



CALIFORNIA STATE SCIENCE FAIR 2017 PROJECT SUMMARY

Name(s) David A. Lipman	Project Number S1818
Project Title Algorithmic Search of the Automated Planet Finder Spectra to Identify Extraterrestrial Laser Signals	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals This project analyzes the spectra of 157 stars, collected by the Lick Observatory's Automated Planet Finder (APF) telescope, to search for potential laser signals from extraterrestrial civilizations.</p> <p>Methods/Materials Spectra were analyzed to identify narrow peaks meeting the criteria for an artificial laser signal: Full width half maximum (FWHM) close to the telescope's point spread function value of 0.05 A, with Gaussian photon count in both the spectral and spatial dimensions, and at a wavelength that does not correspond to known emission lines for the host star or to atmospheric airglow lines. Pixel-by-pixel analysis of each spectrum was performed to identify peaks 3 standard deviations above the median. A simulated Gaussian curve was fitted to each peak to isolate highly Gaussian peaks with FWHM less than 0.075 A. False positives resulting from cosmic ray events were eliminated through a multi-step analysis process. The redshifts of stars containing candidate signals were calculated. Redshifted candidate signals were compared to known spectral emission lines and non-redshifted values compared to a database of atmospheric airglow lines to rule out natural phenomena.</p> <p>Results Three candidate laser signals were identified: HIP50583 at wavelength 3870.02 A, HIP39064 at wavelength 3870.06 A, and KIC8462852 (Tabby's Star) at wavelength 4357.42 A. The two candidate signals at 3870 A correspond with a cometary CN emission line, however it is highly unlikely they are due to comets, as the spectra for the stars were recorded on different dates. The Tabby's Star candidate corresponds closely with a krypton emission line at 4355.48 A which is redshifted by an equivalent amount to the star's underlying spectrum. However, krypton emission lines are not characteristic of this star type. The signal was only found in one of the two Tabby's Star spectra, further supporting the suggestion that it could be artificial.</p> <p>Conclusions/Discussion Although it is not possible to definitively conclude that the 3 candidate signals are of extraterrestrial origin, they meet the criteria for how a laser signal from an extraterrestrial civilization would appear. Currently, the APF has only recorded single spectra for each star, so each of the candidate signals requires follow-up observations to verify its existence.</p>	
Summary Statement I developed an algorithm to analyze high resolution stellar spectra in order to identify potential extraterrestrial laser signals.	
Help Received I developed the algorithm myself after having been inspired by a tutorial on the Breakthrough Listen Initiative's website. One of the Breakthrough Listen scientists answered a few of my initial questions.	