

AST103
Spring 2008

Home work #4
Due Monday May 5th

1. (20%) a) What are the differences between Pop I and Pop II stars? Describe at least 3.

PopI : First population discovered. Higher metallicity. Younger on average. More massive on average. More likely to be found in disk, with circular orbits. Found in spirals

PopII: second pop discovered. Lower metallicity. No young stars. No very massive stars. Found in Halo. Found in ellipticals.

b) What are Pop III stars. What do we know about them and why?

PopIII are the hypothesized first stars to form. Even lower metallicity than PopII, almost primordial metallicity. None discovered yet all info is theoretical!

2. (10%) Name the three primary types of galaxies and describe their differences.

E type (elliptical) : "old, red and dead", older populations redder color, very little gas, very low star formation, "random" orbits. No bulk motion of stars. Elliptical shape on the sky, bulge component only

S type (spirals): younger stars, more gas, recent or ongoing star formation. Stars in circular orbits. Spiral arms. Bulge plus disk,

Irregulars: no set shape, some star formation and gas, old plus young stars

3. (20%) What do Astronomers believe powers the light we see from Quasars? Why do we believe that are small relative to galaxies?

Accretion onto Super massive black holes:

Time variation in light output is over order a few days or less which implies they are light-days across or less.

4. (10%) (Sample Exam Question) The surprising observational fact about quasars is that they appear **answer is B**

A. to be associated with ancient supernova explosions

B. to produce the luminosity of 100 galaxies in a volume similar to the solar system

C. to be the largest known structures in our Universe, while producing modest amounts of energy

D. to be moving rapidly towards us, while emitting large amounts of energy

5. (20%) a) What is meant by "critical density" in the universe?

This is the density required to just close the universe. Any greater density will result in the big crunch, any less will have the universe expand forever.

b) If the Hubble constant is as large as 100 km/sec/Mpc, what is the maximum age

of anything in the Universe?

Maximum age = 1 / Hubble constant = $1 / (100 \text{ km/sec/kpc}) = 9.5 \text{ Gyr}$

6. (20%)

a) What is "Olber's Paradox" in an unbounded universe (one with no edge)?

Olbers paradox asks why the sky is dark. i.e. if the universe is infinite why doesn't every line of sight end on a star or galaxy making the sky very bright?

b) Explain how an evolving, expanding universe can help explain the paradox
an expanding universe implies a finite age (had to start from a point) this implies a finite observable size equal to the light travel time across the universe. Finite size means possible dark spots.