Cosmic Inflation and the Beginning of the Universe

by

Roger Ellman

Abstract

Fundamental theory underlying the cosmic inflation hypothesis and its relation to fundamental theory on the beginning of the universe.

Roger Ellman, The-Origin Foundation, Inc.
320 Gemma Circle, Santa Rosa, CA 95404, USA
RogerEllman@The-Origin.org
http://www.The-Origin.org

Cosmic Inflation and the Beginning of the Universe

by

Roger Ellman

Fermilab's in-house magazine of February 2008 ran a spoof personal ad that stated: "mature paradigm with firm observational support seeks a fundamental theory in which to be embedded". It was referring to inflation – a period of exponential expansion [of the universe] thought to have taken place 10^{-35} seconds after the big bang, which, although able to account for the large-scale appearance of the universe, lacks a firm theoretical footing.[1]

The problem of a theoretical footing for the inflation hypothesis is directly related to another unresolved fundamental cosmological problem, the very beginning of the universe.

- The universe is thought to have had to have started at a singularity, a dimensionless, volumeless point. That is required because it is thought that any other start involves an infinite rate of change from the immediately prior state of no universe to what followed.
- But, how could the universe have started at a singularity, a point, which is dimensionless, volumeless, and not conceivably able to deliver anything, not able to be the origin of anything ?
- And, how could the universe come into existence without a violation of conservation, without "getting something from nothing" ?

As with the theoretical footing for cosmic inflation, that dilemma, that set of contradictions, has never been resolved. But, in spite of that apparent barrier to any beginning of the universe, the universe does exist [as DesCartes might have observed] and, therefore, it had a beginning. What is needed is not to say that it is impossible, that there can be no solution, etc. Rather we must "bite the bullet", accept the conditions, and deduce how the conflict resolved.

It turns out that the solution to the very beginning of the universe is also the solution to the problem of inflation.

The origin of the universe was not a dimensionless singularity. It was a volume of radius equal to about $4 \cdot 10^7$ $meters$.[3] That resolves the inflation problem. The universe did not have to extremely rapidly and unreasonably [far exceeding the speed of light] expand a super-brief moment after its beginning. It began already so inflated.

[Why that particular size ? Why any size ? There was nothing to compare it with. It simply was. The value is derived and calculated from the estimated number of particles in the universe, about 10^{84}. See the derivation of reference.[3]]

But, what about the infinite rate of change from the just prior state to that beginning ? There are two aspects to the resolution of that problem: how did the substance of that beginning develop; and what is a singularity.

The change from nothing to something, both itself and its consequences, were subject to the restriction of the impossibility of infinity as well as the requirement of conservation. Resulting further implications are:

- the rate of change was finite; that is, rather than an instantaneous jump from nothing to something there had to have been a gradual transition at a finite rate of change;
- the rate of change of the rate of change (in calculus the 2nd derivative) was also finite; that is, rather than an instantaneous jump from zero to some non-zero rate of change there had to have been a gradual transition;

- similarly for the rate of change of the rate of change of the rate of change (in calculus the 3rd derivative) and so on *ad infinitum*.

These require that the change took place in a manner describable either as a natural exponential or some form of sinusoid. Only those forms can assure there being no derivative that is infinite. There are five forms of that type; the: sine, cosine, hyperbolic sine, hyperbolic cosine, and natural exponential.

In addition to the finite derivatives requirement there are other requirements to match such a function to the real situation (e.g. being zero just before the beginning). See *Detail Notes 2, Analysis: All Derivatives Finite, Selecting U(t)* [4]. The only function that meets all of the requirements is presented in the figure and equation below.

In the figure, the equation which follows it, and the discussion, t_0 is the instant of the beginning and $U(t)$ is the quantity (the substance of the Universe) that changes with time, t.

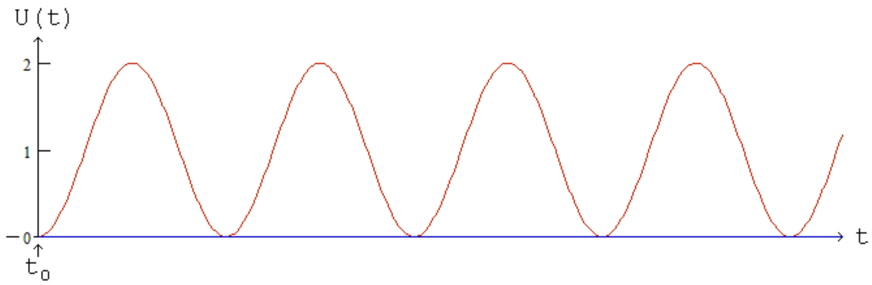

Figure 1
Form For The Beginning of the Universe

The curve of the above is that $U(t)$ is of the form:

(1) $U(t) = [1 - \text{Cos}(2\pi ft)] \qquad t \geq t_0$
$U(t) = 0 \qquad t < t_0$

This form for $U(t)$ has the uniform content of the $4 \cdot 10^7$ meters radius volume starting at being zero throughout and smoothly changing with all rates of change finite. Thus, there is no infinite change from nothing to something.

Furthermore, at every instant the substance of $U(t)$ is the same, uniform throughout that initial volume. At every instant there is no difference anywhere within that volume. There can be no mensuration, no dimensioning. It is all the same place everywhere within that volume. It is a *singularity*.

Finally, the positive $U(t)$ so far addressed had to be precisely accompanied by an equal but opposite negative $U(t)$ so that conservation is maintained; the sums, the totality, before and after time t_0 are identical. There is no "something from nothing".

Much more could be developed about the implications of the oscillatory form of $U(t)$ and about the implications of the positive and negative aspects of $U(t)$. For those see *The Origin and Its Meaning* in general. [2]

Finally, the initial $U(t)$ was extremely unstable [5] and an infinitesimal instant after the beginning it all exploded as the Big Bang. Several aspects caused that explosion to fail to be perfectly spherically symmetrical, resulting in the universe's varied structure:

- The explosion and projection outward was of particles, not a smooth continuous substance and no arrangement of particles could be perfectly uniform and symmetrical;

- The entire volume contents could not perfectly simultaneously explode so that the progress of the explosion [although extremely rapid] defeated uniformity and symmetry;
- The explosion was analogous to a radioactive decay of a very large and complex nuclear type proceeding in stages of decay down to the ultimate end of the chain.

[1] http://physicsworld.com/cws/article/news/32964;jsessionid=BFA55B6A4C873E6C53D2D5F4A2B92CDC

[2] *The Origin and Its Meaning*, Roger Ellman, The-Origin Foundation, Inc., 1996, Available at http://www.The-Origin.org .

[3] Same as [2], *Section 21, equation (21-66)*.

[4] Same as [2], *Detail Notes 2, Analysis: All Derivatives Finite, Selecting U(t).*

[5] Same as [2], *Section 20, The Cosmic Egg*.