

The Minimum Cosmic Time Uncertainty

Pavle I. Premović,
Laboratory for Geochemistry, Cosmochemistry&Astrochemistry,
University of Niš, pavleipremovic@yahoo.com, Niš, Serbia

The Heisenberg uncertainty principle says that the product of the uncertainty in energy ΔE and time Δt is greater than or equal to Planck's constant h ($= 6.32 \times 10^{-34}$ J sec). Mathematically expressed

$$\Delta E \Delta t \geq h \quad \dots (1)$$

and we get the uncertainty in time energy is at least h over ΔE . So we can find the minimum possible uncertainty in time by dividing both sides by ΔE and we get that the uncertainty in time Δt is at least h over ΔE or

$$\Delta t \geq h/\Delta E \quad \dots (2).$$

Premović in his communications [1-3] suggested that the minimum photon quantum energy of the observable Universe (or the Hubble photon quantum energy of the observable Universe)

$$\varepsilon = hH_0 (= 1.5 \times 10^{-51} \text{ J}) \quad \dots (3)$$

where H_0 is the Hubble constant. For a galaxy at a known distance from the Earth, this constant can be used to predict how fast it should be moving away from us. Or it represents the rate at a particular cosmic time since the Big Bang. This rate at present $H_0 \sim 2.3 \times 10^{-18} \text{ sec}^{-1}$ (or about 70 km Mpc⁻¹).

Combining eqns. (2) and (3), and after a bit of algebra we get

$$\Delta t \geq 1/H_0.$$

where $1/H_0$ is the minimum time uncertainty at a present cosmic time. This term $1/H_0$ is also the current Hubble time; it is thus related to the age of the Universe from the Big Bang to today. For the above value of H_0 , $1/H_0 \sim 14$ Gy or $\Delta t \geq 14$ Gy.

General relativity states that the Hubble constant is not constant it changes with the cosmic time. It may increase or decrease over various cosmic time intervals, expressed in terms of this time it is known as the Hubble parameter, H_t . Now, the eqn. (3) can be written as

$$\Delta t \geq 1/H_t.$$

Now it represents the minimum time uncertainty at a cosmic time t .

References

[1] P. I. Premović, *The Hubble photon quantum of energy of the observable Universe*. The General Science Journal, September 2024.

[2] P. I. Premović, *Minimum quantum energy of the observable tired-light Universe*. The General Science Journal, June 2023.

[3] P. I. Premović, *The Big Bang Universe and the Principle of Energy Conservation*. The General Science Journal, October 2024.