**Project Overview: Johnathan Le, Jonathan Valencia, Vadim Naumchuk**

**Potential title:** Optical Properties of a 2.5-micron thick sheet of CP-1.

**Introduction:**

Solar sailing is an exciting new method of space travel effective for transporting extremely light payloads, it’s low cost and low weight makes it effective for long-distance travel and satellite functions. The key factor that differentiates the solar sail from other spacecraft is its propulsion method. Solar sails harness the pressure from solar radiation to propel themselves through space. In order to do this, the solar sail is made up of large sails of a lightweight and highly reflective material, light from the sun reflects off the mirror-like sails, imparting their momentum. One such reflective material is CP-1, as a sail material, it is constructed of a polymer sheet covered in a thin sheet of aluminum. The optical properties of the reflective material dictate the quality of space travel, especially reflectivity. Many mathematical models exist that can be used for controlling the solar sail in flight given that you know the optical property of the sail. To control the flight of this specific solar sail, the individual sails must be controlled accurately much like sailboats on earth. Using the mathematical method we developed we can calculate what orientation each sail must be in given various material and design properties. One such material property necessary that is not given by the manufacturer is material’s emissivity. In this experiment, we will attempt to determine the material emissivity for a 2.5-micron thick sheet of CP-1.

The manufacturer of CP-1 includes specific measurements for reflectivity, transmissivity, and absorptivity for 2.5-millimeter thickness. For this experiment, we’ll be using molecular spectroscopy to measure reflectivity, transmissivity, absorptivity, and emissivity for a 2.5-micron thick sheet of CP-1 and comparing it to the manufacturer specifications.

**Method:**

For this experiment, we will be using an optical spectrometer to measure the optical properties of CP-1. For the spectrometer set up, we’re using a small piece of CP-1 measuring 2x2 inches attached to a customized bracket that holds the CP-1 under constant tension to attain a smooth surface. This bracket is then attached to one of three modules that are designed for measuring reflectivity, transmissivity, and absorptivity. Each module holds the bracket at a certain location where the light will shine through the CP-1 material. The difference between the modules is the location of mirrors and prisms that affect the direction and intensity of the light.

We’ll also be looking to test the CP-1 when there is little tension applied so it has a rough surface due to wrinkling.