

## **Holographic dark energy**

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**Abstract.** The holographic principle provides a fundamental relation between the ultraviolet (UV) and infrared (IR) cutoffs of a quantum field theory. Holographic Dark Energy (HDE) arises from the application of this principle to cosmology, offering a dynamical explanation for the current accelerated expansion of the Universe. In this review, we summarize the theoretical foundations of HDE, the implications of various IR cutoffs including the Hubble horizon, particle horizon, and future event horizon, and their corresponding thermodynamic behaviors. We present the equation of state and the deceleration parameter for the standard HDE model. Finally, we review observational constraints on the HDE parameter  $c$  using Cosmic Microwave Background (CMB) measurements from Planck, Baryon Acoustic Oscillations (BAO), and Type Ia Supernovae (SNIa), showing that a phantom regime ( $c < 1$ ) is generally favored by current data.

**Keywords:** Dark Energy; Holographic Principle; Cosmology; Observational Constraints.