

Quiz 4 Study Guide

Astronomy 1143 – Spring 2014

(This includes many concepts that will be on Quiz 4; no guarantee that it includes all of them)

Forces

Did the forces always have different strengths?

Why does fusion require high speeds=high temperatures to happen?

The Nature of Normal Matter, Dark Matter and Anti-matter

What is the difference between hot and cold dark matter?

What is an example of a hot dark matter candidate?

What is an example of a cold dark matter candidate?

How do we know that the Universe has cold dark matter and not hot dark matter?

How do we know that the dark matter is not baryonic?

What is the leading candidate for the dark matter particle?

What observations are being made to try and detect the dark matter particle?

Why are astronomers looking for the results of dark matter annihilation towards the centers of the Milky Way and nearby dwarf galaxies?

Why does the probability of annihilation between two dark matter particles have to be small (R)?

What is the difference between weak lensing and strong lensing (R)?

How does weak lensing let us test dark matter models (R)?

How do observations of the Bullet Cluster show that dark matter is a better explanation than Modified Gravity?

Curvature of Space and Destiny of Universe

What is the fate of our Universe?

Can you have a flat Universe that is decelerating?

Can you have a positively curved Universe that is accelerating?

How can Ω_M and Ω_Λ tell you about the fate of a universe?

What does our Universe look like (Flat? Negatively curved? Positively curved?)

How can we calculate the curvature of our Universe by measuring the energy/mass density?

How can we calculate the curvature of our Universe by measuring the sizes of distance objects?

How is dark energy different than gravity?

How is a cosmological constant different than quintessence (R)?

What is the most important contributor to the matter-energy density of the Universe today?

The Big Bang

What is the Big Bang?

What has been happening to the average density of the Universe since the Big Bang?

What has been happening to the average temperature of the Universe since the Big Bang?

What are four pieces of observational evidence for the Big Bang?

Age of Universe

What is the Hubble time?

Why doesn't the Hubble time give us the correct age of the Universe?

Why is it important to measure the ages of stars and compare them to the age of the Universe?

The Cosmic Microwave Background Radiation

What kind of spectrum does the CMB have?

What kind of object produces such a spectrum?

What causes the CMB to appear so cool today?

What causes the CMB photons to redshift?

About how many years after the Big Bang was the CMB created?

Why can't we see photons from earlier in time (=higher in redshift) than this?

Why do free electrons make a gas opaque?

Why does the CMB appear hotter in the direction of the constellation Leo?

Why do small density fluctuations in the early Universe appear as small temperature fluctuations in the CMB?

The Earliest Moments of the Universe

What is the Planck epoch?

What is a theory of everything?

What is the electroweak epoch?

In what order do the forces separate?

What is inflation?

Why can't the Universe make protons and neutrons in the earliest phases?

What is nucleosynthesis?

Why can't the Universe make helium in the earliest phases?

Why can't the Universe make atoms in the earliest phases?

Which of these appears last: quarks, protons, a hydrogen atom, a helium nucleus?

Why is the Universe no longer radiation-dominated or matter-dominated?

Which happened first, the Universe became matter-dominated or the electroweak force separated from the strong force?

Which happened first, baryogenesis or nucleosynthesis?

Inflation

How does inflation explain the flatness of the Universe?

How does inflation explain why the observable Universe looks so homogeneous?

How does inflation explain how quantum fluctuations produced the seeds of large-scale structure?

How does inflation explain why we haven't detected a magnetic monopole yet?

What other evidence do we have that inflation happened?

Big Bang Nucleosynthesis

What observations does Big Bang Nucleosynthesis (BBN) explain?

How can we measure the amount of He, D, and Li in the early Universe?

Why did it take ~3 minutes from the Big Bang for BBN, instead of starting right after the Big Bang?

Why did the Universe make about ~25% (by mass) of matter into helium?

Why does the expected amount of deuterium get smaller if the density of normal matter increases?

Why doesn't BBN make heavy elements, such as carbon and oxygen?
Where are such elements made instead?

Formation of Structure

If an area of the Universe has a slightly higher density than other areas, what happens to the density of that area as time passes?

What force is important for the growth of structure (galaxy clusters, galaxies, stars, planets, etc)?

What evidence do we see that galaxies form by merging?