

## ASTR 124 – Observational Astronomy – Syllabus

**Class:** Thursdays 7:20pm-8:35pm, Planetary Hall 112 + Zoom

<https://gmu.zoom.us/j/92460207717>

<https://discord.gg/RCykSGP>

**Instructor:** Dr. Peter Plavchan

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**Observatory Assistants:** Thunyapong “M” Mahapol [tmahapol@gmu.edu](mailto:tmahapol@gmu.edu),

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**Learning Assistant:** Sara Falgiano, [sfalgia@masonlive.gmu.edu](mailto:sfalgia@masonlive.gmu.edu)

**Office Hours:** Discord asynchronous – message 24/7, by appointment, and MTu 11am-noon during my lunch break.

### Materials:

*Required:* *Turn Left at Orion* by Guy Consolmagno & Dan M. Davis

*Required:* *Observational Astronomy*, by Birney, Gonzalez, and Oesper

**Exams:** None

**Assessment:** There will be weekly preparatory project assignments that build upon each other, culminating in the project presentations at the conclusion of the semester.

<b>Grading Policy (subject to change):</b>	Project Assignments	60%
	Lecture Q&A	20%
	Project Presentation	20%

Grade determined as follows (subject to change):

90-100 – A    80-89 – B    70-79 – C    60-69 – D    <60 – F

## Course Outline – ASTR 124 – 2022 Spring Semester

Class Date	Week #	Lecture Topics	In Class Activities	Notes / Observatory Work
1/27	1	Introductions; Course Overview	Observatory Tour; Night sign-up	Tour
2/3	2	Locations in the Sky	Q&A; Exercise 1 – Night sky	12-inch observing
2/10	3	CCDs	Q&A; Exercise 2 – AIJ Intro & Dark/Bias Images	12-inch observing
2/17	4	Image Processing	Q&A; Exercise 2 continued	12-inch observing
2/24	5	Making a Measurement	Q&A; Exercise 3 – Dark Current	12-inch observing
3/3	6	Properties of Light	Q&A; Exercise 4 – Flatfield Images	32-inch observing
3/10	7	Properties of Telescopes	Q&A; Exercise 5 – Image Processing & Telescopes	32-inch observing
3/17	8	Spring Break		32-inch observing
3/24	9	Aperture Photometry	Exercise 6 – Statistics	32-inch observing
3/31	10	Spectroscopy	Q&A; Exercise 7 – Aperture Photometry	32-inch observing
4/7	11	Radio Astronomy	Q&A; Exercise 8 – Radio Astronomy	
4/14- 4/16	12	<b>Green Bank</b>	Exercise 9 – Green Bank Observing	Field trip (date to be confirmed)
4/21	13	Infrared, High Energy & Gravitational Wave Astro	Q&A; Exercise 10 – Project Work	
4/28	14			
5/5	15	Project Presentations		Last Class

### Course Description:

For millennia, humankind has gazed upon the night sky with wonder, and 400 years ago Galileo showed us there was more to discover with the first telescopic observations of the sky. Today

we live in dense urban environments producing ever-increasing amounts of light pollution that obscures our unaided eye views of all but the brightest planets and stars, with increasing numbers of low-earth orbit satellites streaking through. This muted view of our sky is only occasionally punctuated by events like the majestic total Solar eclipse in 2017. Meanwhile, in the darkest, driest remote mountaintops, astronomers have continually reinvented and advanced upon Galileo's first telescope to build telescopes that are bigger than tennis courts with mirrors that can actually correct for a star's twinkle, launched telescopes into space, and replaced our eyes with unblinking digital sensors that can record the presence of objects a billion times fainter across large swaths of the sky. Telescopes will allow us to peer towards the cosmic dawn of the first stars, find the nearest Earth-like worlds, and help us to understand the fundamental physics of the cosmos.

In this course, you will use our campus telescope to observe the magnificent hidden vistas of the natural night sky. You will learn the basic scientific principles of light, telescopes, and modern astrophotography techniques. You will collect astronomical images with our telescope and learn how to mosaic, calibrate and extract information from them and to evaluate their scientific data quality. You will learn essential scientific practices, including digital lab notebook writing and documentation, and scientific communication with your peers as part of the project presentation. The skills you will develop in this class can lay the foundation for a future major or minor in astronomy and astrophysics, or can help you start a life-long hobby of star-gazing and astrophotography of the Universe above.

In addition to the topics described above, you will learn about the process of defining a scientific research question, collecting information to try to address the question, and critically assessing your results to determine what you have (and have not) learned from the data that you collected. You will be expected to work with other students in the class, please do your part as it is important for collaboration that everyone does their share.

*Specific goals:*

- You will learn the basic principles of light, telescopes and astrophotography.
- You will be able to operate the campus telescope such that you can select a source, and take a sequence of images of your source and the necessary calibration images.
- You will keep a scientific record of observations taken and data analysis performed with a digital lab notebook. This includes learning reduction steps such as read noise and dark current subtraction from digital CCDs, and flat-fielding interpixel response functions.

- You will show that you can extract information from images and use that information to draw scientific conclusions about the objects that you have observed. This will be accomplished with what is known as aperture photometry.
- You will be introduced to the statistical mathematics concept of error analysis in the context of the images obtained.
- You will gain experience presenting your work to other students, through the use of Powerpoint, Keynote, Google Slides, Prezi or similar presentation software.

### **Computers:**

The use of computers is fundamental to astronomical work so they are required and will play an important role in this class. For data calibration and analysis, we will use AstroImageJ.

Computers are provided in class, but you are welcome to use your own laptops. AstroImageJ is a point-and-click visual tool that is specifically designed for astronomical image data reduction and aperture photometry. You can download and install the software and manual here to get started:

<http://www.astro.louisville.edu/software/astroimagej/>

Digital lab notebooks will be kept with the aid of Google Docs for recording observations and analysis.

We will frequently be using the internet as a means to enhance our discussions. Please be respectful of your peers and your instructor and do not engage in activities that are unrelated to the class. Such disruptions show a lack of professionalism and may affect your participation grade.

### **Telescopes:**

Using telescopes is always a bit tricky and never works as you plan it. There will undoubtedly be obstacles to deal with including instrumentation that does not always work as planned and weather that can oftentimes be uncooperative. You will spend some of our unscheduled class time learning to use telescopes on an assigned night of every week, weather permitting.

### ***Useful Campus Resources:***

**Writing Center:** A114 Robinson Hall; (703) 993-1200; <http://writingcenter.gmu.edu>

**Counseling and Psychological Services (CAPS):** (703) 993-2380 <http://caps.gmu.edu>

### ***Policies:***

**Withdrawal:** If you need to withdraw from this course you must do it within the University established time frame. See the GMU academic calendar for important dates: <https://registrar.gmu.edu/calendars/>

**Students with Disabilities:** Please contact Disability Services (SUB I, Room 4205, Phone 703-993-2474, <http://ods.gmu.edu>) if you have a learning or physical disability that will require accommodation in the astronomy laboratory. You must obtain the proper paperwork and notify your instructor in advance to be accommodated.

**Academic Integrity:** GMU is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. Collaborative group work is encouraged in the lab, but it will be considered academic dishonesty to attach your name to work when you did not actively participate and contribute.

**Sexual Haassment, Sexual Misconduct, and Interpersonal Violence:** As a faculty member and designated "Responsible Employee," I am required to report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's [Title IX Coordinator](#) per [university policy 1412](#). If you wish to speak with someone confidentially, please contact the [Student Support and Advocacy Center](#) (703-380-1434), [Counseling and Psychological Services](#) (703-993-2380), [Student Health Services](#), or [Mason's Title IX Coordinator](#) (703-993-8730; [cde@gmu.edu](mailto:cde@gmu.edu)).

**Name and pronoun use:** If you wish, please share your name and gender pronouns with me and indicate how best to address you in class and via email. I use he/him for myself and you may address me as Professor Plavchan or Dr Plavchan in email and verbally.

**Safe Return to Campus:** All students taking courses with a face-to-face component are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (<https://www2.gmu.edu/safe-return-campus>). Similarly, all students in face-to-face and hybrid courses must also complete the Mason COVID Health Check prior to coming to campus. The COVID Health Check system uses a color code system and students will

receive either a Green, Yellow, Red, or Blue email response. Only students who receive a “green” notification are permitted to attend courses with a face-to-face component. If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. Faculty are allowed to ask you to show them that you have received a Green email and are thereby permitted to be in class.

Students are required to follow Mason's current policy about facemask-wearing. As of August 11, 2021, all community members are required to wear a facemask in all indoor settings, including classrooms. An [appropriate facemask](#) must cover your nose and mouth at all times in our classroom. If this policy changes, you will be informed; however, students who prefer to wear masks will always be welcome in the classroom.

If the campus closes, or if a class meeting needs to be canceled or adjusted due to weather or other concern, students should check Blackboard and/or Discord for updates on how to continue learning and for information about any changes to events or assignments.

## **Project Presentation**

Presenting your research is an important skill as an astronomer. It is also a skill that crosses many disciplines and professions. At the end of the semester we will have a presentation session in which each group will present the observations they obtained. The talk should be directed at your fellow students (i.e., freshman and sophomore astronomy students – we may have additional people viewing the talks, but this is still your target audience). Everyone in your group is expected to give part of the presentation so you will need to coordinate what each member of your group is talking about. Important things to include in the talk:

- Background material explaining what is known about the object or objects you observed. This is where you set the stage for the project you have just executed. (1-2 slides)
- An explanation of why you pursued this particular project, why it is interesting. (1 slide)
- A thorough discussion of your observational method and calibration/analysis. (2-4 slides)
- Summary of your observations. This section could also include a discussion of possible future work. (1 slide)

Presentation duration is 5 minutes per group.