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Prospective Study

On freedman equation and the shape of our universe

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Abstract

In the nineteen twenties, the famous Russian mathematician Alexander Freedman formulated an equation which determines the shape and fate of our universe. Freedman derived his equation in general relativity. The equation reveals that the geometry of the universe may be flat, closed or open. The Euclidean, hyperbolic and spherical geometries describe the flat, open and closed universes respectively. Both NASA's WMAP and ESA's PLANCK mission show the cosmological curvature parameter, Ω_K, to be 0.000±0.005, consistent with a flat universe. Many observational cosmological probes revealed that the universe is flat obeying the classical Euclidean geometry. But till this day, there is no mathematical formulation/proof for the geometry of our universe. In this work, the attempts to establish that the shape of our universe is flat.

Proof one

The density parameter Ω, the curvature parameter k and the Hubble parameter H are related as [1-5].

$(1 - \Omega) = -kc^2 / H^2R^2$ (1)

If omega less than 1, k is less than 1

If omega is equal to 1, k is zero

If omega greater than 1, k is +1.

If k is -1, the geometry of the universe is open,

If it is greater than one, the shape of the universe is closed

And the universe obeys Euclidean geometry if k is equal to zero.

I.e if $\Omega = 1$, the universe is Euclidean,

If Ω = less than 1, the geometry of the universe is open,

And if Ω = greater than 1, the universe is closed,

Let $-n = -kc^2 / H^2R^2$ in (1) (1a)

Assuming (1a) in (2), $1 - \Omega + n = 0$

Squaring, $1 + \Omega^2 + n^2 - 2\Omega - 2n\Omega - 2n = 0$

i.e $(\Omega - n)^2 = 2\Omega + 2n - 1 = 0$

From (1a) we have, $\Omega - n = 1$. Putting this in the first factor of the above equation,

$= 2\Omega + 2n - 1$

Simplifying, $1 = \Omega + n$

But from eqn. (1a) ,$1 = \Omega - n$

Adding the above two relations, $1 = \Omega$ (2)

As we have previously seen in Ω is equal to 1, the curvature of our universe is zero and the geometry of our universe is flat [6].

Proof two

The density parameter Ω, the curvature parameter k and the Hubble parameter H are related as [7,8]

$(1 - \Omega) = -kc^2 / H^2R^2$ (1)

If omega less than 1, k is less than 1

If omega is equal to 1, k is zero

If omega greater than 1, k is +1.

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If k is -1, the geometry of the universe is open,

If it is greater than one, the shape of the universe is closed

And the universe obeys Euclidean geometry if k is equal to zero.

I.e if $\Omega = 1$, the universe is Euclidean,

If Ω = less than 1, the geometry of the universe is open,

And if Ω = greater than 1, the universe is closed.

For our convenience, let us assume in (1), $-n = -kc^2 / H^2R^2$

So, $(1 - \Omega) = -n$ (1a)

Applying (1a) and cubing (1) we get that,

$1 - \Omega^3 - 3\Omega(1 - \Omega) = -n^3$

i.e($n^3 - \Omega^{3)} + 1 - 3\Omega(1 - \Omega) = 0$

By applying the famous algebraic cubic formula $a^3 - b^3 = (a-b)^3 + 3ab\,(a\ b)$ in the first factor of the above relation we obtain that,

$(n - \Omega)^3 + 3n\Omega(n - \Omega) = -1 + 3\Omega(1 - \Omega)$

From (1a) we have , $n - \Omega = -1$

Putting this relation in the above eqn. we have, $n\ (n - \Omega) = \Omega(1 - \Omega)$ (1b)

Again applying (1a) in RHS, $n\ (n - \Omega) = -n\Omega$ (3)

From (1a) we also have, $n - \Omega = -1$

By assuming the above relation in the LHS of (2) we get $-n = -n\Omega$

By simplifying we get that $\Omega = 1$ (4)

Discussion

From equations (2)and (4) we can conclude that the geometry of our Universe is FLAT.

The shape of the entire relies on the following properties:

1. Finite or infinite
2. The geometry is flat, hyperbolic or elliptic

Simply connected space or multiply connected space

The exact shape is a burning problem in physical cosmology. Several experimental and observational data WMAP, PLANCK, BOOMERanG confirm that the universe is flat with only a 0.4% margin of error. Theorists believe that the universe is flat and infinite. Our finding adds more and more favorable arguments for the shape and fate of our universe.

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