Abstract

We present a theory based upon the treatment of the gravitational field as a sea of gravity quanta, as defined elsewhere. The resultant model for the Universe is a static one, like Einstein first saw, with a new feature: a local shrinking quantum world that completely explains the Hubble red shift under a new point of view. The presently accepted expansion of the Universe is interpreted here as an apparent effect, as seen from the Lab system of reference. The static Universe has immersed in it a local shrinking atomic world: a fundamental change in the interpretation of the Hubble's observations. The conservation principles (momentum, angular momentum and energy) can be dealt with under 2 different points of view: local (apparent) and COSMOLOGICAL (“real”). The 2 are in complete agreement with observation. They are also free of well known contradictions or paradoxes/incoherencies (i.e. in the Big Bang model). By dealing now with very well known first principles (Heisenberg, Mach, de Broglie, Weinberg's relation) under the same 2 points of view, we arrive at the conclusion that our new approach is in accordance with the Einstein’s field equations of General Relativity, and Quantum Mechanics. We consider this to be a promising first step towards the way of dealing with the gravitational field coherently both from the General Relativity and from the Quantum Mechanical theories. The agreement with the present values of the cosmological parameters is very satisfactory.

1 Introduction

The point of view of considering the gravitational field as a sea of gravity quanta has been dealt with elsewhere. The published result there for the mass mg of this quantum is given by the relation \( m_g = \frac{\hbar}{c^2 t} \), where t is the age of the Universe (then today \( m_g \) is of the order of \( 2 \times 10^{-66} \) grams).

The first important consequence of the above approach is the need to introduce a new concept, that we call the Mass Boom, \cite{2}, \cite{3}, \cite{4} and \cite{5}. In essence it expresses the property of any gravitational mass that, due to the emission of these gravity quanta, having a negative energy, its mass increases linearly with cosmological time. This linear dependence between mass and time makes it possible to
identify the mass of the Universe \( M \) with the cosmological time \( t \). A philosophical statement like *we are made of time* obviously follows and merits a deep reflexion. Clearly this approach is of the Machean type.

The second important consequence of this approach is that the speed of light must decrease with time. In fact it can be equated to the inverse of \( t \), \( c = 1/t \) \([4]\) and \([5]\). Then the resultant model for the Universe is a static one, as Einstein first proposed, and mathematically stated as \( a(t) = ct = \text{constant} \), i.e. a constant cosmological scale factor. The expansion of the Universe, a generally accepted interpretation of the red shift, is interpreted here as an apparent effect seen from the laboratory system of reference. The reinterpretation of the Hubble red shift is that the quantum world is shrinking, an effect coming directly from the time variation of Planck’s constant \([3]\), proportional to \( 1/t^2 \) or equivalently to \( c^2 \).

The work we present here is based upon the above results. We analyze, from this new point of view, the conservation principles, and solve both: the Schrödinger equation together with the Einstein cosmological equations, which represents a first step in the harmonization of Quantum Mechanics and Relativity. The conclusion is that the whole approach is very promising and liberates present theories (like the Big Bang) from contradictions and paradoxes. The agreement with the known numerical values for the cosmological parameters, as accepted today, is very satisfactory.

### 2 New concepts in the conservation principles

A summary of the new concepts is as follows:

- The mass of the gravity quanta, \( m_g = \hbar/(c^2 t) \).
- The Mass Boom effect: any gravitational mass \( m \) has a time dependence as \( m = \text{constant} \, t \) (\( t \) the age of the Universe).
- The decrease of the speed of light with time, \( c = 1/t \).
- The \( G = c^3 \) relation, following the Action Principle.
- Heisenberg and the De Broglie wavelength (perhaps the Compton wavelength as an alternative), \( \hbar/mc = \text{constant} \) in the Lab.
- The \( v/c \) constancy as seen from the LAB system in order to conserve the constancy of the relativistic relations at any time.
- The Mass Boom is always present (as long as gravity is present).
- The decrease of the speed of light with time as \( c = 1/t \), always present as a consequence of the constancy of momentum (in the absence of mechanical perturbations).
- The apparent interpretation of the cosmological expansion, following the Hubble’s observations.
• The $h = c^2$ relation (which explains the contraction of the quantum world).

• Weinberg’s relation under a new point of view: not only explains the quantum of mass at the local Lab. It explains the Universe as a quantum black hole whose mass increases linearly with time.

• The introduction of $H = 1$, the cosmological Planck’s constant, given by the relation $H = \hbar t^2 = 1$, which is the essence of the quantum approach to cosmology.

• The Cosmological Planck’s units using $H$, instead of $\hbar$, defining the cosmological quantum given by the whole Universe (mass, size and time $M = t$, and size $ct = 1 = 10^{28}$ cm with the constant homogeneous tic given by Planck’s time).

• The fluctuation of the whole Universe, seen as a quantum black hole (corroborated by the Weinberg’s relation using $H$).

• The determination of the age of the Universe as $t = 10^{61}$ units of time (the age of the Universe today) and given by the ratio of Planck’s length at $t = 1$ (the constant length 1028 cm) and the present value of $10^{-33}$ cm).

• The solution to the cosmological Schrödinger equation coupled with the Einstein’s cosmological equations (harmonization of General Relativity and Quantum Mechanics).

• The new entropy concept, that includes the gravitational entropy: $S = kM/m_g = M = t$ (for the Universe, [6]).

3 The solution to the Schrödinger cosmological equation coupled to the Einstein cosmological equations

The Schrödinger equation can be formulated from a cosmological point of view by using the "cosmological" Planck’s constant $H = \hbar t^2 = 1$ (a real constant). The resultant equation is then:

$$\frac{H^2}{2m} \frac{\partial^2 \Psi}{\partial x^2} + V \Psi = iH \frac{\partial \Psi}{\partial t}$$

We see that all the terms in this equation vary as $1/t$. Then multiplying by $t$ we have both members of the equation constant, as in the normal quantum mechanical treatment. The solution is then, assuming the wave function to be represented by a product of two functions: one depending on space and the other depending on time only, in the usual way one has:

$$\Psi(x,t) = \text{const } (\sin x) t^2$$
On the other hand the Einstein cosmological equations have the solution \( a(t) = t^2 \) \[5\] which coincides with the above time dependence, as seen from the Lab reference system. Hence we have the same time dependent solution for both: General Relativity and Quantum Mechanics.

4 Conclusions

The main implications of this work are: a change in basic paradigms, perhaps the most important one is the new explanation for gravitation, in quantum mechanical terms, and coherent with general relativity. Also a new approach to the entropy concepts, in particular to the Hawking-Bekenstein treatments, where the entropy of a black hole is here defined as linear with mass \[7\]. A return to the Einstein initial cosmological model is the most significant change in the formulation of cosmological models.

References

[1] A. Alfonso-Faus, "Gravity Quanta, Entropy and Black Holes", Physics Essays 12, n. 4 (1999). Also in arXiv: gr-qc/0002065 v1, February 18, 2000.

[2] A. Alfonso-Faus, "Mass Boom versus Big Bang: Einstein was right". International Symposium n° V "Frontiers in Fundamental Physics". Hyderabad, India 2003. arXiv:physics 0302058

[3] A. Alfonso-Faus, "Mass Boom versus Big Bang: the role of Planck's constant", Journal of Theoreticals June 12 (2003) (arXiv: physics/0309108)

[4] A. Alfonso-Faus, "Quantum Gravity and General Relativity Consistent with a Decreasing Speed of Light and Mach’s principle". Spacetime and Substance 3 (13) (2002) 130

[5] A. Alfonso-Faus, "Laboratory Physics and Cosmology", Physics Essays, July 2004 and arXiv: physics/0407150 v1

[6] A. Alfonso-Faus, "Entropy in the Universe: A new Approach", online Entropy, 2 (2000) 168 (at www.mdpi.org/entropy/)

[7] A. Alfonso-Faus, "Black Hole Entropy: Linear or Quadratic?" arXiv:astro-ph/0211053 v1, November 4, 2002