

Homework 6 Just for Practise All questions 10 points

1) Describe the AGN Zoo. What are the implications of the unified model for the classifications. How are observations affected by geometry and intrinsic differences.

2) Calculate how long it takes a black hole to double its mass if it is accreting at the Eddington limit. Use this calculation to estimate how long it takes to grow a $10^6 M_{\odot}$ black hole assuming one starts with a seed stellar mass black hole of $M=10M_{\odot}$. Comment on how one can produce a $10^9 M_{\odot}$ BH at a redshift of 6 when the universe was 950 million years old.

3) You observe an accreting black hole with a maximum disk temperature of 10^6 K and a luminosity of 10^{40} erg s^{-1} . To within a factor of 10, derive the mass of the black hole assuming emission from a geometrically thin disk, that the hole is nonrotating, and that there is no emission inside the ISCO.

4)

- a) Are there any observational signatures of strong gravity (e.g.. relativistic effects are dominant) around a black hole?: if there are such signatures describe at least one and why it is indicative of strong gravity.
- b) How does the innermost stable orbit change with spin? If possible please be quantitative (e.g. quantitatively describe what happens, e.g. numbers/equations).

5)

- a) How can one determine the mass of the neutron star or black holes in an accreting binary system?; that is, what are the type of measurements are needed to obtain the masses.
- b) Give the observables used in sec (a).
- c) How can one determine the mass of a supermassive black hole; that is, what are the type of measurements are needed to obtain the masses.
- d) Give the observables used in sec (c).