

# Syllabus for Astronomy 302: Introduction to Observational Astronomy

Spring 2015

2-2:50 PM MWF

Prof. Laird Close

office hours: 3-4 MWF after class



The 1.6m (61 inch) Kuiper telescope that you will use in this class.

This course is solely intended for those who desire to pursue a career in astronomy or related imaging fields. The prerequisites are (PHYS 105A or 305) and (PHYS 142 or 162H) and (MATH 122B or 125). You cannot take this course without these required courses (astr 250 is good to have as well). The goal of the course is to prepare the student for professional research experience in astronomy. If your career goals do not align with these goals, you may not like this class --as it is a lot of work for someone not interested in an astronomical career.

## GROUP PROJECTS

This is a unique course to the University of Arizona where you get a chance to do real astronomical research with a professional 1.6m (61inch) telescope with an excellent 4096x4096 pixel CCD. The 61inch Kuiper telescope is located on Mt.

Bigelow and operated by Steward Observatory. Dr. Betsy Green will oversee the observing runs. You will have the first part of a night at the 61inch to carry out a "Professor Approved" observing project that you design with the other members of your group. Then using the skills you have learned in class you will each individually lead the reduction and analysis of your CCD data. Leading to a scientific result. Which will be reported in an individual paper and a class presentation.

The student projects in this class can lead to refereed publications and often lay the foundation for a successful exciting career as an astronomer. The more you put into this class the more you will get out.

## Evaluation

Performance in this course will be judged primarily on the basis of the lab projects (20% of the final grade), group observing project (40% of the grade). There will be one in-class closed-book mid-term exam (worth 15% of the final grade) and one full course exam worth 25%. This class is different in that we will have our exam on April 8th 2015. The rest of the term will be spent working on our observing projects. This early exam will definitely help prepare you for your group observing project, which you will finish by April 24.

As the lab projects and observing projects are intense, there are very few homeworks assigned in this class, the student is expected however to understand the material covered in the lectures. Please use this web page (see schedule and links below) to print out each lecture before the lecture and take notes on these pages during class.

**GRADE SCHEME:** A>80%, B>70%, C>60%, D>50%, E<50%

## Policies

- *Do your own work.* Modern science is collaborative, and people learn from talking to each other. We will have group assignments. Feel free to talk to me or to other students about homework assignments or projects. But the work you turn in must be your own -- don't just copy assignments/projects. Cheating will be handled according to university policies and given a grade of zero to everyone involved.
- The instructor subscribes to the University's Code of Academic Integrity: [http://deanofstudents.arizona.edu/sites/deanofstudents.arizona.edu/files/code\\_of\\_academic\\_integrity.pdf](http://deanofstudents.arizona.edu/sites/deanofstudents.arizona.edu/files/code_of_academic_integrity.pdf) for more info. The Code prohibits all forms of academic dishonesty, including cheating, plagiarism, and facilitating dishonesty by others. The repercussions for all of those found guilty of violating the Code will include loss of credit for the work (grade=0) and may include failure of the course or more extreme measures as needed.
- *Attendance and participation.* I will take attendance on occasion. Students should attend every day to keep up with the material. There is no textbook, so your class notes will be your primary study material. All lab sessions (Fridays in rm 208) must be attended.
- *Students requiring special accommodation* in testing or note taking must notify Prof. Close and must deliver to Prof. Close the Disability Resource Center faculty letter within the first few days of the course.
- *Grading.* You have one week from the time an assignment or exam is returned to

challenge any perceived errors. Although rare, there are occasions when grading errors occur, and you should review your returned work.

- **Late homework is downgraded by 20% per day (so there is no point, as far as grades are concerned, in turning in homework that is 5 or more days late).**
- **Class notes I have gone through some trouble to "compose" lecture notes from various sources (see below). I have gone through the additional effort of posting each of these lectures as HTML files hosted off my own server**

**<http://exoplanet.as.arizona.edu/~lclose/a302>**

**before each lecture please print out the lecture on paper and bring it to class so you can mark-up the notes as you see fit. After class I may pull each lecture off the web as you will all have copies by that time. Typically you only need to print the main page of the lecture.**

**There is no textbook for the class although the following may be useful references:**

"Data Reduction and Error Analysis for the Physical Sciences" by P.R. Bevington (Good reference for statistics and error analysis)

"Observing the Universe", edited by A.J. Norton, The Open University Press

"Handbook of CCD Astronomy" by S.B. Howell (Very good reference for CCDs)

"Handbook of Infrared Astronomy" by I.S. Glass

"Astronomical Observations: An Optical Perspective" by G. Walker (good intro to instrumentation)

"Fundamental Astronomy" by H. Karttunen et al.

"Numerical Recipes: The Art of Scientific Computing", Press et al (good place to find algorithms )

## Current Schedule of Classes for Astronomy 302 Spring 2015

Wed. Jan 14

Lecture 1: [Introduction to the Class & Telescopes](#) -- Karttunen Chapter 3.1 & 3.2

**\*\*sign up for sagan LINUX account on computers\*\***

Steward Observatory, room 204

Fri. Jan 16

Lab 1: **Introduction to Lab and CCDs** -- Chapter 2 Howell

**\*\* test out accounts, intro. to IRAF --start project #1: simple data reduction\*\***

NOTE: Steward Computer Lab (rm 208)

Mon. Jan 19 -- No Class

Wed. Jan 21 -- Introduction to Class projects and 61inch with Dr. Betsy Green

Fri. Jan 23

Lab 2: **work on project #1, basic data reduction, bias, flat, and averaging**

**\*\*continue work on project #1\*\***

rm 208

Mon. Jan 26

Lecture 2: [More on Telescopes, Diffraction, & Imaging](#) -- Karttunen Chapter 3.3

rm 204

Wed. Jan 28 -- assign groups

Lecture 3: [Noise](#) -- Discrete and Continuous, Variance, Gaussian, Sigma, RMS

room 204

Fri. Jan 30

Lab 3: **Continue working on project#1, intro to photometry, lists, imexam etc.**

room 208

Mon. Feb. 2

Lecture 4: [Finish Noise Lecture](#) --Poisson Distribution, Counting statistics, Example of sky noise

General Case, Chi-squared

room 204

Wed. Feb 4

Lecture 5: [How to Observe](#)

room 204

Fri. Feb. 6

Lab 4: ***finish Project #1***

room 208

Mon Feb 9

\*\*\*\*\* PROJECT 1 Due t Start of Class \*\*\*\*\*

Lecture 6: [RA, Dec, Airmass etc](#) -- Howell Chapter 4

room 204

Wed. Feb 11

\*\*\*\*\* Submit Observing Proposals \*\*\*\*\*

Lecture 7 & 8 : [CCDs](#) and [CCD data reduction](#) -- Karttunen Chap 4, 2

room 204

Fri. Feb 13

Lab 5: Start project#2: Advanced CCD reduction, make flats, DAOPhot Apphot

room 208

Mon. Feb 16

\*\*\*\*\* Assign Nights \*\*\*\*\*

Lecture 7: [CCD noise calculations](#) -- Karttunen Chap 4, 2

room 204

Wed. Feb 18

Iterate on the proposed projects. Finalize the projects

finish [CCD noise calculations](#) -- Karttunen Chap 4, 2

Iterate on the proposed projects. Finalize the projects

room 204

Fri. Feb 20

\*\* Group 1 goes with Dr. Green around 2PM, ---first half night Dark\*\*

Lab 6: Work on project#2: PSF fitting Photometry & Astrometry with IRAF DAOPHOT

room 208

Sat Feb 21,

\*\*\*\*\*Group 2 leaves at 2PM to Mt Bigelow with Dr. Green., ---first half night Dark\*\*\*\*\*

Mon. Feb. 23  
Midterm review  
rm 204

Wed. Feb 25  
\*\*\*\*\* MIDTERM EXAM \*\*\*\*\*  
rm 204

Fri. Feb. 27  
\*\*\*\*\*Group 3 goes observing at 2PM --- for either half, bright time\*\*  
Lab 7: Continue work on Project#2, sorting final list etc.  
room 208

Sat. Feb 28  
\*\*\*\*\* Group 4 goes observing at 2PM -- for either half, bright time\*\*

Mon. March 2  
Lecture 9: [Image Formation, Deconvolution, and Photometry](#) -- Chapter 5 Howell  
room 204

Wed. March 4  
Lecture 11: [Adaptive optics](#)  
room 204

Fri. March 6  
Lab 8 Finish Project#2, sorting final list etc.  
room 208

Mon March 9  
Lecture 12: [AO systems](#)  
room 208

Wed. March 11  
\*\*\*\*\* Hand in Project #2 \*\*\*\*\*

Lecture 13: [Spectra](#)

room 204

Fri. March 13

*\*\*\*Backup groups leave 2PM to Mt. Bigelow with Betsy Green (as needed) for second half gray\*\*\*\*\**

Lab 9: **Work on group projects**

room 208

Sat. March 14

*\*\*Backup groups leave 2PM to Mt. Bigelow with Betsy Green (as needed) for second half gray\*\*\*\*\**

SPRING BREAK WEEK

Mon. March 23

Lecture 14: [Spectra part 2](#)

room 204

Wed. March 25

Lecture 15: [How to Write An Astronomy Paper: Project Report Format](#)

room 204

Fri. March 27

Lab 10: **Work on group projects**

room 208

Mon. March 30

Lecture 18: [Steward's Large Telescopes, and National Facilities](#)

room 204

Wed. April 1



lecture 19: Large Telescopes Now and in the Future

room 204

Fri. April 3

Lab 11: **Work on group projects**

room 208

Mon. April 6

\*\*\*\*\* REVIEW for EXAM  
\*\*\*\*\*

room 204

Wed. April 8

\*\*\*\*\* Course EXAM  
\*\*\*\*\*

room 204

Fri. April 10

Lab 10: **Work on group projects**

room 208

Mon. April 13

present group Analysis progress to Dr. Close (groups 1-4)  
rm 204

Wed. April 15

Present informally group power points to Dr. Close (groups 1-4)

Fri. April 17

**Lab 10: Final Work on group projects**

room 208

**Mon. April 20**

**Groups 1 & 2 Present to Class  
rm 204**

**Wed. April 22**

**Groups 3 & 4 Present to Class  
Rm 204**

**Friday April 24**

**All 302 students Submit their final individual Projects Reports to Dr. Close  
rm 208**