Jacob Ross Romeo

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INTRODUCTION

I enjoy studying physics and how it applies to our every-day lives and in the field. I am driven to use my experience in research towards future internships/co-ops. I look forward to apply my research experience towards new development.

SKILLS

- **Engineering:** Programming (Python,C++, Java, LaTex), PCB Development (KiCad), CAD (Fusion 360).
- **Astronomy:** AstroImageJ (stacking, calibration, aligning, photometry, astrometry), Period04 (frequency and amplitude curves, Fourier transform), TopCat (data analysis, cone search, plotting), R-Spec (spectroscopy).

RELEVANT EXPERIENCE

Physics **2022 -Present**

- **(Project) ALMA:** The Advanced LASER Mining Array is a project in the Engineering Physics Propulsion lab (EPPL) I started, consisting of simulations to prove we can use a Fiber LASER to mine water ice in space.It is still in the development stage; you can see the progress on GitHub at bit.ly/3Tf79M5.

Astronomy **2022 - Present**

- **(Project) ROAST:** This is a research project I am working on with a professor on campus. We are taking data for known and possible roAp stars (calculating their period). Normalizing the known roAps with our roAp candidates. Using a multitude of softwares (AstroImageJ, Period04, Topcat, python) to compile the data to complete the calculations and normalize the data.

Software Engineering **2021 - Present**

- **(Project) EasyDrift:** In EPPL, this is an autonomous go-cart and is in the development stage. I am working on the object detection code for the project. You can see the progress at bit.ly/3T8O4Ls.
- **(Project) EasyControls:** In EPPL, this is an attitude controller and is in the testing stage. I am working on the control theory along with programming these functions and coding the I2C communication between the Raspberry Pi and arduino nanos. You can see the progress of this project at bit.ly/3ytZWje.

Electrical Engineering **2020 - Present**

- **(Project) NOVA:** This is a development flight computer I am working on in the rocket lab, ERFSEDS, on campus. It is currently still in the testing phase.
- **(Project) EasyDrift:** In EPPL, I am working on the PCBs for the cart, allowing for the cart to be powered via a battery bank, controlling the motors that steer/drive the cart, the hand brake to allow for drifting, and communicating to a server in the lab.
- **(Project) EasyControls:** In EPPL, I am working on the PCBs that power the apparatus, using a LiPo, controlling it with I2C communication from a Pi to 6 standalone nanos. The nanos then take instructions from the Pi and turn the solenoids on/off to allow movement for balancing, using compressed air.

PRIOR EXPERIENCE

(Research Lab) Lead Research Intern: Engineering Physics Propulsion Lab **2021 - Present**

- I work on a variety of projects in this lab, listed in **Relevant Experience**, and will continue to work in the lab until I graduate. The projects I work on include topics of circuit design, programming, engineering physics, and particle physics.

(Research Assistant) Astronomer: Embry Riddle University **2022- Present**

- This is the **ROAST** project I started working on with Dr. Stephen Gillam over Summer of 2022, described in **Relevant Experience**.

(Astronomy Lab) Student: Embry Riddle University **2022 Spring Semester**

- In PS 318, intro to astronomy lab, we learned how to use AstroImageJ, how to operate a telescope, a multitude of techniques to collect data, the anatomy of telescopes and a CCD camera, and how to use R-Spec for spectroscopy.

EDUCATION & CERTIFICATION **CGPA: 3.23**

Bachelor of Science in Astronomy and Astrophysics **(2020 - 2024)**

- Minor in Computer Science **(2021 - 2024)**
- Certified SARA telescope operator **(2022 - Present)**

Junior: Graduating 2024

ERAU 1-Meter Attachment

SURF 2023

Jacob R. Romeo
Supervisor: Dr. Vikas Sudesh

1 Introduction

Embry-Riddle Aeronautical University (ERAU) was equipped with a one-meter Ritchey-Chretien (RC) Cassegrain telescope by DFM engineering back in 2014. The 1-Meter telescope, has a focal ratio of f/8, where f is the focal length and is composed of primary and secondary mirrors. These mirrors are made up of materials with negligible expansion coefficients, meaning the mirrors have little to no expansion under different climate conditions. This is currently the largest teaching telescope in Florida, thus it is a large attraction to our community. Allowing not only to the students to have amazing hands-on experience but also to local public to come and observe with the spectacle themselves. The College of Arts and Science (COAS) conducts three Astronomy open houses a semester for the public. The current setup for eyepiece observations with the 1-meter telescope is uncomfortable, poses risks to telescope instrumentation. The observation spot is directly underneath the telescope and also there are power, signal, and fiber optic cables. Additionally, if the object they are trying to observe is too high in the sky, the eyepiece becomes inaccessible under the telescope and there is insufficient space to observe. An extended eyepiece will mitigate the problem allowing a fun, easy, and safe way for the public to visit and observe sky using the telescope. We have come up with designs to make a 3D-printed eyepiece extension that would be compact and sturdy and eliminate these problems. My task as a fellow will be to design and run the simulations using an optical software and assemble the attachment under the mentorship of Dr. Vikas Sudesh.

2 Objective

We have two main objectives, with multiple sub-objectives, which we are planning to complete during the course of 10 weeks over the summer through May to July. My mentor Dr. Sudesh at ERAU Daytona Beach campus will work along with me and help me through the two main objectives. The first of which is to simulate the optical extension using an optical software, namely CODE V. The sub-objectives for this are learning how to use CODE V, understanding the functionality of the software, and optimizing the design. The second main objective comes after the first and that is building the extension. This will allow the public who attend the open houses to easily and safely observe with the 1-meter telescope. The sub-objectives are evaluating which filaments are best to print the optical tube, learning how to use the 3D printer, assembling of the wedge on the end of the tube in the most efficient way, and making everything as light (in weight) as possible.

3 Methods

To get the best and most efficient design for the eyepiece, I will design it using the CODE V optical software. Code V is available in the physics department and used in the Electro-Optical Engineering course (EP 320). After satisfactory design, assembling and installing the extension on the 1-meter will be conducted. Before installing we will be getting the measurements needed for the perfect fit and most comfortable position while observing. The area of the telescope where the extension would be connected is 4 and 7/16 inches in diameter. The eye-piece would then extend by 22 inches from the position in the horizontal direction. This would still be inconvenient, so the end of the extension needs to have an elbow or wedge. This allows the observer to view the Field of View (FOV) at a comfortable height/position. The length of the wedge is 18 inches, making the overall length 40 inches, and would be angled down at 25 degrees, with respect to the ground, and rotated by 30 degrees. The functionality of this piece takes the light from the telescope, traveling through the tube, and reflects it, allowing the observer to see the FOV with ease. The current eye piece will connect to the end of the wedge. With the current setup, the observer can only look

through the eyepiece at a certain parked position, whereas this extension, achieved at the end of the Fellowship, will allow observers to view at virtually any telescope position.

The tube, where the optics will be placed, will be 3D printed using either PETG or TPU filament and assembled in the optics lab . The reason for this is that 3D filament is cheap and lightweight, allowing the tube to be used without supports on the telescope. PETG is best for humid conditions, which is very important due to it being stored in the observatory where high humidity is common. TPU would be best due to its flexibility, impact resistance, and vibration-dampening qualities. Because the tube is small in size, we can make multiple iterations with a single kilogram roll of PETG or TPU, where a kilogram of PETG can be used in making 111 meters and TPU is 117 meters in length. Both are also cheap, coming in at an average of $20 and $30, respectively, per kilogram. The major expenses will come from the optic pieces themselves, coming in at an average of $200.

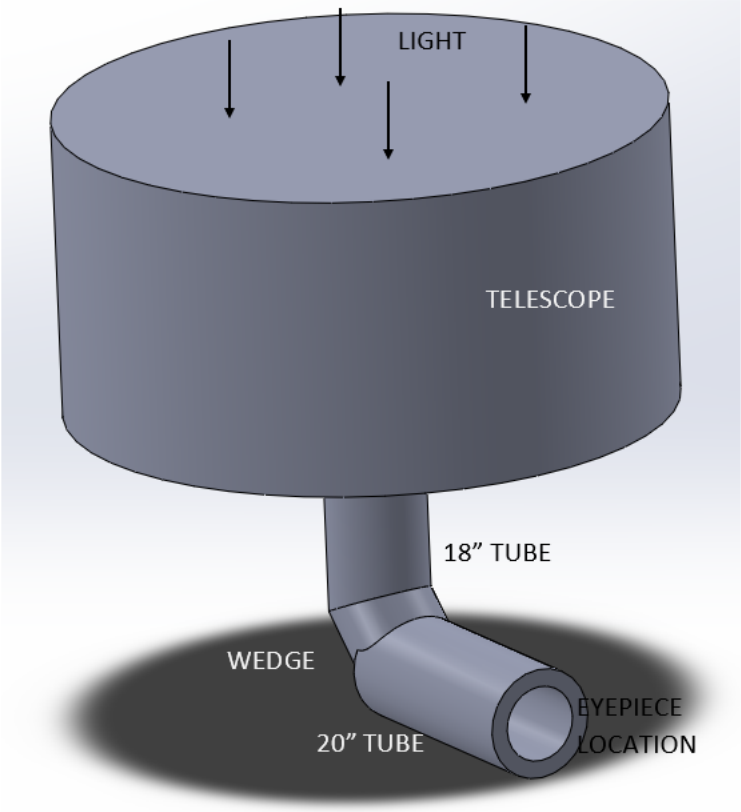

Figure 1: Simple render of the setup

4 Tasks

	TASKS
1	Creating a model of the extender and optimizing it in CODE V
2	Creating the tube in CAD and making it lightweight but also sturdy
3	Printing the tube over a few iterations and making the assembly simple and efficient
4	Investigating type of optic we need for the wedge to reflect the image from the telescope to the observe
5	Aligning the optical components
6	Assembling the final product and start testing
7	Attach the eye-piece extender to the telescope

5 Background

Presently, I am a junior studying Astronomy and Astrophysics with a minor in Computer Science. I love research and am involved in a few research projects in the Engineering Physics Propulsion Lab (EPPL). My research interests are CubeSats, altitude controllers, optics, and lasers. I have completed most of my physics courses and all of my math courses. I believe I am a good candidate for the fellowship, since I have hands-on experience with manufacturing, electronics, coding, and applied physics. Since I work in labs on campus and have completed all my physics labs, I have safety and lab competency knowledge allowing me to efficiently but safely work on research. The proposed research will help me gain knowledge of optics and optical software and manufacturing optics. Additionally, through the fellowship my knowledge of optical alignment will be improved.

6 Budget

	ITEM	QUANTITY	PRICE
1	Overture PETG	2	$40
2	Overture TPU	2	$60
3	Optics	1	$200

EMBRY-RIDDLE
Aeronautical University
DAYTONA BEACH, FLORIDA

Department of
Physical Sciences
Tel: 386-226-6709

February 20, 2023

To whom it may concern,

Re: Letter of Support for Jacob Ross Romeo (Student ID: 2544074)

It is my pleasure to strongly support Mr. Jacob Romeo's application for a Summer Undergraduate Research Fellowship 2023 and I commit to be a mentor during the tenure of his fellowship. I am a photonics/laser physicist and was actively involved in performing similar research work and also acted as a supervisor of the NSF funded REU program students in Professor Martin Richardson's laser plasma laboratories at CREOL/UCF (2006 – 2009). I have mentored two Summer Undergraduate Research Fellows in the past (2017, 2020).

Jacob is a junior in Bachelors of Science in Astronomy and Astrophysics. I believe that he is a talented, hardworking, intelligent and honest student who is ready for any challenge. I believe that Jacob has tremendous potential as a future scientist and innovator, and he will definitely be an excellent choice for the ERAU Summer Undergraduate Research Fellow.

Jacob will get an opportunity to experience first-hand top-class research work and learn several laboratory and analytical skills which will be useful in any research he does in future. This fellowship also opens a path for future NSF grant for undergraduate research in optics/photonics at ERAU.

Jacob will have my full mentorship, guidance and supervision during his 10 weeks fellowship. I recommend him very highly and without reservation.

If you have any further inquiries regarding Jacob, please feel free to contact me.

Sincerely,

Vikas Sudesh.

Vikas Sudesh, Ph. D., M. Tech., M. Sc.
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Engineering Physics – Space Physics – Astronomy & Astrophysics
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