Radiation and Matter

Overview

I. Physical Introduction

1 Review of Classical Radiation
       1.1 Maxwell's equations, field energy and potentials
       1.2 Potentials in the wave zone – classical radiant energy
       1.3 Point charges, the LW potentials, Larmor radiation formula
       1.4 The radiation field as a set of oscillators
       1.5 Oscillator energies and Hamilton's equations

2   Quantum Radiation
       2.1 Quantized SHM
       2.2 Quantizing the radiation oscillators

3   Quantum interaction of radiation with matter
       3.1 Fermi's Golden Rule
       3.2 The interaction and the transition matrix
       3.3 Radiative transitions
       3.4 Black body radiation
       3.5 Electric dipole transitions and selection rules
       3.6 Electric quadrupole and magnetic dipoles

4   Radiative transfer
       4.1 Specific intensity and the equation of radiative transfer
       4.2 Optical depth and a solution to the equation of RT
       4.3 Line profiles

5   Collisions
       5.1 Cross-section and collision rate
       5.2 Critical density

II. Astronomical applications

       1 Lyman alpha line
       2 HI 21 cm line
       3 CO

Bibliography

       Standard texts on electromagnetism (Jackson is best; new ed. in SI, or Duffin, or
          Grant and Phillips, or Griffiths ...)
       Standard texts on quantum mechanics (Mandl, Bransden & Joachain, Landau & Lifshitz ...)
       Emerson, Interpreting Astronomical Spectra, Wiley, 1996
       Rybicki & Lightman, Radiative processes in astrophysics, Wiley, 1979
       Osterbrock, Astrophysics of Gaseous Nebulae and AGN, University Science, 1989