The holographic wave function

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In this paper we study the nature of space - time based on the geometry of the holographic surface .

The holographic principle states that the maximum number of degrees of freedom the in volume of space in proportion to the area of the boundary of this volume .

$$N = \frac{F}{4l_p^2} \qquad l_p^2 = \frac{G\hbar}{c^3}$$

For the first time , such a definition has also been obtained for the surface of the event horizon of a black hole . If we consider a black hole using the laws of quantum mechanics , the event horizon is determined by the quantum numbers , or more accurately the quantum phase.

$$\varphi = N$$

In this case, the area of the black hole and quantum phase have a linear relationship .

$$F = 4l_p^2\varphi$$

This formula can be generalized to all types of surfaces . For example, the Cauchy horizon in the special theory of relativity . Area light sphere is a surface .

$$F = 4\pi(ct)^2$$

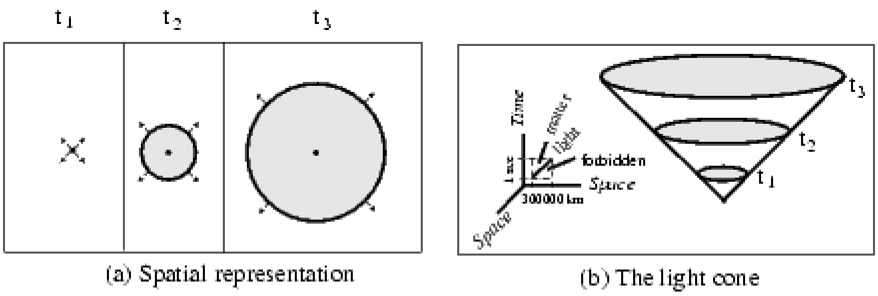
This gives an idea of quantum phase as a function of not only the coordinates but also of time .

$$\varphi = \frac{\pi}{l_p^2}\left(c^2t^2 - R^2\right)$$

In this formula , the minus sign in front of the radius vector is associated with the evolution of a quantum phase in time.
Quantum phase for the Cauchy horizon of events is determined by the equation

$$\varphi = \frac{\pi}{l_p^2}c^2t^2 \qquad R = const$$

The figure shows the evolution of the quantum phase when Cauchy horizon is determined by the surface area of the light sphere .



(a) Spatial representation (b) The light cone

Figure 1

The presence of quantum phase for the light cone shows that space-time has a holographic wave nature. In other words , the state and the space-time evolution can be described using a holographic wave function.

$$\Psi = Ae^{-i\varphi} = A\exp\left[-\frac{i\pi}{l_p^2}\left(c^2t^2 - R^2\right)\right]$$

It is easy to notice that the holographic phase is related to the square of the interval in space-time .

$$\varphi = \frac{\pi}{l_p^2} s^2$$

It gives a new holographic representation of metrics

$$g_{ik} = \frac{1}{2}\frac{\partial^2 s^2}{\partial x^i \partial x^k} = \frac{\ell_p^2}{2\pi}\frac{\partial^2 \varphi}{\partial x^i \partial x^k}$$

Quantum phase can be determined .

$$\varphi = i \ln \Psi$$

In this case , the space - time metric is determined by the holographic wave function .

$$g_{ik} = \frac{i\ell_p^2}{2\pi}\left(\frac{1}{\Psi}\frac{\partial^2 \Psi}{\partial x^i \partial x^k} - \frac{1}{\Psi^2}\frac{\partial \Psi}{\partial x^i}\frac{\partial \Psi}{\partial x^k}\right)$$

Thus, the space - time as a wave nature. This is strongly reminiscent of holography , where a three-dimensional image of the object can be created by the incident and the reference waves . The space - time is a quantum object created using the holographic wave function , having the direction of evolution and causality .
This view is consistent with the notion of an interval in space-time .
Indeed, the phase of the normal wave is an invariant .

$$\begin{aligned} &\varphi = \varphi^{|} \\ &t\omega - xk = t\omega^{|} - xk^{|} \end{aligned}$$

For holographic phase invariant conserved.

$$\begin{aligned} &\varphi = \frac{\pi}{l_p^2}\left(c^2 t^2 - x^2 - y^2 - z^2\right) \\ &c^2 t^2 - x^2 - y^2 - z^2 = c^2 t^{|2} - x^{|2} - y^{|2} - z^{|2} \end{aligned}$$

Thus, the holographic nature of space - time itself does not contradict the theory of relativity of Einstein

In general, a holographic wave function of space-time will

$$\Psi = A e^{-\frac{i\pi}{l_p^2}\int dF}$$

Where any two-dimensional hypersurface area

$$dF = \sqrt{-h} h_{ik} dx^i dx^k$$