New Laser SETI project will look for signals that most telescopes cannot see

August 1 2017

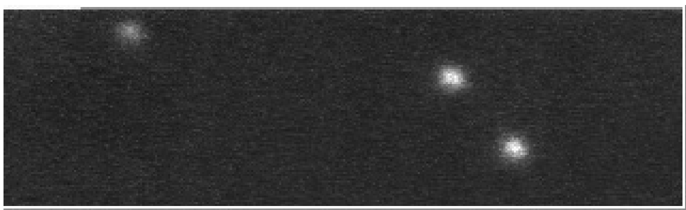

Figure 1: This video taken with a radio telescope shows two ordinary stars and one pulsar on the lower left. Credit: SETI Institute

Big discoveries in science are often made when innovative instruments probe nature in new ways. Laser SETI will search the sky for a variety of pulsed light signals that might have been overlooked before. We may find ET, and we also may find new physics.

SETI scientists spend most of their time looking for themselves. That is, we tend to look for the kinds of radio or light signals that we generate on Earth. For example, when Frank Drake began the first SETI observations in 1960, he chose to look for signals similar to those for AM radio broadcasting. It seemed to make sense that if humans use AM radio to communicate, then ET might do the same. But there is a vast menagerie of methods to encode sound into a radio signal, for example, using pulses. Drake did not look for short pulses. If he had he might have discovered a kind of neutron star called a pulsar (figure 1), discovered in 1967 by Jocelyn Bell and earning a Nobel Prize for her postdoctoral advisor, Anthony Hewish.

Drake might be forgiven for not discovering pulsars. While the electronics in Drake's and Bell's telescopes were similar, the designs of their telescopes were vastly different from one another. In order to be very good at discovering carrier-wave like signals, Drake's telescope sacrificed sensitivity to rapidly variable sources. The opposite was true for Bell's telescope. Neither one of Drake's nor Bell's telescopes could have replaced the other. In science, specialization is often the key to success.

You might imagine that after the first 70 years of radio astronomy we would have noticed all the types of radio signals that nature has to offer. But you would be wrong. In 2008 Duncan Lorimer and coworkers discovered a completely new kind of radio signal we now call the fast radio burst or FRB. Ironically, FRBs are among the brightest astronomical radio sources in the universe and detectable bursts appear hundreds of times every day.

Why did it take so long for someone to discover FRBs? Because no one had guessed that enormously bright singleton radio pulses that last only a millisecond were even possible in nature. Hence, no one had designed a telescope capable of detecting them until the twenty-first century. Their discovery required a radio telescope with an appropriate response time (milliseconds) and exploration of a very large fraction of the sky.

Switching gears now to optical SETI, until now searches have been designed to find either continuous laser signals lasting hours at a time, or extremely short laser pulses lasting only one billionth of a second (one nanosecond). These searches have a simple motivation; since the most powerful lasers on Earth operate either continuously or by generating nanosecond pulses, we suppose that ET will communicate with those types of signals. But isn't this anthropocentrism? These searches are good as far as they go, but they are blind to pulse durations lasting one millionth or one thousandth of a second.

At the SETI Institute, we are mindful of anthropocentrism. We believe in the necessity of exploring all kinds of electromagnetic signal types, and particularly, all possible light pulse durations. And generally speaking, most optical telescopes examine only a tiny fraction of the sky at a time. Even the so-called wide field of view optical telescopes used in the Sloan Digital Sky Survey or the Large Synoptic Survey can probe only about 1 part in 5,000 of the sky at any given time.

That is where Laser SETI comes in. Laser SETI will observe all of the sky, all of the time so even relatively rare events can be found. Laser SETI can discover pulses over a wide range of pulse durations, and is especially sensitive to millisecond singleton pulses which may have been overlooked in previous astronomical surveys. There are good reasons to imagine that ET might produce millisecond laser pulses (hint: light-sail spaceships). But equally exciting is the fact that by exploring new territory our chances of finding something completely unexpected are not zero.

It is hard to describe the level of excitement we feel about this search. We will be probing nature in a new way, looking where no one has looked before. Who knows what we may find? We might find evidence for an extraterrestrial civilization, and this is our greatest hope. We also might find some kind of unexpected natural optical signal revealing new physics. In the latter case, we'll just have to console ourselves with a Nobel Prize.

We invite you to become a part of this scientific endeavor. Preliminary designs and proofs of principle are complete. When we meet our fundraising goal of $100,000, we can install the first of several optical telescopes around the world and begin searching in this new way. We hope you will join us.

Provided by SETI Institute