Optical SETI Detector Design
Search for Extraterrestrial Intelligence
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Abstract
In the last decade OSETI, the Optical Search for Extraterrestrial intelligence, has come to be seen as an attractive means of looking for signals from other intelligent life forms. The High Energy Astrophysics group is developing a new experiment for Optical SETI that we hope will exceed the performance of previous and current projects. Our approach will be to use a large Fresnel lens and small PMTs which will improve the overall signal-to-noise ratio. To obtain signals and differentiate between potential messages and other light pulses, we are building a detector that operates with timing precision of a few nanoseconds. The threshold for this device will need to be tuned so as to cut out background noise and light flashes associated with Cherenkov radiation due to high energy cosmic rays in the atmosphere. Additionally, experiments are underway to determine the suitability of an off the shelf Fresnel lens for the project.

Introduction
Current levels of technology suggest that laser communication is a viable alternative to radio communication over stellar distances. We believe it is not unlikely that other intelligent life in the universe may be near our own level of technological development and therefore could be attempting to communicate through a pulsed laser signal. Searching in the optical range of frequencies has the advantage that we can observe all frequencies at once. Searching in the radio frequencies requires tuning to specific frequencies.

Lens Test
The first step in creating our optical detector system is the development of a prototype telescope using a single commercially available Fresnel lens with a collection area of just over 1.5 square meters. Determining the optical performance characteristics of the lens, primarily the off-axis response, is of utmost importance for determining acceptance of the instrument and ensuring optimal light collection. The primary concern is the characteristic ‘spot size’ of the focal plane images of a distant light source.

During preliminary testing of the lens the off-axis response, images were taken of the focal plane over a small range of angles. I conducted an analysis of these images using astronomy imaging software. Using this set of measurements to characterize the distortion of the spot as a function of off-axis angle we can conclude that the lens is performing as hoped. These encouraging results suggest that this type of relatively inexpensive Fresnel lens will be usable for scaling up to a larger, more sensitive system.

Coincidence Circuit
The coincidence circuit plays an important role in the overall detector. The circuit will allow us to distinguish possible signals from random night sky background fluctuations. It will compare the signals observed by corresponding PMTs within a telescope pair and use a threshold to determine if an actual signal was seen. If both telescopes within a module see a flash of light in corresponding PMTs within a range of a few nanoseconds the circuit will emit a pulse and time stamp to be recorded. This data can then be compared to the other modules to determine if the light was from OSETI or Cherenkov radiation.

Future Work
The High Energy Astrophysics group at Case Western Reserve University is working toward a fully functional prototype model of a single optical telescope by September of 2009. To this end there are currently several components under development, including the following:

- A “home” built optical hut to house each telescope, PMT camera system and the electronic components, with a roll-away roof to protect the equipment during foul weather.
- A custom-designed threshold and dual coincidence logic circuit that will identify and time tag simultaneous light flashes.
- An end-to-end detector simulation program that will optimize the telescope configuration based on precision measurements.

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