

Astronomy 244/444: advanced astrophysics laboratory

Spring 2020

Prerequisites: AST 142; MTH 281, PHY 227 and PHY 218 completed or concurrently enrolled; permission of the instructor.

AST 244/444 is the astronomy-only version of our Advanced Laboratory, in which challenging observing projects and analyses are carried out using the 24-inch Cassegrain telescope, and its research-grade instrument suite, at Mees Observatory. The semester will be front-loaded with a modest number (~8) of introductory lectures on instruments, observations, and image processing. Afterwards, most of the effort will go into planning and executing observations, analyzing the data, and writing papers about the results.

Professor: Dan Watson (B&L 418, 275-8576, dmw@pas.rochester.edu, www.pas.rochester.edu/~dmw).

World Wide Web site: <http://www.pas.rochester.edu/~dmw/ast244/>. All background reading material and project manuals will be posted there. Linked from these pages is a Wiki to enable sharing of observing logs and the rather large amounts of data we'll be collecting.

Textbooks: none required.

Software: largely provided; accessible by remote login to a server devoted to Mees observing. We will use several specialized programs such as CCDStack and DS9; the programming environment IDL which enables programs like ATV and XStarfinder; and broadly useful commercial applications such as Photoshop. We will also encourage the use of python and the astropy subroutine library.

Electronic communication: an email list server, ast244@mail.pas.rochester.edu, and a Slack channel, #advanced-astrophysics-laboratory, on ast244.slack.com. We will also use Zoom for teams at Mees and on campus to communicate with one another during observations.

Class meetings: Tuesdays 7-9:40 PM, in room 203H B&L, conducted by Dan, except when it's clear. These will be devoted at first to introductory lessons on such topics as these:

Instrumental sensitivity	Telescope control and observations
Calibration, image reduction, tessellation of fields	Uncertainties in astronomical observations
Deconvolution of images	Spectral-line imaging
Crowded-field stellar photometry	Observation of periodically-variable objects
The use of Photoshop to make pretty astronomical images	

but before long they will be taken up by observational planning and data reduction.

Observing: whenever it's clear, some will go to Mees and others will observe remotely from 203 B&L. A great deal of spontaneity and schedule flexibility will be demanded to take advantage of clear nights; such is astronomical life in the cloudy Northeast. Coordination is also necessary, as AST 244/444 will share the telescope with the more numerous students of AST 142.

Projects: to be executed by pairs of students, with each student conducting two (AST 244) or three (AST 444) projects chosen from a palette which includes:

Globular clusters, “cluster variable” stars, and stellar evolution	Seyfert galaxy nuclei: the retrospective discovery of black holes
Observations of transiting exoplanets	Asteroid 306128 Pipher
Excitation of H II regions and planetary nebulae	Herbig-Haro objects and mass loss from protostars

Dan would prefer for you to have different project partners for each project. Groups that choose the same project should choose different targets when possible. (There are lots of globular clusters, galaxies, exoplanets...)

Project reports: each pair of students will write a complete description of each project – motivation, observations and reduction, analysis, scientific discussion, conclusions – in the style of articles in *The Astrophysical Journal*, and at approximately 15-page length. In the interest of moving as quickly as possible from observations to finished report, the use of $\text{\LaTeX}$ and $\text{\LaTeX}$ will be strongly discouraged.

Depending upon enrollment, poster presentations may also be prepared, as in PHY 243.

Grades: Project reports will be graded according to the quality and correctness of the planning, observations, reduction, analysis, scientific discussion; and the quality of the writing as well. Each author will share the grade with their project partner for their work in common. Grades on projects will be averaged to produce each student’s final grade.