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Spring 2019

PHYS 322-102: Observational Astronomy

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Course Outline Link: <https://web.njit.edu/~hmkim/phys322/phys322.html>

PHYSICS 322 OBSERVATIONAL ASTRONOMY

COURSE OUTLINE (SPRING 2019)

Time: Tue. 6-9 pm (plus other clear nights)

Room: 106 Faculty Memorial Hall/Observatory

Prof. Hyomin Kim

Office: Tiernan Hall 104

Office Hours: Mon. 2:00-4:00 pm

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Course Web Page: <http://web.njit.edu/~hmkim/phys322/phys322.html>

A. DESCRIPTION

The emphasis of this course is observations of celestial objects using a telescope system. This is largely a lab-based, hands-on course in which students learn to use a telescope and CCD camera system to obtain, present and analyze astronomical data using computational tools such as Python, IDL and Matlab. Prerequisite: PHYS320 (Astronomy and Astrophysics I)

B. ORGANIZATION

Readings: Read over the lab assignment before the corresponding class period. Some basics are described here. For further information, read Lecture 1 and Lecture 2 of Phys 321.

Observing Sessions: Attendance is required every Tuesday night (the weekly lecture/demonstration and observing session, cloudy or clear). Missing, without a doctor's excuse, a Tuesday night on which observing is possible will result in a 5% drop in your grade. All observing sessions are at the observatory on the roof of Faculty Hall. Keep in mind that we may have to move the observing night to a different night due to weather.

Lab Report Due Dates: The due dates for the assignments are shown below. You are expected to complete the labs on these dates. If you have a legitimate excuse for not getting the lab done on time (i.e. equipment or weather not cooperating), seek permission to turn it in late from Prof. Kim. A late lab without express permission will receive only half credit. Bad weather is NOT an excuse if it is clear on Tuesday/Thursday. In the case of a run of bad weather, you will be supplied with data taken by the instructor on an earlier date, so that lab due dates need not be missed.

Final Project: The "final exam" will consist of a final imaging project to be done at UACNJ (uacnj.org), Jenny Jump State Forest. The final project will count as two labs. The observations will be done in an overnight session some time during finals week (or just before).

Data Repository: NJIT Google Team Drive will be used to share data.

C. TEXT AND REQUIRED SUPPLIES

Textbook (desired but not required in class): Observational Astronomy 2nd Edition, D. Scott Birney, Guillermo Gonzalez, and David Oesper, Cambridge University Press 2006.

Lab Notebooks (required!): National Brand Laboratory Notebook (something like this). The procedure for each lab is described in the lab assignment. You must keep a lab notebook containing your notes while you take and analyze your data. These will be turned in with each lab report. Lab reports, written in Word or some similar word processor, are the final product of each lab assignment, and must be prepared as a separate document, well illustrated and explained (Sample lab report). Neatness and thoroughness counts!

Computer and Software: A personal computer is necessary for data analysis. It is recommended to install Aladin, an interactive sky atlas (see Lab 1 below) before the first class. A programming language to read astronomical data (*.fits) should be installed on your computer. Python is highly recommended.

Bundle up!: Most class time will be spent in our observatory using the telescope. It can be cold outside. Prepare warm clothes.

D. GRADES

The course grade will be based on your lab notebooks (30%), lab reports (50%), attendance and class participation (20%). The grading breakdown is as follows:

85-100 %

A

80-84%

B+

70-79%

B

65-69%

C+

55-64%

C

50-54%

D

0-49%

F

E. ACADEMIC INTEGRITY

NJIT has an honor code (see University Code on Academic Integrity) that you are all expected to apply rigorously to your conduct in this course. All work that you submit must be your own. All written words and ideas must be your own, unless cited (and using quotes where appropriate). All books, web materials, or other sources that you consult must be included in a bibliography at the end of your report. Any violations will be reported to the Dean of Students.

Again, this is a lab-based course where each student is expected to use the telescope and obtain data. No bystanders allowed!

F. SCHEDULE

The table below shows the schedule of due dates for the 6 lab assignments and final project for Spring, 2019. Click on the links in the table to download the PDF version of the lab assignment.

Date

01/22

Lab 1: Learning the System

Learn Aladin web interface

Learn to point the telescope (Cartes du Ciel)

Learn to operate the camera (MaxIm DL) and focus (Focusmax)

Learn basics of astrometry (astrometry.net): Astrometry.net uncertainties

01/29

02/05 (Lab 1 due)

Lab 2: CCD Digital Imaging

Learn about CCD cameras

Learn calibration procedures (bias and dark frames)

Learn Python image analysis (Python Tutorial)

Learn about signal to noise ratio and photon statistics

02/12

02/19 (Lab 2 due)

Lab 3: Imaging Asteroids

Precision astrometry and photometry of moving objects

Learn to obtain minor planet center information

Calibration (including flats), combining, and aligning of CCD images

Finding moving objects with Astrometrica.

Create minor planet center report

02/26

03/05

03/12 (Lab 3 due)

Lab 4: Eclipsing Binary Stars

Planning observations

Precision photometry

Obtaining light curves

Epoch fitting

Binary star analysis

03/19

(Spring Recess)

03/26

04/02 (Lab 4 due)

Lab 5: Spectroscopy

Basics of spectroscopy

Laboratory measurement and calibration of spectral data

Taking astronomical spectra

Stellar classification, physical properties

04/09

04/16 (Lab 5 due)

Lab 6: Solar H-alpha Imaging, Lunar Imaging, Planetary Imaging, Star Color Photometry (Student Choice Lab, choose one)

Planning observations

Learning new software

Taking appropriate images for the purpose

Calibration, combining, enhancement of images

Quantitative analysis of data

04/23

04/30 (Lab 6 due)

Final Project: Make a true-color deep sky image

Observe from a dark sky site (<http://uacnj.org>)

Choose your own object to image

Take images in multiple color filters

Learn to combine LRGB filters to a single color image.

2006 Student Images

2008 Student Images

05/07

No class (Friday classes meet)

05/16 (Thu)

Final project due

Useful Links:

New Jersey Clear Sky Clocks

Find out a day or so in advance what the weather will be like for observing.

Moon Phases

Check out whether the Moon will be a problem for your observations.

Moon Map

A detailed map of the Moon, with longitude and latitude lines.

Minor Planet Center

Many links for asteroid observation.

Calsky

Check out where planets and moons are, and what they look like on any date.

Astronomy Picture of the Day

Just a nice picture, often of current interest.

Messier Object List

The list of Messier Deep Sky Objects (clusters, nebulae, galaxies)

New General Catalog List

See images of all of the NGC objects.

CCD University

Learn details about CCDs and their use for Astronomy from Apogee Instruments