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Holographic Principle Applications to Cosmology

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Abstract: *The holographic principle at first developed within the context of black hole thermodynamics. It has emerged as a central paradigm in the pursuit of a consistent theory of quantum gravity. All physical data inside a volume of spacetime may be presented on its outer surface; the main problems describe locality as well as dimensionality. It non-practical part using frameworks like the AdS/CFT has shown how gravitational phenomena in a higher-dimensional bulk may be described by a lower-dimensional, non-gravitational boundary theory. The utilization of this concept in cosmology has given new interpretations of the entropy of de Sitter horizons, the origins of fluctuations, as well as the accelerating growth of the universe. Models including holographic dark energy, entropy bounds, as well as entanglement-based geometry, have modified fundamental cosmological constructs. However, some challenges faced include the absence of a fully formulated dS/CFT duality, the inflexibility of boundary conditions in highly growing spacetimes, as well as the difficulty of reconciling non-locality with observable cosmological dynamics. However, with these limitations, the holographic principle is still one of the most reliable frameworks on behalf of bridging quantum theory as well as gravitation..*

Keywords: Holographic principle; cosmology; entropy bounds; AdS/CFT correspondence; de Sitter space; holographic dark energy; quantum gravity; entanglement entropy; emergent spacetime; dS/CFT

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