Astronomy 102: Relativity, Black Holes, & the Big Bang

Prof. Kelly Douglass

Fall 2024

In Astronomy 102, we present a physical and astronomical (but mostly non-mathematical) picture of the workings of Einstein's theory of relativity and its application to black holes and the Big Bang. Black holes turn out to be quite real, and the origin and expansion of the Universe has a lot in common with black holes. All of this is connected with relativity in a manner that is a lot less mysterious than one might think. As we explore the connections, we will find many good examples of the processes by which scientific theories are conceived and advanced.

Instructor Prof. Kelly Douglass

Email kellyadouglass@rochester.edu

Phone number 5-5549

Office B&L 425

Office hours Tuesdays & Thursdays 3:30–4:30PM ET or by appointment *in advance*

TI James McKeown

Email jmckeown@u.rochester.edu

Office POA Library

Office hours Wednesdays 7–8PM ET

TI Srujamya Sampathi

Email ssampat3@u.rochester.edu

Office POA Library

Office hours Mondays 8:15–9:15PM ET

Website

The course website can be found at `http://www.pas.rochester.edu/~kdouglass/Classes/Astr102/`; this is the main reference for the course. Here, you can find complete lecture presentations, the electronic homework and exams, as well as other helpful resources.

Blackboard

The class Blackboard page does exist, but it will only contain the bare minimum information for this course. Please consult the class website (listed above) for all details.

Textbooks

Required: *Black Holes and Time Warps: Einstein's Outrageous Legacy* by Kip Thorne.

Here is a list of supplemental recommended texts for your reference. They will sometimes be referenced during the lecture. All of these books are available on reserve at the POA for your reference; you should not feel compelled to buy any of these.

Michael A. Seeds	*Foundations of Astronomy*
Stephen Hawking	*A Brief History of Time*
Joseph Silk	*The Big Bang*

Lectures

Tuesdays and Thursdays from 2:00–3:15PM in ~~Wegmans 1400~~ LeChase 141, conducted by Prof. Douglass. All the material for each lecture will be available to you on the class website. It is strongly encouraged that you take notes on the slides during lecture, so either print these out and bring them with you or have them downloaded on your laptop/tablet with note-taking capabilities.

Recitations

Recitations will begin the first week of classes. James and Srujamya will conduct the recitation sections. You may attend any or all of the sections, but you must register for one. See the Recitations page on the course website for a schedule of events.

Day	Time	Location	TI
Wednesday	2–3:15PM	B&L 203H	Srujamya
Thursday	4:50–6:05PM	Gavett 301	James

Attendance & class participation

All members of the class are expected to attend all lectures and one recitation each week. This is, of course, for your own benefit. To emphasize the importance of coming to and being an active member of class, class participation will comprise 5% of your final grade for the course. Your class participation score will be based upon the submission of your answers to in-class questions and upon your attendance in recitation.

Films and clips

A few short movies elaborating on or illuminating crucial aspects of the material introduced in lectures or textbooks, as well as some TV clips will be shown during recitations as exhibits of Bad Astrophysics in the Mass Media. These will help you learn to detect the frequent, unintentionally humorous, mistakes made by filmmakers when they refer to astronomy or other sciences. Each film or clip will be followed by a thorough discussion led by the teaching assistants. The films and clips will be shown throughout the semester; screenings will be listed on the Recitations page of the ASTR 102 class website. You should see each film and clip at least once: the Bad Astrophysics material will appear on each of the exams.

The ASTR 102 Film Festival

We will also watch two feature-length Hollywood movies, *Star Trek* (2009) and *Interstellar* (2014). They are both good movies, rich in references to and discussions of black holes and related objects, but one of them is scientifically correct *much* more frequently than the other. They will be shown on two different evenings during the semester starting at 6pm both nights. The first movie on the first night will be the second on the second night, and vice versa. Abundant refreshments will be served. You should see each of them at least once, as the material introduced will appear on Exam #3.

Homework assignments

Problem sets will be due roughly every other week at 11:59PM ET on either Monday or Wednesday (see schedule). Each problem set will involve use of the WeBWorK system, a program that enables students to answer questions interactively with immediate feedback and immediate, automatic grading. In general, your problem sets will be different than your classmates'. Once assigned, your personalized problem sets will be accessible online. Each problem set will be 2.5% of your final grade; with eight total throughout the semester, this means that your homework assignments count for 20% of your final grade for the course.

We strongly encourage you to work together with your fellow classmates on the problem sets. The solutions you submit, however, must be your own thought and expressed in your own words, in accordance with the University's academic honesty policies.

Exams

There will be three exams given in class on Thursday, September 26, November 7, and December 5. Each exam is cumulative, although they will concentrate on any material that was not yet covered on another exam. Therefore, there is no final exam for this class. You must take all three exams in order to pass the course. Each exam is worth 25% of your final grade for this course.

If you miss an exam due to illness or emergency, a make-up exam can be scheduled. All make-up exams will be oral examinations of one hour and fifteen minutes in length. Prof. Douglass will determine if a situation is an emergency or not; her decision is final, whether or not it aligns with your opinion. Suddenly finding yourself with airline tickets for an exam date, for example, does not count as an emergency. Oral exams will be administered and graded by Prof. Douglass.

The best way to study for an exam is by doing the homework and working through the sample exams on the class website (made available a few days before each exam). The TIs will host review sessions the night before each exam.

Academic honesty

According to the UR Academic Honesty Policy, cheating consists of submission of homework or exam solutions that are not your own work, or submissions of solutions under someone else's name. By University rules, any detected act of cheating that is not the result of a simple misunderstanding will be handed over to the Board on Academic Honesty for investigation.

Grading

As outlined above, your grade for this course will be calculated as follows:

Homework	20%
Exam 1	25%
Exam 2	25%
Exam 3	25%
Class participation	5%

No extra credit assignments will be assigned that are not available to the entire class. Final letter grades will be assigned based on an absolute scale (not "by a curve"). The grading scale will be as follows:

Percentage score	≥ 85	≥ 80	≥ 75	≥ 70	≥ 65	≥ 60	≥ 55	≥ 50	≥ 40	< 40
Final grade	A	A-	B+	B	B-	C+	C	C-	D	F

Extra help

Office hours are listed on the course website; if you cannot make the hours, appointments are available. Please come in and see us. We will also answer questions via email and will often be electronically accessible late into the night when problem set due dates and exams approach. We are happy to answer any questions you have concerning the course by either means. Questions from those who find the material confusing enough that they do not know what to ask are most welcome.

Credit hour policy

This course follows the College credit hour policy for four-credit courses. This course meets two times weekly for three academic hours per week. The course also includes recitations that meet for 1.5 academic hours per week.

Statement of inclusion

The University of Rochester, this course, and its teaching staff are committed to inclusion and welcome students of all backgrounds and abilities. Services and reasonable accommodations are available to students with temporary and permanent disabilities, to students with DACA or undocumented status, to students facing mental health issues, other personal situations, and to students with other kinds of learning needs. Please feel free to let any of us know if there are circumstances affecting your ability to participate in class or your full participation in this course. Some resources that might be of use include:

- Undocumented/DACA Student Support Contacts `https://www.rochester.edu/college/ccas/undergraduate/daca/index.html`
- University of Rochester CARE network `https://www.rochester.edu/care/`
- Office of Disability Resources (see below)

Disability resources

The University of Rochester respects and welcomes students of all backgrounds and abilities. In the event that you encounter any barrier(s) to full participation in this course due to the impact of a disability, please contact the Office of Disability Resources. The access coordinators in the Office of Disability Resources can meet with you to discuss the barriers that you are experiencing and explain the eligibility process for establishing academic accommodations. You can reach the Office of Disability Resources at disability@rochester.edu; (585) 276-5075; Taylor Hall; `www.rochester.edu/college/disability`.

Mental health services

Managing your mental and physical health while keeping up with all the academic responsibilities may be especially challenging, given the ongoing pandemic. The University offers support services in a variety of areas and has adapted to supporting students both in-person and online. We encourage you to review the services offered and reach out should you find yourself struggling. You can find a list of services, with descriptions, at `https://www.rochester.edu/college/first-year/guide/support/index.html`.

