Calculation of Cosmological Observables from Constants of Nature *

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Abstract

Hubble's constant is calculated exclusively from the constants of nature, e, α, c, and $\hbar$, yielding the value 71.73 km/sec/Mparsec. Corroborative results can be obtained from a quantum fluctuation scenario of the early universe. The theory also yields the radius of the universe, $1.296 \times 10^{26}\ m$, its energy density, $5.403 \times 10^{-9} J/m^3$, and age, $13.7 \times 10^9\ years$, and the energy density of CBR, $2.63 \times 10^{-7}\ eV/m^3$.

I INTRODUCTION

A recently developed relativistic construct [1,2,3] identifies two space-like separated observers who measure respectively an orbital velocity as seen from origo and line increments in the direction of observation as seen from the periphery towards the center. The peripheral observer performs direct measurements in one spatial dimension whereas the observer at origo is non-local in the sense of only being capable of measurements on the time axis. This construct naturally accommodates the Sommerfeld equation of relativistic electron energy as well as the Bohr atom in its ground state. The theory also, for the first time, offers a framework for determining cosmological parameters based on plain quantum physical considerations. In this application, observations are made towards the non-local frame at origo, yielding numerical agreement between the apparent Hubble expansion rate and Λ_0 decay at the cosmological horizon [1].

II RESULTS

It is customary to evaluate Hubble's constant by comparing results of different types of measurement while relating to some relevant theory. A recently reported method of determining Hubble's constant is based on equating the gravitation of the universe as measured

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from the cosmological horizon with particle creation at the horizon [1]. The cosmological horizon is defined as the laboratory frame, which is space-like separated from a frame at origo at a radial distance equal to and no longer than as given by having the most distant expansion rate equal to the velocity of light. The generation of primordial matter is estimated from the decay of the Λ_0 particle in a quantum fluctuation scenario of the early universe. This method of calculating Hubble's constant yields the value $0.7668 \times 10^{-26}s^{-1}$ [1] (The symbol s is used for the geometrized unit of time to distinguish from SI units, *sec*). Corroborative data can be obtained by factorizing the Planck length in terms of the apparent expansion rate [2], yielding:

$$H = \sqrt{\hbar}\ \frac{\pi}{2}\frac{2\alpha}{e\ c}\ Ampere\ =\ 0.77145 \times 10^{-26}s^{-1} \tag{1}$$

where e is the elementary charge, α is the fine structure constant, $c = m/s$ is the velocity of light, and $\hbar$ is Planck's constant. This value, corresponding to 71.37 km/sec/Mparsec agrees within experimental errors with that obtained from the particle decay and is also within acceptable limits of current astronomical observations [4].

The reported Lorentz construct allows the identification of a radius the magnitude of which is numerically given by the inverse of the line increment, $\bar{q}_0 = -m^2/\Delta\bar{q}$. The constraint by applying $v \leq c$ to the distant expansion rate identifies this as the radius of the universe, $1.296 \times 10^{26}\ m$, and the average energy density is directly obtained as $5.403 \times 10^{-9} J/m^3$. The age of our local universe is defined by the time it takes for a light signal to go from origo (the origin of space and time coordinates) to the cosmological horizon (=the laboratory frame), $13.7 \times 10^9 years$.

Much attention has been given through the years to the cosmic background radiation at 2.7 degrees Kelvin. Since $\Delta\bar{q} << 1$, Rayleigh-Jeans' law of energy density of radiation emerging from a hot cavity,

$$U(\nu) = \frac{8\ \pi\nu^2}{c^3}kT\ \ , \tag{2}$$

where ν is frequency, k is Boltzmann's constant and T is absolute temperature, may be used for the present purposes. The global (non-integrable) frequency is set to $\Delta\bar{q}/ms$ while the Boltzmann factor is taken from the unit radius as (m^2/s) whereby mc has unit energy and $\hbar = \Delta\bar{q}m$ corresponds to Planck's constant in the present geometry. Having the relation $\Delta\bar{q}/m = -m/\bar{q}_0$ for the unit radius the source of CBR is thereby assigned to origo, which is equivalent of the cosmological horizon in the standard models. The rather high apparent temperature in the Boltzmann factor arises because of a transformation from three dimensions on a cosmological scale to the unit radius. It is not known at present how the classical concept of (material) diffusion in three dimensions should be expressed along the coordinate of observation in the present model. This ambiguity applies to Boltzmann's constant as well as to temperature. In the present two-dimensional model one may try and divide the unit radius (corresponding to the Boltzmann factor) by $2\pi r_U$ (r_U is the distance to the cosmological horizon where the thermal agitation giving rise to the CBR presumably takes place), then apply Eq. 1 divided by α to get the contribution of kinetic energy from diffusion on the surface of a sphere tangential to the axis of observation, $1.242\ \times\ 10^{-67}\ m$. The correct SI-value for the Boltzmann factor with CBR is $3.11 \times\ 10^{-67}\ m$ ($= k\ \times\ 2.725$), exactly 5/2 times the calculated value. The close agreement between the two numerical values might suggest that some kinetic energy giving rise to the CBR is quantized as a multiple of $\hbar$.

Noteworthily however, the frequency $\Delta\bar{q}/ms$ is equivalent of the Hubble expansion rate in the present theory. Eq. (2) reduces to

$$U(\Delta\bar{q}) = 8\ \pi\ \frac{\Delta\bar{q}^2}{m^3}\ \ , \tag{3}$$

where it is implicit that the line increment (like H) is time-dependent as s^{-1}. The equation should apply to observations along the line increment towards the (non-local) center of a circle so a factor 4π, which is ascribed to the surface angle of a glowing cavity in the conventional derivation, is taken away. Furthermore, the right side of Eq. (2) is divided by 3/2 since the line increment in the laboratory frame augments by exactly this factor to contribute from three local dimensions to the global energy density [1] whereas one is interested only in the non-local contribution from a single axis of observation. After thus having made the numerator of Eq. (2) one-dimensional on the presumption that all observations must be made along the axis of observation, the end result further requires the transformation

$$\Delta\bar{q}^2\ \rightarrow\ \frac{e^2\ \ c^2}{\alpha^2\pi^2 m^2(Ampere)^2}\Delta\bar{q}^2 = \hbar \tag{4}$$

which is implicit in Eq. (1). Both the electric and the magnetic vectors of radiation are perpendicular to the axis of observation so Eq. (4) may be regarded as a prescription for obtaining the energy from the perpendicular line increment. (It can be derived from the Bohr atom [2]). The end result is

$$U = \frac{2\hbar}{s}\ \frac{1}{3/2} = 3.48 \times 10^{-70}\ m/m^3\ \ , \tag{5}$$

corresponding to $2.63 \times 10^{-7}\ eV/m^3$, which closely agrees with the published [5] experimental value, $2.604 \times 10^{-7} eV/m^3$. Thus, the CBR appears to be straightforwardly associated with Hubble's constant and with any arbitrary observation made on the basis of the present cosmological model.

III DISCUSSION

The present results show for the first time that plausible numerical values of several cosmological observables can be calculated directly from constants of nature. The use of fixed boundary conditions for the observables within a well-defined quantum physical framework circumvents any speculations about the history of the universe including the problem of its closure in the "Big Bang" hypothesis. A numerically more confident determination of Hubble's constant and the CBR than in standard models is made possible while maintaining the notion of the latter's distant origin. All numerical values are within acceptable limits of contemporary astrophysics. The somewhat higher value of the energy density (twice the critical density) might be necessary for nucleation of matter given that an early expansive phase is not in the focus of the present theory. Also standard models must face the factually observed matter deficiency. The theory might also contribute to the Big Bang field, related to non-local entanglement in the early universe. It is too early to determine which one of the five or so existing conceptual frameworks for deriving the Planck distribution should be applied here for determining the spectral profile.

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