

Editorial:

Accept No Substitutes

by Dr. H. Paul Shuch, Executive Director

Since its inception three years ago, I have enjoyed the honor of heading The SETI League, Inc., the premier non-profit, membership supported amateur SETI organization, with nearly 1,000 members in three dozen countries on six continents. We collaborate closely with the other established SETI organizations in the US, notably the SETI Institute, the Planetary Society, U.C. Berkeley's Serendip program, the BETA project at Harvard University, and the Big Ear team at Ohio State University, and are pleased to support their efforts.

Recently, various other organizations have emerged which express a desire to contribute to amateur SETI. We welcome this development, and feel these new organizations can make a positive contribution to our mission. However, with but two exceptions (AMSAT and Artemis Society, both of which are official SETI League Affiliate Societies), The SETI League has no formal ties to any of these newly emerging organizations.

Any contributions which you may care to make to us, or to any other organization, are a matter of personal choice, and we welcome whatever support you might wish to offer to SETI, in any form. However, we must emphasize that your support of other organizations with SETI in their name does not necessarily equate to support of The SETI League, and is probably not tax-deductible under our IRS [501(c)(3)] designation.

The SETI League is always looking for like-minded organizations with which to affiliate, and announcements of future member-society designations will be posted to our Web site, and mentioned in *SearchLites*, our quarterly newsletter, as such affiliations are formalized. Meanwhile, there is only one SETI League, and your support of our mission is greatly appreciated.



**433 Liberty Street
PO Box 555
Little Ferry NJ 07643**

SearchLites

the Quarterly Newsletter of The SETI League, Inc.

Volume 4 Number 1 Winter 1998

Conference Calendar

SearchLites' readers are apprised of the following conferences at which SETI-related information will be presented. To obtain further details check under Membership Services Department on our Web site, <<http://www.setileague.org/>>, or email to us at <info@setileague.org>. Members are encouraged to send in information about upcoming events of which we may be unaware.

January 21 - 23, 1998: *International Conference on SETI in the 21st Century*, Sydney Australia.

February 13 - 15, 1998: *Boskone*, Framingham MA.

March 6 - 8, 1998: *Contact XV Conference*, Sunnyvale CA.

March 20 - 22, 1998: *Lunacon 1998*, Rye Brook NY.

March 29, 1998: *SETI League Annual Membership Meeting*, Little Ferry NJ.

April 3 - 5, 1998: *Southeastern VHF Conference*, Marietta GA.

April 10 - 12, 1998: *Balticon 32*, Baltimore MD.

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 / 1998 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: *International Amateur Radio Union Region 2 Triennial Meeting*, Caracas Venezuela.

October 3, 1998: *Mid Atlantic VHF Conference*, Horsham PA

October 9 - 11, 1998: *16th AMSAT Annual Meeting and Space Symposium*, Vicksburg MS.

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.

Clips and Quotes

A brief outline of SETI and history of The SETI League, as told through press clippings and quotations.

Using sophisticated radio telescopes, scientists are expanding their survey of distant celestial bodies and listening hopefully for signals from intelligent life.

USA Today

That strategy is SETI, the Search for Extraterrestrial Intelligence. It consists of the use of radio telescopes to detect electromagnetic (EM) signals of potentially intelligent origin from beyond earth.

Popular Electronics

The acronym SETI was coined in the 1960s to describe the use of radiotelescopes to seek out electromagnetic signals of possible extraterrestrial intelligent origin.

Radio Communication (UK)

Through studies of microwave measurements from outer space, SETI enthusiasts hope to determine whether or not there is intelligent alien life out there.

North Jersey Herald & News, Passaic, NJ

To this day no definite extraterrestrial signals have been recorded by the more than 70 radio searches undertaken.

Science News

Since 1993, when NASA's own ambitious SETI program was eliminated by Congress, the search has been carried out largely by two groups.

Time

The SETI League was formed as a nonprofit corporation to help continue the project's research. Headquartered in New Jersey, the league has 400 members worldwide and is supported by membership dues.

Daily News, Conejo Valley, CA

[SETI League president Richard] Factor began the non-profit league shortly after Congress killed funding for the National Aeronautics and Space Administration's SETI program in 1993.

Daily Record, Morris County, NJ

"I got really mad when Congress killed SETI and the Superconducting Supercollider in the same year," said Factor. The Supercollider, with a price tag of \$10 billion, was beyond his help. But SETI, he decided, could have been salvaged.

Huntsville Times, Huntsville, AL

The plan is to divide up the sky. Then, have a different volunteer monitor each patch for radio broadcasts from distant planets.

Philadelphia Inquirer, Philadelphia, PA

We are at the very beginning of a systematic SETI program, covering the whole sky, the full radio frequency spectrum, etc. To me, this seems hardly the moment to give up. To search is key.

Carl Sagan, in Planetary Report

The SETI League needs astronomy or ham-radio buffs with satellite TV dishes, three to five meters in diameter.

Globe & Mail, Toronto, ON, Canada

Seth Shostak, an astronomer at the unrelated SETI Institute, says this is a viable effort. "There are analogs in

conventional astronomy research where amateurs dominate, like searching for comets," he says.

Air and Space Smithsonian

The aim of Project Argus is to prove once and for all that intelligent extra-terrestrial life exists on other planets . . . by coordinating thousands of amateur radio telescopes.

Evening Gazette, Middlesbrough, Teesside, UK

[Executive Director Dr. H. Paul] Shuch is developing the hardware needed to conduct the search phase.

Sun-Gazette, Williamsport, PA

"You never know!" [pioneer radio astronomer Dr. Frank] Drake says with a chuckle. "Shuch's plans are quite reasonable. It's not flaky stuff like the UFO people."

San Francisco Examiner, San Francisco, CA

Recent discoveries have confirmed many of Drake's assumptions. Within the past year, astronomers discovered several planets that orbit other stars. Scientists have found complex organic molecules floating in interstellar space. And NASA stunned the world with evidence that primitive life may have existed on Mars . . .

Science News

The interstellar medium is anything but an empty void. It is a veritable chemistry set.

Analog

Because there's no reason that the laws of physics or chemistry are different elsewhere, there might be billion of Earth-like planets circling sun-like stars. Most of the planets are older than the earth and so have had more time to spawn life.

Popular Electronics

Finally, with all the planets that are being discovered out there, the question of how many other intelligent civilizations populate them is being asked with renewed interest.

Natural History

"We seek to answer a fundamental question that has haunted humankind -- are we alone?" Shuch said. "What we seek is existence proof -- not contact -- simply to know if they are there. Because the knowledge of existence of any other civilization will profoundly change our view of our place in the cosmos."

Los Angeles Daily News

Reading about SETI is fun, but many amateur astronomers and radio hams are deciding to get into the act. For a few hundred to a few thousand dollars, they are converting satellite TV dishes to backyard radioastronomy stations. One of these SETI hams may well become the first person to discover an alien civilization.

Mercury Magazine

[SETI League member Dr. Rachel] Tortolini says, "The dishes remind me of big flowers pointing their petals to the skies, waiting to receive whatever's out there. There's nothing between my dish and the end of the universe."

Wired

"If there were thousands of amateur systems (there are only a few at present), and there were a few civilizations with transmitters a million or so more times more powerful than the typical transmitter, an amateur system might just happen on a detectable signal first."

Frank Drake, cited in Omni

Ask Dr. SETI

What's this I hear about SETI and Hungarians? Supposedly it has something to do with the Fermi Paradox.

MH, Hungary

The Doctor Responds:

Physicist Enrico Fermi, said to be a firm believer in the existence of extra-terrestrials, was frustrated by the lack of firm evidence of their existence. Reasoning that advanced civilizations should by now have filled the Galaxy, Fermi came downstairs one morning at Los Alamos and blurted out his now-famous question, "Where are they?"

"They are among us," it is reported that Hungarian-born physicist Leo Szilard responded, "but they call themselves Hungarians."

Apparently, Szilard's comment had some cultural and historical basis. The following passage is from The Curve of Binding Energy by John McPhee (1973, Farrar, Straus and Giroux, pp. 104-105):

"Not all the Los Alamos theories could be tested. Long popular within the Theoretical Division was, for example, a theory that the people of Hungary are Martians. The reasoning went like this: The Martians left their own planet several aeons ago and came to Earth; they landed in what is now Hungary; the tribes of Europe were so primitive and barbarian it was necessary for the Martians to conceal their evolutionary difference or be hacked to pieces. Through the years, the concealment had on the whole been successful, but the Martians had three characteristics too strong to hide: their wanderlust, which found its outlet in the Hungarian gypsy; their language (Hungarian is not related to any of the languages spoken in surrounding countries); and their unearthly intelligence. One had only to look around to see the evidence: Teller, Wigner, Szilard, von Neumann -- Hungarians all. Wigner had designed the first plutonium-production reactors. Szilard had been among the first to suggest that fission could be used to make a bomb. Von Neumann had developed the digital computer. Teller -- moody, tireless, and given to fits of laughter, bursts of anger -- worked long hours and was impatient with what he felt to be the excessively slow advancement of Project Panda, as the hydrogen-bomb development was known. ... Teller had a thick Martian accent. He also had a sense of humor that could penetrate bone."

So perhaps Szilard was trying to let his Italian-born colleague in on the secret.

Send your questions to Ask Dr. SETI, PO Box 555, Little Ferry NJ 07643, or email your questions 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.

Membership Meeting Scheduled

In accordance with Article IV, Section 1 of our duly approved Bylaws, the Trustees of The SETI League, Inc. hereby announce our Third Annual Membership Meeting, scheduled for 2 PM Eastern time on Sunday, March 29, 1998, at SETI League Headquarters, 433 Liberty Street, Little Ferry NJ 07643. Please mark your calendars. As attendance by one percent of the League's membership constitutes a quorum, all members in good standing are encouraged to attend. The preliminary agenda for this meeting, per Bylaws Article XII, is as follows:

Agenda

- Call to Order
- Minutes of 1997 Membership Meeting
- Financial Report
- Committee Reports
- Old Business
- New Business
- Good and Welfare
- Adjournment

Members are encouraged to submit Old Business and New Business items for inclusion in the Agenda. Please email your agenda items to our Executive Director, at n6tx@setileague.org, not later than 1 March 1998. In accordance with Bylaws Article IV Section 3, written notice of this Meeting, along with a full Agenda and driving directions to SETI League headquarters, will be mailed to all members in good standing, not less than ten days nor more than sixty days prior to the meeting date.

Field Organization Takes Shape

Your SETI League now boasts nearly 1,000 members in over 30 countries on six continents. We are currently averaging more than one new member per day. The organization's rapid growth, spurred in part by the success of last summer's film "Contact," has challenged your Headquarters staff's limited resources. Fortunately, our membership has once again stepped forward to fill the void, with the establishment of a volunteer Field Organization.

More than 30 volunteer Regional Coordinators have now been appointed to assist members in areas which enjoy significant SETI League membership and activity. These individuals are identified in the upcoming Membership Roster, and on the Web site. Members in good standing are encouraged to serve as volunteer Regional Coordinators in areas where vacancies exist. Detailed operating rules pertaining to such positions appear on the Web (under Membership Services Department), or will be mailed to interested members upon request.

Technical Feature:

Detecting Weak Signals at Receiver IF

by Chris Cadogan G3XWB
chris@cadogan.u-net.com

A recent article reminded me of some development work I did some 20 years ago as a new graduate RF engineer at Racal in Tewkesbury, England. I worked on a signal detection system, in principle a reliable squelch circuit. What might make it of interest for SETI is that it was good at detecting weak signals in a very wide bandwidth.

The SETI League is using DSP to pick out narrow bandwidth signals from the receiver's audio output. What I did is a variation on a theme, and involves two phase locked loops working together to pick out narrow band coherent signals from within a wideband IF output of a microwave receiver - typically 4 MHz wide at 70 MHz.

This wouldn't be as sensitive as audio DSP filtering, but does have the advantage of 'seeing' the whole of the receiver wideband IF at once. The wider the receiver bandwidth the better it works. The sensitivity comes about by virtue of the PLL bandwidth being much narrower than the receiver IF bandwidth, the PLLs only see the noise in (or close to) their own filter passbands.

[See Block Diagram, next page]

The vital bit is the Phase Sensitive Detector that multiplies the two PLL VCO outputs together (the PSDs are straight analogue multipliers, not the digital coupled D types variant). The output is a DC level more or less proportional to signal strength, up to limit of about 4 dB sig/noise, after which it flattens out. I grant you that any signal with a 4 dB sig/noise in 4 MHz is a fairly beefy signal, but I do remember that there was a detectable and reliable change in DC at very low signal to noise ratios. At the time I was concerned with reliability - not false triggering - rather than sensitivity. It was the radio ham in me that was interested in weak signals, the professional just wanted to know if there was a good signal or not.

There are a number of different ways of thinking about how it works. Here's one of them: with no signal present the two PLLs both see the wideband noise output. Their loop bandwidths are much

narrower than the receiver bandwidth, so at any instant their 'centre frequencies' lie randomly within the IF passband. The VCO control voltages are noise like, and there is no correlation at all between the two VCO frequencies, giving a zero volts DC output.

If a weak signal appears then each PLL will wander over the top of it for some of the time. During the time the signal is within the loop bandwidth the phase detector will 'see' the signal and generate a DC term to pull the VCO towards the signal - the PLLs start to capture the signal.

As each PLL starts to see the signal the two feedback loops make each VCO spend more time near the signal, and less time randomly wandering about. This shows up in the two VCO starting to become correlated, which generates a DC term at the output - you've detected a signal. At low signal to noise ratios the DC output has a straight line relationship to signal strength. It is a good 'S' meter, between S0 and S1.

For the amateur SETI site I'd think of it in terms of an alarm signal - something's there in the passband, go and find it with a narrow band filter switched in. Alternatively it could be used in a scanning system to decide whether this wideband chunk of spectrum is of any interest. This is what it was developed for in the first place.

The Theory

I'd put quite a lot of effort at the time into analysing how it worked, and frankly didn't get very far. What puzzled me was why each PLL did its own thing and stayed uncorrelated with respect to each other. I'd put this down to the non-linearity of the PLL phase detectors - the output is proportional to the cosine of the phase of the two inputs - and that large phase excursions moved the operating point over the top of the cosine wave and dumped an uncorrelated block of noise into the feedback loop. With twenty years hindsight this looks like Chaotic behaviour - a small change in input could make the output flip over the top of the detector curve or not. It then looks reasonable to regard both systems as being chaotic and thus independent.

What is puzzling is that it continues to work - although not as well - with small phase inputs and a loop bandwidth of the same order as the IF

bandwidth. As the receiver bandwidth narrows then the IF noise signal looks more and more coherent, and the DC output goes up. It gets harder to tell the difference between a weak signal and noise. The converse is that the wider the IF bandwidth is the less coherent the IF noise signal becomes, giving a lower DC output on no signal, and hence a larger change when there is a signal.

Enough of the theory - the pragmatic answer is that it works reliably.

Practicalities

This circuit idea is only of use to you if you can get at the first or second IF - not common on amateur receivers. However, if you're developing your own receiver then the circuitry is inexpensive. You have to take care with layout and supply decoupling so that the two PLLs don't see each other.

I used a PLL bandwidth of a few kiloHertz, giving recognition times of about ten milliseconds. There's an optimum ratio of IF bandwidth to centre frequency, it works well two or four megs wide at 21.4 MHz : you really want the IF bandwidth to be as wide as possible, until you start to strain the swing of the VCOs. I'd made several variants on the basic idea for differing applications, and there's nothing particularly critical needed in the circuitry or that's difficult to set up. I'd recommend varactor diode tuned LC VCOs - alignment is done simply by tuning the core so that the PLL control voltage is noisy when it sees the receiver IF frequencies, and is centred on zero volts.

I'd imagine you could make it more sensitive by reducing the loop bandwidth, at a cost of making the detect time longer. As I pointed out in the theory bit, the relationship between receiver bandwidth and the phase locked loop bandwidth isn't a simple one. It is a splendid system for detecting receiver spurious.

Racal took out a patent on this system about twenty years ago. I was one of the co-authors. At the time they were more interested in detecting narrow band HF signals, in which case using two phase locked loops was overly complicated.

I'm pretty sure the patent would have lapsed, because I've not heard of the idea being used commercially. I can't be too sure about this, because I've not had any contacts with the radio industry for

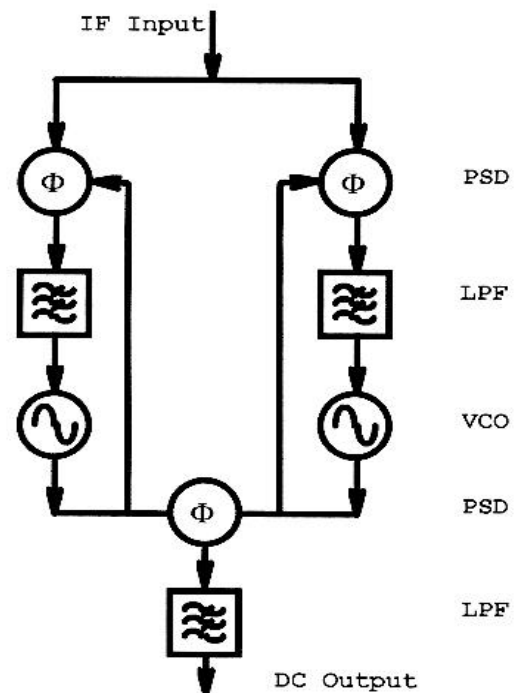
quite a while now - these days I work on DSP in the pro-audio Industry. I do know that the particular company in Tewksbury - one of a large group - no longer exists. In any case, amateurs are free to build whatever they choose.

I'm afraid I no longer have access to the sort of RF test gear needed to develop this sort of thing, but perhaps other SETI League members might wish to pursue it. I have a ham radio licence - G3XWB -, but I've not done anything with it for years - I gave a whole garage full of electronics away to a school a long time ago, when I decided that home made high voltage transmitters and babies didn't mix.

It occurred to me that any real SETI comms using radio - as opposed to perhaps narrow beamwidth lasers - would be optimally coded and hard to distinguish from noise, I wouldn't necessarily expect to pick up a narrow band signal or a carrier. Just a thought.

I hope this will be of interest to SETI League members. At the time I thought it might be really useful, I just wasn't sure what for.

G3XWB Detector Block Diagram:



- PSD = Phase Sensitive Detector
- LPF = Low Pass Filter
- VCO = Voltage Controlled Oscillator

SearchLites, Volume 4, Number 1, Winter 1998.

SearchLites, ISSN 1096-5599, is the Quarterly Newsletter of **The SETI League, Inc.**, a membership-supported, nonprofit [501(c)(3)], educational and scientific corporation, dedicated to the electromagnetic Search for Extra-Terrestrial Intelligence. Entire contents copyright (c) 1998 by The SETI League, Inc. Permission is hereby granted for reproduction in whole or in part, provided credit is given. Address all editorial submissions to:

The SETI League, Inc.

433 Liberty Street, PO Box 555, Little Ferry NJ 07643

Tel: (201) 641-1770; fax: (201) 641-1771

memberships: 1(800) TAU-SETI

email: info@setileague.org

Web -- <http://www.setileague.org/>



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New! SETI Nerd Gift Set (one each Mouse Pad, Pocket Protector, *Project Cyclops* and *Tech Manual*) at 20% Savings to Members Only: \$30 \$40

The above recommended contributions include surface postage to (u) United States, or (o) other addresses.