# PHY100 — Recitation #9

1) According to Big Bang cosmology, “nucleosynthesis” occured ~100 seconds after the Big Bang.

   a) What is meant by nucleosynthesis?

   b) Why didn't nucleosynthesis occur earlier... say at a time like 1 microsecond after the Big Bang?

2) What is the Cosmic Microwave Background (CMB)?

   What is the origin of the light in the CMB?

   What is it that you are seeing when you observe the CMB?

3) Review the concept of blackbody radiation if needed.

   Order in terms of photon energy (frequency):

   Microwaves, ultraviolet light, visible light, infrared light, radiowaves

4) The light that became what we call the CMB was emitted by a “blackbody” with a Temperature of 3000° K. The spectrum of this light peaked in the ultraviolet region of the spectrum. Why, then, do we observe this light to be in the infrared and microwave portion of the electromagnetic spectrum?

5) In Big Bang cosmology, the point at which light nuclei and electrons join together to create neutral atoms is sometimes called “recombination”. Why is this term misleading?

6) Water has a chemical formula $H_2O$. You are mostly water.

Where did most of the Hydrogen atoms in your body originate? Where did most of the oxygen atoms in your body originate?

Why is it that these sources differ?

7) The next time you meet someone who thinks they are the center of the universe, you can tell them that according to Big Bang cosmology they are most certainly NOT the center of the universe. Explain this.

Is the sun the center of the Universe? The Milky Way? The Virgo cluster? Where is the center?

8) If you had little boxes containing matter from different times during the early universe, what particles would you expect to find in boxes labeled

$10^{-20}$ s

300 s

500,000 years

after the Big Bang, respectively?

9) What is meant by observable universe? How big is it? Does our observable universe change with time? If so, how?

10) Suppose light could reach us from the moment of the Big Bang. In what direction would you look to see it?

11) Name one (or more) problems with the basic Big Bang cosmological model which is resolved by the idea of inflation

"Misconceptions about the Big Bang", *Scientific American,* February 2005

The observable Universe: If space were not expanding, the most distant object we could see would now be about 14 billion light-years away from us, the distance light could have traveled in the 14 billion years since the big bang. But because the universe is expanding, the space traversed by a photon expands behind it during the voyage. Consequently, the current distance to the most distant object we can see is about three times farther, or 46 billion light-years.