



SearchLites

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The Quarterly Newsletter of The SETI League, Inc.

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Education vs. Training

by H. Paul Shuch, Ph.D., Executive Director Emeritus

Do you know the difference between *education* and *training*? Although the SETI League is officially chartered as an educational and scientific nonprofit organization, its mission includes a distinct training component as well. Because the two endeavors often overlap, they are easily mistaken one for the other. The distinction is a subtle but important one.

As a gross oversimplification, you can consider education as the imparting of knowledge, while training involves the acquisition of skills. In the context of a disciplined Search for Extra-Terrestrial Intelligence, prior knowledge is often necessary before specific skills can be acquired. Conversely, prior specific skills can often enhance or accelerate the accumulation of knowledge.

In my role as SETI League Executive Director Emeritus, as well as in my capacity as a professor, educational activities fall clearly within my purview. I am tasked with developing curricula and materials both to teach my own students, and to help other educators teach courses on radio astronomy, astrobiology, and other SETI-related topics. Often, this has nothing whatever to do with The SETI League's direct search activities, and everything to do with the interdisciplinary nature of the SETI enterprise as a whole. If you think SETI is only about aiming a dish and tuning across the water hole, perhaps you are missing its full educational potential.

Training within The SETI League generally involves helping our members to master the nuts and bolts of assembling and operating an effective Project ARGUS station. It seeks to foster manipulative skills, thus requires hands-on practice with real equipment. The SETI League's training cadre is our growing network of volunteer Regional Coordinators, organized through a structured Membership Services department, communicating largely through the ARGUS email list. If you need a helping hand in making your station play properly, you can thus turn to your fellow members for swift and skillful training.

There is a lot of overlap between these two distinct areas, however, so our educational and training missions are cooperative in nature. As an educator, I sometimes find myself helping fellow teachers to lash together a surplus TVRO dish with a feedhorn, LNA, microwave receiver, and some DSP software, so their students can gain hands-on SETI observational experience. And many's the Regional Coordinator who has had to educate local members in everything from Kepler's laws to Doppler shift to the Fermi Paradox and the Drake Equation, so they could understand the science behind the technology they employ. Perhaps this is why the two distinct functions become blurred in the minds of many.

SETI serves us well as an educational tool. It not only captures the imagination of students, but provides them a concrete means for applying scientific theory that might otherwise seem abstract. But before such education can take place, one or more people in the classroom may need to be trained in the physical operation of electronic equipment. This makes tangible what might otherwise seem distant and abstract.

Conversely, before the typical SETIzen can be trained to search for signals of artificial origin, a little formal education in coordinate systems (azimuth, elevation, right ascension, declination, latitude, longitude, and altitude) is probably in order. Without a solid educational background, operation reduces itself to "push this button, twist that knob, and hope for the best."

If education involves the acquisition of facts, training leads to a mastery of tasks. The factual emphasis in education is well suited to the classroom environment, so textbooks and the Internet make excellent educational tools. The task-oriented nature of training, on the other hand, means that it most often occurs in the laboratory. The amateur SETI station is a laboratory of sorts, and thus an excellent training ground. When you show someone how to interface the hardware, aim the antenna, scan the skies, and collect data, you are training him or her in important manipulative skills. When you help a fellow member to use these skills in calculating relative motion from Doppler shift, analyzing a data file, or estimating sky coverage, you are engaged in education.

Still not convinced that the distinction between education and training is a significant one? Consider this: if you have school-age children, they probably receive sex education in the health science classroom. Sex training, on the other hand, most likely takes place extracurricularly. ❖

Event Horizon

SearchLites' readers are apprised of the following conferences and meetings at which SETI-related information will be presented. League members are invited to check our World Wide Web site (www.setileague.org) under *Event Horizon*, or email to us at info@setileague.org, to obtain further details. Members are also encouraged to send in information about upcoming events of which we may be unaware.

April 21, 2007, 0000 UTC - 2359 UTC: Eighth annual SETI League Ham Radio QSO Party, 14.204, 21.306, and 28.408 MHz.

May 18 - 20, 2007: *Hamvention 2007*, Dayton OH.

June 1 - 3, 2007: *Rochester Hamfest*, Rochester NY.

June 2007 (dates TBA): *Society of Amateur Radio Astronomers* Conference, NRAO Green Bank WV.

July 26 - 29, 2007: *Central States VHF Conference*, San Antonio TX.

August 30 - September 3, 2007: *65th World Science Fiction Convention*, Yokohama Japan.

September 24 - 28, 2007: *58th International Astronautical Congress*, New Delhi, India.

October 2007 (dates TBA): *AMSAT Space Symposium*, Pittsburgh, PA.

April 19, 2008, 0000 UTC - 2359 UTC: Ninth annual SETI League Ham Radio QSO Party, 14.204, 21.306, and 28.408 MHz.

May 16 - 18, 2008: *Hamvention 2008*, Dayton OH.

May 30 - June 1, 2008: *Rochester Hamfest*, Rochester NY.

June 2008 (dates TBA): *Society of Amateur Radio Astronomers* Conference, NRAO Green Bank WV.

July 24 - 27, 2008 (Tentative): *Central States VHF Conference*, Wichita KS.

Mid August 2008 (dates TBA): *EME 2008*, Florence Italy.

September 30 - October 4, 2008: *59th International Astronautical Congress*, Glasgow, Scotland.

October 2008 (proposed - dates TBA): *AMSAT Space Symposium*, Orlando, FL.

April 18, 2009, 0000 UTC - 2359 UTC: Tenth annual SETI League Ham Radio QSO Party, 14.204, 21.306, and 28.408 MHz.

May 15 - 17, 2009: *Hamvention 2009*, Dayton OH.

May 29 - 31, 2009: *Rochester Hamfest*, Rochester NY.

June 2009 (dates TBA): *Society of Amateur Radio Astronomers* Conference, NRAO Green Bank WV.

October 2009 (dates TBA): *60th International Astronautical Congress*, Daejeon, Korea.

October 2009 (proposed - dates TBA): *AMSAT Space Symposium*, Atlanta, GA.

April 17, 2010, 0000 UTC - 2359 UTC: Eleventh annual SETI League Ham Radio QSO Party, 14.204, 21.306, and 28.408 MHz.

June 4 - 6, 2010: *Rochester Hamfest*, Rochester NY.

June 2010 (dates TBA): *Society of Amateur Radio Astronomers* Conference, NRAO Green Bank WV. ❖

SETI League Members Honored by European Radio Astronomers

Heidelberg, Germany., 10 September 2006 --

This afternoon during the final session of the three-day Fourth European Radio Astronomy Congress, four SETI League members from four different countries were elected Fellows of the European Radio Astronomy Club.

Recognized for significant contributions to European radio astronomy were Peter Wright, The SETI League's volunteer Regional Coordinator for Germany; Marko Cebokli, a pioneer in digital interferometry techniques who holds that position in Slovenia; Stelio Montebugnoli, chief engineer for the Medicina Radio Observatory in Italy; and SETI League Executive Director Emeritus H. Paul Shuch, the first American ever so honored. Three of the four were on hand to accept Certificates of Fellowship in ceremonies held in the Great Hall of the Science Tower at the Heidelberg University of Applied Sciences. (Montebugnoli was, regrettably, otherwise occupied with professional obligations.)

Following the lead of other respected professional societies, ERAC presented each new Fellow with a parchment certificate stating that he "has been granted Fellowship of the European Radio Astronomy Club. This is a token of highest respect for the work that has been done. You are herewith allowed to use the title officially, 'Fellow of the European Radio Astronomy Club' ... [and to sign] 'FERAC' after your name, to indicate your affiliation with our Society."

Founded in 1995, the European Radio Astronomy Club (ERAC) boasts over 250 Members in 16 different countries, with a good representation of both amateur and professional radio astronomers, as well as students and professionals from other related fields. A large number of ERAC members own their own radio telescopes and exchange information regularly via the internet and the club's Newsletter. ERAC is a SETI League affiliated society, many of whose members help to promote SETI science.

Largely using radio telescopes and optical telescopes, SETI scientists seek to determine whether humankind is alone in the universe. Since Congress terminated NASA's SETI funding in 1993, The SETI League and other scientific groups have privatized the research. Amateur and professional scientists interested in participating in the search for intelligent alien life, and citizens wishing to help support it, should email join@setileague.org, check the SETI League Web site at <http://www.setileague.org/>, send a fax to +1 (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. The SETI League, Inc. is a membership-supported, non-profit [501(c)(3)], educational and scientific corporation dedicated to the scientific Search for Extra-Terrestrial Intelligence. ❖

Ask Dr. SETI:

Frequency of the Cosmic Background

Dear Dr. SETI:

I was talking with my professor about Radio Astronomy and he asked me about the temperature of the microwave cosmic background radiation, and what frequency that would be. I did a little research and found that the background radiation is about 2.7 degrees Kelvin, but it does seem to me that energy, even at that low temperature, should peak (be strongest) at a given frequency. However, I could find no further information on this, or a method of conversion.

Stephen (member of Society of Amateur Radio Astronomers)

The Doctor Responds:

Of course, your professor knew the answer, Stephen; he was trying to get you to do a little research. So, asking another professor is really cheating, isn't it? Nevertheless, I will attempt a response:

The short answer is that there is indeed a peak in the amplitude of the cosmic background radiation, and that it occurs at around 279.5 GHz.

The long answer is found by assuming a thermal radiation curve with a blackbody temperature of the stated 2.7 Kelvins. Planck's law ($e = h f$) tells us that e , the kinetic energy per photon, varies with frequency f according to Planck's Constant h . Since energy varies with frequency, a thermal energy curve should logically peak in amplitude at some specific frequency, which varies as a function of temperature.

From Wein's Law (a special case of Planck's Law), we find that the product of equivalent blackbody temperature times peak wavelength is a constant, which we call Wein's Constant A :

$$A = \text{Lambda (peak)} \times T_{eq}$$

When the peak wavelength Lambda is expressed in meters, T_{eq} is the equivalent thermal blackbody temperature, in Kelvins, Wein's Constant comes out to something like 2.898×10^{-3} meters times Kelvins. Thus, we can solve for peak wavelength:

$$\text{Lambda (peak)} = A / T_{eq}$$

For the cosmic microwave background,

$$\text{Lambda (peak)} = (2.898 \times 10^{-3} \text{ m} \cdot \text{K}) / (2.7 \text{ K})$$

Note that the Kelvins in the numerator cancels the Kelvins in the denominator, and wavelength thus comes out simply in meters.

Given your stated temperature, the wavelength peak is thus about seven percent more than 1 mm. Dividing this into the speed of light (300 million meters per second), we find the equivalent frequency to be just seven percent lower than 300 GHz, or around 279.5 GHz. So, if you're looking to receive the peak of the cosmic microwave background radiation with your radio telescope, tune it below 300 GHz and look around. Only, a thermal blackbody emission of just 2.7 Kelvins is going to be pretty weak, and not all that easy to detect, even at its amplitude peak.

You may recall that, at Holmdel in 1963, Penzias and Wilson first detected the cosmic microwave background radiation (research which won them the Nobel Prize). They were receiving at a frequency around 4 GHz -- well below the amplitude peak, but still detectable with their huge horn antenna and cryogenically cooled maser amplifier. Four decades later, even using the best equipment available to advanced amateurs, the measurement still presents a challenge. May you rise to it!

What Color is the Sun?

Dear Dr. SETI:

This may sound like a trivial question, but what color is the Sun? Really -- I realize it appears yellow to our Sun-adapted eyes. But I also know that our eyes do not respond uniformly to all colors. So, to a completely unbiased instrument, in what part of the electromagnetic spectrum does the Sun's radiation intensity peak?

Colorblind in Kansas

The Doctor Responds:

Your question is not at all trivial, Colorblind. It touches on a basic principle which was discussed in the previous column, that of finding the radiation peak of a Planck blackbody curve. So, let's run the numbers.

We start by considering the Sun a 5780 Kelvin thermal blackbody. From Wein's Law, we compute:

$$\text{Lambda (peak)} = A / T_{eq}$$

where A is Wein's Constant, 2.898×10^{-3} meters times Kelvins. Solving for peak wavelength:

$$\text{Lambda (peak)} = (2.898 \times 10^{-3} \text{ m} \cdot \text{K}) / (5780 \text{ K})$$

Note that the Kelvins in the numerator cancels the Kelvins in the denominator, so wavelength thus comes out simply in meters.

Solving the above equation, we find that the peak wavelength of the Sun's thermal emission is on the order of 5.01×10^{-7} m, or 501 nm. Converting to frequency, we divide into the speed of light (3×10^8 m/s), for a result of 599 THz.

Now, the optical spectrum extends from red, a wavelength of 750 nm (frequency = 400 THz) all the way to violet, at a wavelength of 400 nm (frequency = 750 THz). Note the interesting symmetry there. In any case, our sunlight peak occurs about 29% up the optical spectrum from the red end, for an equivalent color of ... yellow!

So, in fact, solar radiation peaks just where our Sun-adapted eyes say it does. This is no surprise, since our eyes evolved to see by sunlight. In a few billion years, when our Sun has cooled and expanded into a red giant, our eyes will need to adapt to this longer wavelength. Of course, by then, the frequency response of our eyes will be the least of our worries.

Earth TV as Interstellar Ambassador

Dear Dr. SETI:

Say you're an alien watching our TV shows (it seems to me that decoding them would be fairly simple). First you get the Hitler rallies. Then Howdy Doody. Then Vietnam and Wa-

tergate. And now... the worst of all... Jerry Springer. What would you think?

You would indeed think Earth should remain in strictly enforced quarantine.

TC (who writes SF)

The Doctor Responds:

Although the thought of extraterrestrials watching Earth television makes for great speculation (and marvelous science fiction), in fact I consider it highly unlikely that *any* advanced technology can decode our television signals past a couple of light years distance (and the nearest star to our Sun is over 4 LY away). Thus, the content of our TV programming is not really an issue. The computations appear in the engineering literature, though the full analysis would fill pages. Thus, I will summarize it below.

How can I rule out ETI decoding our transmissions? Let's quantify that. The video information is contained in a portion of the signal called its sidebands. These are accompanied by a strong reference signal called the carrier. The peak carrier power is 10 dB stronger than the peaks of each sideband component (that's a power ratio of 10:1). The sideband information is spread across about 6 MHz of spectrum, while the carrier is concentrated in a 1 Hz bandwidth. That's a 6 million to one ratio. Multiplying the two together, the spectral density of the sidebands is thus 60 million times weaker than that of the carrier. Detection range varies with the square root of spectral density. Thus, the carrier can be detected at a range eight thousand times greater than that over which the TV channel can be decoded. So, say the carrier can be detected out to 30,000 LY (roughly the distance to the center of the Milky Way galaxy). Under identical conditions, the range for receiving the TV programming is under 4 LY (and the nearest neighboring star is more than 4 LY away). So, can aliens watch 'I Love Lucy'? I think not.

Note that we're talking here about *decoding* our TV signals, which is very different from *detecting* them. Over interstellar distances, it is relatively easy to detect the presence of our TV carriers, even though the information content is far below the noise threshold of alien radio telescopes. From the presence of signals, it is possible to deduce that there is technology on this planet, even if the specific information content is inaccessible.

As for interstellar quarantine, there are far better indicators than our TV programming that ours is a planet to shun. The chemical signature of our atmosphere (which is detectable over interstellar distances) most likely marks us as environmentally suicidal.

Faster-Than-Light Revisited

Dear Dr. SETI:

I feel your response to Don from San Antonio as regards faster than light communication is an over simplification. Faster than light communication is actually quite simple to physically demonstrate. Take that office desk toy, the line of steel balls hung on wire where one ball is raised and released to strike the next ball in the queue. The signal to the last ball which then "jumps" is transferred instantaneously. On a nano scale there is potential for this type of action using bucky

balls. This is all pretty useless in the grander scheme of communication, because our knowledge is limited to sending signals via wave frequencies such as light and radio. It should be noted that gravity does transcend the faster than light barrier without breaking any known physical laws; e.g., were another planet to somehow immediately appear next to the sun its presence in terms of gravitational effect would take place instantaneously, not in the 8 odd minutes it takes for light to get here.

Whilst we cannot readily manipulate gravity, we do know that it is possible with the transfer of matter to energy during nuclear events. I believe that manipulation of gravity on a nano scale will allow communication across the universe in an instant and that the search for ET's using SETI is probably a waste of time as it is not only limited in scope of survey area, but in time, as radio communication may only be utilised for a short few hundred years before it becomes antiquated.

Feel free to remonstrate with me, but am willing to bet that radio communication will be old hat in 200 years.

Peter, New Zealand

The Doctor Responds:

Let me agree up front, Peter, with both your initial and your concluding statements. Certainly, my responses are an oversimplification. The nature of this medium requires it -- otherwise, I'd have to dedicate a significant life-fraction to researching and writing each and every Ask Dr. SETI response. Further, if radio communication has not become obsolete on Earth within the next two centuries, it means that we technologists are not doing our job!

Now that we've gotten that out of the way, allow me to respectfully disagree with your other assertions, starting with the instantaneous nature of gravity. No, it's not simple to physically demonstrate, although one can surely demonstrate mechanical *analogies* to instantaneous gravitation, such as the desktop toy you have described. Only, please do not confuse the analogy with the reality.

Admittedly, your idea that the gravity from an instantly appearing planet would immediately assert itself, violates no known laws of physics. However, the *instantaneous* appearance of the planet which gave rise to that gravitational effect most assuredly does! Gravitational manipulation, though often proposed as an instantaneous communications medium, presents us with engineering challenges which humans, and I dare say even advanced extraterrestrials, would find daunting.

This is not to say that other proposed means of FTL communication are completely without merit, and I remain cautiously optimistic that one will eventually be demonstrated. To date, I have been disappointed.

A case in point is the realization of quantum microwave tunneling, an effect I am on record as stating I will believe only when I see it with my own eyes. The desired effect was claimed in the 1990s by a scientist from Physikalisches Institut der Universität zu Köln (Germany). I was thus quite excited to learn that Herr Prof. Dr. Günter Nimtz had been scheduled to demonstrate his apparatus and methodology at the Fourth European Radio Astronomy Congress in Heidelberg, in September, 2006. On the appointed day, I scrambled for a front-row seat. The assembled multitude and I were disappointed when the good Professor failed to materialize for his presenta-

tion. This leads me to suspect that the claimed instantaneous communication, if in fact it was ever achieved, could not be duplicated on demand. (Or, perhaps he traveled through the lecture hall at a superluminal velocity.) So, I continue to wait for a personal demonstration of this promising technique.

To date, I am inclined to consign quantum microwave tunneling to the category of a "Technology Not In Evidence" (TNIE). The late SETI pioneer Philip Morrison used to speak of "zeta waves," mythical communications means which the aliens presumably possess, but of which humans remain ignorant. Whenever someone suggested employing a TNIE, he would reply, "sure -- just as soon as you build me a zeta wave detector."

Is FTL communication theoretically possible? I'm not ready to rule it out. Do we have any clue how to achieve it? I doubt it, Prof. Nimitz' claims notwithstanding. When we have the technology, I'm sure we'll embrace it. Until then, I'm afraid we're stuck with good old fashioned, obsolete electromagnetic waves. Maybe even for the next 200 years. ❖

SETI League Member Launches mm-Wave Search

Tucson, Arizona., November 2006 -- The latest in a series of SETI searches looking for intelligent civilizations emitting signals in the advanced millimeter wave radio band took place on 1 - 2 November 2006 at the 12 meter Radio Observatory operated by the Steward Observatory of the University of Arizona. This advanced radio telescope is located on top of Kitt Peak, Sells, Arizona. The innovative SETI search was led by Peter Panayiotis Vekinis, a member of the SETI League, Inc., a grass-roots, international non-profit educational and scientific organization, and was partly funded by the Steward Observatory of the University of Arizona's Radio Observatory, as well as by private funds.

Millimeter wave SETI is not new, but very few telescopes are available for SETI searches in this wave band on Earth. Following ideas in Vekinis' new book, GJ139 to be published early next year, his search concentrated on two stars, GJ139 and GJ71 both Sun-like and relatively close to Earth. Millimeter waves were used because it is hypothesized that advanced civilizations will use advanced frequencies, transmit on beacon frequencies already existing in the universe, and synchronize their signals emitted with natural timing sources such as pulsars.

SETI league members around the world were able to follow Vekinis' search in real time on the web using a Quicktime Streaming Server from the telescope site. During the two nights of observation, this experiment generated nearly 6 GBytes of data, saved as multiple raw audio files of 300 Mbytes each.

Members are encouraged to experiment with the data collected by Vekinis, using a variety of digital signal processing techniques. Raw data files can be downloaded from Vekinis' server, at http://vekinis.com/SETI_Research.html.

The 12 meter telescope is available for use by others for SETI or Radio Astronomy research. Contact Lucy Ziurys at lziurys@as.arizona.edu. ❖

Searching for Extraterrestrial Idiots?

by Dr. Alexander Zaitsev, IRE ([alzaitsev @ yahoo.com](mailto:alzaitsev@yahoo.com))

This short note is in response to Peter Backus' editorial "Three SETI Myths," on the SETI League web site at www.setileague.org/editor/myths.htm. Dr. Backus identifies Myth # 4:

"SETI is Search for Extraterrestrial Intelligence"

I have long been a proponent, practitioner, and advocate of deliberate Messaging to Extraterrestrial Intelligence, or METI. See, for example, my previous SETI League Guest Editorial "Transforming SETI into METI," online at www.setileague.org/editor/metitran.htm. It has been suggested in a friendly fashion by Michael Michaud (see www.setileague.org/editor/actvseti.htm), David Brin (see www.setileague.org/editor/brin.htm), the authors and apologists of the Rio and San Marino Scales (see iaaseti.org/smiscale.htm), and others, that sending deliberate messages to probable Aliens is a dangerous and foolish adventurism. It could be, they suggest, that SETI scientists have yet to detect signals from our cosmic neighbors, precisely because *the extraterrestrials* recognize the dangers of transmission. In short, my colleagues contend, one must be an idiot to risk transmitting into space.

If only idiots transmit, then by implication, those of us on Earth who propose or practice METI must be idiots. Still, we continue to practice observational SETI, hoping some other civilization will transmit our way, the possible risks notwithstanding. So, from my colleagues' arguments, does it not follow that the true interpretation of the SETI acronym is:

"Search for Extraterrestrial Idiots"? ❖

Executive Director Introduces New Astrobiology Course

Williamsport, PA., December 2006 – in his capacity as Visiting Professor of Physics and Astronomy at Lycoming College, H. Paul Shuch, The SETI League's executive director emeritus, is pleased to introduce "Life in the Universe," a new undergraduate course that explores the origin, development, and distribution of life in the cosmos. The four semester hour class, which includes lecture and laboratory components, has been approved by Lycoming College as an Experimental Course and scheduled for the Spring, 2007 semester, which begins on January 8th.

The first scientific life-in-the-universe conference was held at the National Radio Astronomy Observatory, Green Bank WV, in 1961. For about four decades now, conferences touching on the topics of this course have been sponsored periodically by the International Astronomical Union, and under the auspices of the International Academy of Astronautics. In the past, these meetings fell under the heading of "Bio-astronomy." "Astrobiology" is merely NASA's latest buzzword for this ongoing research. Nevertheless, as an academic discipline, astrobiology is only recently arrived on the scene. Few colleges or universities currently offer astrobiology courses – and still fewer at the undergraduate level. Thus, students can envision themselves as standing on the pier, looking out across largely uncharted waters. Prof. Shuch's course is intended to bring order and understanding to the regions where once there be only dragons. ❖



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