

# DR. SETI'S STARSHIP

Searching For The Ultimate DX

## Does SETI Theory Hold Water?

The electromagnetic spectrum, as viewed from Earth, is a noisy place. Low frequencies are plagued by quantum-effect emissions, and the whole continuum experiences a  $3^{\circ}$  Kelvin background from the residual radiation of the Big Bang. These natural radiation sources limit our ability to detect artificial emissions. In addition, the Earth's own ocean of air generates spectral absorption and emission lines, which draw a further curtain across our sky.

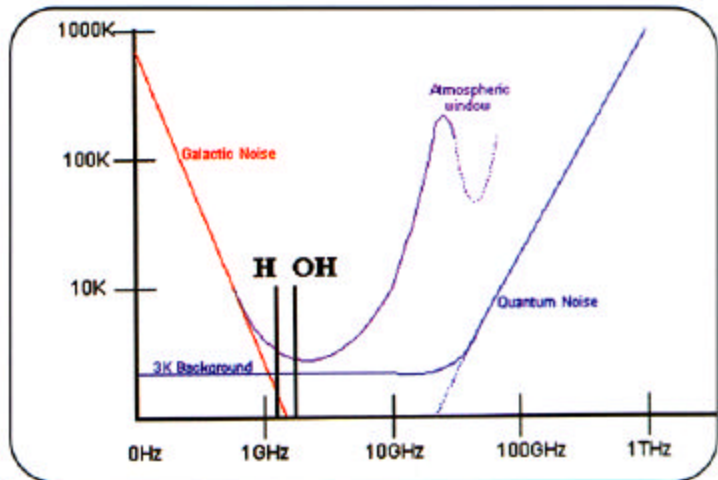
Fortunately, there are a few relatively clear windows on the cosmos. Our eyes evolved to operate in one such window, the optical spectrum. It is this window that first allowed us to observe the stars and planets. Another clear spot is in the microwave region, between about 1 and 10 GHz.

Within this so-called Microwave Window, photons (the substance of electromagnetic communication) travel relatively unimpeded through the interstellar medium at the speed of light. This is, as far as we know, the fastest possible speed, making photons the fastest spaceships known to man. Thus, the Microwave Window, where natural noise is at a minimum, is a favored region for conducting radio astronomy research, including the Search for Extra-Terrestrial Intelligence (SETI).

Toward the bottom of the microwave window, radiation from the precession of interstellar hydrogen is clearly heard in our receivers at a frequency of 1420.40575 MHz (corresponding to a wavelength around 21 cm). The Hydrogen Line, first detected by Harold Ewen and Edward Purcell at Harvard University in 1951, provided us with our first direct evidence that space is anything but an empty void. It is a veritable chemistry set. For their efforts, Professor Purcell received a Nobel prize, and Doc Ewen received his PhD—but had the distinction of writing the shortest astrophysics doctoral dissertation on record, a scant dozen pages. (My own dissertation, by contrast, ran 214 pages. I suppose if I had actually discovered something, I wouldn't have had to write as much.)

We hypothesize that any civilization in the cosmos that possesses radio astronomy already knows about the Hydrogen Line. Since there is roughly one hydrogen atom per cubic centimeter of space, the combined voices of countless hydrogen atoms produce a raucous chorus. The very first SETI studies were conducted near the Hydrogen Line, and today it still looks like a logical place to seek deliberate beacons from Beyond.

Just a little way up the spectrum, near 1660 MHz (a wavelength of 18 cm), in the 1960s a team of scientists at MIT Lincoln Labs detected a cluster of radiation lines from interstellar hydroxyl ions (OH). Like the Hydrogen Line, the Hydroxyl Lines occur near the very quietest part of the radio spectrum. They, too, should be known to other civilizations which have studied the cosmos at radio frequencies.



Water Hole diagram, courtesy of Jenny Bailey, GØVHQ, SETI League volunteer, Regional Coordinator for England.

The chemist looks at H and OH and recognizes them as the dissociation products of water, the solvent essential to the very existence of life as we know it. During the landmark Cyclops study of 1972, Dr. Bernard M. Oliver, then the vice-president of engineering for Hewlett-Packard Company (and later the chief of the NASA SETI program) hypothesized that the Hydrogen and Hydroxyl Lines constituted obvious signposts to a natural interstellar communications band, a thought which would likely occur to other water-based life-forms who had some knowledge of the radio sky. Since the H and OH Lines are visible from anywhere in the cosmos, in the quietest part of the spectrum, they are markers that are by no means geocentric.

It was Barney Oliver who dubbed the spectral region between H and OH the Cosmic Water-Hole. "Where shall we meet our neighbors?" he asked. "At the water-hole, where species have always gathered."

Fortunately, the equipment required to tune the waterhole is well within the grasp of today's dedicated microwave radio ham. Think of the typical amateur radio telescope as the cheap half of a 1296- or 2304-MHz EME system. In fact, many of the first radio amateurs to tune the waterhole for cosmic clues used their existing 23- or 13-cm moonbounce receivers to do so.

Although other regions of the spectrum hold much promise, The SETI League and other organizations concentrate a part of their resources on the Water-Hole in the hopes that there we might detect signs of other life. We only hope our theories hold water.

**Editor's note:** In the "Dr. SETI's Starship" column in the fall 2002 issue of *CQ VHF*, we edited the column to indicate that John Kraus, W8JK, was a Silent Key. In fact, he is very much alive and continues to serve as a Taine G. McDougal Professor Emeritus of Electrical Engineering and Director, Radio Observatory, of the Ohio State University. —N6CL

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