PHAS2525: Homework 1

Interstellar Astrophysics

To be handed in on or before the 6th November, in person or
via email to: Paul.Woods@ucl.ac.uk **(PDF only)**.

1. (a) State the condition of ionisation equilibrium for an H II region.

   (b) Describe the physical process by which the gas in an H II region is heated, with reference to the terms 'ionisation' and 'thermalisation'.

   (c) Briefly describe what happens when you balance the heating and cooling rates in a pure hydrogen H II region. What assumption must we relax in order to solve this problem?

2. (a) What energy does a photon need to have to photoionise hydrogen?

   (b) Describe (with the aid of a diagram) what the Lyman, Balmer and Paschen series are.

   (c) A pure H gas cloud of number denisty, $n = 10^7$ m^{-3} surrounds an O star that generates 10^{49} photons s^{-1} at wavelengths shorter than 912 Å. The recombination rate of such photons is $\alpha_R = 2 \times 10^{-19}$ m^3 s^{-1}. Equate the ionisations and recombinations to determine the radius of the Strömgren sphere.

3. Briefly describe the physical process by which the gas in an H II region is cooled by forbidden line radiation.