Course Syllabus

Jump to Today ✎ **Edit**

AST 301: Observational Astronomy

Dr. Maria Drout & Dr. Michael Reid

Classes: Wednesdays, 12-2pm in **MY 380**
Tutorials: Thursdays, 3-4pm in **MY 330** (note the different room number for tutorials)
The course will begin meeting on September 5th, during the first tutorial timeslot
Discussion Forums: The discussion forums should be your main point of contact for us. Any question for which there is no specific forum can be asked in **General Questions**.
Email: ast301@astro.utoronto.ca (mailto:ast301@astro.utoronto.ca) Please reserve email exclusively for confidential questions. All other questions should go on the discussion forums, where other students may benefit from the answers.

Course Description

Astronomers make a lot of bold claims about the universe: that it is filled with strange and tenuous substances called dark matter and dark energy, that it is filled with planets, that it may be infinite in size, and that it is always getting bigger. How can we possibly know these things? What methods allow us to make these discoveries from our humble position on an out-of-the-way planet?

In this course, we will use hands-on activities to explore the methods used by modern astronomers to answer some of the Big Questions. Using some of the same equipment used by professional astronomers, you'll make your own observations of the cosmos. You'll study stars as they explode in real time, reveal the motions of galaxies, and prove to yourself that the universe is getting bigger every day. This course is intended for students with majors outside the physical sciences who want to gain experience with hands-on observational astronomy. Basic arithmetic will used, but no advanced mathematics. Most of the math you will need to do for this course will be done via simple programs in the Python programming language, for which templates will be provided. No previous experience with programming is required.

Important Dates

The course will begin meeting on September 5th, during the first tutorial timeslot

Due dates for graded materials are as follows:

▾ Assignments   `25% of Total` + ⋮

Assignment 1: The Powers of Telescopes
Week 2 (Sep. 11 & 12): Powers of Telescopes Module | **Not available until** Sep 11 | **Due** Sep 18 at 11:59am

Assignment 2
Week 5 (Oct. 2 & 3): Flex Week Module | **Not available until** Oct 2 | **Due** Oct 9 at 11:59am

Assignment 3: Measuring Distance Using Parallax
Week 6 (Oct. 9 & 10): Astronomical Distances Part 1 -- Parallax Module | **Not available until** Oct 9 | **Due** Oct 16 at 11:59am

Assignment 4: Supernova Distances
Week 9 (Oct. 30 & 31): Astronomical Distances Part 3 -- Supernovae Module | **Not available until** Oct 30 | **Due** Nov 13 at 11:59am

Assignment 5: The Motions of Galaxies
Week 11 (Nov. 20 & 21): The Motions of Galaxies Module | **Not available until** Nov 20 | **Due** Nov 27 at 11:59am

▾ Reports   `60% of Total` + ⋮

Report 1: Properties of Optical Detectors
Week 3 (Sep. 18 & 19): Properties of Optical Detectors Module | **Not available until** Sep 18 | **Due** Sep 25 at 11:59am

Report 2: Essentials of Spectroscopy
Week 4 (Sep. 25 & 26): The Essentials of Spectroscopy Module | **Not available until** Sep 25 | **Due** Oct 2 at 11:59am

Report 3: Variable Stars
Week 7 (Oct. 16 & 17): Astronomical Distances Part 2 -- Variable Stars Module | **Not available until** Oct 16 | **Due** Oct 23 at 11:59am

Report 4: Photometry of Supernovae
Week 8 (Oct. 23 & 24): Photometry of Supernovae Module | **Not available until** Oct 23 | **Due** Oct 30 at 11:59am

Report 5: The Motions of Stars
Week 10 (Nov. 13 & 14): The Motions of Stars Module | **Not available until** Nov 13 | **Due** Nov 20 at 11:59am

Report 6: Measuring Hubble's Law
Week 12 (Nov. 27 & 28): Hubble's Law and the Expansion of Space Module | **Not available until** Nov 27 | **Due** Dec 4 at 11:59am

▾ Pre-class Activities   `15% of Total` + ⋮

Pre-Class Activity: The Powers of Telescopes
Week 2 (Sep. 11 & 12): Powers of Telescopes Module | **Not available until** Sep 5 | **Due** Sep 10 at 11:59am

Pre-Class Activity: Properties of Optical Detectors
Week 3 (Sep. 18 & 19): Properties of Optical Detectors Module | **Not available until** Sep 11 | **Due** Sep 17 at 11:59am | 9 pts

Pre-Class Activity: Essentials of Spectroscopy
Week 4 (Sep. 25 & 26): The Essentials of Spectroscopy Module | **Not available until** Sep 18 | **Due** Sep 24 at 11:59am

Pre-Class Activity: Astronomical Distances Part 1 -- Parallax
Week 6 (Oct. 9 & 10): Astronomical Distances Part 1 -- Parallax Module | **Not available until** Oct 2 | **Due** Oct 8 at 11:59am

Pre-Class Activity: Astronomical Distances Part 2 -- Variable Stars
Week 7 (Oct. 16 & 17): Astronomical Distances Part 2 -- Variable Stars Module | **Not available until** Oct 9 | **Due** Oct 15 at 11:59am

Pre-Class Activity: Photometry of Supernovae
Week 8 (Oct. 23 & 24): Photometry of Supernovae Module | **Not available until** Oct 16 | **Due** Oct 22 at 11:59am

Pre-Class Activity: Astronomical Distances Part 3 -- Supernovae
Week 9 (Oct. 30 & 31): Astronomical Distances Part 3 -- Supernovae Module | **Not available until** Oct 23 | **Due** Oct 29 at 11:59am

Pre-Class Activity: The Motions of Stars
Week 10 (Nov. 13 & 14): The Motions of Stars Module | **Not available until** Nov 6 | **Due** Nov 12 at 11:59am

Pre-Class Activity: The Motions of Galaxies
Week 11 (Nov. 20 & 21): The Motions of Galaxies Module | **Not available until** Nov 13 | **Due** Nov 19 at 11:59am

Pre-Class Activity: Hubble's Law and the Expansion of Space
Week 12 (Nov. 27 & 28): Hubble's Law and the Expansion of Space Module | **Not available until** Nov 20 | **Due** Nov 26 at 11:59am

Required Materials

There is no required textbook for this course. You will be provided with online resources to read in preparation for each class. We will draw many readings from **OpenStax Astronomy** **(https://openstax.org/details/books/astronomy/)**, a high-quality free astronomy textbook. It's available on the web, in many downloadable formats, and in a print edition (there is a fee for the printed version). The online version is the most up-to-date.

Course Learning Goals

By the end of the course, you will be able to:

1. Demonstrate that the universe is expanding.
2. Use astronomical techniques such as photometry and spectroscopy to characterize stars and galaxies.
3. Describe how astronomical cameras work and plan observations using them.
4. Distinguish different types of spectra and interpret them.
5. Measure the distances to stars using parallax and understand the limitations of this technique.
6. Use "standard candles" such as type Ia supernovae to measure distances across the universe.
7. Measure the Doppler shift of stars from their spectra, and understand the uncertainties of these measurements.
8. Measure the recession rate of a galaxy using its spectrum, and use recession rates to measure Hubble's Law.

Office Hours

No appointment is required for office hours. Both of our offices are located at 50 St. George Street, just across the road from the Myhal building where our classes take place.

- Dr. Drout's office hours in AB 227:
  - Mondays, 3:10-4:00pm.
- Dr. Reid's office hours in AB 129.
  - Tuesdays, 2:10-3:00 p.m.
  - Thursdays 1:10-2:00 p.m.
- TA Bethany Ludwig's office hours, in AB 123.
  - Mondays, 2:10-3:00 p.m. (Starting the week of Sept 18th).

Grading Scheme

This course is broken into themed modules. For each module, you will be graded on a pre-class activity, and either a short assignment or a longer report. The relative weights of these activities are as follows:

Pre-class Activities: 15%
Reports: 60%
Assignments: 25%

To allow you some opportunity to practice your skills without too much fear of failure, **we will drop your lowest score among the pre-class activities and the reports** (but not among the assignments, of which there will be relatively few). The remaining grades in each category will be weighted equally before computing for your final grade in that category. So, for example, if one report is out of 21 marks and another is out of 32 marks, they will both be converted to percentages and weighted equally within the "reports" section of your final grade.

There will be no midterm or final exam in this course. We want to see the best work you can do on an ongoing basis, not what you can do in a burst in a few hours. Keep in mind that this means you will need to put in sustained effort during the semester to earn a good grade. Remember to ask for help when you need it--we are very happy to provide it.

Pre-class Activities

Prior to each class, you will be assigned a graded activity on Quercus. To complete this activity, you will need to have done the recommended readings. The purpose of these activities is for you to choose a methodology to use to complete the in-class activity. It is very important that you complete these pre-class activities prior to coming to class. The deadline for each one will be 24 hours prior to the start of class. As soon as the deadline passes, the answers will be released to everyone so that you can consider any alterations you may have

to make to your method before coming to class. **Because the answers will be released immediately after the deadline, no extensions are possible for these pre-class activities, and no part-marks will be awarded for answers submitted after the deadline.**

Deadlines

We have posted preliminary deadlines for each graded component of the course.The nature of this course is that we will be somewhat dependent on the weather. A few of the modules depend on access to the sky in order to make observations. In the event that the weather does not cooperate, we will revise the deadlines to allow you more time complete any given assignment or report. We will notify you of these changes in advance and they will always be in your favour, meaning that they would only ever constitute extensions.

Requirement to Work Evenings/After Hours

One of the modules for this course will require using the telescopes on the roof of the McLennan Physics building after dark. This work is weather-dependent: you will have to wait for a clear night to complete your observations. We will schedule observing sessions mainly during October and will notify you a week or more in advance. Each of you will be responsible for coming to the observatory on **at least one clear night**, but you will have some flexibility in choosing which night. We will monitor the cloud forecast and will notify you in the afternoon if a scheduled observing session will have to be cancelled.

If working on campus late in the evening a few times a semester will pose insurmountable difficulties for you (for example, because of family care responsibilities or inflexible employment hours), please **speak to us within the first week of the semester** and we will work through possible accommodations.

Please be aware of your personal safety when returning home from campus after dark. U of T offers a free **TravelSafer program (http://campuspolice.utoronto.ca/travelsafer-2/)** to escort you safely to your dorm or to public transit.

Illnesses, Absences, & Missed Work

Valid reasons for missing work or class include: illness or injury, death or illness of a loved one, religious observance, national service, invited participation in a major musical/athletic/political event, late enrolment, etc. Please send us an email to **ast301@astro.utoronto.ca (mailto:ast301@astro.utoronto.ca)** if you are unsure whether the reason for your absence warrants an accommodation. Please also note that it is at the instructors' final discretion to determine whether a reason is valid.

In case of illness, you can ask your doctor to fill out this form: **http://www.illnessverification.utoronto.ca/ (http://www.illnessverification.utoronto.ca/)** . The medical certificate will need to excuse you from whatever term work you have missed. It's important to note that the form can only be accepted if it is signed, stamped and dated by a Dentist, Nurse/Nurse Practitioner, Physician/Surgeon, Psychologist, Psychotherapist or Social Worker registered and licensed in the Province of Ontario. Please send a photo or scan of the form to us at **ast301@astro.utoronto.ca (mailto:ast301@astro.utoronto.ca)** if you are unable to give us the hard copy.

For non-medical absences, other documentation can be evidence of participation, for example, a note from your registrar. Please contact us if you are unsure of what documentation to provide to obtain an accommodation.

Academic Integrity

All students are expected to rigorously adhere to the university's **Code of Behaviour on Academic Matters (https://www.viceprovoststudents.utoronto.ca/students/)** .

Make completely sure that you understand the Code and all of its contents before submitting any work to be graded in this course. In brief, if you submit work for us to grade, you are certifying that the entirety of your work is uniquely and originally your own. Anything you use that is not your own creation (ideas, text, images, and so on) must be clearly cited. While we encourage you to collaborate with your classmates, especially across disciplines, whatever work you submit for grading must reflect your individual understanding of the material. We strongly encourage you to review this helpful **webpage on what constitutes Academic Misconduct. (https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity-osai/academic-misconduct)**

You should also read the university's excellent advice on **proper use and citation of sources in research. (https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity-osai/where-get-help)**

Accessibility

Our aim is to accommodate any student who wishes to take this course. If you have any accessibility needs, please feel free to visit us during office hours or email us at **ast301@astro.utoronto.ca (mailto:ast301@astro.utoronto.ca)**

Please note that the on-campus observatory, which you will need to visit once during the semester, is not accessible. It is up two flights of stairs with no direct elevator access. If this will represent a barrier to you, please let us know as soon as possible and we will work with you to make alternate accommodations.

The University of Toronto offers a wide variety of accommodations for students with disabilities and persistent health problems. Please see **Accessibility Services (https://www.studentlife.utoronto.ca/as)** to learn about accommodations that may be available to you. They can make a confidential assessment of your needs and pass this information along to your professors. If you are registered with Accessibility Services, please forward your documentation to **ast301@astro.utoronto.ca (mailto:ast301@astro.utoronto.ca)** as early as possible and we will be happy to make accommodations.

Course Summary:

Date	Details	
Thu Sep 5, 2019	📅 **Class (https://q.utoronto.ca/calendar?event_id=127341&include_contexts=course_121430)**	3pm to 4pm
Tue Sep 10, 2019	📝 **Pre-Class Activity: The Powers of Telescopes (https://q.utoronto.ca/courses/121430/assignments/203380)**	due by 11:59am
Wed Sep 11, 2019	📅 **Class (https://q.utoronto.ca/calendar?event_id=127354&include_contexts=course_121430)**	12pm to 2pm
Thu Sep 12, 2019	📅 **Class (https://q.utoronto.ca/calendar?event_id=127342&include_contexts=course_121430)**	3pm to 4pm
Tue Sep 17, 2019	📝 **Pre-Class Activity: Properties of Optical Detectors (https://q.utoronto.ca/courses/121430/assignments/198192)**	due by 11:59am
Wed Sep 18, 2019	📅 **Class (https://q.utoronto.ca/calendar?event_id=127355&include_contexts=course_121430)**	12pm to 2pm
	📝 **Assignment 1: The Powers of Telescopes (https://q.utoronto.ca/courses/121430/assignments/203370)**	due by 1pm
Thu Sep 19, 2019	📅 **Class (https://q.utoronto.ca/calendar?event_id=127343&include_contexts=course_121430)**	3pm to 4pm
Tue Sep 24, 2019	📝 **Pre-Class Activity: Essentials of Spectroscopy (https://q.utoronto.ca/courses/121430/assignments/188130)**	due by 11:59am
Wed Sep 25, 2019	📝 **Report 1: Properties of Optical Detectors (https://q.utoronto.ca/courses/121430/assignments/203381)**	due by 11:59am
	📅 **Class (https://q.utoronto.ca/calendar?event_id=127356&include_contexts=course_121430)**	12pm to 2pm
Thu Sep 26, 2019	📅 **Class (https://q.utoronto.ca/calendar?event_id=127344&include_contexts=course_121430)**	3pm to 4pm
Wed Oct 2, 2019	📝 **Report 2: Essentials of Spectroscopy (https://q.utoronto.ca/courses/121430/assignments/188131)**	due by 11:59am
	📅 **Class (https://q.utoronto.ca/calendar?event_id=127357&include_contexts=course_121430)**	12pm to 2pm
Thu Oct 3, 2019	📅 **Class (https://q.utoronto.ca/calendar?event_id=127345&include_contexts=course_121430)**	3pm to 4pm
Tue Oct 8, 2019	📝 **Pre-Class Activity: Astronomical Distances Part 1 -- Parallax (https://q.utoronto.ca/courses/121430/assignments/203501)**	due by 11:59am
Wed Oct 9, 2019	📝 **Assignment 2 (https://q.utoronto.ca/courses/121430/assignments/206030)**	due by 11:59am
	📅 **Class (https://q.utoronto.ca/calendar?event_id=127358&include_contexts=course_121430)**	12pm to 2pm

Date	Details	
Thu Oct 10, 2019	📅 **Class** (https://q.utoronto.ca/calendar?event_id=127346&include_contexts=course_121430)	3pm to 4pm
Mon Oct 14, 2019	📅 **Thanksgiving - University Closed** (https://q.utoronto.ca/calendar?event_id=129031&include_contexts=course_121430)	12am
Tue Oct 15, 2019	📝 **Pre-Class Activity: Astronomical Distances Part 2 -- Variable Stars** (https://q.utoronto.ca/courses/121430/assignments/205990)	due by 11:59am
Wed Oct 16, 2019	📝 **Assignment 3: Measuring Distance Using Parallax** (https://q.utoronto.ca/courses/121430/assignments/203502)	due by 11:59am
	📅 **Class** (https://q.utoronto.ca/calendar?event_id=127359&include_contexts=course_121430)	12pm to 2pm
Thu Oct 17, 2019	📅 **Class** (https://q.utoronto.ca/calendar?event_id=127347&include_contexts=course_121430)	3pm to 4pm
Tue Oct 22, 2019	📝 **Pre-Class Activity: Photometry of Supernovae** (https://q.utoronto.ca/courses/121430/assignments/206002)	due by 11:59am
Wed Oct 23, 2019	📝 **Report 3: Variable Stars** (https://q.utoronto.ca/courses/121430/assignments/206031)	due by 11:59am
	📅 **Class** (https://q.utoronto.ca/calendar?event_id=127360&include_contexts=course_121430)	12pm to 2pm
Thu Oct 24, 2019	📅 **Class** (https://q.utoronto.ca/calendar?event_id=127348&include_contexts=course_121430)	3pm to 4pm
Tue Oct 29, 2019	📝 **Pre-Class Activity: Astronomical Distances Part 3 -- Supernovae** (https://q.utoronto.ca/courses/121430/assignments/206004)	due by 11:59am
Wed Oct 30, 2019	📝 **Report 4: Photometry of Supernovae** (https://q.utoronto.ca/courses/121430/assignments/206032)	due by 11:59am
	📅 **Class** (https://q.utoronto.ca/calendar?event_id=127361&include_contexts=course_121430)	12pm to 2pm
Thu Oct 31, 2019	📅 **Class** (https://q.utoronto.ca/calendar?event_id=127349&include_contexts=course_121430)	3pm to 4pm
Mon Nov 4, 2019	📅 **Fall Reading week** (https://q.utoronto.ca/calendar?event_id=129003&include_contexts=course_121430)	12am
Tue Nov 5, 2019	📅 **Fall Reading week** (https://q.utoronto.ca/calendar?event_id=129004&include_contexts=course_121430)	12am
Wed Nov 6, 2019	📅 **Fall Reading week** (https://q.utoronto.ca/calendar?event_id=129005&include_contexts=course_121430)	12am
Thu Nov 7, 2019	📅 **Fall Reading week** (https://q.utoronto.ca/calendar?event_id=129006&include_contexts=course_121430)	12am
Fri Nov 8, 2019	📅 **Fall Reading week** (https://q.utoronto.ca/calendar?event_id=129007&include_contexts=course_121430)	12am
Tue Nov 12, 2019	📝 **Pre-Class Activity: The Motions of Stars** (https://q.utoronto.ca/courses/121430/assignments/206006)	due by 11:59am
Wed Nov 13, 2019	📝 **Assignment 4: Supernova Distances** (https://q.utoronto.ca/courses/121430/assignments/206033)	due by 11:59am
	📅 **Class** (https://q.utoronto.ca/calendar?event_id=127363&include_contexts=course_121430)	12pm to 2pm
Thu Nov 14, 2019	📅 **Class** (https://q.utoronto.ca/calendar?event_id=127351&include_contexts=course_121430)	3pm to 4pm
Tue Nov 19, 2019	📝 **Pre-Class Activity: The Motions of Galaxies** (https://q.utoronto.ca/courses/121430/assignments/206010)	due by 11:59am

Date	Details	
Wed Nov 20, 2019	📝 **Report 5: The Motions of Stars (https://q.utoronto.ca/courses/121430/assignments/206035)**	due by 11:59am
	📅 **Class (https://q.utoronto.ca/calendar?event_id=127364&include_contexts=course_121430)**	12pm to 2pm
Thu Nov 21, 2019	📅 **Class (https://q.utoronto.ca/calendar?event_id=127352&include_contexts=course_121430)**	3pm to 4pm
Tue Nov 26, 2019	📝 **Pre-Class Activity: Hubble's Law and the Expansion of Space (https://q.utoronto.ca/courses/121430/assignments/206017)**	due by 11:59am
Wed Nov 27, 2019	📝 **Assignment 5: The Motions of Galaxies (https://q.utoronto.ca/courses/121430/assignments/206039)**	due by 11:59am
	📅 **Class (https://q.utoronto.ca/calendar?event_id=127365&include_contexts=course_121430)**	12pm to 2pm
Thu Nov 28, 2019	📅 **Class (https://q.utoronto.ca/calendar?event_id=127353&include_contexts=course_121430)**	3pm to 4pm
Wed Dec 4, 2019	📝 **Report 6: Measuring Hubble's Law (https://q.utoronto.ca/courses/121430/assignments/206037)**	due by 11:59am
	📅 **Class (https://q.utoronto.ca/calendar?event_id=127366&include_contexts=course_121430)**	12pm to 2pm