
W6VIO Calling

JPL



Jet Propulsion Laboratory Amateur Radio Club
PO Box 842, La Canada CA 91012-0842

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Upcoming Events:

- **Emergency Communications Net:** Every Monday at Noon, on WR6JPL 224.08/(-)/156.7 & 445.20/(-)/103.5, or WR6AZN 223.96/(-)/156.7 on Table Mountain.
 - **JPLARC Regular Membership meeting:** Second working Friday every month from Noon to 1pm in 180-703C. Call-in: 818-354-4044 ID-number: **997 183 539** (without the spaces). Slides (if any) broadcast via JPL WebEx (same ID-number). Next is June 17th: **speaker is Bob Dengler NO6B discussing "IRLP on a Raspberry PI."**
 - **JPLARC Board of Directors (BOD) meeting:** Normally, the first working Friday, every month, from Noon to 1pm in 180-703C. The next BOD meeting will be **July 1st**. Call-in: 818-354-4044 ID-number: **997 183 539** (without the spaces).
 - For more upcoming events, see the ARRL Los Angeles Section website: <http://www.areslax.org>
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JEARS Table at JPL Safety Day

By Chris Gaylord W6YTB

I wanted to thank Jonathan Cameron KF6RTA, Lew Soloway AC6LS and David Seidel KC6NRL who all helped staff our JEARS table (Figure 1) at the Safety Day event down on the mall this morning (May 12th), as well as all the other Club and JEARS members who stopped by to say hi. We passed out information to quite a few interested people (both currently unlicensed and licensed) on our activities, and had several people inquire about how to get licensed.



Figure 1: Lew Soloway AC6LS at the JEARS table during JPL Safety Day on the JPL Mall.

Field Day 2016 Coming!

By Jim Marr AA6QI

Field Day 2016 is coming up June 25th and 26th. We will again be operating jointly with the Pasadena Radio Club (PRC) and the Caltech Amateur Radio Club (CITARC) in the Art Center south parking lot just across the 210 freeway from JPL.

As usual, setup starts at 7am Saturday morning, contest operations start at 11am Saturday and continue for 24 hours, and takedown begins at 11am Sunday.

There will be a potluck dinner at 6pm on Saturday (bring something to share) and a pancake breakfast at 8am Sunday morning. On Saturday, bring your own lunch or you can buy one at the Art Center cafeteria.

I will be sending out SignUpGenius links soon via our email reflectors that will enable you to sign up for setup, takedown, to operate any of the various stations that will be there and sign up to bring something to the Saturday potluck dinner.

Hope to see you there to join the fun!

Regular Membership Meeting May 20th

By Chris Gaylord W6YTB & Jim Marr AA6QI

Present were: Jonathan Cameron[†]* KF6RTA, Chris Gaylord[†]* W6YTB, Mark Lysek[†] AG6TD, Jim Marr[†] AA6QI, Steve Noland[†] WA6KLC, Lew Soloway[†] AC6LS (formerly KK6QJE), Steve Townes[†]* WB4ILW, Bill Weber[†] N6CI, Siomeon Young[†] KI6BWO. On the Phone/JPLWebex: Mike Roche[†] N6XLK, Chuck Sarture[†] KG6NF, Rob Smith[†] W6GRV, Walt Mushagian[†] K6DNS.

Note: † indicates a 2016 regular voting member (i.e., JPL/Caltech/Retiree and 2016 dues paid), and * Indicates a 2016 BOD member. For a regular meeting quorum, the JPLARC Bylaws require a majority of the BOD (four or more) and at least five other regular members. We had 4 BOD members, and 8 other regular members (total of 12 attendees), so we **did** have a quorum.

General Updates:

There was a successful work party on Friday, May 13. The remaining antennas near the old B173 shack were removed and put into storage and the 440 repeater antenna on the Mesa was replaced with a different antenna which has solved many of the recent issues with that repeater. Some preliminary testing was also performed on the HF antennas at the Mesa antenna farm, but more work is needed.

Weed abatement is being scheduled for the cable run leading to the Mesa as well as the antenna farm site.

The storage trailer next to B329 still needs to be relocated for the pending construction in the area, but Emergency & Continuity Management has now been informed that the relocation needs to be permanent (not temporary as previously stated) to accommodate fire lane access for the new building.

As an alternative, the project will provide a 10x10

storage container to be located near B329 to store items that need to be close to the shack and the Club/JEARS will need to split stored equipment between this new container and the trailer. The project is currently researching a permanent location for the trailer and it is hoped that the relocation can be delayed until the new container arrives to simplify the transfer of items.

Guest Speaker: Jim Marr AA6QI (Figure 2), "Making and using quadrifilar helicoidal antennas (QHA) for working amateur satellites."



Figure 2: Jim Marr AA6QI

I had been thinking about working satellites for some time and had obtained a radio (Yaesu FT-847) and satellite tracking software (MacDoppler) but didn't have a suitable antenna yet. Sitting with Tom Mikkelson WA0POD at his satellite station during Field Day 2015 lit the fire for me to get on the air working satellites.

Antenna requirements: I didn't want to sit outside with a handheld antenna (e.g., Elk or Arrow) while trying to learn how to make contacts (too much else to do) and wasn't quite ready to invest in a set of crossed Yagi's, rotator and rotator-to-computer interface. Plus, I really wanted to build something myself and to be able to leave it up all of the time so that I could make satellite contacts whenever I had a free moment.

This led to looking at omni-directional antennas with hemispherical (or nearly hemispherical) radiation patterns. These included eggbeaters (e.g., the M2 SatPack #1 or similar homebrew), turnstyles, Moxon squares, Lindenblads and quadrifilar helical designs. Designs for most of these are available on AMSAT's web pages, in the ARRL Satellite Handbook and in the ARRL Antenna Book (on the CD that comes with it). After a lot of study and tradeoffs, I decided that quadrifilar helix antennas would be the best performers so began looking seriously into the design of this type of antenna.

Brief history: The QHA was first described by Dr. C.C Kilgus in 1969 while he was working at the Applied

Physics Laboratory. Later, Walter Maxwell W2DU did extensive research on the design while at RCA's Astro-Electronics Division in Princeton, NJ, some of which he published in Chapter 20 of the 15th edition of the ARRL Antenna Book (the 22nd edition has about 1-page devoted to this antenna with, as I later learned, some important omissions) and he dedicates Chapter 20 of his book Reflections to this antenna type. QHAs have been used for spacecraft (e.g., AO-7, MSL & others) and for satellite ground system antennas (especially for receiving weather satellite signals).

Examples: A Google search for 'quadrifilar helix antenna pictures' turns up a huge number of examples of homebrew QHAs with widely varying construction techniques, for both 137.5 MHz weather satellites and for Low Earth Orbit (LEO) amateur satellites. It is worth studying some of these to get ideas for how to build your own (should you decide to do so).

Hemispherical radiation pattern: You might wonder why the peculiar shape of the QHA (see Figure 3 below) results in a hemispherical radiation pattern? A heuristic argument taken from W2DU's book Reflections starts with the square driven element of a cubical quad antenna where the currents in the top and bottom are in the same direction but the currents in the sides are 180° out of phase, resulting in the radiation from the sides canceling and the major radiation lobes being perpendicular to the plane of the element. Now, twist the bottom of cubical quad element 180° around the vertical axis so that the previous 'top' and 'bottom' sections are now again in the same plane but the currents are now going in the opposite directions and thus canceling each other, yet the former sides, now being twisted into 'helixes', no longer exactly cancel, resulting in a radiation pattern along the vertical axis in both directions (up and down), with a radiation null lying in the plane perpendicular to the vertical twist axis. Finally, add another such twisted element oriented at 90° to the first and drive it with currents that are 90° out of phase and you get radiation in only one direction along the twist axis (upwards, called 'endfire', or downwards, called 'backfire', depending upon both the twist direction and current phasing – more about this later). Note that I didn't know much of any of this when building my first QHA, leading to a problem that I will later describe.

Key parameters: There are several key parameters that must be chosen when building a QHA. These are: target frequency (determines the length of elements); antenna diameter to length ratio (tall-skinny or short-fat; primarily determines radiation pattern beam width on the sky); conductor diameter (primarily determines the antenna frequency bandwidth); filar length (a filar is one arc of the antenna conductor from top to bottom, of which there are four in a quadrifilar antenna); twist from

top to bottom (in multiples of ¼ turn); twist direction (again, from top to bottom, clockwise or counter-clockwise); phasing method (how to set the relationship between the currents in the filars); and the balun method (i.e., how to isolate the feedline from the antenna so that the feedline doesn't radiate). These choices are easier to make than it might seem at first.

Diameter-to-length (D/L) ratio: After the target frequency, which sets the overall size of the antenna, the D/L ratio is the next key parameter that must be chosen. The D/L ratio mostly determines the gain at zenith and the half power beam width (HPBW) of the antenna (i.e. how far from zenith the 3dB-down antenna response is located). A tall-skinny design has a broader HPBW (e.g., a D/L=0.2 has about a 154° HPBW and zenith gain of about 3dB) than a short-fat design (e.g., a D/L=0.6 has about a 120° HPBW and about 5dB zenith gain).

Self-Phasing: Phasing is about how you control the relative phase of the currents in the filars. This can be done using conventional phasing networks (e.g., 1/4-wave coax sections) or what is referred to as self-phasing, which is what most people do. In the self-phasing design, the QHA combines opposite filars, forming two loops. One of these loops is tuned below the antenna target frequency and the other is tuned above the target frequency such that exactly at the target frequency the resistance, R, exactly equals the reactance, X for the large loop and -X for the small loop. When this is the case, the current in the larger loop *leads* the voltage by 45° and the current in the smaller loop *lags* the voltage by 45°, resulting in the currents in the two loops being 90° out of phase with each other. So how do you choose what frequencies to tune the two loops to in order to make this happen?

Loop Q: How far above or below the target frequency the two loops need to be resonant depends upon the Q of the individual loops. Recall that Q is a measure of how impedance varies with frequency, with a high Q describing a narrow bandwidth and a low Q describing a broader bandwidth. Recall that we generally want high Q for the tuned circuits in our radios in order to get high selectivity and low Q for our antennas so that we can cover as much of the amateur band as possible. Back to the QHA, the lower the individual loop Q is, the farther apart the resonant frequencies of the individual loops need to be in order to meet the R=X requirement at the target frequency and the broader the overall bandwidth of the antenna will be. So what determines the individual loop Q?

Conductor diameter: The loop Q is largely determined by the size of the conductor used to form the loops (filar pairs). The "ideal" size is said by W2DU as being 0.0088 times the wavelength, which is about three-quarter inch at 2m and about a quarter-inch at 70cm. I used #8 copper wire for both 2m and 70cm and found that I had

adequate bandwidth to cover the satellite bands for both. W3KH used #10 copper wire for his 137.5MHz weather satellite antenna. If you intend to use your antennas for more than just the satellite bands, then you might want to consider the larger diameters (e.g., soldered copper tubing) in order to get a larger antenna frequency bandwidth.

To determine the Q of the loops, you can either build a test loop and measure the Q, or you can use a QHA design calculator that takes into account the conductor diameter in determining the dimensions of the antenna. One such on-line calculator is provided by John Coppens (<http://jcoppens.com/ant/qfh/index.en.php>) or you can use the table in R.W. Hollinder's TechNote 1999-1 (available on the web), both of which work well.

The balun: The balun is both a means of feeding a balanced antenna like the QHA with an unbalanced feed line (e.g. coax) and a means of uncoupling the antenna from the feed line in order to keep the feed line (coax) from becoming part of the antenna. There are two usual balun techniques used with QHA's. The first is to wind a sufficient number of turns of the feed line coax, typically wound around the support tube, to obtain a choke impedance on the outside of the coax of greater than 1000 ohms at the target frequency (see your ARRL Handbook), which is the technique I used on my 70 cm antennas. The second is the so called "infinite balun" where the outside of the feed line coax shield serves as one of the filars; this being the technique that I used with my 2m QHA. Both methods appear to work well.

My first QHAs: For my first QHAs I copied the design by W3KH, described in his article in the ARRL Satellite Handbook, among other places, in which he describes his 137.5MHz weather satellite QHA but also provides dimensions for both 2m and 70cm satellite band QHAs.

This design is for a $D/L=0.67$, $\frac{1}{2}$ -turn, $\lambda/2$ filars, with 5dBi zenith gain and about 120° half-power beam width relative to zenith ($\sim 60^\circ$ from zenith at all azimuth directions).

After building both (2m & 70cm) (Figure 3), I found the resonant frequencies of my antennas to be too low to be useful and began the process of adjusting them, quickly learning that I really didn't understand how the antennas worked sufficiently to be able to make the adjustments.

After much internet research, I found an outstanding article by R.W. Hollander published by the Dutch group "De Kuntzman" (The Satellite), titled TechNote 1999-1, that provided the technical information that I needed to be able to tune my QHAs.

I was quickly able to successfully tune my 2m QHA but the way that I had built my 70cm QHA, using $\frac{1}{2}$ " PVC pipe for spacers with the filar wires threaded through

the ends of the spacers, made it too difficult to tune so I abandoned it and built a new 70cm QHA that didn't use spacers at all, relying on the stiffness of the #8 wire to hold its shape.



Figure 3: AA6QI's QHA's (left - 70cm LHCP; upper right 70cm RHCP; lower right 2m RHCP). Note that there is a 40m dipole in the background that is not part of the QHAs. The plastic covers below the antennas house diplexers and preamps for each band.

I found that the adjusted 2m QHA worked fine, in that I could hear satellites with downlinks in the 2m satellite band quite well. On the other hand, I couldn't hear any satellites with my 2nd generation 70cm QHA. Nor could I transmit into any satellites with uplink on 70cm.

Investigation: This led me to build a spreadsheet model of the QHA based upon the equations in Hollander's TechNote 1999-1 and I was able to reproduce his results for his 137.5 MHz weather satellite antenna, suggesting that I hadn't made any serious mistakes in my model and could safely proceed to applying it to my 70cm antenna.

I then had to figure out how to use my Comet CAA-500 Mark II antenna analyzer (which at 70cm provides only SWR and the absolute value of the impedance, $|Z|$) to obtain R and X measurements that I could compare with the QHA model output. I first tried using Smith charts since SWR is a circle on the Smith chart and $|Z|$ curves are perpendicular to the R axis, curving away from the imaginary axis as reactance increases, so I could get R and $|X|$ from where the $|Z|$ curves cross the SWR curve, leaving only the sign of X as ambiguous (it will

cross once below and once above the horizontal real axis).

Since I also had a length of coax (balun plus an additional length of feedline) between the antenna and the antenna analyzer, I had to take the impedance transformation of the coax into account in order to be able to compare what I measure at the CAA-500 with what the model predicts. I first started doing this manually using paper Smith charts but found that it was both laborious and error prone so I decided to learn how to use SimSmith, a Smith chart program that is available for both PCs and Macs at no charge for internet download and that has lots of excellent on-line tutorials. Using SimSmith, I was able to model what my antenna analyzer should read at the end of the coax and compare the results with those obtained by my antenna analyzer over the frequency range of interest. These results clearly said that the antenna should be working perfectly but it clearly wasn't.

Epiphany: After a couple of months of struggling with this, I woke up in the middle of the night wondering whether the winding direction (clockwise vs. counterclockwise) might matter and whether I had wound mine as I had intended. The next morning, I checked and found that I had inadvertently wound my 2nd generation 70cm antenna clockwise looking downward from the top instead of the intended counterclockwise). I immediately took the antenna apart and rewound the antenna counterclockwise and, voila, the antenna began working perfectly. So why did the winding direction make so much difference?

After much additional internet searching, I found a paper that provided the explanation that I needed. It turns out that winding direction (CW vs CCW) and the connections at the top of the antenna together determine whether the antenna radiates upward or downward and whether it has right-hand circular polarization or left-hand polarization.

Figure 4 shows this relationship between the feedline coax connections at the top of the antenna, the filar winding direction, the resulting radiation direction and circular polarization handedness. I found it interesting that pretty much all of the papers describing building QHAs don't relate this information, nor does the ARRL Antenna Book article on the QHA.

I had intended to build an upward radiating, right-hand circular polarization (RHCP) antenna but had inadvertently built a downward radiating left-hand polarization (LHCP) antenna. Thus, I had built the perfect antenna for communicating with subterranean satellites, of which I found exactly none (surprise, surprise).

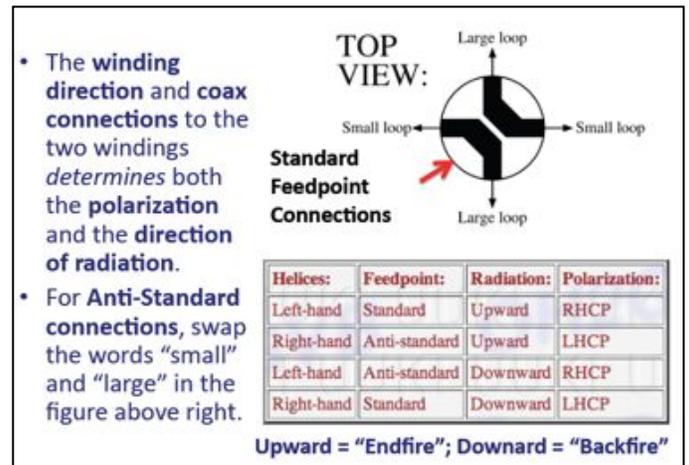


Figure 4: Self Phasing QHA Connections & Helix winding direction

Figure 5 shows the components and assembly details for a 70 cm LHCP QHA, my 3rd 70cm QHA, that I built (to test out whether LHCP vs RHCP makes a difference on SO-50; -- it doesn't). You can see, however, that the antenna is quite simple to build, although the dimensions are fairly critical.



Figure 5: Building a 70cm LHCP QHA

QHAs in my station (Figure 6): Starting at the 2m QHA, the signal first passes through a diplexer that serves to suppress the transmitted 2m 3rd harmonic that might cause de-sense of the 70cm preamplifier, then passes through a 2m Advanced Receiver Research (ARR) preamplifier, all of which is at the antenna under a rain cover, then passes through 50 feet of 9913 coax to the VHF connection of my Yaesu FT-847 transceiver.

The 70cm QHA signal also passes through a diplexer that serves to suppress the strong 2m signal (since the two antennas are mounted on the same mast), then passes through an ARR 70cm preamp, and finally through 50 feet of 9913 coax to the UHF connection of the FT-847.

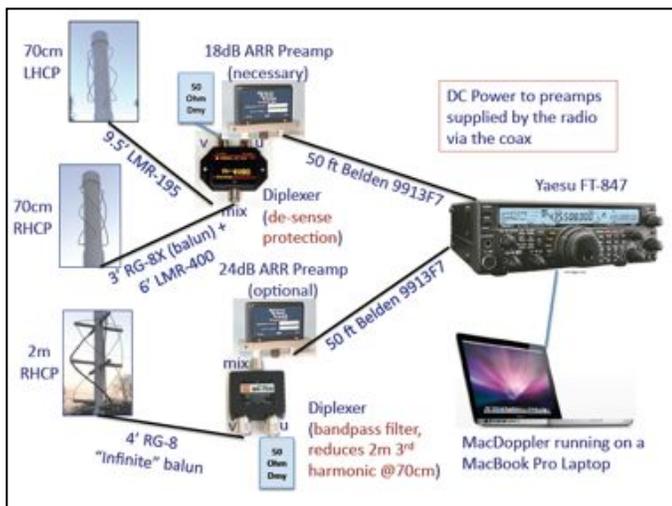


Figure 6: QHAs in my system (see text)

I chose to order my ARR preamps with internal connections that allow supplying the 12VDC preamp power over the coax, since the FT-847 supports this. Be aware that you need to think about how you are going to provide the DC power to your mast-mounted preamps when you order them (there are multiple ways to do it, so do some research).

You also need to think about your preamp transmit/receive (T/R) switching that bypasses the preamp during transmit since you will blow up your preamp if you transmit into it. My ARR preamps have internal automatic RF-sensing T/R switching so I don't need to worry about that but for many preamps you will need to provide a sequencer that switches out the preamp before the transmitter transmits. So be aware of this when designing your system.

Are preamps really necessary?: In my opinion, the 70cm preamp is essential and the 2m preamp is optional. To test my preamps, I found that without any preamp at all (ARR external or FT-847 internal), I could hear the JPL repeaters (2m & 70cm), to which I do *not* have line of sight, at about an S2 level. With the FT-847 internal preamps, I had about an S8 level. With the external preamps, I had about 50dB over S9 signals on both bands. When working satellites, I found that I actually prefer to use the external preamp for whatever the satellite downlink frequency is).

But, how well do my QHAs work?: My going-in expectations were not very high for an omni-directional antenna of any design, though my actual experience with the QHAs has really (pleasantly) surprised me.

I started by trying to work five satellites that were routinely reported as being operational (both uplink and downlink) on the AMSAT satellite status page. These were: AO-85 and SO-50 (both FM repeater satellites), AO-29, AO-73 and AO-7 (three inverting linear

transponder satellites). I later added XW-2A, XW-2C, XW-2F (all three inverting linear transponder satellites), and, just recently, LILAC-2 (an FM repeater satellite that has had a checkered operational status recently).

I found that I was easily able to make contacts through all 9 satellites at elevations down to my local horizons (varies by azimuth). Following my first satellite contact on February 8th, I've made about 300 satellite contacts distributed over much of North America. At first, I was working everyone that I possibly could in order to characterize the radiation pattern of the antennas but now I just listen to most passes and try to work stations located in Maidenhead grid squares that I haven't previously worked (the world is divided up into 10°x20° fields, each field into 1°x2° grid squares and each grid square into 2.5'x5' sub-squares, but satellite operators usually exchange only fields & squares, not sub-squares) as a shorthand to give approximate location without having to transmit full latitude and longitude; you can find more information about this via internet search if you're not already familiar with this. So far, I've been able to make contacts with about 1/6th of the 488 grid squares in the continental U.S., plus a few in Canada and Mexico, with range being mostly limited by the small footprint of these LEO satellites and my relatively high local horizons limiting me to elevations above 15° to 20°, except directly to the south.

Full duplex & EIRP: When working satellites, it's important to be able to listen to yourself on the downlink (satellite communication should be 'full duplex', like a telephone conversation, unlike the 'half duplex' one-way-at-a-time transmissions that we use for most amateur communications).

One of the most important rules in satellite communications is "*Never use more uplink transmitter power than required to be able to hear yourself clearly in the downlink*" (which assumes that you *are* listening to yourself on the downlink!). This is very different than in HF communications where many amateurs think more power is better regardless of whether it is really needed or not. With linear transponder (SSB/CW) satellites especially, downlink power from the satellite is allocated according to the strength of the uplink signal so someone using too much power on the uplink basically robs downlink signal from everyone else on the transponder, possibly driving them further down into the noise and even potentially terminating their QSOs. Not following this rule is a significant problem in the satellite community in general and you really don't want to be one of those who violate it.

With the 1970's AO-7 satellite, operating just on its solar panels when sunlit due to the failure of its battery, using too much uplink power can actually cause the satellite to reset itself, often changing modes as a result. It usually comes up in mode B (UHF up, VHF down) but can come

up in mode A (VHF up, 10m down). I've actually heard this happen. You can tell this might be about to happen when you hear someone's downlink signal 'chirping', indicating that their uplink signal is strong enough to be pulling down the satellite's power bus voltage.

Another thing that I've learned is that the uplink PL for FM satellite AO-85 (Fox 1A) is actually closer to 69.3 Hz rather than the advertised 67 Hz. Today, I (and several others that I know of) routinely use the 69.3 Hz PL and have better uplink access to the satellite.

Conclusions: Overall, I am very much happier with my QHA performance than I ever expected to be. I can reliably make contacts through any of the currently working LEO satellites when they're above my local horizons (different in different azimuth directions) and I don't have to worry about antenna pointing at all. On the other hand, the all-mode FT-847 satellite transceiver does have a lot of power (up to 50W when needed, such as when at very low elevation angles where there is significant path loss and the QHA gain is reduced) and supports full duplex operations, things that might not be available if you plan on using your handheld radio to make FM satellite contacts (in which case an Arrow or Elk handheld Yagi antenna will work better for you).

References: If you are thinking about getting started in working amateur satellites, I strongly recommend Gould Smith's book Getting Started With Amateur Satellites. This book provides lots of background information and many suggestions for your station configuration depending upon which satellites you would like to work.

Another good book, although a little dated now, is the ARRL Satellite Handbook. This book provides a lot of pertinent operating information and is worth your while to study a bit before starting your satellite operations.

More LEO satellites coming: At our upcoming September meeting, you'll hear AMSAT's Patrick Stoddard WD9EWK talk about more LEO satellites coming in the near future, as well as about HEO and GEO satellites that are in development (though these higher orbit satellites will require higher gain antennas than QHAs can provide).

BOD Meeting June 3rd

By Jim Marr AA6QI

Present were: James Bartok† KK6IHF, Jonathan Cameron† KF6RTA, Bob Cesarone WA9JIB, Bob Dengler† NO6B, Chris Gaylord† W6YTB, Josh Miller† KB3UUS, Steve Townes† WB4ILW. On the Phone: Chris Carson† KE6ABQ, Jim Marr† AA6QI, Walt Mushagian† K6DNS, Rob Smith† W6GRV.

Note: † indicates a 2016 regular voting member (i.e.,

JPL/Caltech/Retiree & 2016 dues paid), and * Indicates a 2016 BOD member. For a BOD meeting quorum, the JPLARC Bylaws require a majority of the BOD (four or more) to be present. We had all six BOD members present so we **did** have a quorum.

Treasurer's Report: Jonathan Cameron presented Chuck Sarture's report: Previous balance of \$5,574.02; income from new memberships \$100; Expenses for radio repair and antenna supplies of \$264.16; Ending balance \$5,409.86.

Membership Report: Secretary Chris Gaylord reported that there was no change in membership so membership remains at 51 total members, of which 42 are voting members and 69% are ARRL members.

Trailer Update (T9342): Chris Gaylord reported that Trailer 9342 (the new trailer next to B329) move date and destination are both currently TBD but the destination will likely be up on the JPL Mesa. One limitation on where it can go is that it can't take up any parking spaces. Chris solicited ideas for alternate locations for T9342. Please contact Chris directly (and ASAP) if you have any good ideas. A new 10' X 10' container will be provided next to B329 to provide some local storage.

Guest speaker update by Josh Miller: Still don't have speakers lined up for October and November. Jonathan Cameron suggested a couple of possible topics: Yaesu's Fusion (C4FM) and Mesh Networking, both of which the Board thought were worth pursuing.

NASA HF Net: No progress yet on being able to participate in the weekly NASA net.

Field Day (FD) Update:

-- Jim Marr AA6QI gave a brief update on FD preparations. The Pasadena Radio Club (PRC) now has the contract in place for use of the Art Center's south parking lot (same place we've used for the past two years).

-- The PRC held their first FD planning meeting. Since Ray Overman KJ6NO's antenna trailer and radios won't be at this year's FD (he moved out of the area), the possibility of sharing the CITARC Force 12 was discussed. Jim has arranged to borrow Ray's Dunestar M333-P HF triplexer (20/15/10m) in case we want to do this, although Jim proposed an option to the PRC that doesn't use this, preserving the CW station's frequency agility. Stay tuned for further updates.

-- The use of the Comm Van was approved by Will Michael KC6LOK as a JEARS training activity and efforts to prepare it were discussed. Significant work includes checking the operation of the FT-897; preparing the Cushcraft ATB-34 triband (20/15/10m) Yagi in C7111 for use on the Comm Van crank-up mast;

ordering the CAT cable; checking out the generators, and arranging with the PRC for a logging computer.

-- The CITARC antenna trailer was prepared on Friday May 27th at Caltech by a team consisting of: Gary Block KJ6IZX, Jonathan Cameron KF6RTA, Kate Hutton K6HTN, Jim Marr AA6QI, Mike Tope W4EF, Steve Townes WB4ILW, & Fred Vescelus N6FV.

-- Mike Tope W4EF has the CITARC switchable band pass filter that we've used in the previous two years and will pass it off to Jim Marr next week.

-- Jonathan Cameron ordered the club's new Honda EU2000 2kw generator that will replace our 1970's, very noisy Honda EM2200X generator that we've been using for many, many prior FDs.

-- Jim Marr will prepare SignUpGenius links for FD setup/takedown, CW operators, and CommVan CW operators and distribute to all three club's email exploders. He will also include SignUpGenius links for the PRC 40m SSB station and Saturday night potluck dinner contributions.

Work Party May 13th: Jonathan Cameron reported that the two remaining antennas in the vicinity B173 were removed and relocated to C7111 (now located half way up the road to the Mesa). Other antennas from T9342 (the new white trailer near B329) were also relocated to C7111).

The work party also replaced the GP-9 antenna on the 445.20 repeater that had failed (coax was exonerated), improving performance from that repeater significantly. On-air testing was assisted by: Jim Marr AA6QI, Walt Mushagian K6DNS, Bob Dengler NO6B, Janet Cameron KG6NJO, and Eric Vander Velde KK6YVS.

The work party, under the lead of Josh Miller KB3UUS tested the Mesa HF antennas at the connections to the Ameritron RCS-4 remote antenna switch located about 100 ft east of the Rohn tower with the Hy-Gain TH-7DX triband (20/15/10m) Yagi and the Cushcraft XM-240 2-element 40m beam, as well as other inverted V's. Based upon Josh's measurements, none of these antennas is resonant where they're intended to be. The question was raised as to whether the antenna analyzer might be aliasing other frequencies and the suggestion was made to use the MFJ-731 Analyzer Filter with subsequent measurements (we always have to use this at the Art Center FD site in order to get accurate antenna SWR measurements).

Things that didn't get done included: terminating and grounding the four smaller hard-lines at the Rohn tower; buzz out and label matching hard-line ends; create a plan to repair/replace the sloping dipole antenna.

Jonathan plans to organize a meeting of the Station Subcommittee next week to plan out the next steps for

the Mesa HF antennas and to start the process of recommending new HF radios for EmComm and Club use.

Mesa Repeater Antenna Upgrades: Jonathan has purchased some of the materials for the cross bar for the pole just north of the 35A repeater cabinet on the Mesa. He also showed a proposed layout of the antennas on the cross bar that, based upon discussion at the Board meeting, may need some adjustments. Jonathan will arrange for a Repeater Committee meeting sometime next week to discuss how to proceed.

JPLARC Equipment Inventory: Jonathan still needs assistance to complete the inventory. Please contact Jonathan to offer your assistance.

JPL Interest Fair: Wednesday 9/21/16 from 11am to 1pm on the JPL Mall. We have agreed to staff a table that will be both the JPLARC and JEARS. Steve Townes will take the lead in organizing this.

Weekly Net (Noon on Mondays): Weekly net is still having participation from about twenty hams each week. On May 17th Josh Miller conducted a simplex net on 446.52 MHz from 180-R6 with good participation from both on and off Lab. This was a good exercise in learning how to relay messages for those simplex operators who couldn't hear each other. Josh presented a Google Earth map of the simplex net participant's reported locations.

Related Radio Activities: The PRC holds a net each Tuesday at 7pm on the W6MPH repeater (145.18, -, 156.7). The PRC club meeting is the 4th Tuesday of each month at the Walnut/Los-Robles Kaiser building in Pasadena. See <http://w6ka.net> for details.

The Altadena ALERT net is held on Monday's at 8pm, also on the W6MPH repeater (145.18, -, 156.7). For more information see <http://altadenaradio.com>.

ARRL Membership:

By Jim Marr AA6QI

As an ARRL affiliated club, we need to maintain at least 51% ARRL membership among our voting members.

While there are no requirements to maintain ARRL membership, there are some clear advantages to having ARRL membership. Some of these are:

- Receiving the monthly QST magazine and having access to all back issues electronically.
- Being able to subscribe to weekly ARRL news, propagation forecasts, and satellite ephemeris notifications.
- Being able to subscribe to the electronic monthly Amateur Radio Emergency Service (ARES) newsletter that may be of interest to members who wish to stay current on emergency communications.

- Member discounts on materials and training. For example, the ARRL Introduction to Emergency Communication Course is \$85 for non-members but only \$50 for members.

- You support ARRL, the only significant amateur radio advocacy organization in the U.S. that is fighting to protect our access to the airwaves.

Should those of you who are not already members and may wish to join, **please do so through the Club** rather than joining directly through ARRL. Why? If you join through the Club (new members), the Club retains \$15 of your membership fee to support Club activities. From your point of view, the amount you pay is the same either way. Even if you are a member who is just renewing, doing so through the Club nets the Club \$2, again without changing your costs at all.

To renew through the Club, see Secretary Chris Gaylord who will help you with the paperwork (don't worry, it's really simple!).

Thanks in advance for considering joining ARRL or for maintaining your membership.

Future Meetings

By Jim Marr AA6QI

All JPLARC meetings are being held on non-RDO Friday's from Noon to 1 PM in 180-703C. Upcoming talks (subject to change, as always):

July 15th: Gary Wong W6GSW and Jon Bell KA6JON, "Winlink Messaging."

August 26th: Chris Gaylord W6YTB, "Great Shakeout Planning."

September 23rd: AMSAT's Patrick Stoddard WD9EWK, "AMSAT Future" (Patrick may be coming out to Pasadena to give this talk).

October 21st & November 18th speakers are still TBD.

2016 JPLARC Organization:

