Physics of Galaxies: Set 7

Issue Date: 23/11/17 Hand-In Date: 30/11/17
Students should hand in their exercises by **4.00pm** on the date given above; exercises will not be accepted for marking later than this. The **Course Title**, the exercise **Set Number** and the **Student's Name** should be stated clearly.

1. Briefly describe properties of Active Galactic Nuclei (AGN). In particular, you should describe:
i) AGN's nucleus appearance;
ii) the nucleus emission wavelength range and its comparison to normal galaxies;
iii) AGN spectra description referring to emission and absorption lines;
iv) possible origin of AGN emission lines and whether they are wide or narrow;
v) the difference between Seyfert 1 and Seyfert 2 galaxies and its possible explanation;
vi) the radio lobes.

[10 marks]

2. In the linear theory of density waves in spiral galaxies, the surface density is given by
$\sigma_1 = \sigma_{10} \exp[i(\omega t - m\theta + kr)]$ or $\sigma_1 = \sigma_{10} \exp[i(\omega t - m\theta - kr)]$.

• By calculating the phase speed of a wave for a fixed angle θ, state which sign of k in the above two expressions for σ_1 is for *leading* or *trailing* spirals.

[2 marks]

• Show that the galaxies that have spiral arms have trailing spiral density waves in them. Your answer should include discussion of: (i) how a trailing spiral density wave becomes shocked; (ii) how a cloud of a galactic gas responds to this shock, given that the Jeans mass is proportional to the inverse root of the density; (iii) how the lifetime of OB stars, that highlight the front edges of the spiral arms, compares to the gas and/or spiral rotation periods around the galactic centre.

[9 marks]

3. Explain briefly and qualitatively why there is a limit to the luminosity of an object that derives its power from accretion.

[4 marks]

25 marks in total