9:00 and 2) the Night Patrol every night at 10:30, both on W9ANL/R. The Peanut Whistle Net (PWN) every Sunday at 1:30 p.m., and many evenings at 8:30 p.m. on 1932 kHz (cw/am/ssb), QRP.

RADIOACTIVITIES is published monthly by the Argonne Amateur Radio Club as a nonprofit newsletter intended only for the use of its membership. Material appearing here does not represent the official position of Argonne National Laboratory or the U. S. Department of Energy. Please give credit to the author and to Radioactivities or the Argonne Amateur Radio Club, when using original material published here. Deadline for submissions normally is the 20th of the preceding month.

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Please send club and editorial correspondence to the club address, or to travisdj@bigfoot.com Please include "AARC" in the subject.