

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. The course grade will be based 90% on the homework assignments, which will be weighted equally, and 10% on class participation.

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, *The Physics of Astrophysics, Volume I: Radiation* by Frank Shu, and *Physics of the Interstellar and Intergalactic Medium* by Bruce Draine.

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 on the web.

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