Syllabus for Phys 595/495: High-Energy Astrophysics

Fall 2015

Instructor: Craig Heinke
Phone: (780) 222-4815
Email: heinke@ualberta.ca
Office: CCIS 2-109 (north side of CCIS)
Office hours: Wednesday 11:00am–noon.
I will also be happy to meet you at other times; email me to arrange an appointment, or just talk to me after class.

Course webpage: http://www.ualberta.ca/∼heinke/HiEAstro.html
Homework will be regularly posted to this page, along with other useful information.

Course time: generally **TTh 12:30-1:50 PM**, location CAB 273. I will be away Sept. 14-18, missing three class periods; I will find times acceptable to the class to make up these lectures (one will be for term project presentations). I will similarly make up any other class periods if I am forced to miss other classes.

Course Description: This course covers the interaction of radiation and matter, as it applies to astrophysical situations, except for stellar interiors (detailed in Astro 465).

Prerequisites: Background in electromagnetism, special relativity, quantum mechanics, and (preferably) statistical mechanics, at the undergraduate level. Astrophysical knowledge optional, but useful.

Required Textbook: Much of Bradt's "Astrophysics Processes" will be covered in this course. An additional chapter (the first to be covered) is provided on my course website. Carefully reading the chapters of Bradt discussed in class will be critical for learning the material.
Other useful texts are "Radiative Processes in Astrophysics", by Rybicki & Lightman (specifically for the first unit), Andrew Cumming's notes
(http://www.physics.mcgill.ca/∼cumming/teaching/642/phys642_all_notes.pdf) and "High Energy Astrophysics" by Malcolm Longair (especially the new 3rd edition).

Marking Schemes:

Scheme A (students not doing a term project)	
Homework (approximately every two weeks):	40%
Final Exam (likely Dec. 15, 2 pm):	40%
Midterm Test (date TBA):	20%
Scheme B (students doing term projects)	
Term project:	
-including written report	30%
-& oral presentation	15%
Homework (approximately every two weeks)	35%
Midterm Test (date TBA):	20%

Your homework problem set with the lowest score will be dropped from your final mark. Calculators and formulae sheets (I will distribute formulae sheets; feel free to modify them) are allowed in exams. The midterm will be in class, either Oct. 14, 16 or 19 (date chosen with input from students to minimize conflicts).

Term Projects:
Students may do term projects, involving literature research on a significant question in high energy astrophysics not covered in detail in our course, but related to physics discussed. The topic should be chosen by Oct. 30. It will involve a written report explaining the question, the relevant physics, and the current state of research in the area, of not more than 10 pages of text (not counting figures or references), due on Dec. 4. It will also include a presentation in class, 15 minutes long. The date for the term project presentations (one of the three replacement classes) will be between Dec. 8 and 15, agreed to in class.

Topics Covered: (and relevant chapters from the text)
1.) Fundamentals of radiative transfer. Equation of radiative transfer, optical depth, thermal radiation, the nature of absorption and emission lines (Bradt supplemental notes, Bradt 3.1-3.3, 6.1-6.2, 1st unit of Cumming notes).
2.) Radiation from free electrons: radiation from moving charges (2nd unit of Cumming notes, Bradt 5.3), and from relativistic particles (Bradt ch. 7).
3.) Bremsstrahlung radiation and its applications (Bradt ch. 5).
4.) Synchrotron radiation, curvature radiation, and their applications (Bradt ch. 8).
5.) Compton scattering and its applications (Bradt ch. 9).
6.) Radiation from bound electrons: examples of radiative transitions (Bradt ch. 10).
7.) Effects of plasma on the propagation of radiation (Bradt ch. 11).
We may cover additional topics if time allows, depending on the interests of the students.

Academic Integrity:

You may work together on homework assignments if you choose, but you must write up your solutions independently. Direct copying of another's work is plagiarism.

From the University Calendar:
"The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behavior (online at www.ualberta.ca/secretariat/appeals.htm) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University."

"All forms of dishonesty are unacceptable at the University. Cheating, plagiarism and misrepresentation of facts are serious offenses. Anyone who engages in these practices will receive at minimum a grade of zero for the exam or paper in question and no opportunity will be given to replace the grade or redistribute the weights. Any offense will be reported to the Senior Associate Dean of Science who will determine the disciplinary action to be taken."