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SEARCHING FOR LOW FREQUENCY OPTICAL SETI SIGNALS BURIED IN ATMOSPHERIC SCINTILLATION

Abstract

If one imagines that an extraterrestrial society has developed the capability to modulate its sun's light, perhaps using large structures or fleets of drone satellites, such modulation might be detectable from Earth. In that case one would not be looking for a monochromatic laser beam, but perhaps a series of low frequency white light pulses. This paper examines the possibility of detecting such pulses with a low-noise photometer used in conjunction with a modest size telescope. Previous work with this system concentrated on detecting higher frequency optical signals (1 to 10,000Hz) buried in a bright starlight background (j.actaastro.2018.05.061). It was shown that sinusoidal modulation as weak as 10-4 of that background light level might be detectable. This paper extends those results to frequencies as low as 0.002Hz, and to pulse signals of various duration. In order to detect these low frequencies one has to deal with high levels of optical scintillation due to turbulence in the Earth atmosphere. Three related techniques for extracting signals in this environment are compared: 1) autocorrelation of the time-series data, 2) searches of power spectra and 3) threshold detection of individual time-series pulses. Each of these approaches is strictly limited by background noise. But using "realistic" signals inserted into existing time series star data it is shown that each has distinct advantages depending on signal frequency and pulse duration. To date no plausible ETI signals have been found in data from over 300 stars taken with a 30-inch telescope. But a few interesting "other signals" were found that illustrate the power of these techniques.