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Famous models of inflation and solving some problems

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Abstract
There is a set of principles that our current research deals with that are part of the cosmic system that is in a state of expansion and inflation at a very fast and continuous rate. The theory of expansion and inflation of the universe is considered renewed and in rapid development with the progress of modern science, especially astrophysics. Scientists have paid attention to this phenomenon that resulted from the big cosmic explosion. The inflation of the universe occurred after the Big Bang in a short period of time during which the inflation of the universe intensified and became very large. The gravitational forces become infinite after this Big Bang, which makes it expected that the emerging universe will turn on itself at a certain moment.

Keywords: Inflation, universe, and quantum fluctuations

Introduction
The physics of the universe considers cosmic inflation, and the inflation of the galaxy, an exponential expansion that occurs continuously for space. Astronomers believe that this inflation and expansion that occurs in the universe is between 10 and 36 seconds, or about between 10 and 33 seconds after the Big Bang that happened to the universe. After that, the universe continued to expand, but at a slower rate [1]. The theory of the expansion and inflation of the universe was developed in the late 1970s and early 1980s, with clear and notable contributions by a number of theoretical astrophysicists, among them (Alexei Starobinsky) at the Landau Institute for theoretical Physics, and (Alan Guth) at Cornell University, and (Andrei Linde) at the Lebedev Physical Institute. These scientists won in 2014 and received awards as a result of their pioneering theory of cosmic expansion and inflation [2]. Shortly after the Big Bang, the theory assumes that the expansion of the universe continued, but at a very low rate, as it allowed the formation of elementary particles of protons and electrons, through which both hydrogen and helium are formed. According to the timeline of this great explosion and the largest that originated in space, the first stars and galaxies were formed from clouds of hydrogen and helium. And from here began the first stage from which these stellar clusters and galaxies were formed, as well as huge quasi-stars within the range of about (380.000) years after the big cosmic explosion, as the evolution of these large, massive systems continued to the present time. The quantitative fluctuations in the inflationary microscopic region are in continuous development, commensurate with the cosmic size, to form seeds for the growth of structure in the universe. This is evident in the formation and evolution of galaxies and the formation of structure [3].

The inflationary universe
According to the well-known scientific concept that confirms the theory of cosmic inflation, the continuous expansion is very fast for a fraction of a second, as it continues exponentially after the (Big Cosmic Bang). Since 1981, many cosmologists have introduced this idea in order to solve many very important problems in the field of cosmology. The first of these problems is the problem of the horizon, and evidence of the expansion of the universe. If a photon was launched from space early in time and traveled freely until it reached the north pole of the earth, and if another photon was launched at the same time, as shown in figure (1), but completely opposite the direction of the first, can it be exchanged? These two photons information from when they were fired? The answer would be no, because the time required to transmit information from one photon to another would be twice the age of the universe. The inflaton field is the hypothetical scalar field that is thought to underlie cosmic inflation in a very early period [4, 5, 6]. But if there were two photons directed from cosmic space, one towards the North Pole and the other towards the South Pole, we would notice that the photons come from opposite directions and they must have communicated in some way, because the cosmic microwave radiation has almost the same temperature in all directions above the Earth sky, as shown in figure (2).

Fig 1: There is no communicated between two photons unless inflation occurs during the early universe.

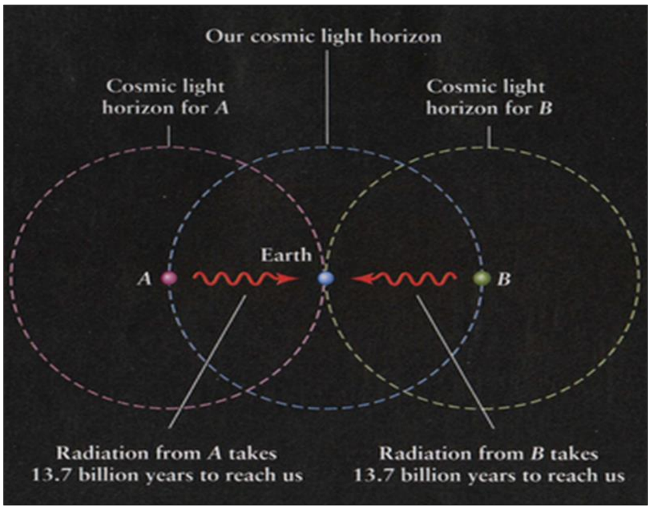

Fig 2: Two photons comes from opposite sites, toward earth (one towards the North Pole and the other towards the South Pole) during the early universe.

Quantum fluctuation

Suppose that before the balloon is inflated, we write a message so small that you can't read it on the surface of that balloon. Inflating the balloon will make the message clear and readable for us. This means that the inflation works like a microscope that magnifies what is written on the balloon before it is inflated.

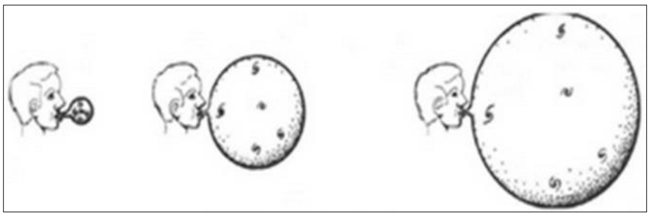

Fig 3: Showing the phenomenon that prove quantum fluctuation.

Starobinsky-inflation

Soviet scientist (Alexei-Starobinsky) noted that quantum corrections to general relativity are very important to the early origin of the universe, correcting the quadratic curvature concept of Einstein-Hilbert work and a form of modified gravity f(R) [7].

- It was concluded through this correction that when the curves are large, this leads to the existence of an effective cosmic constant.
- On this basis, it was suggested that the early universe passed through the inflationary decetre era.
- This led to a solution to the problems of cosmology and thus to specific predictions for corrected microwave background radiation, which was fully calculated according to the following law [8]:

$$S = \frac{1}{2}\int d^4x \left(R + \frac{R^2}{6M^2}\right)$$

$$V(\phi) = \Lambda^4 \left(1 - e^{-\sqrt{2/3}\phi/M_p^2}\right)^2$$

as the Einstein-frame, the results in the observables:

$$n_s = 1 - \frac{2}{N}, \qquad r = \frac{12}{N^2}$$

Monopoly-problem

Since 1978, (Zeldovich) had noticed one of the cosmological problems, the magnetic monopole problem. It was considered an unambiguous quantum version of the horizon problem, a sub-field of particle physics, which led to several conflicting attempts at its solution. In the 1980s, (Alan Guth) realized that the theory of pseudo-vacuum decay in the early universe could solve the problem, which led him to propose that inflation is driven by a series of changes that differ only in mechanical details [9].

Horizon problem and the flatness problem

These problems were caused by $\dot{a} = aH$ was a decresing function a1l the way since the universes (i.e. $\ddot{a}<0$). Now we have a period of inf1ation $\ddot{a}>0$ before the hot big bang. As a resu1t, the horizon, and f1atness problems are reso1ved if the $\dot{a}>0$ period is 1ong enough. Figure 5 i1lustrates this position, where the left and right paintings draw the same physics, in spacetime Observed data that changed the horizon scale respectively [11].

The comoving Hubb1e length decrases as the cosmos expands signficant1y during inf1ation. The fluctuations then extended beyond the horizon during inflation and returned to the horizon in the late universe, see Figure 4. In fact, before inf1aton, sca1es that were outside the horizon during CMB-dceoupling were inside it. Therefore, before inf1ation, the space and similar to the visible universe, and before that it was in a state of thermal equilibrium [10].

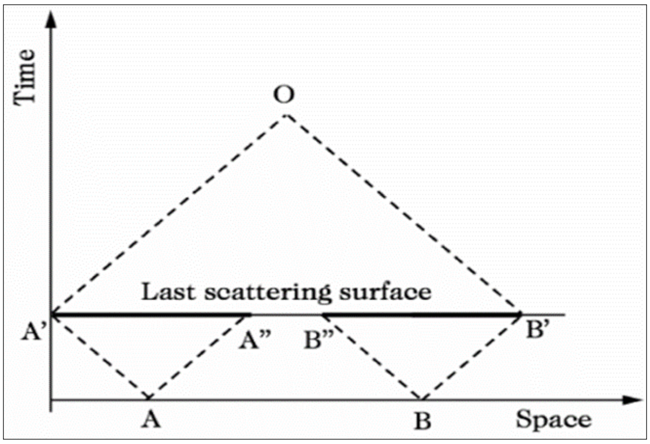

Fig 4: Inf1ation solves the horizon prob1em. Thanks to the acce1erated expansion, the conformal time τ is no longer tightly bounded by the big bang singularity t = 0". Thus the past light cons on the CMB [11].

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