A Short Guide to the Universe

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Big Bang

The standard Big Bang model has three important properties, or predictions, all of which have been spectacularly verified observationally. First, the model postulates that all the distant galaxies are traveling away from one another, with a speed that is equal to the distance between them, which was precisely what was observed by Edwin Hubble. Second, the model predicts that the entire universe basks in a highly uniform radiation bath, which today is but a cold reminder of the intensely hot distant past. The discovery of the cosmic background radiation was by Arno Penzias and Robert Wilson, and the determination of its properties by COBE satellite, again confirmed the Big Bang predictions. Finally, the model predicts successfully abundances of light elements such as helium, deuterium and lithium. These nuclei were made from protons and neutrons during the first few minutes after the big bang.

A Hot Start

The fact that the universe started from one point some 14 billion years ago and has been expanding ever since is now known as the hot Big Bang model.

In this particular model, the universe was not only extremely dense but at the beginning it was also extremely hot, with a temperature of about a decillion (10 followed by 32 zeroes, which is such a high temperature that it doesn't matter if it is Celsium or Fahrenheit). At the time the universe's dimensions were about 10-38 centimeters (0.00……1, with one at the thirty-third decimal place).

As the universe expanded, it cooled rapidly, due to the shift of radiation to a lower frequency for there was less space, which reduced its energy. By the time the temperature had dropped to about 100 million times that in the center of our sun (the latter being about 30 million degrees Fahrenheit), the basic building blocks of matter began to form. There are the elementary particles called quarks, which combine to form protons and neutrons of ordinary matter. After the universe had expanded one thousand times more, the quarks became confined in neutrons and protons, and it took an additional expansion by a factor of one thousand before the protons and neutrons started to combine to form nuclei of light atoms. In particular, most of the nuclei of the element helium that are present today, about 23 to 24 percent of all visible matter in the universe, were formed in that era. Everything that I have just described so far occurred during a period of about a minute from the start of the expansion. The universe was still too hot for electrons to be captured by nuclei and remain bound to them to form atoms, the electrons were too energetic. Under these conditions, radiation could not travel very far without encountering some particles, especially electrons, and being absorbed and reemitted or scattered by them. The universe was there for opaque electromagnetic radiation.

Classifications of Particles

Here are a few fundamental particles that you might not have known about. The first is quarks. Quarks come in three “colors;” red, blue and green. One of each are bound together by the weak nuclear force and gluons, and become a neutron or proton. Next there are protons and neutrons; neutrons have a neutral charge, and protons have a positive charge. Protons are made up of one down quark and two up quarks and that makes a positive charge. Neutrons are made up of one up quark and two down quarks and that makes a neutral charge. Now what I mean by “up” and “down” is that “up” is a positive charge and down is a negative charge. So, that would mean a “up” quarks charge is positive two thirds of a protons charge, and a “down” quarks charge is negative one third charge of a proton for two negative one third charges combined with positive two thirds charge equals zero which is a neutrons charge. And two sets of positive two thirds charge of a proton combined with one negative one third of a proton equals positive three thirds of a proton which is a protons charge and is there forth a proton. Now we move on to electrons, electrons have a negative charge, and they orbit the nucleus of an atom. The nucleus of an atom is made up of neutrons and protons. An atom is made of neutrons, protons and electrons. An atom always has the same amount of protons and electrons for if it didn’t it wouldn’t be neutral. Now if an atom did not have the same amount of protons as electrons then it would be an ion. If it had one too many electrons it would be a negative ion and if it had one too many protons then it would be a positive ion. Another type of particle is photons. Photons are mass-less particles of force and are created by the electromagnetic force which also keeps the electron orbiting the nucleus.

Finally, there is antimatter. Most particles have antimatter that has the same mass but whose charge and other properties are opposite. A positron is the antimatter of an electron, it has a positive charge. Anti-up quarks have a negative charge and are the antimatter of an up quark. Antiproton has a negative charge and is the opposite of a proton. Antineutron has a neutral charge for there is no opposite of zero. Further particles have been hypothesized that do not have a place in this particle classification. They include magnetic monopoles and WIMPs (weakly interactive massive particles) and many more.

The Four Fundamental Forces

There are four natural forces that the universe runs on; the strong nuclear force, the weak nuclear force, the electromagnetic force and the gravitational force. The electromagnetic force (in short form EM) force is extremely important for it holds the electrons within an atom in their shells surrounding the nucleus. It attracts the negatively electrically charged electrons toward the positively charged nucleus and keeps the electrons apart. The force carrier for the electromagnetic force is the photon.

For the strong nuclear force, there are two types: the fundamental and the residual. The residual strong nuclear force binds the protons and neutrons together to form the nucleus of the atom. It is carried by the pions. Pions are a generated from energy formed when the nucleons try to move apart. This energy arises as a byproduct of the strong force. Once generated, the pions are exchanged back and forth between the nucleons, creating a binding force. The fundamental strong nuclear force (also known as the color force) binds quarks within protons and neutrons. It controls the quarks “color” property, and as it operates, the quarks constantly change “color” by exchanging virtual gluons (the force-carrier particles).

The weak nuclear force governs radioactive decay, among other interactions. Its force governs radioactive decay, among other interactions. Its force carrier particles are W+, W-, and Z0 bosons. A W+ boson controls the changing of a neutrino into an electron and the transformation of a down quark into an up quark, converting a neutron into a proton.

The gravitational force might have the shortest description but it is not the least important. The gravitational force is an attraction that acts between each and every particle in the universe. It is always attractive, never repulsive. it pulls matter together, causes you to have a weight, apples to fall from trees, keeps the Moon in its orbit around the earth, the planets confined in their orbits around the Sun, and binds together galaxies in clusters.

A Unified Theory

The search for a unified theory of physics can be thought of in terms of two great theories of twentieth-century physics. The first, the general theory of relativity, relates gravity to the structure of space and time. It tells us that they should be treated as a unified whole, spacetime, and those distortions in the geometry of spacetime are responsible for what we perceive as the force of gravity. The second, quantum mechanics, describes the behavior of the atomic and subatomic level; there are quantum theories which describe each of the other three forces of nature, apart from gravity. A fully unified description of the cosmos and all it contains (a “theory of everything”, or as odd as it is TOE) would have to take gravity and spactime into the quantum fold. That implies that spacetime itself must be, on an appropriate very short-range scale, quantized into discrete lumps, not smoothly continuous.

The Open Universe Theory

If the universe is less dense than a critical value known as omega it is negatively curved or "open," then scientists are pretty sure that it will expand forever. If this is true eventually the Milky Way will be millions of light years from the Andromeda galaxy. This is a great theory however, it does not give any information about why it is expanding. The

2-D analogy of such a universe is a saddle-shaped surface on which parallel lines diverge.

The Closed Universe Theory

If the universe is denser then a critical value known as omega it is positively curved or “closed” and is finite. This means eventually it will stop expanding and contract and once it contracts it will trigger the big band all over again and start expanding again. In such a universe parallel liens converge. It is a good theory, but it gives no information about why it’s expanding just like the open universe theory.

The Flat Universe Theory

If the density of the universe is exactly the critical value omega (which is highly unlikely) it is "flat". If the universe is "flat then parallel lines never meet. Once again none of these TOE's give any information about the universe and why it is expanding. However it does give a very good idea about the beginning and fate of the universe.

String Theory

Superstring theory in short, string theory, naturally produces a description of gravity in physical terms which was initially set to quantum terms, however it took several years for gravity to fall out of the equations. String theory only started to be a more know theory in the middle of the 1980's, after new variations on the theme was developed by John Schwartz and Michael Green. They began working together at the end of the 1970s, after meeting at a conference a CERN (The world's largest particle physics laboratory), and realizing that, unlike everybody else studying particle physics, they were both interest in string. String Theory is a theory that is thought to unify the four fundamental forces of nature (shown on page 5-6) and could provide an underlying scheme for completely understanding how particles are constructed. A leading contender is string theory, which postulates that each fundamental particle consists of a tiny vibrating filaments called strings. The vibrational modes, or frequencies, of these strings lend particles their varied properties. Although it sounds bizarre, many leading physicists are enthusiastic adherents of string theory.

Expanding Space

A crucial property of the universe is that it is expanding. It must be growing, because distant galaxies are quickly going away from Earth and more distant galaxies are receding even faster. Assuming that the universe has always been expanding, it must once have been smaller and denser, a fact that strongly supports the Big Bang theory of its origin.

“Although the universe is expanding, it is not expanding into anything. Instead space itself is stretching and carrying clusters of galaxies with it.” Despite the expansion of the universe some galaxies, with the mass that they have, are moving closer to the Milky Way. For example, the Andromeda galaxy is moving closer to us here Professor Daniel Reichart explains;

> “Everything is being carried away, but gravity is still trying to pull things together, and Andromeda galaxy, being the closest big galaxy to us, is close enough that gravity wins the battle, so despite the expansion of the universe gravity is still stronger (at this distance) and it’s pulling it towards us.” (Dr. Riekhart, Friday, March 3, 2006)

The Nature of Expansion

Several notable features have been established about the universe’s expansion. First, although all distant galaxies are moving away, neither Earth nor any point in space is at the center of the universe.

> "It is not true to say that everything in the universe is expanding in the universe is expanding Earth is not getting bigger; nor is the solar system or the Milky Way Galaxy."

Rather, everything is receding from everything else, in other words everything is moving away from everything else, and there is no center. Second, at a local scale, gravity dominates the cosmological expansion and holds matter together. The scale at which this happens is very large, even entire clusters of galaxies resist expansion and hold together. Third, it is incorrect to think of galaxy clusters moving away from each other through space. A more accurate picture is that of space expanding carrying stars, galaxies and many other things in it. Last, but certainly not least, the expansion rate almost certainly varies. Cosmologists are greatly interested how the expansion rate might change in the future. Eventually the rate of expansion will decide the fate of our entire universe.

Time and Expanding Space

The continued expansion of space, combined with the constant speed of light, turns the universe into a giant time machine. The light from a remote galaxy has taken billions of years to reach our planet Earth, so astronomers see the galaxies light that it gave off billions of years ago. In effect, the deeper astronomers look into space, the farther they can see into the universe's history. In the remotest regions, they can only see incompletely formed galaxies if they look soon after the Big Bang.

> ”Astronomers believe that the universe started expanding about 15 billion years ago. At that time, it was a very different place. Everything must have been so close together that the universe was a tiny point, called a singularity, which is even smaller than a atom!”

The most dim and distant of the galaxies is receding from Earth at speeds increasingly close to the speed of light. If astronomers observe such objects for millions of years, they will see them evolving more slowly than if they were closer and not being carried away so fast. At greater distances yet, beyond the observable universe there may exist other objects that have moved away so fast that light from them has never reached Earth.

Inflation

In a Big Bang without inflation, what are now widely spaced regions of the universe could never have become so similar in density and temperature.

Inflation theory proposes that our observable universe is derived from a tiny homogenous patch of original universe. The effect of inflation is like expanding a wrinkly of sphere after the expansion in this diagram below that appears to be smooth and flat.

“Most astronomers the Big Bang was quite small. Conditions in the early universe turned energy directly into equal amounts of matter and antimatter.”

My Theory

My theory is that our cosmos was created by the Big Bang and somehow this created a circular motion with the cosmos. As a result of this circular motion, space is expanding outward into a vast “land” of nothing. Some astrophysicists have predicted that space is not expanding, but that the galaxies within the cosmos are moving apart. I believe that it is a combination of theories, and that the cosmos is expanding. As a result, the stars and galaxies seem to move apart.

Two common theories that astronomers believe in are; the open universe and the closed universe. My theory is somewhat related to the closed universe theory. For my theory suggests that the universe, as a whole, is spinning. As it spins, it expands. Galileo's ideas and Newton's laws of inertia states, "A body in motion will stay in motion unless acted upon by another object." So, it would seem that the universe will expand forever for there is nothing large enough to act upon the universe's expansion. However, there is something that could stop the universe's expansion but, it's not an object, its gravity, the universe's gravity upon itself could cause it to contract. So, as the universe contracts, the spinning would slowly stop and this would cause the galaxies to get closer together, and eventually the universe will collide and this may cause it to explode and the Big Bang will start all over again.

So, the universe would explode then implode, explode and implode and that would go one for all of eternity. Of course, this is just a suggestion as to why the universe is expanding. And it still remains hypothetical.

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