



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Isaac Broudy	Project Number S1705
Project Title Developing and Calibrating a Linear Polarimeter for Astrophysical Tests of Beyond Standard Model Physics	
<p style="text-align: center;">Abstract</p> <p>Objectives The objective of this study was to develop an autonomous, functional, and low instrumentally biased optical polarimeter for Standard Model Extension studies.</p> <p>Methods The optical polarimeter was made from 3D printed PLA plastic, an achromatic polymer half wave plate, and a double calcite savart plate. The half wave plate was driven by a step motor and monitored by a rotary encoder and photodiode. This was ultimately controlled by an Arduino Uno. Python scripts were made to automate the control of Arduino and data analysis pipeline. The optical polarimeter was placed on a 90mm Stellarvue refractor telescope, with an Astrodon V Band filter and a ZWO ASI 178mm CCD camera. This was important in calibrating the polarimeter, reproducing published polarizations, and Standard Model Extension tests.</p> <p>Results A compact and easily reproducible optical linear polarimeter was constructed for astrophysical measurements. The linear polarimeter was calibrated through the measurements of unpolarized standard star observations. This allowed for the measurement of an instrumental bias of 0.00154 fraction of polarization. Two astronomical bodies were then measured to reproduce published result. The optical linear polarimeter is to be used in Standard Model Extension studies to come.</p> <p>Conclusions I was able to develop, calibrate, and automate an optical linear polarimeter for astrophysical tests of Standard Model Extensions. The optical polarimeter was almost entirely 3D printed making it easy to mass produce them for future studies. The linear optical polarimeter was made so that data acquisition is fully autonomous, along with an automated data analysis pipeline. The instrumental polarization measured was a polarization fraction of 0.00154, comparable to that of other polarimeters. This demonstrated that this optical polarimeter could perform Standard Model Extension studies.</p>	
Summary Statement A linear optical polarimeter was successfully constructed and calibrated with astronomical measurements, to be used in Standard Model extensions.	
Help Received I was mentored by Dr. Brian Keating and Dr. Andrew Friedman of Center for Astrophysics and Space Sciences at UCSD. I was additionally provided with materials and access to lab facilities.	