Cosmological Constant from the Entropy Balance Condition

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In the action formalism variations of metric tensors usually are limited by the Hubble horizon,

$$R_H = \frac{1}{H} \approx 14.5\ Gly\ .$$

Contrary, variations of quantum fields should be extended up to the event horizon,

$$R_e = \int_1^\infty \frac{da}{a^2 H} \approx 16.7\ Gly\ ,$$

which is the real boundary of the space-time. As the result the entanglement energy of quantum particles across the apparent horizon is missed in the cosmological equations written for the Hubble volume. We identify this missing boundary term with the dark energy density and express it (using the null energy assumption for the finite universe [1]) as the critical density multiplied by the ratio of the Hubble and event horizons radii [2],

$$\rho_{DE} = \frac{\rho_c R_H^2}{R_e^2} = \ 0.75\ \rho_c\ ,$$

which is very close to the observed value of the dark energy.

References:

[1] **M. Gogberashvili**, "Information-Probabilistic Description of the Universe", *Int. J. Theor. Phys.,* **55**, 4185 (2016).

[2] **M. Gogberashvili**, "Cosmological Constant from the Entropy Balance Condition" *Adv. High Energy Phys.* **2018**, 3702498 (2018).