Radiative Processes in Astrophysics / Spring 2021 / Syllabus

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.

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

The lectures are based on *Radiative Processes in Astrophysics*, by Rybicki & Lightman. Other useful books are *Astrophysics of Gaseous Nebulae and Active Galactic Nuclei* by Osterbrock and Ferland, and *The Physics of Astrophysics, Volume I: Radiation* by Frank Shu.

Class meets Monday and Wednesday at 3:30pm in Room 1045 of 726 Broadway, according to Albert.

The classes will proceed as shown on the next page (subject to revision!).

Homework will be based on exercises posted on the course web site. You will submit an answer in the form of a LaTeX file or Python notebook, emailed to me.

This is the first year of this course so there is plenty of padding at the end—I expect that many of these topics will take longer than planned. If we do have time, the following topics may be covered: Cherenkov Radiation, the Wouthuysen-Field Effect, Collisional Excitation Cooling, Photoelectric Heater, Ly-α absorption and scattering, Radiation-driven Winds, or others.

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 3.4–3.6)	
Mar. 1	Emission from Relativistic Particles (RL 4)	**Exercise #3 due**
Mar. 3	Bremsstrahlung (RL 5)	
Mar. 8	Synchrotron (RL 6.1–6.3)	**Exercise #4 due**
cr *Mar. 10*	Synchrotron (RL 6.4–6.6)	
Mar. 15	Synchrotron (RL 6.7–6.9)	**Exercise #5 due**
Mar. 17	Compton Scattering (RL 7.1–7.3)	
Mar. 22	Compton Scattering (RL 7.4–7.7)	**Exercise #6 due**
Mar. 24	Plasma Effects (RL 8)	
Mar. 29	Atomic Structure (RL 9.1–9.3)	**Exercise #7 due**
Mar. 31	Atomic Structure (RL 9.4–9.5)	
Apr. 5	Radiative Transitions (RL 10.1–10.5)	**Exercise #8 due**
Apr. 7	Line Broadening (RL 10.6)	
Apr. 12	Molecular Structure (RL 11.1–11.3)	**Exercise #9 due**
Apr. 14	Molecular Structure (RL 11.4–11.5)	
Apr. 19	**NO CLASS**	
Apr. 21	Masers	
Apr. 26	Dust Absorption	**Exercise #10 due**
Apr. 28	Dust Scattering	
May 3	TBD	**Exercise #11 due (maybe)**
May 5	TBD	
May 10	TBD	**Exercise #12 due (maybe)**