## ASTRONOMY\_PART 2 NOTES

Origins of the Universe

What is A I <sup>-</sup>	a Theory? Theory is a hypothesis that containsto support it. t provides a framework for and
What is T e:	The Big Bang? Theory that states that the Universe began to expand with the xplosion of concentrated and
A tł	fter the "Big Bang", the force of began to affect he matter shooting outward in every direction.
	Time V Singularity
G	ravity began to pull into clumps.
T ot	hese clumps formed huge clusters which became f the universe.
The Exp II	panding Universe n 1929, Edwin Hubble showed that most galaxies are (moving away from us), and that a galaxy's
Ve	elocity is to its distance (galaxies that
G,	



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Predictions for The Big Bang:

The expansion of the Universe

Edwin Hubble's 1929 observation that galaxies were generally receding from us provided the first clue that the Big Bang theory might be right.

The abundance of the light elements H, He, Li

The Big Bang theory predicts that these light elements should have been fused from protons and neutrons in the first few minutes after the Big Bang.

The cosmic microwave background (CMB) radiation

The early universe should have been very hot. The cosmic microwave background radiation is the remnant heat leftover from the Big Bang.

Evidence for The Big Bang:

\_\_\_\_\_\_\_ - as light from distant galaxies approach earth there is an increase of space between earth and the galaxy, which leads to wavelengths being stretched

•In 1964, Arno Penzias and Robert Wilson, discovered a noise of extraterrestrial origin that came from all directions at once -\_\_\_\_\_\_ left over from the Big Bang

•In June 1995, scientists detected helium in the far reaches of the universe - consistent with an important aspect of the Big Bang theory that a mixture of \_\_\_\_\_\_(75%) and \_\_\_\_\_\_(25%) was created at the beginning of the universe.

History of the Universe:

The universe begins ~\_\_\_\_\_ Billion years ago The universe begins as the size of a single \_\_\_\_\_

All \_\_\_\_\_\_ and \_\_\_\_\_ were created from a

single point of pure energy in an instant.

How do we know?

-\_\_\_\_\_\_ -know distances, rates of retreat,

relative positions

-Pervasive \_\_\_\_\_\_ of 2.7°C above absolute

zero - afterglow of the Big Bang

3	Minutes	after	The	Big	Bang	
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The universe has grown from the size of an \_\_\_\_\_\_ to larger than the size a \_\_\_\_\_  $E=mc^2$ Energy froze into matter according to Albert Einstein's equation. This basically says that like snowflakes freezing, energy forms matter into clumps that today we call\_\_\_\_\_, \_\_\_\_, and \_\_\_\_\_. These parts later form into \_\_\_\_\_.

Three Hundred Thousand Years after The Big Bang

\_\_\_\_\_ form (specifically Hydrogen and its isotopes with a small amount of Helium.)

•The early Universe was about 75% Hydrogen and 25% Helium. It is still almost the same today.



Neutrons and protons are held together in the nucleus by the "strong" force, which has to overcome the electrical repulsion of the two positively charged protons in helium (and in more complex atoms too). Electrons are held around the atom by the electrical attraction between their negative charge and the positive charge of the protons in the nucleus.

200-400 Million Years after The Big Bang First stars and galaxies form.

4.6 Billion Years Ago Our Solar System Forms









Misconceptions about The Big Bang Theory

There was no \_\_\_\_\_; there was (and continues to be) an \_\_\_\_\_.

-Rather than imagining a balloon popping and releasing its contents, imagine a balloon expanding: an infinitesimally small balloon expanding to the size of our current universe

We tend to imagine the singularity as a little fireball appearing somewhere in space.

-space began inside of the singularity. Prior to the singularity, *nothing* existed, not space, time, matter, or energy - nothing.





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