

Observational Astronomy (PHYS-380)

Fall 2008 Course Information

Observational astronomy has come a long way since the time of the Babylonians, 2000 BCE, mostly due to advancements in equipment. However, many of the tasks remain the same, such as using polar coordinates, locating your object, observing it thoroughly, and reducing the data so that it can be analyzed for meaning and compared with theories.

General procedure:

We will do many lab activities together to illustrate the various techniques. Then each student will do an individual project and write a report and make a poster. Hopefully these will be good enough so that they can be presented to the Annual MSU Student Research Symposium in May, and may even be submitted as an article to a journal.

For each class please bring a calculator, lab notebook, red flashlight, and your laptop, if possible. We will go outside to observe if the weather permits, so dress warmly. Early in the semester we will observe the sun, later the night sky. We will stay later than 8 PM if it is clear since clear nights are precious in NJ.

Goals: What I hope you will develop from this type of course:

the ability to think and visualize in 3D, a facility in handling equipment with all its quirks, a cooperative spirit in dealing with a team, the drive to plan ahead, a fluency with image manipulations, and an ease in moving from observations to theory and back again.

You will learn how to use specialized equipment:

Meade 12 inch GPS LX200 telescope

SBIG CCD camera

Sivo spectroscope

Radio Jove receiver

Sunspotter solar telescope

Coronado Personal Solar Telescope (PST)

Assorted other telescopes, cameras, and accessories

You will learn how to use specialized software:

Planetarium program (The Sky, Voyager, Cartes du Ciel)

Aladin

SIMBAD

MaximDL

Astrometrica

AIP4WIN

RadioSkyPipe

Google Sky

Specific techniques to learn:

Finding information about a star, planet, asteroid, galaxy, quasar, etc.

Planning an observing session

Pointing and controlling the telescope

Focusing the telescope

Taking an image, and a sequence of images

Taking color images

Calibrating a radio receiver

Analysis and modeling tasks:

Calculating the rotation rate of the Earth

Image processing

Calculating heights of lunar features

Photometry

Generating a Light curve for a variable object

Astrometry

Generating a path or an orbit

Taking a spectrum

Analyzing a spectrum

Targets:

Moon

Sun, sunspots

Moving object (asteroid, planet, comet, star)

Variable brightness object (star, eclipsing binary, exoplanet, nova)

Stars of various temperatures

Nebula (emission nebula, reflection nebula, absorption nebula)

Galaxy

Quasar

Other activities:

Visit to UACNJ Observatory, private amateur astronomy observatories

Guest speakers

Individual Project ideas:

Rotation of giant planets, Mass of planet from orbit of a moon, HR diagram of a star cluster, stellar spectra and classification, nebula spectra, light curve of a variable star, light curve of an asteroid, true color image of a deep sky object, distribution of galaxies in a cluster, planet transit

Assessment:

Attendance and class participation (20%), homework assignments and lab reports (30%), final exam (20%), individual project with oral report, written report, and poster (30%).

One homework assignment: Attend an astronomy lecture and write a one page report on it. (NJAG, AAI, UACNJ, AAAP, Newark's Dreyfuss Planetarium, Hayden Planetarium, ...)

Schedule, tentative:

Weeks 1 and 2 (September 4, 8): Basic knowledge of the sky (constellations, coordinates, time)

Observe: the sun, rotation of the Earth, Greenhouse Effect, Light pollution (counting stars)

Weeks 3 and 4 (September 15 and 22) Planning an observing run (SIMBAD, JPL, Aladin), lunar cartography

Observe: the Moon, Jupiter

Weeks 5 and 6 (Sep 29, Oct 6): Telescopes and CCD cameras)

Observe: nebulae and galaxies

Weeks 7 and 8 (Oct 13 and 20): Spectra, analyzing CCD images (AIP4WIN, Registax, calibration, photometry)

Observe: asteroids

Weeks 9 and 10 (Oct 27, Nov 3): Compare with other observations and models (SDSS, MOC, RBSE novae search, POSSI)

Observe: variable stars, eclipsing binary star pairs

Weeks 11, 12, 13 (Nov 10, 17, 24): Work on individual projects

Week 14 and 15 (Dec 1, 8): Present oral poster reports, Review

Final exam: Tuesday December 16, 5:30-7:30

Lab Activities:

1. Greenhouse Effect (Week 1)
2. Rotation of the Earth (Sunspotter) (Week 1)
3. Individual Constellation (Week 3)
4. SIMBAD Query (Week 3)
5. Sunspot Data, Excel cycle lengths (Week 4)
6. Calculations of Star Distances and true Space Velocities (Week 5)
7. Heights of Lunar Features (Week 7)
8. Eclipsing Binary Times (Week 8)
9. Novae Search in M31 (Week 9)
10. Photometry of Delta Cephei (Week 11)
11. Spectra of gases and Vega (Week 12)
12. Messier Objects (Week 13)