Optical Instrument

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Overview

Our radio frequency (RF) instrument is novel in its real time mapping of the ionosphere through the orbit, however, it will only be able to estimate the charge density in sections around the CubeSat through the time difference in receiving signals. In order to create even more accurate mapping of the ionosphere, the CubeSat will support an optical payload. This payload will allow us to better estimate the path through which the radio signals travel, allowing for a more accurate mapping of the ionosphere charge density.

Low Level Process

- First, white light enters the aperture from airglow and other sources, this light must be filtered such that only the 557.8nm band is sent to the detector.
- This band is the primary green line of atomic oxygen which makes up roughly 96% of the lower atmosphere.
- Light will first travel through two filters in order for the correct band to travel into the detector
- Initially, the light will travel through a lowpass filter with a cutoff line at around 1000nm. This filter will prevent the possibility of leakage through the other parts of the system at high wavelengths.
- Then, the light will travel through a bandpass filter centered at 560nm with an error of +/- 5-10nms. This will filter out all other unwanted wavelengths for accuracy in processing.
- Next, light will be sent through a triplet lens set which will focus the rays into the detector. The use of this type of mechanism will allow for more accurate readings than a standard convex lens.
- Lastly, the light will converge upon a photodiode, which is optimal for this application because of its small profile and low voltage requirements. Photodiodes also feature a fast response time and high level of accuracy.
- Photodiodes emit very low currents, in the range of microamps . In order to make it easier to accurately convert the analog signal from the diode into a digital one for processing, this signal must be amplified.
- We plan to use a low noise amplifier to amplify the current into the range of milliamps for more accurate readings. The amplification will make changes in current seem larger when they enter the converter circuit which will lower error.
- The system is shown in a labeled raytrace in thediagram below: