Measuring Cosmological Parameters by Using Uncertainty Principles in the $S^3 \times S^1$ Space-Time

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Abstract

Finite size of the $S^3$ universe suggests that the maximum spatial uncertainty should be $(\Delta x)_{\text{Max}} = 2\pi R_{\text{Univ}}$, where $R_{\text{Univ}}$ is the radius of the universe. It follows from the Position-Momentum uncertainty principle $\Delta x \Delta p \geq \hbar / 2\pi$, that there exists a minimum uncertainty in the momentum - i.e., $(\Delta p)_{\text{Min}} = \hbar / (2\pi)^2 R_{\text{Univ}}$. Similarly, the finite duration $T$ of the $S^1$ Time Cycle, suggests that the maximum temporal uncertainty is $(\Delta t)_{\text{Max}} = T$. It follows from the Time-Energy uncertainty principle $\Delta E \Delta t \geq \hbar / 2\pi$, that there exists a minimum uncertainty in the energy - i.e., $(\Delta E)_{\text{Min}} = \hbar / 2\pi T$. These consideration suggest the following conclusions - (1) Quantum states with $\Delta E \leq (\Delta E)_{\text{Min}}$ and $\Delta p \leq (\Delta p)_{\text{Min}}$ will be indistinguishable, (2) It should be possible to determine radius of the finite $S^3$ universe, i.e., $R_{\text{Univ}} = \hbar / [2\pi^2 (\Delta p)_{\text{Min}}]$, by locally measuring $(\Delta p)_{\text{Min}}$, and (3) Determine duration of the universe's time cycle, $T = \hbar / 2\pi (\Delta E)_{\text{Min}}$, by locally measuring $(\Delta E)_{\text{Min}}$. If one considers the 5000 years Time Cycle $T$, and 5000 light years radius of the $S^3$ universe - as propunded by Brahma Kumaris; one obtains the prediction $(\Delta p)_{\text{Min}} = 2.230893507958458 \times 10^{-53} \text{ kg m/s}$; and $(\Delta E)_{\text{Min}} = 6.688050482871086 \times 10^{-45} \text{ Joules}$. 

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In context of quantum mechanics and uncertainty principles - one can ask the question, what could be the maximum spatial and temporal uncertainty. Arguably, the maximum spatial uncertainty cannot be larger than the size of the universe - for a static $S^3$ universe. For an expanding universe, the uncertainty should have the particle horizon as the maximum spatial uncertainty. For a cyclic universe, the temporal uncertainty cannot be larger than the duration of the time cycle. Segal [1] has extensively studied cosmology on $S^3 \times S^1$ space-time ($S^3$ space and $S^1$ time) - in which both the spatial factor as well as the temporal factor are finite. His motivation is to develop cosmology on the spatial part of the Einstein Cylinder ($S^3 \times R^1$). He introduces $S^1$ times and uses the Uni-energy operator to arrive at cosmological red-shift of distant galaxies. Guillemin [2], develops periodicity for particles propagating along the null geodesics - with the null geodesics being closed curves.

Finite size of the $S^3$ universe suggests that the maximum spatial uncertainty should be -

$$(\Delta x)_{Max}=2\pi R_{Univ},$$

where $R_{Univ}$ is the radius of the universe. It follows from the Position-Momentum uncertainty principle

$$\Delta x \Delta p \geq h/2\pi,$$

that there exists a minimum uncertainty in the momentum - i.e.,

$$(\Delta p)_{Min}=h/(2\pi)^2 R_{Univ}.\tag{3}$$

Similarly, the finite duration $T$ of the $S^1$ Time Cycle, suggests that the maximum temporal uncertainty is -

$$(\Delta t)_{Max}=T\tag{4}$$

It follows from the Time-Energy uncertainty principle,

$$\Delta E \Delta t \geq h/2\pi\tag{5}$$

that there exists a minimum uncertainty in the energy - i.e.,

$$(\Delta E)_{Min}=h/2\pi T\tag{6}$$

These consideration suggest the following conclusions -
(1) Quantum states with $\Delta E \leq (\Delta E)_{\text{Min}}$ and $\Delta p \leq (\Delta p)_{\text{Min}}$ will be indistinguishable.

(2) It should be possible to determine radius of the finite $S^3$ universe, i.e.,

$$R_{\text{Univ}} = \frac{h}{(2\pi)^2(\Delta p)_{\text{Min}}}$$

by locally measuring $(\Delta p)_{\text{Min}}$, and

(3) Determine duration of the universe's time cycle,

$$T = \frac{h}{2\pi(\Delta E)_{\text{Min}}}$$

by locally measuring $(\Delta E)_{\text{Min}}$.

If one considers the 5000 years Time Cycle $T$, and 5000 light years radius of the $S^3$ universe - as propounded by Brahma Kumaris; one obtains the prediction

$$(\Delta p)_{\text{Min}} = 2.230893507958458 \times 10^{-53} \text{ kg m/s};$$

and

$$(\Delta E)_{\text{Min}} = 6.688050482871086 \times 10^{-45} \text{ Joules.}$$

References