Physics Honors: The Expansion of the Universe

Redshift



Hubble's Law

- Edwin Hubble wanted to see if galaxies were moving, so he measured the redshift to each galaxy
 - All galaxies are moving away from each other, and the ones that are further away are moving away faster!
- He realized that there was a mathematical relationship between how far away galaxies are from Earth and how quickly they move. This is known as Hubble's constant

Hubble's Law & Constant



v = velocity H = Hubble constant d = distance

Also written as v= H₀D



The Big Bang Theory

- If we see our universe constantly expanding, it makes sense that if we play back the clock, it was smaller at an earlier time than it is now
- Based on how fast the universe is expanding now (using Hubble's Constant) the universe would have had to begin expanding about 13.7 billion years ago
- Outside of Hubble's Constant there is additional evidence that the Big Bang occured

Potential Types of Universes

Open Universe: An open universe is a universe where expansion will never stop.

Closed Universe: A closed universe is a universe where expansion will stop and the universe will begin to contract

Flat universe: A flat universe is a universe where expansion stops, but it never begins to contract

Cosmic Microwave Background Radiation



Cosmic Microwave Background Radiation

 Scientists theorized that if the Big Bang occured, there would have to be "left over energy" from the rapid expansion of the universe.

 When larger and better radio telescopes were made, we began to see the CMBR more clearly, telling us that the universe is about 3K

Acceleration of Expansion

- The universe is expanding more quickly than what was predicted.
- This must mean that there is some additional energy driving the expansion (other than the left over momentum from the big bang)
- Scientists call this "Dark Energy" because it is unclear where this energy is coming form

Dark Matter

- Dark matter is matter that does not interact with with normal matter, and can't be viewed using Electromagnetic Radiation (any type of light)
- It was discovered when scientists were looking at how galaxies rotated, and they realized there must be more matter in the galaxies than they could see.
- There are several theories to what dark matter is, but the most commonly accepted one is that a small particle that we haven't discovered yet

