

An unifying Scientific Principle

Francis M. Sanchez¹

¹Paris 8 and 11 University (retired), email: hol137^@yahoo.fr

Abstract. A generalization of the virial theorem, using the basic quantum proportionality between energy and frequency, leads to a Coherence Principle which applies both in atomistic, astrophysics and cosmology, with the determination of several so-called 'free cosmic parameters'. An application in biology is also proposed.

A Coherence Principle (CP), meaning each well-defined phenomena is monofrequency, has been applied by Haas¹ with the form $-E_{\text{pot}} = E_{\text{kin}}$, to compute the atomic radius in a Thomson atomic model, three years before Bohr, with only an excess factor 2 on the atomic radius. The correct calculus uses instead the virial theorem $-E_{\text{pot}} = 2E_{\text{kin}}$, or, $-E_{\text{tot}} = E_{\text{kin}}$ which is another form of CP. Note that the virial theorem is used also widely in astrophysics.

The classical correspondance $E = Mc^2$ has been demonstrated for electromagnetic energy by Poincaré², as soon as 1900; so its generalization to any energy form may be considered as a “mass-energy” principle, without evoking the relativity theory. This letter presents the Coherence Principle as the generalization and idealization of the Planck formula $E = hf$, and applies it to cosmology in order to find several so-called 'free' cosmic parameters. An application to biology is also presented.

So consider *galilean* physics and the *simplest cosmology*: the steady-state model³, characterized by a scale factor $\exp(t/T)$, with an unique parameter T and a recession law: $1/T = v/r = c/R$, where v is the speed of a r - distant galaxy. The gravitational potential energy is given by the well-known formula $E_{\text{pot}} = -(3/5)GM^2/R$, the mass M being the total equivalent mass in the sphere of radius R . The galilean kinetic energy E_{kin} is the integral of $v^2 dm/2$, with $dm = 4\pi\rho r^2 dr$ and the invariant-in-time-and-space mass density $\rho = 3M/4\pi R^3$. This gives $E_{\text{kin}} = (3/10)E$, with $E = Mc^2$.

Using the Haas CP: $-E_{\text{pot}} = E_{\text{kin}}$, this implies $R = 2GM/c^2$, which is the critical condition $\Omega = 1$:

$$-E_{\text{pot}} = E_{\text{kin}} = \Omega_m E \quad ; \quad \Omega = 1 \quad ; \quad \Omega_m = 3/10$$

A fraction 7/10 is excess energy, compatible with the so-called 'dark energy'⁴: $\Omega_\Lambda = 0.692(10)$.

Now, in the natural decomposition $E = E_{\text{cl}} + E_{\text{qu}}$, a further application of CP is to equalize the classical and quantum energies. This means $Mc^2/2 = p^2/2m_e$, with de Broglie impulsions $p = h/\lambda$ and the resonance condition $\lambda = 2\pi R/N^{(\text{eq})}$, where $N^{(\text{eq})} = 2M/m_H = 2N_H^{(\text{eq})}$ is the total *equivalent* number of protons plus electrons in the R -radius Universe, - in conformity with the basic Eddington's symmetry between proton and electrons⁵. This leads to:

$$E_{\text{cl}} = E_{\text{qu}} = E/2 = 2(\hbar N_H^{(\text{eq})}/R)^2 / m_e$$

Replacing $N_H^{(\text{eq})}$ by $\Omega_m N_H^{(\text{eq})}$, one gets a relative density:

$$\Omega_m' = \Omega_m^2/2 \approx 0.0450$$

compatible with the tabulated relative baryon density $\Omega_b \approx 0.045(3)$. The above formula, taking account of the critical condition $R = 2GM/c^2$, gives, after replacing the electron mass by its classical equivalent mass $m_e' = m_e m_p/m_H$:

$$\hbar c/Gm_e m_p = R/2\lambda_H = (M/m_e')^{1/2} \quad ; \quad R = 2\hbar^2/Gm_e m_H m_p = 13.816(2) \text{ Glyr}$$

This is a highly symmetric expression of the double Large Number correlation, being in exact correspondence, including the 2 factor, with the Eddington⁵ statistical formula in his own notations: $R_0/2\sigma = N^{1/2}$. Eddington, at that time, could not recognize the identification $\sigma = \hbar_H$, and also $N = E/m_e c^2$, which is the equivalent number of corrected electrons, – due to an error of about 8 factor in the former galactic redshift length measurement.

Note that in the caption of their Fig. 1, Carr and Rees⁶ wrote: “All these scales can be deduced directly from known physics except the mass and length scale of the Universe, which depends on the age of the Universe being α_G^{-1} times the electron timescale $\hbar/m_e c^2$.” Since here $\alpha_G = Gm_p^2/\hbar c$, this is exactly the above formula, except the 2 factor and a hydrogen-proton mass ratio. Hence the CP answers a lacking argument, but without involving any “Universe age”. Therefore, the famous “large number problem”⁶ is not a problem at all, but a hint towards relations tying micro and macro physics, and there is no need to evoke neither a cosmological anthropic principle (which would mean we live in a very narrow 40 million years temporal window) nor any Multiverse.

Extending the CP to the Eddington's energy⁵:

$$-E_{pot} = E_{kin} = E_{Ed},$$

with $E_{Ed} = M_{Ed}c^2$ (corresponding to the mass $M_{Ed} = N_{Ed}m_H$, with the Eddington's Large Number of hydrogen atoms $N_{Ed} = 136 \times 2^{256}$) and the transit time of the Schwarzschild radius of a hydrogen atom $t_H = 2Gm_H/c^3$, this leads to:

$$T_{Ed} = (10/3)N_{Ed}t_H \approx 13.794 \text{ Gyr}$$

sufficiently close to the above value to rehabilitate once more the Eddington's Theory.

In the *six-parameters spatially-flat Λ -CDM* model, the recession timescale H_0^{-1} (called also a “present day inverse Hubble constant”) and the so-called “Universe age” are close to each other, but distinct and variable. The above results, in the frame of the *one-parameter* critical steady-state cosmology, predict that they are *identical and invariant*, with

$$H_0 \approx 70.8 \text{ km s}^{-1} \text{ Mpc}^{-1}$$

Note that the Planck mission result for H_0 is in high tension with the supernovae type *Ia* one⁴, – to be a sign of disintegration of the mainstream model, which is unable to realize neither that H_0 is invariant nor to derive the above *trivial* values for Ω_m and Ω_b . This study allows other predictions: (a) the far-field galaxies, in average, could present the same features as near field ones, with identical physical characteristics (notice it is already supported by “abnormal” old galaxies of the deep field views), (b) the existence of young galaxies in the near field, (c) the same cosmic background temperature everywhere.

Considering, in a non-reductionism way, that cosmology is the basis for all Science, the Coherence Principle could apply also in Biology, answering the Schrödinger question⁷ “*how can the events in space and time which take place within the spatial boundary of a living organism be accounted for by physics and chemistry ?*” So, an organism would be driven by a unique frequency.

References

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