

**High Energy Astrophysics**  
**01:750:442**  
**Fall 2020**

Instructor: Professor John P. Hughes

Summary: Radiation and scattering processes in plasma. Detection and X- and gamma-rays. Supernovae and remnants, pulsars. Gamma-ray bursts. Accretion disks and binary star outbursts. Quasars and active galactic nuclei. Cosmic rays.

This course is one of four 400 level astrophysics courses that serve as electives for the astrophysics major and astronomy minor. It is offered in fall semester every other year (even years).

Pre-requisites: 01:750:342 or (01:750:361 and 01:750:385 and 01:750:386)

Co-requisites: None

Meeting times: Two 80 minute lectures per week.

Lecture: T-Th 6 (5:00 pm -6:20 pm)

Recitations: None

Texts:

- (1) "Introduction to High Energy Astrophysics" by Rosswog & Bruggen (Cambridge) (purchase)
- (2) "High Energy Astrophysics: An Introduction" by Courvoisier (available on-line from RU libraries)
- (3) "High Energy Astrophysics" by Longair (available on-line at Hathi trust from RU libraries)

LMS: Sakai

Provisional Plans for Remote Instruction:

The course format will consist of two 80-minute lectures each week given remotely at the usual scheduled class time. Slides of each lecture will be prepared beforehand and presented using the Meeting feature of Sakai. Slides will be made available on Sakai before the lecture or shortly thereafter.

Weekly homework (H/W) assignments will be posted on the Assignments tab of the Sakai course web site and must be turned in through Sakai. Only PDF documents will be accepted. H/W is due by 5:00PM, Friday, of the week indicated. Late homeworks will be assessed the following penalties:

- *First assignment*: minus 10% per hour late
- *Second assignment*: minus 50% per hour late
- *Third or later assignments*: no credit if late

In addition to weekly homework, there will be two in-class midterms and a final project. Some assignments may require you to write computer programs using a software package of your choice (e.g., python, IDL, Fortran, java, c, c++, Excel). The final project will be described and listed on the Assignments tab of the Sakai course web site and must be turned in through Sakai. Again only PDF documents will be accepted.

The in-class midterms will be open textbook and notes, but must be your own effort (no outside resources beyond those listed are allowed). While taking these tests, students will need to have their

web camera and microphone on and be visible to the instructor, using a Sakai Meeting session. They will need an app or cell phone camera to scan their test sheets and e-mail to them to the instructor.

Supplementary resources and relevant websites will be made available on the departmental course web site. Additional written materials will be posted under Resources on Sakai.

The instructor will have scheduled office hours several times during the week at times chosen by the class to accommodate students at different time zones. These will be held as Sakai Meetings. At least one office hour will be specifically devoted to the week's homework assignment. The instructor will also be available at other mutually convenient times for one-on-one Sakai Meetings sessions for students who are unable to attend a scheduled office hour or wish to have more detailed discussions about the course material.

Provisional Grading Plans:

Weekly homework: 34%

Two in-class midterms: 33% (total)

Final Project: 33%

Provisional Schedule:

<b>Week:</b>	<b>Topic</b>	<b>Readings</b>
Week 1	Intro to HEA, Special Relativity	
Week 2	Ionization losses, photon interactions with matter	
Week 3	Detectors and telescopes	
Week 4	Thermal processes and optically-thin emission (bremsstrahlung)	
Week 5	Clusters of galaxies	
Week 6	SNR evolution, shocked ejecta in supernova remnants	
Week 7	Optically-thick thermal emission (blackbody)	
Week 8	Binary systems and Compact objects	
Week 9	Accretion disks	
Week 10	Synchrotron and cyclotron radiation	
Week 11	Particle acceleration, shocks	
Week 12	Compton processes, tSZ in clusters	
Week 13	Active Galactic Nuclei	
"Week 14"	Two classes reserved for in-class midterm exams	

Academic Integrity:

Students are expected to maintain the highest level of academic integrity. You should be familiar with the university policy on academic integrity: <http://academicintegrity.rutgers.edu/academic-integrity-policy/> Violations will be reported and enforced according to this policy.

Use of external sources to obtain solutions to homework assignments or exams is cheating and a violation of the University Academic Integrity policy. Cheating in the course may result in penalties ranging from a zero on an assignment to an F for the course, or expulsion from the University. Posting of homework assignments, exams, recorded lectures, or other lecture materials to external sites without

the permission of the instructor is a violation of copyright and constitutes a facilitation of dishonesty, which may result in the same penalties as explicit cheating.

Not only does the use of such sites violate the University's policy on Academic Integrity, using such sites interferes with your achievement of the learning you are paying tuition for. Assignments, quizzes, and exams are given not simply to assign grades, but to promote the active learning that occurs through completing assignments on your own. Getting the right answer is much less important than learning how to get the right answer. This learning is critical to your success in subsequent courses and your careers.

### **Student wellness Services**

Student Counseling, ADAP & Psychiatric Services (CAPS) wellness for non-emergency psychological health issues services (848) 932-7884, 17 Senior Street, New Brunswick, NJ 08901  
<http://health.rutgers.edu/medical-counseling-services/counseling/>

Violence Prevention & Victim Assistance (VPVA), (848) 932-1181, 3 Bartlett Street, New Brunswick, NJ 08901, <http://www.vpva.rutgers.edu/>

Office of Disability Services (848) 445-6800, Lucy Stone Hall, Suite A145, Livingston, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854, <https://ods.rutgers.edu/>

Scarlet Listeners for confidential peer counseling and referral hotline, (732) 247-5555,  
<http://www.scarletlisteners.com>