Source Universe today

Could we detect an alien space Station?

As of February 5, we know of 136 extrasolar planets. These have been discovered in four ways: The first - called pulsar timing - allowed us to detect Earth-sized and smaller planets by studying the variations in arrival time of radiation generated by a pulsar. The next - Doppler spectroscopy - allows ground-based telescopes to measure the "shift" in a star's spectrum caused by the gravity of an orbiting planet. The third - astrometry - is used in much the same way - looking for the periodic "wobble" in position that a possible planet could cause on its parent star. And the last? Transit photometry allows for the study of the periodic dimming of a star as a body passes in front of it from a particular viewpoint - producing a light curve.

In April 2004, Luc F. A. Arnold, (Observatoire de Haute-Provence CNRS 04870 Saint-Michel - l'Observatoire, France) was working on a transit generated by a saturn-like planet when he had an idea. Could this same principle be applied to look for transiting bodies that were artificial in nature?

"I discussed the idea with several colleagues who found it interesting," commented Arnold. A collection of artificial bodies would produce light curves easily distinguishable from natural ones. For example, a triangular object or something shaped like our own man-made satellites would show an entirely different signature. If multiple artificial objects were detected transiting - this could possibly be a form of signaling the presence of other intelligent life - one with an effectiveness equal to the range of the laser pulse method.

A cost-effective alternative to radio SETI or optical SETI is to look for artificial planet-size bodies which may exist around other stars. Since they would always pass in front of their parent star for a given remote observer, there is a strong possibility they can be detected and characterized using the transit photometry method. A planetary transit light curve contains fine features due to the object shape - such as planet oblateness, double planets or ringed planets. As Arnold explains, "The sphere is the equilibrium shape preferred for massive and planet-size bodies to adapt to their own gravity, (but) one can consider non-spherical bodies, especially if they are small and lightweight and orbit a dwarf star. Their transits in front of a star would produce a detectable signal." Non-spherical artificial objects - like a triangle - would produce a specific transit light curve. If multiple objects should transit, a remarkable light curve would be created by their "on again - off again" nature of light. Such an observation would clearly claim an artificial nature. To visualize this, think of a flashlight moving behind a lowered window blind, and you'll begin to get the idea!

The bulk of Luc Arnold's work - just accepted for publication in the "Astrophysical Journal" - has been to prove through computer simulation the effects of different and multiples shapes and show these differing light curves. To help you better understand, the screen that you are now looking at is composed of pixels - a logical rather than a physical unit. If you were to place a triangle shape over your monitor's screen, it would cover the pixels in a specific arrangement. During a simulation, the stellar flux is zeroed out in pixels and compared to the normal flux of the star. This simulated artificial body transit is then fitted against known planetary transit using a Powell algorithm.

"But most complex artificial objects' light curve cannot be exactly superposed by a planetary transit, and the algorithm ends with non-zero residuals, i.e. a non-zero difference between the two light curves. This difference is the 'personal' signature of the artificial object. Should it rotate, the

residual light curves will show additional modulation. When set against a gradient, such as the limb, an artificial object would also show sudden slope variations in the light curve during ingress or egress," explains Arnold.

The equilateral triangle produces a transit light curve different than a sphere. In fact, its light curve resembles a ringed planet transit, so an ambiguity may remain in distinguishing these objects. But more complex objects, such as clusters of shapes, for example, create very specific signatures. For an artificial satellite-like object, its symmetrical structure would be apparent - as each area would impact the light curve at specific intervals. An elongated object, would produce undulation in its longer period of ingress and egress - in effect causing multiple "transits" making detection easier. The nature of these oscillations could very well be considered a sign of intelligent device. If several objects were spatially arranged in groups to ingress a star in a mathematically constant manner, these drops in the light curve could clearly represent a type of message - the language of science.

With the computer simulations perfected, Arnold knows what a natural or artificial transiting body should look like in a light curve - but has science observed a planetary transit? "Up to now, there is only one transit light curve obtained with a very good accuracy - the transit for HD 209 458b observed with the Hubble Space Telescope. T. Brown and colleagues found the light curve could be fitted with a spherical body to within the measurement accuracy." This type of information provides Arnold with the model he needs. In June 2006, his vision may be realized. COROT (a space mission approved by the French Space Agency CNES, with a participation of Austria, Belgium, Brazil, Germany, Spain, ESA and ESTEC) will be dedicated to stellar seismology and the study of extrasolar planets - the first approved space mission solely devoted to these subjects. The spacecraft will consist of a ~ 30 cm telescope with an array of detectors to monitor the light curves of well chosen stars through CCD. The overall potential of COROT (COnvection, ROtation and planetary Transits) is to detect several tens of Earth sized planets and more upcoming programs such as the Terrestrial Planet Finder (TPF) and Space Interferometry Mission (SIM) will change the face of all we know about extrasolar planets.

What does this kind of new technology mean to researchers like Luc Arnold? "These space missions will give a (photometric) accuracy of down to 0.01% - but 1% could be sufficient if objects are big enough." According to his research a single transit of an artificial body would require that kind of accuracy, but a multiple transit would be much more relaxed. "1% photometry is within the capability of thousands of amateur astronomers equipped with CCD." Chances are far greater that a communicative civilization would favour a series of objects over a single non-spherical one for signaling their presence. Transits of opaque objects are achromatic, putting them within detectability of CCD over the entire spectrum.

As Luc points out, this type of research may well be within the realm of the contributing amateur astronomer. Currently the search for signs of extra-terrestrial intelligence are limited to radio and the search for laser pulse which demands specialized equipment. "For the moment, there is no project to apply this idea. If it the idea turns into a specific (SETI) observing program, a number of collaborations would be welcome!"

The search for planetary transits is already in operation, such as the Optical Gravitational Lensing Experiment (OGLE), "and the multiple transit case could be discovered within the course of these programs - maybe tomorrow!" While tomorrow might seem like an impossible dream, Arnold knows differently. His work has already been submitted to the SETI institute. For the rest of the citizens of

planet Earth, we await the results. Will tomorrow show us a possible energy collection, communication or study device put into orbit by another sentient species? If we consider what we know of astronomy to be a basic "truth" throughout the Cosmos, then a discovery of this magnitude could be the biggest news of them all... "Assuming we are sure to have detected an alien artifact in a transit light curve, my opinion is that we should consider it as a clear 'Hello world... We are here!' addressed to the whole Galaxy!"

Written by Tammy Plotner