PHY232: The Dynamic Interstellar Medium

Objectives

At the end of PHY232, the student should:

1. Be able to describe the various conponents of the interstellar medium, including their relative masses and spatial distributions in the Milky Way;

2. Discuss how the cold (molecular), cool (atomic), warm (ionized) and hot (coronal) gaseous components of interstellar gas are traced;

3. Appreciate how interstellar gas cools, plus the various sources of heating;

4. Describe the various pieces of evidence in favour of interstellar dust, the composition and size of dust grains, plus their influence upon the shape of the interstellar UV/optical/IR extinction curve;

5. Be able to explain the various sources of interstellar dust, provide observational evidence for dust in HII regions, and the origin of thermal IR emission;

6. Distinguish between the various types of HII region, make comparisons with PN and ejecta nebulae, and the ionizing stars for each case;

7. Be able to derive the Strömgren radius for a pure hydrogen nebula, discuss the cooling role of metals, the concept of ionization stratification and the effect of dust upon the size of a HII region;

8. Be able to explain how nebular emission lines may be used to derive interstellar extinction using recombination theory, plus how Lyman continuum ionizing fluxes result from ionization-bounded nebulae;

9. Describe techniques from which densities, temperatures and abundances may be derived in HII regions, including their advantanges and limitations;

10. Discuss continuum and line emission from HII regions at radio wavelengths;

11. Be familiar with (but not derive) the basic equations of gas dynamics, and the application of shocks to HII regions, PN and SN remnants. Include the role played by stellar winds, and discuss spectroscopic signatures of shocks;

12. Understand the relative cooling time of shocked gas, and its effect upon observations of SN remnants for adiabatic versus radiative phases;

13. Be able to describe the properties of an isolated protostar, in relation to the origin of Herbig-Haro objects, plus the existence of proplyds in HII regions;

14. Be able to derive the equation for a gas cloud in equilibrium, and explain under which circumstances collapse occurs for spontaneous versus induced star formation, and express this qualitatively in terms of the Jeans mass;

15. Appreciate how multiple SN produce superbubbles, galactic fountains and represent the prime source of coronal hot gas in galaxies;

16. Understand the various ISM signatures of star formation in galaxies, plus how abundances in high-z galaxies may be derived;

17. Appreciate how nebular diagnostics enable studies of the size and densities of narrow and broad line regions of Active Galactic Nuclei to be derived, and appreciate how AGN are powered.

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