The Big Mistake in the Derivation of Friedmann Equation

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Abstract

The Friedmann Equation which is often described as the most important equation in cosmology can be derived from Newtonian gravity without General Relativity. However, it is shown here that this derivation is mathematically incorrect and cannot even be a good approximation specifically because of invalid application of the shell theorem. Derivations from general relativity and Machian derivation are also without foundation.

Introduction

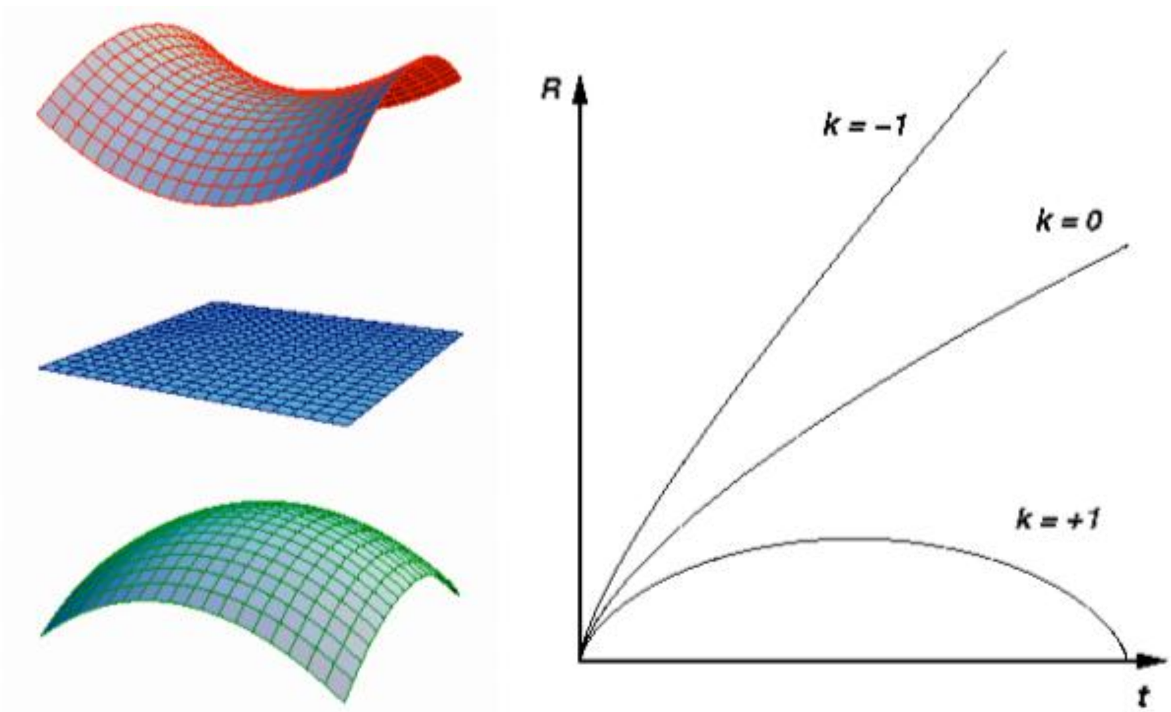
The reader who has seen the above title will most likely be inclined not to continue reading the content due to the general preconceived negative opinion regarding the criticism of the mainstream theories. It is however hoped that some freethinkers will pay a little attention to this review of one of the most important equations in cosmology and to look at the matter from the purely scientific standpoint.

The Mistake in the Derivation of Friedmann Equation from Newtonian Gravity

The derivation of the Freedman equation requires the mathematical result known as the shell theorem which can easily be proved. The theorem states that in a spherical symmetric distribution of matter, a particle at a distance ($r = R$) from the centre ($r=0$) feels no force at all from the material in the outside region ($r>R$).Then the calculation is carried out to lead to Friedmann equation:

$$\boxed{\left(\frac{\dot{R}}{R}\right)^2 - \frac{8}{3}\pi G\rho - \frac{1}{3}\Lambda = -\frac{kc^2}{R^2}}$$

The full derivation can be found in any cosmology textbook and is usually followed by the discussion of the three possible geometries for the universe according to the value of (κ) being zero, positive or negative.



Unfortunately, this equation has been derived by erroneous method making use of the incorrect assumption that the shell theorem can be applied in the case of non-Euclidean geometry. Let us see the case of spherical geometry. Such geometry might well apply to our universe. It can easily be seen that in an isotropic universe with spherical geometry no gravitational force exists at all because every force in any direction is matched by a force of the same magnitude in the opposite direction because of total symmetry of space in this case. This brings out the interesting fact that the large scale geometry of an isotropic universe with spherical geometry is independent of its average density. This fact seems to contradict general theory of relativity at first glance but, interestingly, this contradiction will disappear if we agree to define the cosmological constant in such a way that the average density of the universe is cancelled out from the global application of the field equation. In fact, we are forced to do so because the application of Newtonian gravity in the large scale (not like the case of local application in which GR supersedes Newtonian gravity) should give the same results as that given by general theory of relativity. The independence of the large scale geometry of the universe from its average distance can be attained by assuming that the average density of the universe is a part of the cosmological constant and therefore it is cancelled out because it appears twice in the field equation with opposite sign, first as a part of the cosmological constant and then as the material part of the equation (full details of this definition of the cosmological constant and a proposed cosmological model associated with it is found in (Alternative Cosmological Model without Ad Hoc Elements and without Modifications in GR or QM : by the same author).

Claims of alternative methods of derivation of the Friedmann equation such as Machian derivation (see for example: *Machian derivation of the Friedmann equation by Herman Telkamp*) also fail in front of the total symmetry of the isotropic spherical universe.