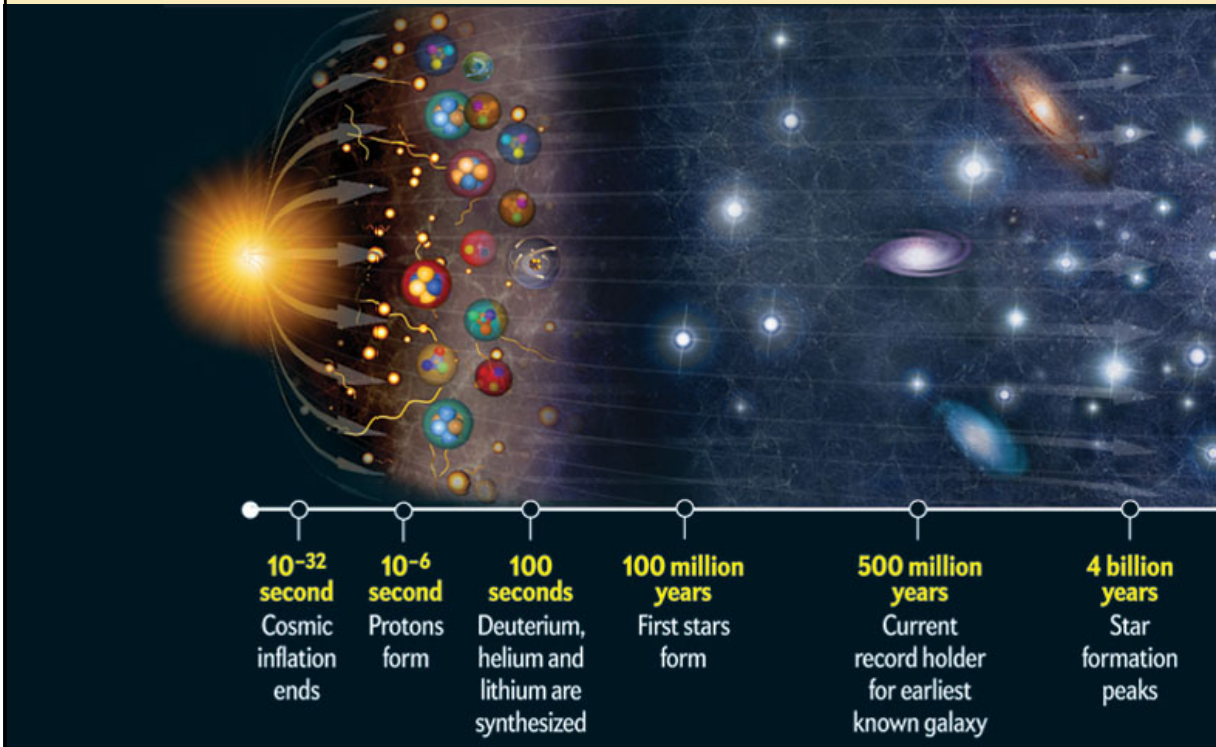


# The Big Bang



'Listen! There they are again - echoes of the Big Bang. The beginning of creation!'

## The Big Bang Theory -- origin of the universe

The universe began:

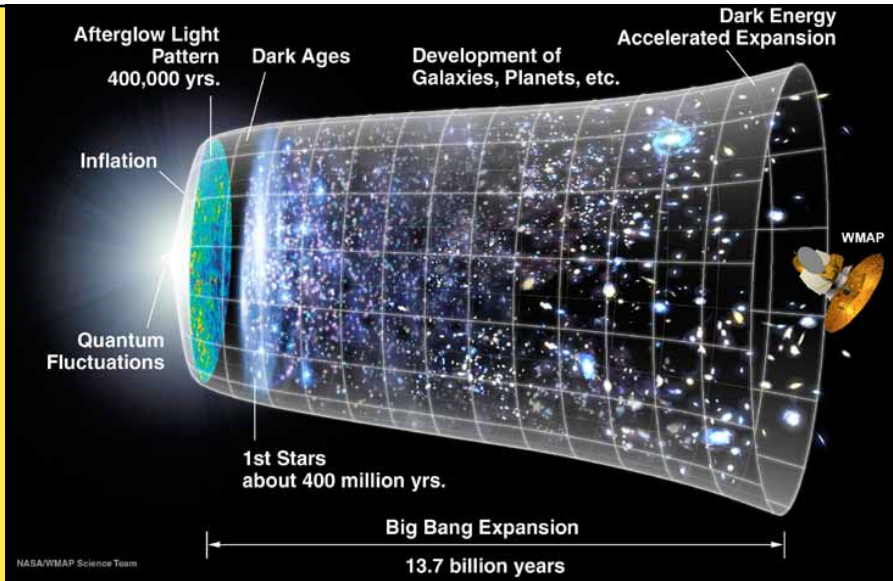
- **~13.7 Billion years ago**  
(approximately)
- **as the size of a single atom**  
(singularity)
- **as a violent expansion**  
(not explosion)

$$E = mc^2$$

Time begins...




**All of our matter and space were created  
from a single point of pure energy in an instant**



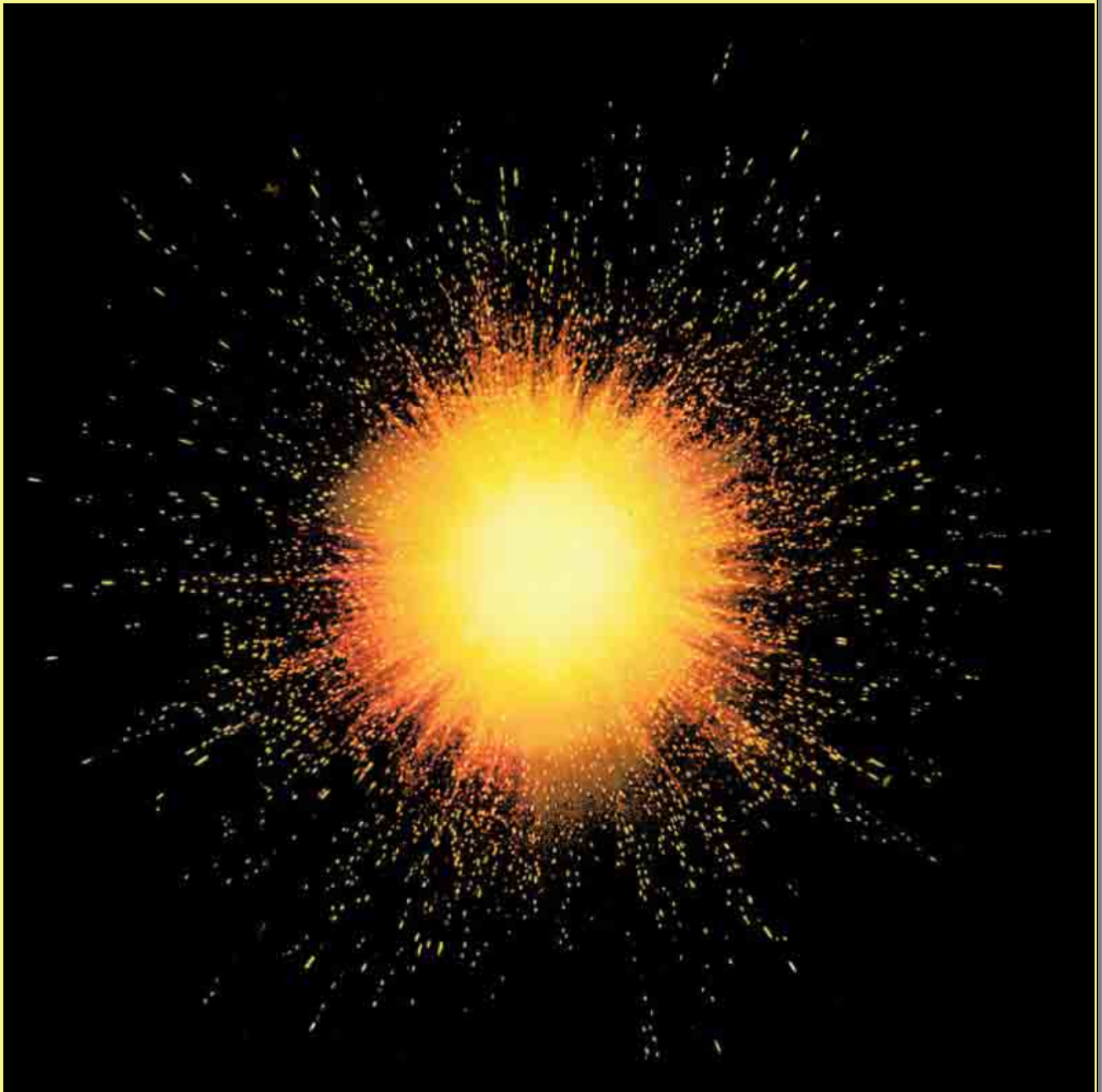
|          |   |            |            |            |            |            |            |          |            |            |            |            |            |          |            |          |          |  |  |  |  |  |  |
|----------|---|------------|------------|------------|------------|------------|------------|----------|------------|------------|------------|------------|------------|----------|------------|----------|----------|--|--|--|--|--|--|
| H<br>B   | <ul style="list-style-type: none"> <li style="margin-right: 10px;"><span style="background-color: #ccccff; border: 1px solid black; padding: 2px;">B</span> Big Bang</li> <li style="margin-right: 10px;"><span style="background-color: #90ee90; border: 1px solid black; padding: 2px;">L</span> Large stars</li> <li style="margin-right: 10px;"><span style="background-color: #ffcc99; border: 1px solid black; padding: 2px;">\$</span> Super-novae</li> <li style="margin-right: 10px;"><span style="background-color: #ccccff; border: 1px solid black; padding: 2px;">C</span> Cosmic rays</li> <li style="margin-right: 10px;"><span style="background-color: #ffff99; border: 1px solid black; padding: 2px;">S</span> Small stars</li> <li style="margin-right: 10px;"><span style="background-color: #ccccff; border: 1px solid black; padding: 2px;">M</span> Man-made</li> </ul> |            |            |            |            |            |            |          |            |            |            |            |            |          |            |          | He<br>B  |  |  |  |  |  |  |
| Li<br>C  | Be<br>C   | B<br>C     | C<br>S L   | N<br>S L   | O<br>S L   | F<br>L     | Ne<br>S L  |          |            |            |            |            |            |          |            |          |          |  |  |  |  |  |  |
| Na<br>L  | Mg<br>L   | Al<br>\$ L | Si<br>\$ L | P<br>L     | S<br>S L   | Cl<br>L    | Ar<br>L    |          |            |            |            |            |            |          |            |          |          |  |  |  |  |  |  |
| K<br>L   | Ca<br>L   | Sc<br>L    | Ti<br>\$ L | V<br>\$ L  | Cr<br>L    | Mn<br>L    | Fe<br>\$ L | Co<br>\$ | Ni<br>\$   | Cu<br>L    | Zn<br>L    | Ga<br>\$   | Ge<br>\$   | As<br>L  | Se<br>\$   | Br<br>\$ | Kr<br>\$ |  |  |  |  |  |  |
| Rb<br>\$ | Sr<br>L   | Y<br>L     | Zr<br>L    | Nb<br>L    | Mo<br>\$ L | Tc<br>L    | Ru<br>\$ L | Rh<br>\$ | Pd<br>\$ L | Ag<br>\$ L | Cd<br>\$ L | In<br>\$ L | Sn<br>\$ L | Sb<br>L  | Te<br>\$   | I<br>\$  | Xe<br>\$ |  |  |  |  |  |  |
| Cs<br>\$ | Ba<br>L   | Hf<br>\$ L | Ta<br>\$ L | W<br>\$ L  | Re<br>\$   | Os<br>\$   | Ir<br>\$   | Pt<br>\$ | Au<br>\$   | Hg<br>\$ L | Tl<br>\$ L | Pb<br>\$   | Bi<br>\$   | Po<br>\$ | At<br>\$   | Rn<br>\$ |          |  |  |  |  |  |  |
| Fr<br>\$ | Ra<br>\$  | La<br>L    | Ce<br>L    | Pr<br>\$ L | Nd<br>\$ L | Pm<br>\$ L | Sm<br>\$ L | Eu<br>\$ | Gd<br>\$   | Tb<br>\$   | Dy<br>\$   | Ho<br>\$   | Er<br>\$   | Tm<br>\$ | Yb<br>\$ L | Lu<br>\$ |          |  |  |  |  |  |  |
|          |   | Ac<br>\$   | Th<br>\$   | Pa<br>\$   | U<br>\$    | Np<br>\$   | Pu<br>\$   | Am<br>M  | Cm<br>M    | Bk<br>M    | Cf<br>M    | Es<br>M    | Fm<br>M    | Md<br>M  | No<br>M    | Lr<br>M  |          |  |  |  |  |  |  |

## Big Bang Theory-

a theory that explains the origin of the universe based on these 3 pieces of evidence:

Evidence 

1. Observed expansion of the universe
2. CBR (Cosmic Background Radiation) **MicroWave**
3. Abundance of Hydrogen and Helium

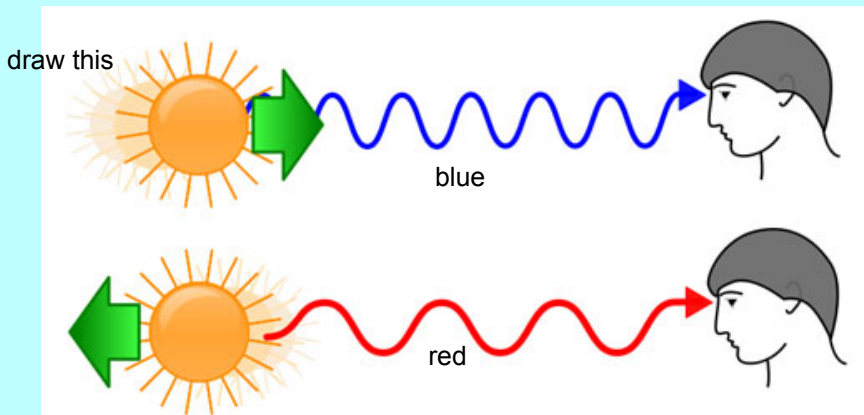


# Evidence 1 - Universe Expansion

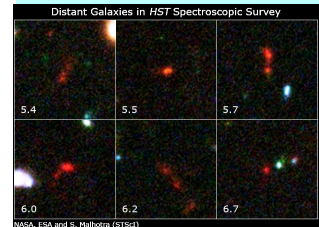
**1. We observe (through red shift) the majority of galaxies are moving away from us and each other**

## Red Shift

-when an object of light is observed moving away from an observer, it's wavelengths shift to the longer (red) end of the spectrum.

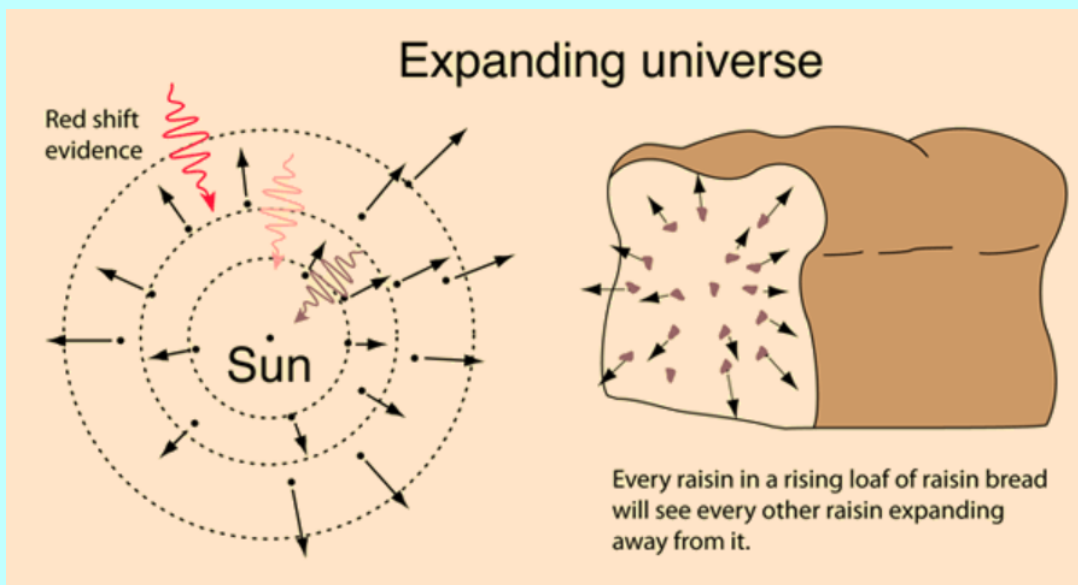


What is red shift?



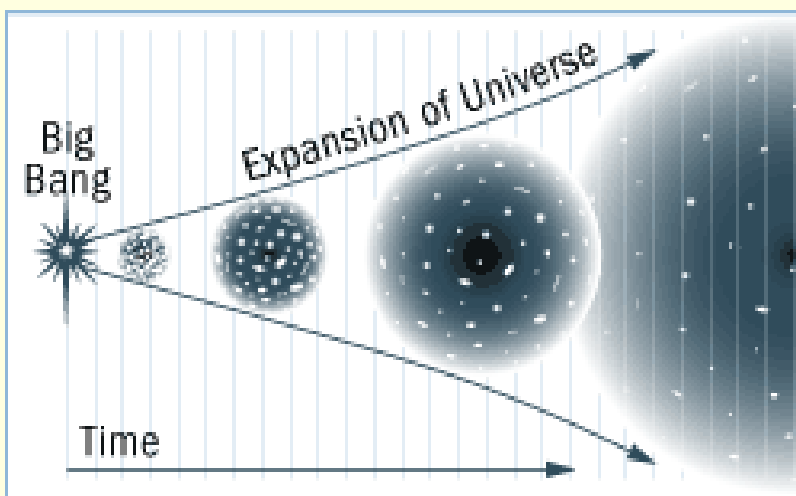
*\* longer wavelengths of visible light are red*

**2. The farther away a galaxy is, the faster it moves away from us. (Hubble's Law)**



Evidence 1 cont...

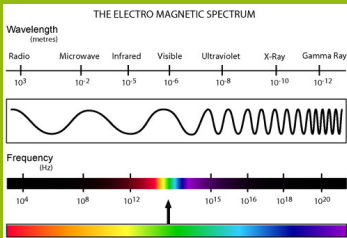
The expanding universe was smaller in the past.



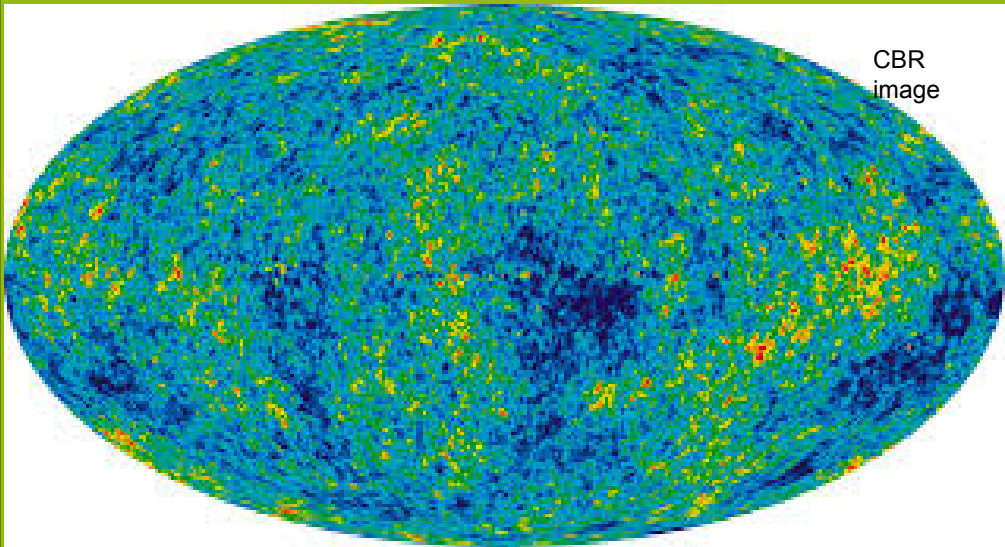
- \* We can calculate the size of the universe and determine how much it has expanded recently.
- \* From this ratio, we then determine the size it would have been in the past.

# Evidence 2 - Cosmic Background Radiation

"afterglow of the Big Bang"



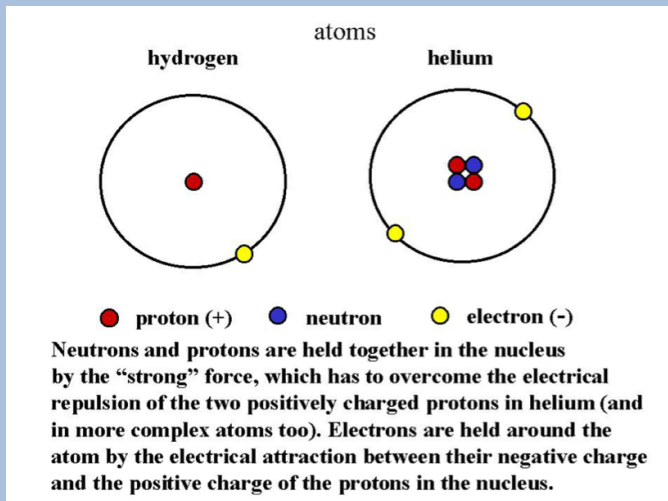
CBR- the leftover thermal energy from the Big Bang.



## Evidence 3 - Element Abundance

The ratio of hydrogen to helium has been shown to be consistent with a universe that was very dense and hot a long time ago.

The early Universe was about 75% Hydrogen and 25% Helium.



### Elements In the Universe

