ASTR 124 – Observational Astronomy – Syllabus

Class: Thursdays 7:20pm-8:35pm, EXPL 1004

Instructor: Dr. Peter Plavchan

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Observatory Assistants: William Matzko wmatzko@gmu.edu,

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Learning Assistant: Sara Jeffreys

Office Hours: TBD

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.

Grading Policy:	Project Assignments	60%
	Lecture Q&A	20%
	Project Presentation	20%

Grade determined as follows:

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

Course Outline – ASTR 124 – 2019 Spring Semester

Class Date	Week #	Lecture Topics	In Class Activities	Notes / Observatory Work
1/23	1	Introductions; Course Overview	Observatory Tour; Night sign-up	Tour
1/30	2	Locations in the Sky	Q&A; Exercise 1 – Night sky	12-inch observing by eye
2/6	3	CCDs	Q&A; Exercise 2 – Linux intro, AIJ Intro & Dark/Bias Images	12-inch observing by eye
2/13	4	Image Processing	Q&A; Exercise 3 – Dark Current	12-inch observing; Plavchan travel; may be virtual lecture
2/20	5	Properties of Light	Q&A; Exercise 4 – Flatfield Images	12-inch observing
2/27	6	Properties of Telescopes	Q&A; Exercise 5 – Image Processing & Telescopes	Sunspotters; Solar telescope
3/5	7	Making a Measurement	Q&A; Exercise 6 – Statistics	32-inch observing
3/12	8	No Class		Spring Break
3/19	9	Aperture Photometry	Q&A; Exercise 7 – Aperture Photometry	32-inch observing
3/26	10	Spectroscopy	Q&A; Exercise 8 – Spectroscopy	32-inch observing
4/2	11	Radio Astronomy	Q&A; Exercise 9 – Radio Astronomy	32-inch observing
4/9	12	Infrared & High Energy Astro	Q&A; Exercise 10 – Project Work	32-inch observing; Class may be canceled
4/16	13			Field trip
4/17	13	**Class Trip to Green Bank Observatory**		
4/23	14		Exercise 10 – Project Work	32-inch observing
4/30	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. 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 going to play an important role in this class. For data calibration and analysis, we will use AstroImageJ. 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 Googie Docs for recording observations and analysis.

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 this facility.

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 http://registrar.gmu.edu/calendars/fall-2017/ for important dates.

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 Harassment, 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).

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 (or two depending on the number of students) 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. This means that you will need to work together and ultimately to practice the talk together before this final presentation. 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.