# Peculiar Relations in Cosmology

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Within the expanding cosmic Hubble volume, the Hubble length can be considered as the gravitational or electromagnetic interaction range. The product of 'Hubble volume' and 'cosmic critical density' can be called the 'Hubble mass'. Based on this cosmic mass unit, the authors noticed three peculiar semi empirical applications. With these applications it is possible to say that in atomic and nuclear physics, there exists a cosmological physical variable. By observing its rate of change, the future cosmic acceleration can be verified, time to time Hubble's constant can be estimated and finally a unified model of the four cosmological interactions can be developed.

## 1 Introduction

If we write $R_0 \cong (c/H_0)$ as a characteristic cosmic Hubble radius then the characteristic cosmic Hubble volume is $V_0 \cong \frac{4\pi}{3}R_0^3$. With reference to the critical density $\rho_c \cong \frac{3H_0^2}{8\pi G}$ and the characteristic cosmic Hubble volume, the characteristic cosmic Hubble mass can be expressed as $M_0 \cong \rho_c \cdot V_0 \cong \frac{c^3}{2GH_0}$. If we do not yet know whether the universe is spatially closed or open, then the idea of Hubble volume [1–3] or Hubble mass can be used as a tool in cosmology and unification. This idea is very close to Mach's idea of distance cosmic background. It seems to be a quantitative description to Mach's principle. In understanding the basic concepts of unification of the four cosmological interactions, the cosmic radius $(c/H_0)$ can be considered as the infinite range of the gravitational or electromagnetic interaction. Within the Hubble volume it is noticed that: 1) Each and every point in free space is influenced by the Hubble mass. 2) Hubble mass plays a vital role in understanding the properties of electromagnetic and nuclear interactions and 3) Hubble mass plays a key role in understanding the geometry of the universe.

## 2 Application 1

Note that large dimensionless constants and compound physical constants reflect an intrinsic property of nature [4,5]. If $\rho_c c^2$ is the present cosmic critical energy density and $aT_0^4$ is the present cosmic thermal energy density, with this $M_0$ it is noticed that $\ln\sqrt{\frac{aT_0^4}{\rho_c c^2}\cdot\frac{4\pi\epsilon_0 GM_0^2}{e^2}} \cong \frac{1}{\alpha}$ and at present if $T_0 \cong 2.725$ °K, obtained $H_0 \cong 71.415$ km/sec/Mpc [6,7]. It is also noticed that $\ln\left[\frac{\rho_m}{\rho_c}\sqrt{\frac{4\pi\epsilon_0 GM_0^2}{e^2}}\right] \cong \frac{1}{\alpha}$ where $\rho_m$ is the present cosmic matter density. Obtained $\rho_m \cong 6.70\times10^{-29}$ kg/m$^3$ is matching with the matter density of spiral and elliptical galaxies. Please note that almost (60 to 70)% of the galaxies are in the form of elliptical and spiral galaxies.

## 3 Application 2

With this $M_0$ it is noticed that, $\frac{\hbar c}{Gm_p\sqrt{M_0 m_e}} \cong 1$ where $m_p$ and $m_e$ are the rest masses of proton and electron respectively. This is a very peculiar result. With this relation, obtained value of the present Hubble's constant is 70.75 km/sec/Mpc. From this relation it is clear that, in the presently believed atomic and nuclear "physical constants", there exists one cosmological variable! By observing its cosmological rate of change, the "future" cosmic acceleration can be verified.

## 4 Application 3

With reference to the Planck mass $M_p \cong \sqrt{\hbar c/G}$ and the elementary charge $e$, a new mass unit $M_C \cong \sqrt{e^2/4\pi\epsilon_0 G}$ can be constructed. With $M_0$ and $M_C$ it can be assumed that cosmic thermal energy density, matter energy density and the critical energy density are in geometric series and the geometric ratio is $1+\ln\left(\frac{M_0}{M_C}\right)$. Thus, $\left(\frac{\rho_c c^2}{\rho_m c^2}\right)_0 \cong \left[1+\ln\left(\frac{M_0}{M_C}\right)\right]$ and $\left(\frac{\rho_c c^2}{aT^4}\right)_0 \cong \left[1+\ln\left(\frac{M_0}{M_C}\right)\right]^2$. It is another peculiar observation and the corresponding present CMBR temperature is $T_0 \cong 2.718$ °K. Independent of the cosmic redshift and CMBR observations, with these coincidences it is possible to understand and decide the cosmic geometry. The mystery can be resolved only with further research, analysis, discussions and encouragement.

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## References

1. Seshavatharam U. V. S. Physics of rotating and expanding black hole universe. *Progress in Physics*, 2010, v. 2, 7–14.
2. Seshavatharam U. V. S. and Lakshminarayana S. Hubble volume and the fundamental interactions. *International Journal of Applied and Natural Sciences (IJANS)*, 2012, v. 1 (2), 45–58.
3. Seshavatharam U. V. S. and S. Lakshminarayana S. Atom, universe and the fundamental interactions. *Global Journal of Science Frontier Research (A)*, 2012, v. 12 (5), 1.
4. Dirac P. A. M. The cosmological constants. *Nature*, 1937, v. 139, 323.
5. Dirac P. A. M. A new basis for cosmology. *Proc. Roy. Soc. A*, 1938, v. 165, 199.
6. Huchara J. Estimates of the Hubble Constant. *Harvard-Smithsonian Center for Astrophysics*, 2010, http://hubble.plot.dat.
7. Freedman W. L. et al. Final Results from the Hubble Space Telescope Key Project to Measure the Hubble Constant. *The Astrophysical Journal*, 2001, v. 553 (1) 47–72.