2023 Technology Fee Full Proposal

Title: Enabling Stunning Student Astrophotography Through Innovative Use of Technology

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Sponsoring Organization: Academic Technology

Purpose and Specific Objectives: **Impact/Benefit**: The University of Florida's Astronomy Department currently teaches a Quest 2 astrophotography course (IDS2935 – The Art & Science of Astrophotography) for which the students use their smartphones as their primary tool for observing the night sky. The course has been well received. Students enrolled are very enthusiastic about their experience and going forward, the Astronomy Department plans to increase the enrollment and teach the course every semester**.** During the current semester the student experience in this class has been greatly enhanced by allowing students to use sophisticated/automated astrophotography equipment personally owned by one of the co-instructors of the course, Noah H. Rashkind. However, due to limited equipment availability, only one telescope is shared among 35 students, which is insufficient for an optimal learning experience. Furthermore, since the equipment is **not** owned by the Astronomy Department, it may not be available for use in future semesters. To improve the learning experiences of the students and to promote an exceptional academic environment, we propose to purchase five (5) astrophotography setups identical to what is currently used by the students, but that would be owned by the University.

The primary goal of this project is to enhance the astrophotography course by providing modern state-of-the-art equipment, which would help students learn and apply advanced techniques in astrophotography. This project will also help to improve the technical skills, competency, and success rate of students which they can apply to other technically oriented courses, by providing a hands-on experience with cutting-edge astrophotography technology, image processing and related computer software. Furthermore, the project will promote an exceptional academic environment through the innovative use of this technology.

Enhancement of Academic Learning Environment: The fundamental purpose of Quest 2 courses is to engage students with real-world issues that are cross-disciplinary and encourage critical thinking. The course taught by our department uses astrophotography as a tool to teach students about the Universe, while at the same time exploring real-world issues such as light pollution and the trade-offs between technological development and preservation. Examples of topics discussed in the course include the Starlink satellite constellation, the impact of light pollution upon sea turtles, cultural issues associated with observatories at Mauna Kea in Hawaii, and debates about routes for the turnpike extension and potential impacts on UF's Rosemary Hill Observatory.

The central means of engaging the students however is via their observations of the night sky. In its current form, the course is predicated on having no technology available beyond smartphones. This choice was made to reduce barriers for scaling the course and to enable flexibility in where the course is taught each week (i.e. not relying on the availability of the teaching observatories). It has become clear however this semester that the course is significantly enhanced by affording students the opportunity to use a telescope and detector system that is optimized for astrophotography – not to replace smartphones, but to enable observations that are not otherwise possible. Smartphones are excellent tools for obtaining wide-field images of the night sky and nightscape images, but lack the sensitivity by themselves to observe smaller, fainter objects. To illustrate this, Figures 1 and 2 below shows two images of the Moon and the Orion Nebula, respectively, both taken by students. The one on the left is with a smartphone, the one on the right with the instructor's personal hardware. We have found that being able to take photos with the instructor's personal hardware greatly increased the excitement of the students, and it also

encourages them to learn about a broader range of astronomical objects than is possible with the smartphones alone.

The hardware that we are requesting consists of astrophotography telescopes – which are fundamentally different in design from the standard telescopes used by our department teaching observatories because they emphasize wide fields rather than deep imaging – coupled with detectors and control hardware that is designed to be very easy and straightforward to use. The students use iPads to control the telescopes and take images, but at the same time have a chance to learn about how telescopes operate and set up the telescopes themselves. These astrophotography telescopes are also portable, which enables us to use them for class field trips to various locations, including darker sites than the campus observatory.

ADA Compliance: The project meets all ADA requirements and complies with the UF Electronic and Information Technology Accessibility Policy.

Innovative Delivery: This project is innovative in delivering a new service, resource, and implementation of a concept that is not simply upgrading existing services or facilities. The project will provide new equipment that will help to enhance The Art & Science of Astrophotography course, and thereby promote an exceptional academic environment.

Improvement of Student Learning Experience: The project outlined in this proposal improves student learning experiences by providing access to new astrophotography equipment, which will help students learn and apply advanced techniques in astrophotography. The project also involves the participation of course instructors, which will ensure that the technology is effectively utilized in the courses. Pictured below (Figure 1) is the equipment owned by the course instructor, and which is sought in this grant proposal. Shown in the photograph is the telescope mount, tripod, main telescope, guidescope, main imaging camera, guide camera (guider), flat panel, auto-focuser, Mini-PC, powerbox, ASIAir Plus wireless controller, dew heaters, and cable management accessories. All of the items sought through this grant proposal, when combined, will create a wireless astrophotography kit that the students can control with an app on an iPad. The telescope requires minimal manual setup. Once positioned in the correct orientation, the telescope controller interacts with the app to automatically plate solve, go-to, track, and guide on any object the student desires to photograph.

Capacity to Create, Innovate, and High-Quality Learning Environments: The project will improve the capacity to create, innovate, and high-quality learning environments by providing modern, state-of-the-art equipment that will help students learn and apply advanced techniques in astrophotography. By way of example, below are side-by-side comparison images taken by students on the same nights with their cellphones and then with the equipment sought by this grant (Figures 1 & 2).

Impact: The new astrophotography equipment will impact the students taking the course by giving them hands on training with state-of-the-art equipment and software for image processing. This proposal will impact a broader UF community as well. For example, as part of the astrophotography course, we will display the photos taken by the students with this equipment in a “gallery showing” on campus for members of the UF community to explore and enjoy. In addition, the equipment can be used to teach the student members of the UF Astronomy and Astrophysics Society, the principles of astrophotography and allow the students to explore the night sky. Finally, these telescopes will be used to explore the night sky and take photographs at our weekly Friday Observatory Nights that are attended by students in our AST 1002 classes, members of the UF community and the general public.

Efficient Use of Resources: The project outlined in this proposal efficiently uses existing resources and services and does not duplicate services or infrastructure**.**

Figure 1 - Student photo of Moon with cellphone (left) vs moon with astrophotography equipment (middle). Astrophotgraphy equipment that we would like to purchase (right).

Figure 2 – On the left we present a student photo of the constellation of Orion taken with a cell phone. On the right is a student photo of the Orion Nebula, located in the sword of Orion, taken with the astrophotography equipment.

Summary: In summary, this project proposes to purchase five astrophotography setups identical to what is currently used by the students, but that would be owned by the university. This project will help to enhance the astrophotography course, improve the technical skills, competency, and success rate of students, promote an exceptional academic environment, and improve the capacity to create, innovate, and high-quality learning environments. We seek funding to support this project, and we are confident that this project will have a positive impact on student learning experiences in astronomy-related courses at the University of Florida.

Sustainability: The project budget covers only technology items and does not include salary, services, facilities, furniture, and similar items. All operation is under the supervision of the course instructors. Repairs and regular maintenance of the equipment will be carried out by the Department of Astronomy's Observatory Director and engineering staff who are highly skilled in this area. Updates and replacement parts will be funded through lab equipment fees which we will collect each semester, once the course has a permanent AST designation. Back-up funds from the Department's maintenance budget will be used until that time and going forward when necessary. Upgrades due to advancements in technology will be evaluated on a 5-year timescale.

Timeline: The project will require one-time purchases of all equipment, which will be used beginning in Fall 2023, and will be used continuously each semester for The Art & Science of Astrophotography course. The course will be taught every fall and spring semester. The equipment may also be used for other astronomy courses, including labs, where hands-on experience may be enhanced incorporated into the curriculum.

Budget and Budget Narrative: We request a total of $49,424 to purchase five (5) fully automated astrophotography set ups for use by UF students. The break down breakdown for the expected hardware costs for each of the astrophotography setups is below. The instructor for the course will assemble each telescope setup and will train the teaching assistants and students on how to operate and automate each setup, maximizing the educational impact of this award.

Five (5) Fully Automated Petzval Refracting Astrographs: A fully portable and automated astrograph requires a smart camera/telescope controller to automate the control of the 71mm primary telescope, computer controlled mount, color and monochrome astrophotography cameras, guidescope and guider camera for precise pointing, electronic auto focuser for precise automated focusing of the main telescope, narrowband and broadband filters to block the heavily light polluted skies around the University of Florida campus, electronic filter wheel for automated changing of filters, automated flat panel for calibration frames, and dew heaters to curb the formation of dew on the optical elements. To be fully functional, the setup also requires power management, a mini-pc for added automation of the flat panel, and a power source to power the entire kit. There is also required software, but it is included as part of the cost of the smart camera/telescope controller. Finally, we request 5 iPad minis to enable the students to control each of the telescopes. The required elements are:

1. ZWO AM5 Mount & Tripod: $2298 x 5 = $11490
2. ZWO 160mm pier extension: $99 x 1 = $99
3. William Optics Redcat 71 Telescope: $1698 x 5 = $8490
4. ZWO Electronic Autofocuser: $248 x 5 = $1240
5. ZWO Electronic Filter Wheel: $399 x 5 = $1995
6. ZWOASI2600MC Pro: $1799 x 5 = $8995
7. Orion 60mm Guidescope: $179 x 5 = $895
8. ZWO ASI120mm Guide Camera: $149 x 5 = $745
9. Robotic Flat Calibration Panel: $346 x 5 = $1730
10. Electronic Autofocuser Upgrade Kit: $105 x 5 = $525
11. Dual Narrowband Filter for Color Cameras: $389 x 5 = $1945
12. Broadband Light Pollution Filter for Color Cameras: $199 x 5 = $995
13. Dew Heaters for Refracting Telescopes: $47.96 x 5 =$239.80
14. Dew Heaters for Guidescopes: $47.96 x 5 = $239.90
15. ZWO ASIAir Smart Camera/Telescope Controller: $299 x 5 = $1495
16. Pegasus Powerbox for Power Management: $240.54 x 5 =$1201.70
17. Mini-PC for Automated Flat Panel Calibration: $153 x 5 = $765
18. Cable Management Accessory for ASIAir Controller: $16.67 x 10 = $166.70
19. Cable Management Accessory for ASIAir Controller: $18 x 10 = $180
20. Portable Powerbank: $469 x 5 = 2345
21. iPad mini $650 x 5 =3250

Total: $49,424