Radiative Processes in Gases / Spring 2021 / Syllabus

Course Description: Introduction to the radiative processes relevant to astronomy and astrophysics at the graduate level, including: energy transfer by radiation; classical and quantum theory of photon emission; bremsstrahlung; synchrotron radiation; Compton scattering; plasma effects; and atomic and molecular electromagnetic transitions. We will refer to applications in current astrophysical research.

Learning Outcomes: Broad knowledge of radiative emission, absorption, and transfer effects and ability to perform theoretical calculations and estimates of these effects.

Assignments: There will be roughly weekly homeworks posted on the course web site. You will submit answers in the form of a LaTeX file or Python notebook, emailed to me. Grading will be based on the homework performance.

Material: The required textbook is *Radiative Processes in Astrophysics*, by Rybicki & Lightman. Other useful books are *Astronomical Spectroscopy* by Jonathan Tennyson, *Astrophysics of Gaseous Nebulae and Active Galactic Nuclei* by Osterbrock and Ferland, and *The Physics of Astrophysics, Volume I: Radiation* by Frank Shu.

The classes will proceed as shown on the next page. Class meets Monday and Wednesday at 3:30pm in Room 802 of 726 Broadway.

You can find the course notes at the course web site.

Feb. 1	Radiative Quantities (RL 1.1–1.3)	
Feb. 3	Radiative Transport (RL 1.4)	
Feb. 8	Thermal Radiation (RL 1.5)	
Feb. 10	Einstein Coefficients (RL 1.6)	
Feb. 15	**NO CLASS**	
Feb. 17	Scattering (RL 1.7–1.8)	**Exercise #1 due**
Feb. 18	E&M Review (RL 2)	
Feb. 22	Radiation (RL 3.1–3.3)	**Exercise #2 due**
Feb. 24	Radiation (RL 3.4)	
Mar. 1	Radiation (RL 3.5–3.6)	**Exercise #3 due**
Mar. 3	Line Broadening (RL 10.6)	
Mar. 8	Bremsstrahlung (RL 5.1)	**Exercise #4 due**
cr *Mar. 10*	Bremsstrahlung (RL 5.2–5.3)	
Mar. 15	Synchrotron (RL 6.1, some of RL 4)	
Mar. 17	Synchrotron (RL 6.2–6.3)	
Mar. 22	Synchrotron (RL 6.5, 6.8)	**Exercise #5 due**
Mar. 24	Compton Scattering (RL 7)	
Mar. 29	Compton Scattering (RL 7)	
Mar. 31	Plasma Effects (RL 8.1-8.2)	**Exercise #6 due**
Apr. 5	Cherenkov Radiation (RL 8.3)	
Apr. 7	Atomic Structure Basics (RL 9.1–9.2)	
Apr. 12	Atomic Structure (Many Electrons) (RL 9.3)	
Apr. 14	Atomic Transitions (Selection Rules) (RL 10.1–10.4)	
Apr. 19	**NO CLASS**	
Apr. 21	Ionization & Recombination (RL 10.5)	
Apr. 26	Molecular Structure (RL 11)	**Exercise #7 due**
Apr. 28	Molecular Transitions (RL 11)	
May 3	Masers	**Exercise #8 due**
May 5	Dust Absorption & Scattering	
May 10	HII Regions	**Exercise #9 due**