

# AST 381 “Astrophysics of Gaseous Nebulae and AGN”

## Required Basic Knowledge

Draft dated 2008 November 29 by G. Shields

1. Atomic structure. What is the basic nomenclature for describing atoms and ions, their quantum states and energy levels, and spectral features? What are the characteristic values for atomic energy levels and ionization potentials, in particular for hydrogen?
2. Photoionization. What are the expressions for the photoionization rate and radiative recombination rate for ions? What is the equation of ionization equilibrium? What other processes can affect ionization equilibrium?
3. Thermal equilibrium. What are the main heating and cooling processes in ionized nebulae? What is the equation of thermal equilibrium? What is the characteristic temperature of typical photoionized nebulae, and why do most nebulae have similar temperatures?
4. Emission spectra. What are the physical processes that give rise to emission-line and continuum spectra in ionized nebulae?
5. Dust. What is the role of dust in ionized nebulae, including extinction, thermal emission, and dynamics?
6. Nebular diagnostics. How can emission-line spectra be used to determine electron density and temperature in ionized nebulae?
7. Characteristics of ionized nebulae. What are the essential characteristics of ionized nebulae, including planetary nebulae, H II regions, novae, and supernova remnants? What are their typical sizes, masses, lifetimes, kinematic properties, ionization source, and their relationship to stellar and galactic evolution?
8. Active galaxies. What are the basic types of AGN as characterized by their broad and narrow emission lines and radio emission? What are the characteristic dimensions of the broad and narrow line regions? What is believed to be the ionization source of AGN emission-line regions? What is the fundamental energy source in AGN? How can we estimate the mass of the central black hole in an AGN?