Conference Calendar

For further details, email <info@setileague.org>, or check <http://www.setileague.org/general/confrnce.htm>.

March 29, 1998: *Annual Meeting*, Little Ferry NJ.
April 3 - 5, 1998: *Southeastern VHF Conf.*, Marrietta GA.
April 10 - 12, 1998: *Balticon 32*, Baltimore MD.
April 21, 1998: SETI Lecture at *Rutgers University Amateur Radio Club*, New Brunswick NJ.
April 25 - 26, 1998: *Trenton Computer Festival*, Trenton NJ.
May 15 - 17, 1998: *Dayton Hamvention*, Dayton OH.
May 22 - 25, 1998: *BayCon '98*, San Jose CA.
May 29 - 31, 1998: *Rochester Hamfest and ARRL Atlantic Division Convention*, Rochester NY.
June 7 - 12, 1998: *IEEE MTT-S International Microwave Symposium*, Baltimore MD.
July 12 - 15, 1998: *Society of Amateur Radio Astronomers*, NRAO Green Bank WV.
July 23 - 26, 1998: *Central States VHF Conference*, Kansas City KS.
August 5 - 9, 1998: *BucCONeer* Worldcon, Baltimore MD.
August 8 - 9, 1998: *8th International EME Conference*, Paris France.
August 21 - 23, 1998: *24th Eastern VHF/UHF Conference*, Enfield CT.
September 24 - 27, 1998: *Microwave Update*, Longmont CO.
September 28 - October 7, 1998: *IARU Region 2* Triennial Meeting, Caracas Venezuela.
October 3, 1998: *Mid-Atlantic VHF Conf.*, Horsham PA.
October 9 - 11, 1998: 16th *AMSAT Annual Meeting and Space Symposium*, Vicksburg MS.
November 13 - 15, 1998: *Philcon '98*, Philadelphia PA.
May 14 - 16, 1999: *Dayton Hamvention*, Dayton OH.
September 2 - 6, 1999: *Aussiecon Three* / 1999 Worldcon, Melbourne Australia.
May 12 - 14, 2000: *ARRL National Convention* and *Dayton Hamvention*, Dayton OH.
August 7 - 19, 2000: *XXIVth International Astronomical Union General Assembly*, Manchester University, UK.

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SearchLites

the Quarterly Newsletter of The SETI League, Inc.

Volume 4 Number 2
Spring 1998

Directions:

A Travel Report from our Executive Director

It's been a busy few months. Last September, Peter Wright (our SETI League coordinator for Germany) hosted the first European Radio Astronomy Congress in Heppheim, Germany. It was a pleasure to meet so many of our European members and to hear about their progress with SETI stations. I especially thank Peter and his wife, Angelika, for their kind hospitality. I only regret that my work schedule afforded me only four days in Germany. Next trip, I must plan to make time for some sightseeing.

In October, I had the honor of being Banquet Speaker at the Mid-Atlantic VHF Conference near Philadelphia. The "Pack-Rats" club which hosts this annual conference is home to a sizable SETI contingent. The following week saw me in Toronto for the AMSAT Space Symposium, and two weeks later I presented a paper at Microwave Update in Ohio. I started November by meeting with our SETI Institute colleagues near San Francisco. Then it was back east for a trip to Cambridge MA (where I had a pleasant dinner with SETI pioneer Dr. Philip Morrison), followed by Philcon, the Philadelphia Science Fiction Society's annual convention.

December 1997 was (thankfully) a quiet month. In January 1998, I had the honor of representing The SETI League at the International Conference on SETI in the 21st Century, sponsored by the SETI Australia Centre at the University of Western Sydney Macarthur. Conference organizers Carol Oliver and Ragbir Bhathal assembled as their list of participants a Who's Who in SETI, and I felt privileged to spend a week with some of our most illustrious colleagues. I then enjoyed side trips to Brisbane and New Zealand, generously hosted by regional coordinators Noel Welstead and Wayne Thresher. This gave me the opportunity to address several down-under ham and astronomy clubs and encourage our members monitoring the southern sky.

As you might guess from the Conference Calendar at left, travel is a major component of my job as your Executive Director. The papers I present at technical conferences around the world are posted to our Web site for your edification and serve to establish our credibility as a serious scientific organization. By meeting with local groups, I'm able to help stimulate the growth of our global *Project Argus* search. And everywhere I go, I am encouraged by the enthusiasm and dedication of our SETIzens.

The SETI League especially owes its thanks to my patient wife, Muriel Hykes, for tolerating my prolonged absences.

SETI Advisor Knighted

In a much overdue honor, distinguished author, futurist, and SETI League technical advisor Dr. Arthur C. Clarke has been named a Knight Bachelor by Queen Elizabeth II. Sir Arthur has graciously requested his staff to issue the following instructions to visiting natives from the American Colonies, who may be ignorant of the correct protocol:

After removing footware, remain standing in a submissive posture at the designated spot. When dismissed from the Presence, however, it is not necessary to exit backwards. A low bow from the waist (or a curtsey in the case of ladies) followed by a normal departure is perfectly acceptable.

Sir Arthur kindly adds that SETI League members are specifically exempted from the above protocols.

Ask Dr. SETI

Send your questions to Ask Dr. SETI, PO Box 555, Little Ferry NJ 07643, or email to askdrseti@setileague.org. Remember, he's not a *real* doctor (but rather, a Ph.D., the kind who actually has to work for a living!). For health questions, consult a competent medical professional.

Dear Dr. SETI:

Do you have any information about Dicke-switching? We have been suggested to use such a switching with the object of eliminating noise generated by the system itself, but we are not sure how this would work.

EN, Norway

The Doctor Responds:

The Dicke switch (named for its inventor, the noted astrophysicist Robert Dicke of Princeton University) is much used in total-power radio telescopes, not so much to eliminate noise, as to eliminate the effects of receiver gain fluctuations during a measurement. The idea is that you repeatedly (and very rapidly) switch the input of the receiver between an antenna and a constant-temperature load resistor. You then look at the difference in receiver output amplitudes between the two conditions (it's rather similar to the technique used to measure receiver noise temperatures by switching between a "hot" and a "cold" load).

Dicke switches are not much used in amateur SETI, mainly because we use other techniques (software Fast Fourier Transform analysis, for example) to differentiate between signals and noise. Nevertheless, they are quite popular in astrophysical observation. One of our suppliers of amateur SETI equipment, Radio Astronomy Supplies of Roswell GA, provides a Dickey switch kit to use with their various radio telescope designs. You can find a link to them from our on-line Technical Manual.

Incidentally, Bob Dicke has quite a unique sense of humor. I once heard him deliver a lecture in which he mentioned (in passing) that the universe is 15 billion years old. Afterward, a grad student asked him how he knew that. Now, Dicke could easily have given the traditional explanations about Doppler shift of the radiation background from the Big Bang, measuring rates of expansion, calculation of the Hubble Constant, and so on. Instead, he said (with a straight face): "Our studies show that, from the beginning of time, it takes about 15 billion years for astrophysicists to evolve. I am an astrophysicist. I am here. Ergo, the universe is 15 billion years old."

Dear Dr. SETI:

I read about the Drake Equation, but I find it´s pure guesswork to predict anything specific about the number of existing technological civilizations in our neighbourhood. I guess it is rather a matter of belief, and one guess can be about as good as another even if they are wildly different. Am I completely wrong about that?

Jan, Denmark

The Doctor Responds:

Not at all, Jan! The importance of the Drake Equation is not in the solving, but rather in the contemplation. It was written not for purposes of quantification at all, but rather as the agenda for the world's first SETI meeting in Green Bank WV in 1961. It was quite useful for its intended application, which was to summarize all the various factors which scientists must contemplate when considering the question of other life.

It is interesting that when the Equation was first written, the only factor which we had any basis to estimate with reasonable accuracy was the first, the rate of stellar formation. In the four decades since, we have learned something about extra-solar planets, so we can now estimate the second factor. We also have direct evidence as to the existence of two planets in their star's habitable zones, so (though the sample size is small) we can roughly estimate the third factor. At this rate, we should have three more factors nailed down by the middle of the next century! A value for the seventh will probably always elude us.

For the record, I consider the Drake Equation to be a marvelous tool for quantifying our ignorance.

Dear Dr. SETI:

I've seen once a picture of a signal that has been broadcast by the SETI people (I think) which showed, very roughly, the human morphology, the solar system, the DNA and other things, like a black-and-white assembly of some 50x50 pixel (no actual idea). Do you know where I could find this? I'd be thankful!

RS, Switzerland

The Doctor Responds:

Your general information is correct. The Arecibo Interstellar Message was transmitted on 16 November 1974 on 2380 MHz, toward the globular cluster M13, 25 kLY distant. It consisted of 1679 bits, to be arranged in 73 rows by 23 columns (those both being prime numbers). It graphically described a binary number sequence, hydrocarbon chemistry, DNA, the human figure (including a height scale), our solar system, and the Arecibo dish transmitting the signal. A very detailed image of this transmission, with complete description, may be found on page 290 of Carl Sagan's 1980 book "Cosmos."

The transmission of this message was somewhat controversial. Some of the concerns regarding transmitting from Earth were discussed previously in this column.

Dear Dr. SETI:

I am extremely interested in project ARGUS, however I do not understand a couple of things. First, why choose a frequency associated with water? After all, we are carbon-based lifeforms dependent on water, yet we use all types of high and low frequency transmission. You can't take a cell phone or any microwave transmission and directly relate that to water, so why pick the "Water Hole"?

Monty G.

The Doctor Responds:

The "water hole" frequencies are not directly related to water, Monty; that's just a poetic description. In the quietest part of the sky, in the microwave region where interstellar space is most transparent, are two radiation lines which can be seen from anywhere in the cosmos. One is from interstellar hydrogen, the other from hydroxyl. Hydrogen plus hydroxyl forms water under the proper conditions, hence the name. These radiation lines are signposts which are not geocentric, of which any civilization which has radioastronomy will be aware. Since we're already looking for astrophysical phenomena in this region, and it's very well suited to interstellar propagation, why not seek civilizations there as well?

Dear Dr. SETI:

My interest in SETI is very narrow. I am interested in how a signal from an intelligent source could be recognized. What sort of characteristics would one look for? I am particularly interested in any examples of theoretical signals that would certainly be generated by an intelligence.

I am not interested in how to filter out the noise and other known, naturally generated signals. I am only interested in how to identify an intelligent signal from what's left after the other stuff is filtered out. I would like some objective standards.

Kirk, California

The Doctor Responds:

If your interest is very narrow, Kirk, so is the signal we are seeking. The current thinking is that we believe the hallmark of artificiality to be narrow bandwidth. The narrowest known natural radiation spectra are hundreds of kiloHertz wide. A stable signal component occupying only a few Hz would be believed clearly artificial, and (we presume) intelligently generated. To determine its extra-terrestrial origin, we then look at its Doppler signature as viewed from two or more locations simultaneously (this test eliminates terrestrial, aircraft and satellite interference, as well as hoaxes). The technique is briefly discussed in an editorial on our Web site <http://www.setileague.org/editor/paired.htm>.

Of course, we could be all wrong about this. SETI may well stumble across an extremely narrow-band source of natural radiation. Wouldn't the discovery of a previously unknown astrophysical phenomenon be almost as exciting as a valid SETI hit?

Technical Feature

Testing the Operation of a SETI System by Using a Sun Traverse

by Ian Drummond, VE6IXD

The method I used is described in two separate articles by David Shaffer W8MIF and Bob Atkins KA1GT in Chapter 7 of the ARRL UHF/Microwave Experimenter's Manual, published in 1990 by the American Radio Relay League, Newington, CT. The basic concept is to measure the change in power output of the receiving system when pointed towards and away from the sun. As the solar flux at microwave frequencies arriving at the Earth is known, the sensitivity of the receiving system can be calculated.

The equipment I used:

A 2.4 m square dish mounted on the original TV polar mount. It was not able to track the sun but could be manually rotated then left stationary, so the sun would pass across the pattern of the dish due to the rotation of the Earth.

An Olde Antenna Lab helical feed connected directly by a male/male N-connector to a Downeast Microwave SETI-LNA preamplifier. The preamp was powered by a 12 volt lead-acid battery through a separate power line (not the coax cable).

20' of International 9096 coax connected the signal to an ICOM R-7100 receiver tuned to 1296 MHz in the USB mode.

The audio output of the receiver was fed to a simple envelope detector (see Figure 1 in the ARRL article), and the resulting DC voltage was fed to a datalogger which sampled the voltage once per second and stored the average reading every 10 seconds. In this fashion I was able to draw a smooth graph of the receiver audio voltage over a period of 30 or 40 minutes as the sun passed across the field of view of the dish.

I also monitored the AGC (automatic gain control) voltage of the receiver via the jack on the back of the unit. The method assumes that the gain of the system is constant. I did not know how to disable the ICOM AGC, so I contented myself by checking that the AGC voltage remained constant within the 10 mV resolution of my voltmeter.

One last requirement is a radio (or a friend with a radio) which can receive WWV on 10 MHz at 18 minutes past each hour. A daily report of the solar flux at 10.7 cm wavelength is given.

The measurements:

I started by getting all the electronics turned on and running for 30 minutes or so to make sure it was settled down. I then positioned the dish so the feed cast its shadow on the centre of the dish. The audio volume of the radio was turned up until a reading of about 20 mV was obtained at the datalogger. As the feed was positioned only approximately at the focus of the dish, I moved it along the axis of the dish until the audio output reading peaked. I learned later that this position may not represent the best signal to noise ratio, as what I did was to maximize the signal plus noise, and this is not quite the same thing.

I then rotated the dish so the sun's shadow was just before the exact centre of the dish. The audio gain was raised so the DC output was about 2/3 full-scale, and I simply waited about one hour while the sun moved across the dish.

The graph of the output of the datalogger looks like a half of a bell-curve. From this output I measured the following values:

Vp = peak voltage during the traverse = 52.4 mV

Vb = voltage of the base of the curve = 22.4 mV

While not necessary for evaluating the system temperature, I also measured the time for the voltage to drop from the peak value to the 3 dB voltage of 43.7 mV (0.71*(52.4-22.4)+22.4). This was 8.5 minutes and it enabled me to measure the 3dB beam width of the dish and compare it to the calculated value. Just a little confidence booster that everything was working right.

WWV informed me that the solar flux on that day was 74 Solar Flux units (10^-22 watts * metres^-2 * Hertz^-1) at 10.7 cm.

The calculations:

First I calculated the antenna temperature when the dish was pointed at the sun.

Ta = F * G * L^2 / 3.468 (Page 7-58 ARRL Manual) where

Ta = antenna temperature pointed at the sun

F = solar flux at 1296 MHz in SFU

(or units of 10^-22 W * m^-2 * Hz^-1)

G = antenna gain as a ratio (that is 13 dB = 20)

L = wavelength in metres

F is found from the WWV number by use of Fig 2, page 7-59 ARRL manual. It was 37 SFU (a very low number).

G = 4 pi * f^2 * A / c^2,

where pi = 3.142

f = frequency in Hertz

A = area of dish in metres^2

c = speed of light in metres/second

So in this case

G = 1,350 (31.3dB) and

Ta = 750 K

So the noise temperature at the output of the system when pointed at the sun is

Tsun = 750 + 30 + Trcvr, Where

750 = Ta = antenna temp due to the sun

30 = antenna temp due to background sky

Trcvr = receiver noise temp

The noise temperature when pointed away from the sun:

Tsky = 30 + Trcvr

The ratio of these two temperatures has been measured, as the (power) ratio of Vp and Vb. So:

Tsun / Tsky = Vp^2 / Vb^2 = (52.4/22.4)^2

So in this case the equation

Tsun / Tsky = (Trcvr + 780) / (Trcvr +30) = 5.47

can be solved to give

Trcvr = 140 K

The unknowns:

There were two items that I would have liked to know how to do. I would have liked a simple way to position the feed horn to maximize the signal to noise ratio. The problem with the method I used was that the noise, as well as the signal, changed as the feed was repositioned along the axis of the dish. I still don't really know if the feed is in the optimum place for detecting weak signals.

I was able to do the sun traverse at 1296 MHz as my helical feed has a wide bandwidth, but this may not be possible for many antenna types. I would have liked to do the traverse at 1420 MHz, indeed at several other frequencies. The only difficulty in doing the traverse at another frequency was knowing what the solar flux was at that frequency. The reference in the ARRL manual gave conversions of the WWV information only to amateur bands. Some way of calculating the flux at SETI frequencies would be very useful.

Editor's Note:

Mr. Drummond is one of The SETI League's *Project Argus* Pioneers. He may be reached via email, at drummondi@enterprise.cybersurf.net

Press Release:

100-Year-Old Hobby Takes On New Life

LITTLE FERRY, NJ.., January 17, 1998-- For the past century, the hobby of Amateur Radio has challenged the technically inclined with its promise of instantaneous global communications. The world's radio amateurs, also known as hams, have contributed to virtually every breakthrough enjoyed by the telecommunications industry, including the development of the Internet. Ironically, the widespread availability of low-cost digital communications (including cellular telephone, email and the web) has in recent years slowed the growth in ham radio's ranks. Now the amateur radio community is revitalizing itself by applying its members' talents in search of other life in the cosmos.

"As our society becomes technologically mature, the role of ham radio has to change," observes Dr. H. Paul Shuch, a lifelong radio ham and the Executive Director of the nonprofit SETI (Search for Extra-Terrestrial Intelligence) League. "Searching for life in space requires the kind of radio skills which hams possess, and cannot be conducted simply by logging on-line. It involves the design and construction of antennas, receivers, and signal analysis hardware and software -- which is what ham radio is all about." With over 700 members in 40 countries on six continents, and a plan in place to grow to 5000 stations in its global radio astronomy network, The SETI League is "the ultimate ham club," according to Shuch. This week he embarks on a two-week lecture tour of Australia and New Zealand, as part of his three-year-old effort to inform and involve radio amateurs around the world.

SETI scientists seek to determine through microwave measurements whether humankind is alone in the universe. Since Congress terminated NASA's SETI funding in 1993, The SETI League and other scientific groups have been attempting to privatize the research. Experimenters interested in participating in the search for intelligent alien life, or citizens wishing to help support it, should email to join@setileague.org, check the SETI League Web site at http://www.setileague.org/, send a fax to (201) 641-1771, or contact The SETI League, Inc. membership hotline at 1(800) TAU-SETI. Be sure to provide us with a postal address to which we will mail further information.

Guest Editorial:

ET Detection of Earth TV Unlikely

by Dale Lamm (DaleLamm@worldnet.att.net)

Recently on the SETI email discussion list there has appeared some good dialog regarding possible detection of Earth TV broadcasts at ET locations. This is not a novel idea. An older book titled *Communication With Extraterrestrial Intelligence* (editor Sagan, 1973, MIT Press, ISBN 0-262-69037-3) mentions the possibility of eavesdropping by ETI in the chapter Techniques of Contact. I have seen this idea mentioned many times in other writings.

Discussion on the list has been centered on detection of UHF television broadcasts, which in the US encompasses the band 470-806 MHz (minus the astronomy allocation at channel 37, 608-614 MHz). Why has interest been focused on UHF television?

Some possible reasons:

In the US, all analog television channels are split across three bands: low VHF (54-88 Mhz), high VHF (174-216 MHz) and UHF. Maximum permitted EIRP is 100 KW for low VHF, 316 KW for high VHF, and 5 MW for UHF. Horizontal polarization is the rule, with circular polarization being allowed at the broadcaster's discretion. It would thus be possible to radiate up to 10 MW EIRP from a single facility. The varied limits across bands help compensate for differences in terrestrial propagation, in theory placing the UHF broadcaster at parity with the VHF broadcaster.

Because UHF TV stations radiate more power, and because the UHF band is nearest to the so called "microwave window" of 1.2-50.0 GHz, it would seem to some that these broadcast signals have the best chances of being detected at astronomical distances. There are hundreds of UHF TV stations in the US alone, each radiating day and night, year after year. Could these act as unintentional beacons to an interested ETI?

This writer's opinion is that there are far better candidates for Earth's "unintentional beacons." Here are my reasons:

One goal of a TV broadcaster is to deliver modulated RF as cheaply as possible to as many receivers as possible. Five MW of power at UHF frequencies is not easy to come by. The typical way of doing so is to generate 60-240 KW of power at the transmitter, then excite an antenna having 10-14 dB of gain. The 60-240 KW of power needed at the transmitter output is obtained with much difficulty, usually by generating a modulated carrier at low levels and passing that through class-A vacuum tube (klystron, IOT or tetrode) amplifiers with attendant low efficiencies.

Electricity is not free. The engineer responsible for design and/or operation of a transmission facility would not think of squandering RF by intentionally directing it into the sky. TV viewers tend to make their homes near ground level. Gain of a TV broadcast antenna is obtained by concentrating the radiation into one direction. From a bird's eye view, the signal radiates in all directions, equally well north, east, south and west. From a side view, the main lobe is carefully engineered to equally illuminate receiving antennas on the ground, both close in and near the horizon. What is often done is to aim just below the horizon, and design in some null-fill to accommodate the close in receivers. From a typical transmitting antenna height of 1000 feet, the desired beam tilt will be something on the order of 0.5 degrees negative (that is, below horizontal). Any energy radiated above the horizon is wasted, as far as the broadcaster is concerned.

In an imperfect world, some energy does radiate above the horizon, but this side lobe is much reduced in amplitude. Likewise, some of the energy striking the ground reflects back into space, but it will be scattered and specular.

There are better "unintentional beacon" candidates for study and speculation. Consider SPASUR (space surveillance radar) at 217 MHz, or various other defense radars operated by the military (see the Raytheon home page for the names of some of these systems). Perhaps even HARRP transmissions (2.8-10.0 MHz at 3 MW+) may be detected at great distances, although the frequencies employed are far from ideal.

Some of you might be interested to know that the US has already orbited what amounts to a sensitive spectrum analyzer which has observed the Earth. Project Blackbeard was established to study TIPP (trans ionospheric pulse pairs), events possibly associated with lightning storms. Frequencies ranging from 25-100 MHz are observed. Spectrograms may be viewed on the project's home page (http://sst.lanl.gov/nis-projects/blackbeard). They show strong RF carriers of Earth TV and FM broadcasts. Keep in mind that these carriers have been detected from a satellite a few hundred miles above the Earth, not from interstellar distances.

I do feel strongly that reception and demodulation of Earth television and radio by ETI are still highly possible, though not from interstellar distances. How?

Many people study extinct cultures such as the ancient Egyptians, just to choose one at random. We know of the Egyptians by their writings and artifacts. What if they had television and we could send a probe back in time to capture a few dozen Terabytes of their transmissions? We would obviously know more about them than we now do. Radio and TV broadcasts can quickly deliver massive amounts of information about the society which generates them.

Somewhere in the galaxy, there might exist a society that has lasted for many thousands of years. This race may feel confident that intelligence will someday arise on a small watery planet orbiting a yellow star in their sky. This culture prides itself in the accumulation of wisdom, and projects that might take a few thousand years to bear fruit are conducted with the same vigor as short-term projects. They therefore send robot probes to promising worlds. If such a probe were to detect the presence of non-natural RF emanating from its target world, it would perform a relay transmission back to the home planet. If ETI is going to watch our TV broadcasts, this is how it will happen, in my opinion.

I hope this stimulates further discussion along these lines and I welcome differing points of view.

Editor's Note:

Now a software consultant, Mr. Lamm was chief engineer of a small UHF TV station for eight years.

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