

A DIRECTED SEARCH FOR EXTRATERRESTRIAL LASER SIGNALS

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The focus of NASA's SETI program is on microwave frequencies, where receivers have the best sensitivities for the detection of narrowband signals. Such receivers, when coupled to existing radio telescopes, form an optimal system for broad area searches over the sky. For a *directed* search, however, such as toward specific stars, calculations show that infrared wavelengths can be equally as effective as radio wavelengths for establishing an interstellar communication link. This is true because infrared telescopes have higher directivities (gains) that effectively compensate for the lower sensitivities of infrared receivers. The result is that, for a given level of transmitted power, the S/N ratio for communications is equally as good at infrared and radio wavelengths. It should also be noted that the overall sensitivities of both receiver systems are quite close to their respective fundamental limits: background thermal noise for the radio frequency system and quantum noise for the infrared receiver. Consequently, the choice of an optimum communication frequency may well be determined more by the achievable power levels of transmitters rather than the ultimate sensitivities of receivers at any specific frequency. In the infrared, CO₂ laser transmitters with power levels >1 MW can already be built on Earth. For a slightly more advanced civilization, a similar but enormously more powerful laser may be possible using a planetary atmosphere rich in CO₂. Because of these possibilities and our own ignorance of what is really the "optimum" search frequency, a search for narrowband signals at infrared frequencies should be a part of a balanced SETI program.

Detection of narrowband infrared signals is best done with a heterodyne receiver functionally identical to a microwave spectral line receiver. We have built such a receiver for the detection of CO₂ laser radiation at wavelengths near 10 μ m (30 THz). The spectrometer uses a high-speed HgCdTe diode as the photomixer and a small CO₂ laser as the local oscillator. Output signals in the intermediate frequency range 0.1-2.6 GHz are processed by a 1000-channel acousto-optic (AOS) signal processor. The receiver is being used on a 1.5-m telescope on Mt. Wilson to survey a selected sample of 150 nearby stars. The current status of the work will be discussed along with a prognosis for further technical development and observational work.