

A NEW QUANTUM WORLD at the Planck Scale

$$m_p = (hc/G)^{1/2}$$

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THE NEW QUANTUM STRUCTURE OF THE SPACE-TIME

“ THE CLASSICAL - QUANTUM DUALITY OF NATURE :

$$“ O_G = o_p^2 / O_Q , \quad L_G = l_p^2 / L_Q , \quad L_G = 2GM / c^2, \quad L_Q = h / Mc$$

“ THE SPACE TIME (X, T) Coordinates as

“ QUANTUM NON COMMUTING OPERATORS : [X, T] = 1

° THE SPACE-TIME AS a QUANTUM HARMONIC OSCILLATOR :

$$[X, P] = i, \quad 2 H = X^2 + P^2 = 2 N + 1, \quad [2H, X] = - i P, \quad [2H, P] = iX$$

P = iT :

$$[X, T] = 1, \quad 2 H = X^2 - T^2 = 2 N + 1, \quad [2H, X] = T, \quad [2H, T] = X$$

QUANTUM SPACE-TIME

“ $(T^2 - X^2) - 1 \geq 0$: *timelike*

“ $(X^2 - T^2) - 1 \geq 0$: *spacelike*

“ $(T^2 - X^2) - 1 = 0$, *null : the "quantum light- cone".*

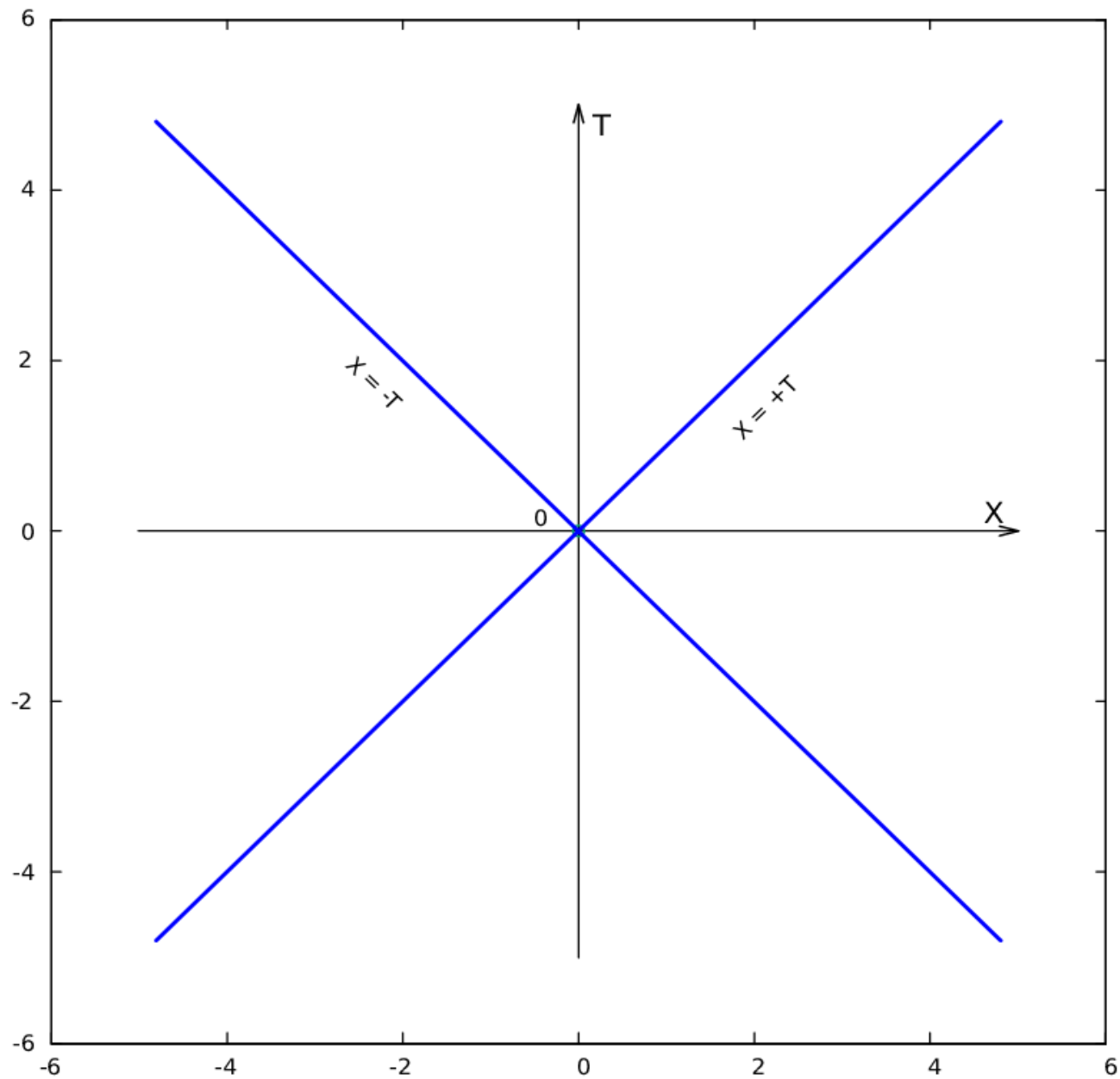
$(X^2 - T^2)_n = 2n + 1$: **discrete levels**

$(X^2 - T^2) = \pm[X, T] = \pm 1, \quad 1 = 2\varepsilon_0, \quad (n = 0)$

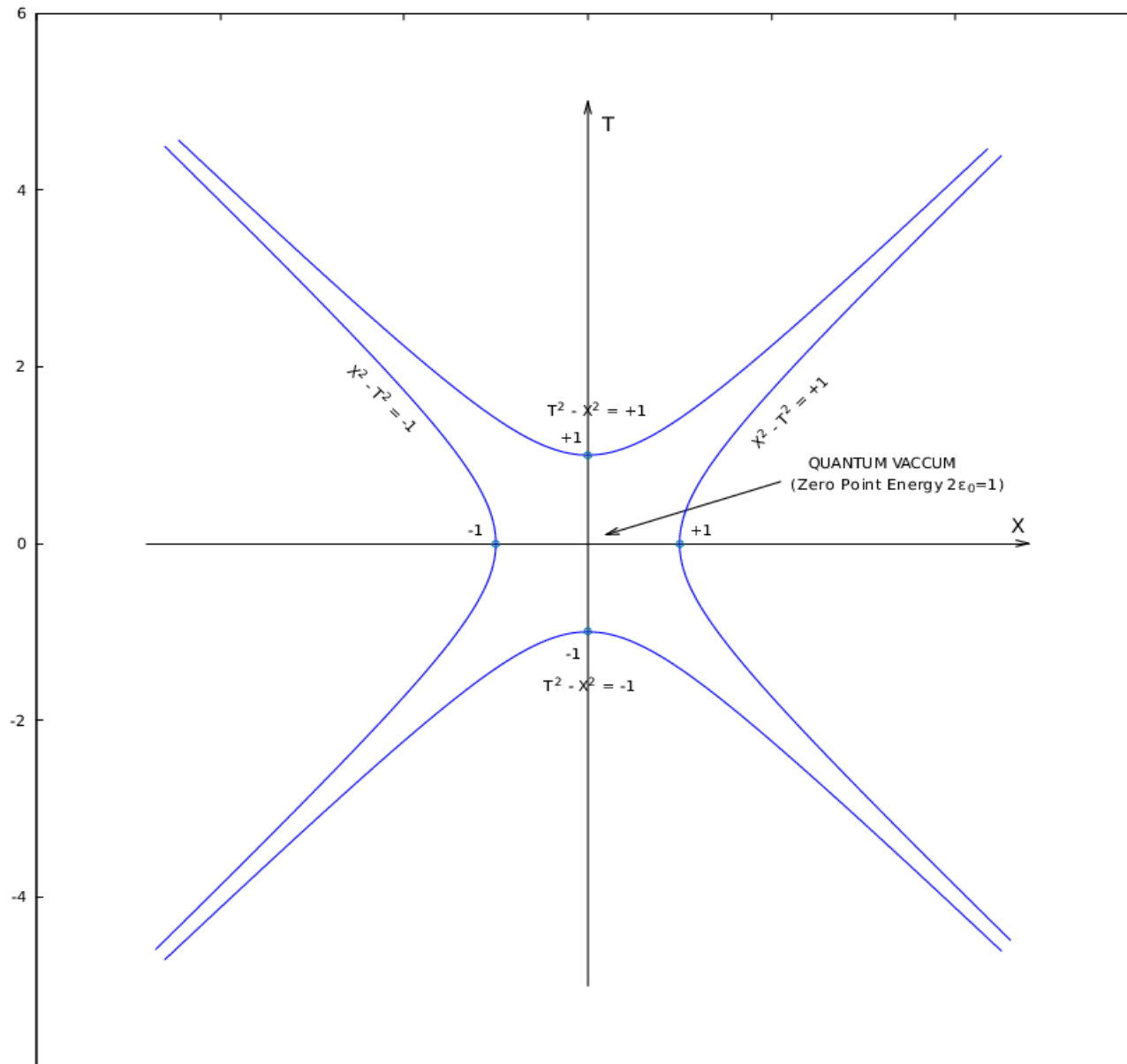
the quantum light cone

“ $[X, T] = 0$: $X = \pm T$ **the classical light cone.**

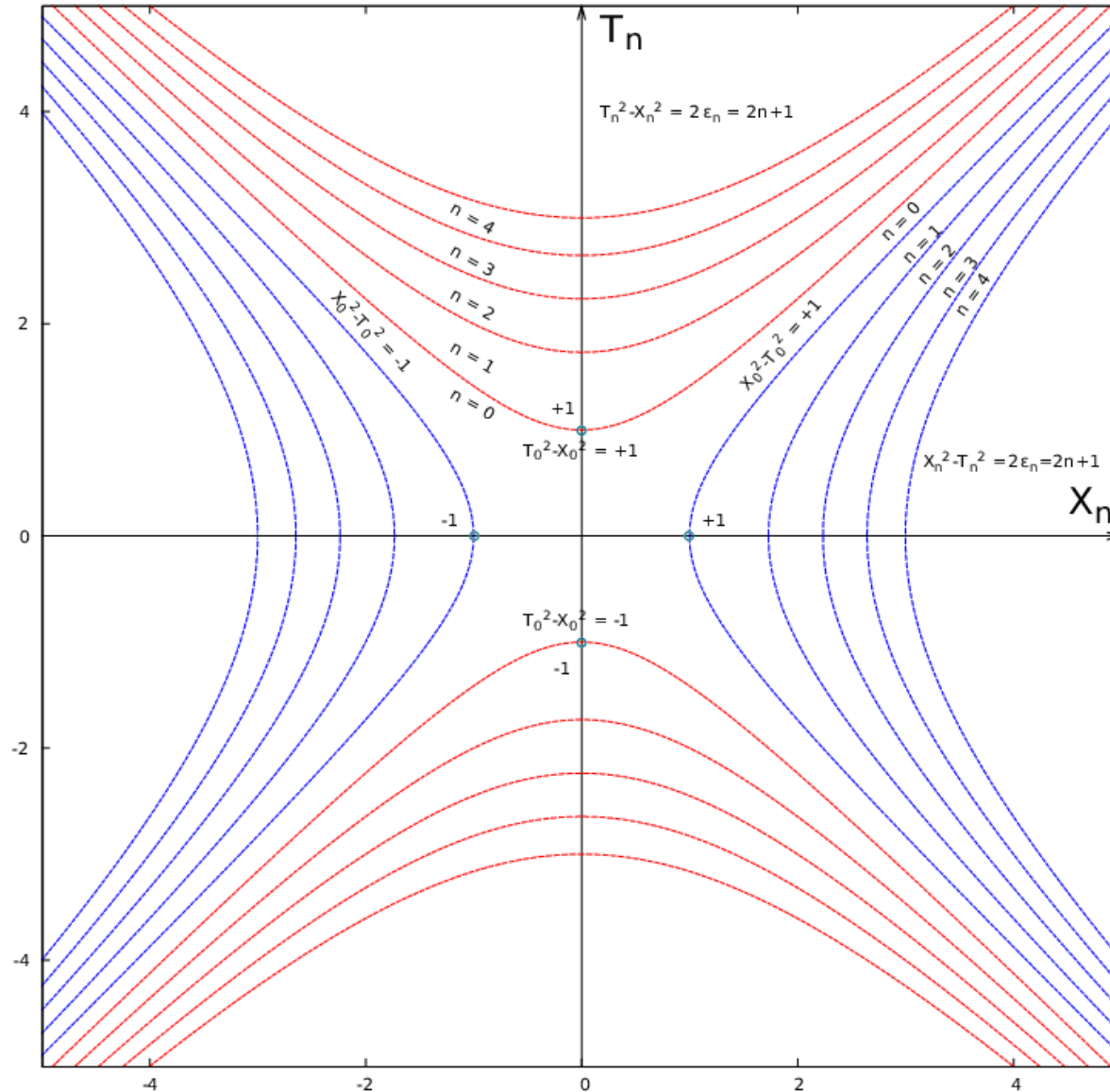
THE CLASSICAL LIGHT CONE



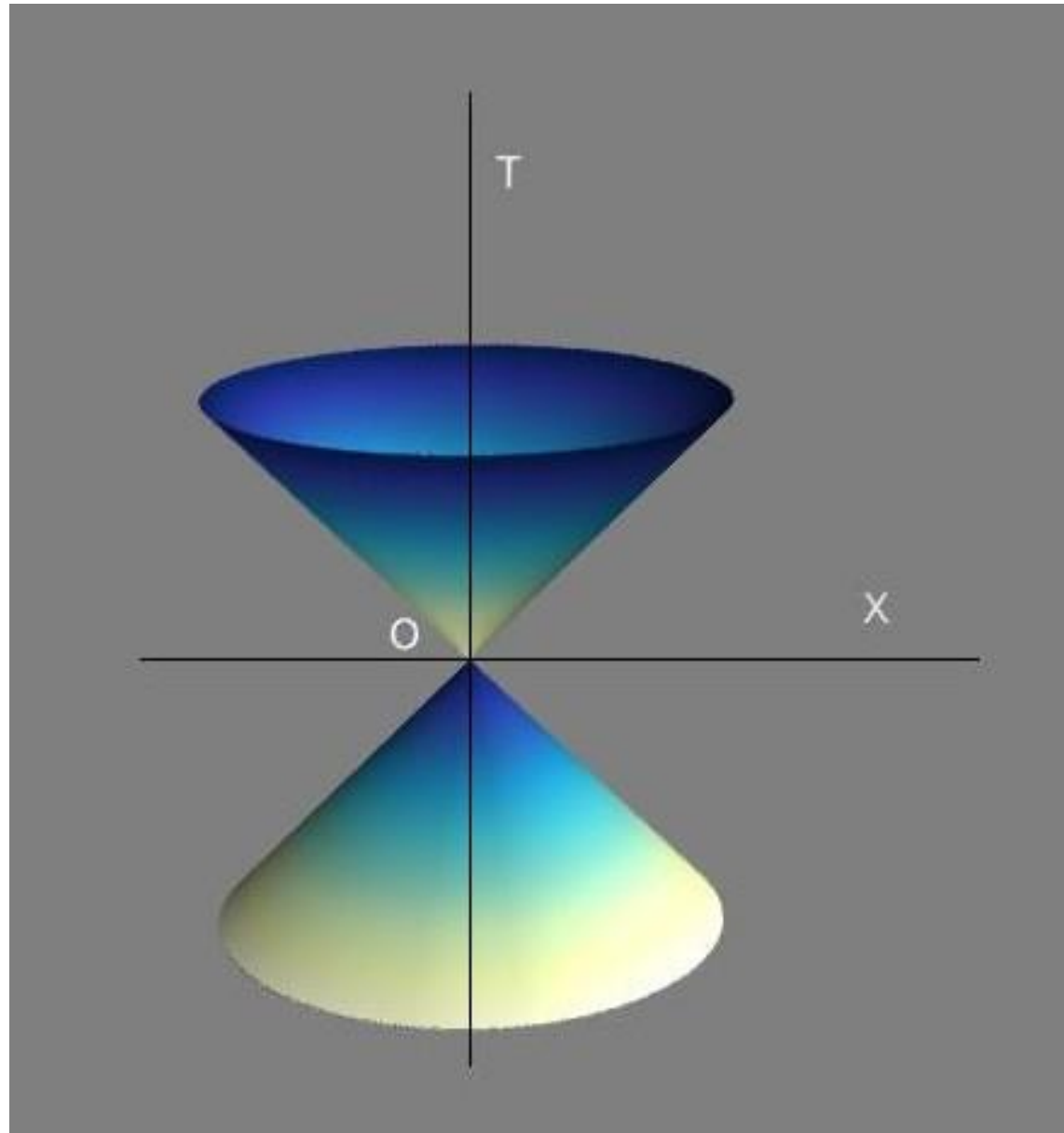
THE QUANTUM LIGHT CONE



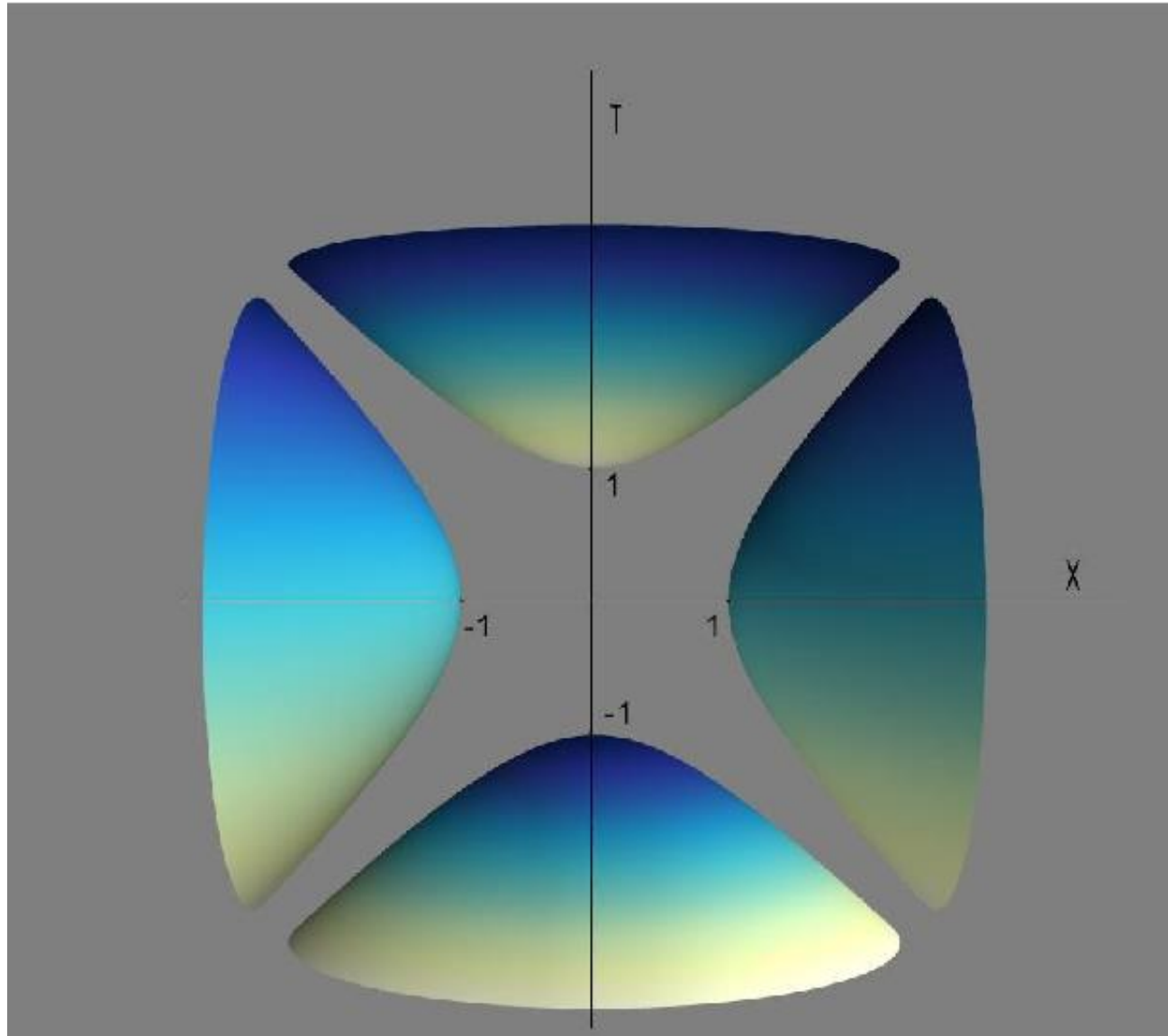
QUANTUM SPACE-TIME STRUCTURE



THE CLASSICAL LIGHT CONE



THE QUANTUM LIGHT CONE



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- **Project:** The New Universe - Le Nouvel Univers

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