Subject: Science

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Problems of the Big Bang

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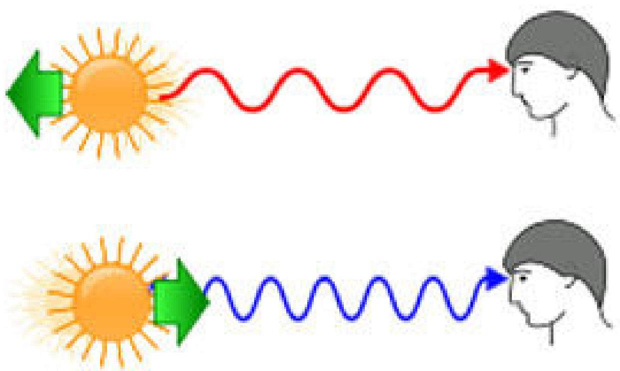
It is believed that our universe started with a Quantum Jump called the Big Bang. The first person who proposed a similar model is George Lemaitre (1894-1966) on 1927. He called his model "The hypothesis of the primeval atom". Fred Hoyle (1915-2001) is credited for coining the term **Big Bang** in 1949. This model is based on two observations.

1. The Red-shift of galaxies. Edwin Hubble (1889-1953) discovered that the distance to far away galaxies is proportional to their Red-shifts. Light waves as well as sound waves change in frequency depending on the motion of their source. If the source moves toward us the wave is compressed and a higher frequency is intercepted by the observer standing still. This is why we hear a high pitch of whistle when a fast train approaches the station. For light waves, this event is called the Blue-Shift. The opposite happens when the source recedes from us. The wave expands and lower frequencies reach a static observer. For light waves this means that a shift towards longer wavelengths occur. Thus a **Red-Shift** is observed. We see below a drawing of these events.

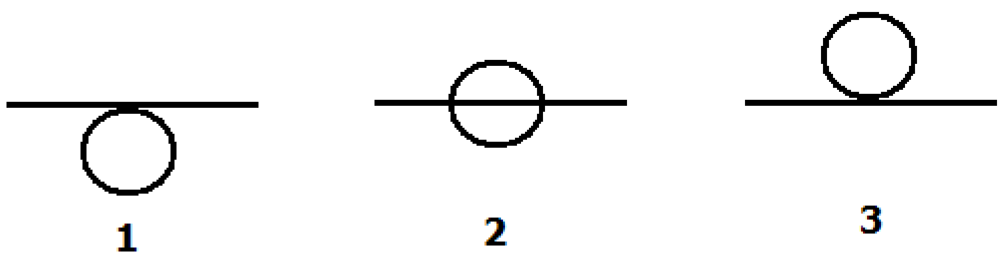


The red-shift of the distant galaxies is accepted as a sign that our universe is expanding. Recent observations show that the universe is expanding at a faster rate then expected. Since the present model of the universe does not include such a possibility, an agent called “***dark matter***” has been postulated in order to explain this phenomenon.

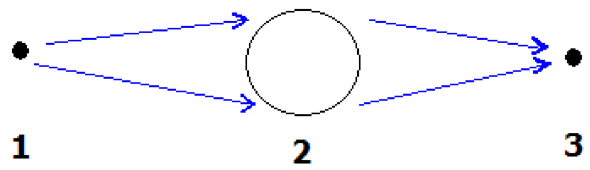
2. Cosmic Microwave Background Radiation. In 1964 this radiation was discovered by two radio astronomers, Arno Penzias and Robert Wilson. Its discovery is considered as a proof of the Big bang. There is a general acceptance that the CMBR is a leftover from the early stage of the universe. The CMBR has a temperature about 2.725 Kelvin degrees. This corresponds approximately to 3 degree above absolute zero. Absolute zero corresponds to -273 Degree C. The CMBR is uniform in all directions, but there exists very small irregularities. These small irregularities, match what would be expected if small thermal variations, generated by **quantum fluctuations** of matter in a very tiny space, had expanded to the size of the observable universe we see today.

The Big bang model is based on the General Theory of Relativity of Albert Einstein (1879-1955). In this model, space is curved around a stellar object, and our universe is inherently curved and convoluted. The universe is a 4-dimensional manifold and cannot be grasped with our senses. This is because four dimensions are not the simple addition of three space plus one time dimension. A 4-dimensional object is quite different than a 3-dimensional object moving in space. It is an object that expands and contracts and vibrates within our three-dimensional space.

In order to understand this phenomenon let us view how a 3-dimensional object will appear in two-dimensions. Consider a 3-dimensional sphere passing through a sheet of paper. In figure 1 the sphere is just touching the paper from below. A 2-dimensional observer existing on the surface of the paper will observe a single point. As the sphere moves through the paper the point will expand to a circle as in figure 2. And as time does by the circle will contract until it becomes a point again (figure 3).



A similar situation is valid for our observation of the universe. We can observe only 3-dimensions of space and one dimension of time. Let us imagine that we are a two-dimensional observer existing on the flat paper. We are not capable to see the whole of the 3-dimensional sphere, but only its cross section on the paper, as shown below.



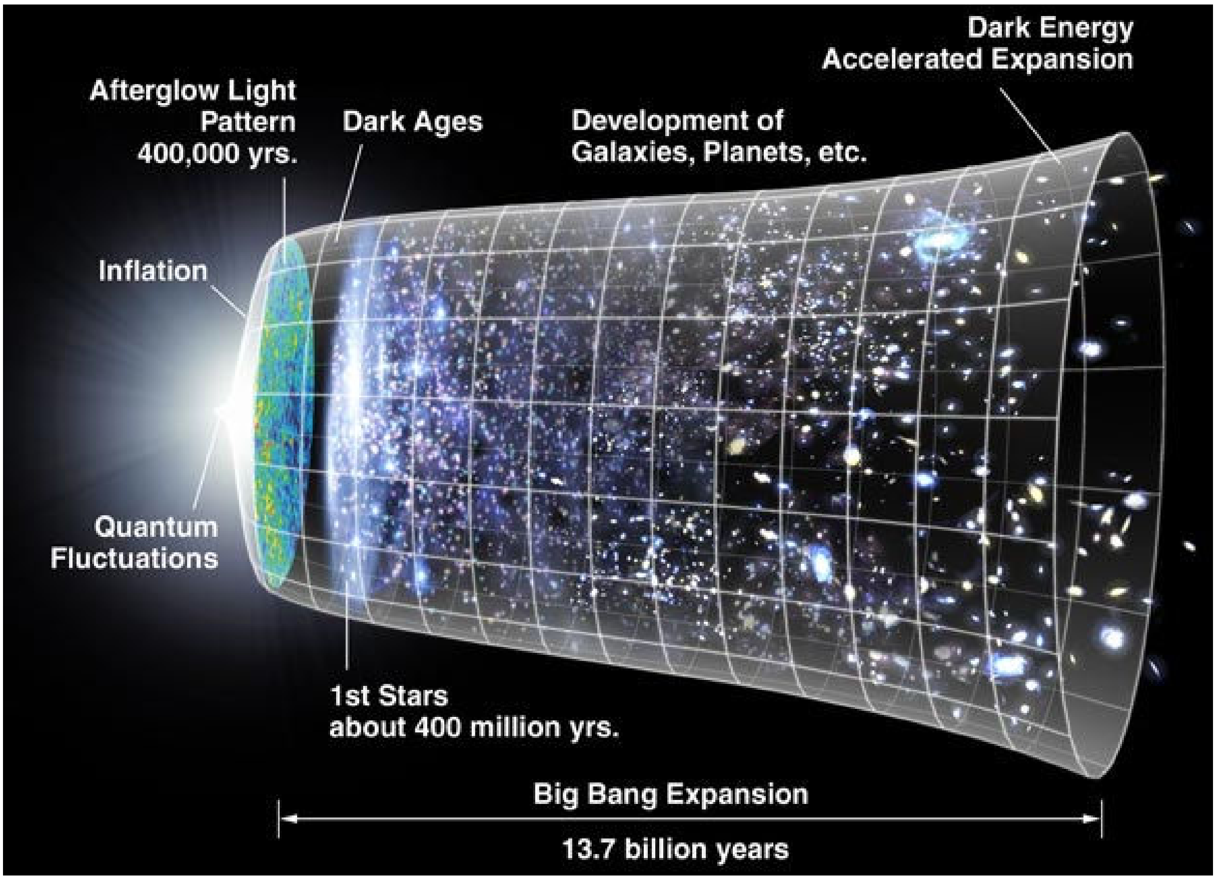
The motion of the sphere will appear first as a point, and that point will expand gradually. So, in a very similar manner, the 4-dimensional universe seems to start from a point (the Big Bang) and expands as time goes by (present observation). It is very probable that it will contract in the distant future. But this contraction will be a mere observation. The universe did not start from a point singularity and will not end in a point singularity (the Big Crunch).

But the expansion of our universe comes hand in hand with a discrete and continuous vibration. This means that as the universe expands it also vibrates with a very high frequency. Each vibration is a quantum fluctuation which creates small irregularities and density variations of the 4-dimensional manifold. The vibration is observed as a wave motion in our 3-dimensional field of view. This is why the electromagnetic field has a constantly vibrating wave motion. The discrete (stepwise) vibration appears to us as a discrete quantum of energy. This is what Einstein called a Photon whose energy was postulated theoretically as **E=hf** by Max Planck (1858-1947). In that equation h is the **Planck constant** (6.626068×10^{-34} m^2 kg / s) and f is the frequency of the wave. We see that the Planck constant is a very small number. Each vibration of the universe happens in a very short time, called the **Planck time** about 5.4×10^{-44} seconds. All scientific experiments and human experiences happen over billions of billions of billions of Planck times, making any events happening at the Planck scale almost impossible to detect. Such a small unit of time cannot be measured with our present technology, but it is an important constant for our theoretical understanding of the universe. Because The Planck time is the unique combination of the Gravitational constant ***G***, the Relativity constant ***c***, and the Quantum constant ***h***, to produce a constant with units of time.

The present Big bang model accepts that nothing existed before the Big Bang. But if nothing existed (neither space nor time) how could a Quantum fluctuation happen? There should "exist" an energy field that would vibrate in order for a Quantum fluctuation to happen. Furthermore, if our universe is expanding there should be an inside and an outside of our universe, which means that a certain medium exists outside or adjacent to our universe. This brings the **Multiverse** model into consideration.

Multiverse is a model based on a set of multiple universes. The term was coined in 1895 by the American philosopher and psychologist William James (1842-1910). There are at least two universes within the Multiverse which can be called **Parallel Universes**. The idea of two universes co-existing both next to each other as well as within each other is quite compelling. One can answer many problematic questions that exist in the Big Bang with the help of such a model.

Below we see the visual representation of the Big Bang model as accepted by most physicists.



After the initial Quantum jump (fluctuation) the universe expanded with a tremendously high speed, far higher than the speed of light. This fast expansion time lasted some 10^{-32} seconds after the Big Bang. Physicists have named this short period of time "the time of **Inflation**". This term was proposed by Allan Guth in 1980 and since then is accepted by cosmologists. During inflation the universe stretched to a factor of 10^{25} or more. After this very short time it is believed that the universe ceased expanding and became almost flat. "Flat" means that our universe appears homogeneous and isotropic in accordance with the cosmological principle, instead of being highly curved and heterogeneous. Inflation also explains the origin of the large-scale structure of the cosmos, which started from Quantum fluctuations in the microscopic inflationary region.

But when it comes to calculate the potential energy of that inflation, one finds out that "**bad inflation**" is more likely than "**good inflation**". Bad inflation means that the universe should not be homogeneous and that the background radiation should not be as uniform as it is presently observed. An article published in **Scientific American**, The Inflation Debate (April 2011) by a leading cosmologist, Paul J. Steinhardt argues that: “the universe is more likely to have achieved its current conditions without inflation than with it”.

In my next article I will propose a new model of the universe that contains neither the Big Bang nor the Inflation period.