Interpretation and solution of the cosmological constant problem.

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Abstract:
The cosmological constant problem or vacuum catastrophe has long been a mystery of physics. We bring a solution and a simple interpretation.

It is sufficient to calculate the dark energy density parameter $\Omega \Lambda$ at Planck time, origin of our universe:

We first consider its expression in the Friedman equation:

$$\Omega \Lambda = \frac{\Lambda c^2}{3H^2}$$

then

with $t_H = 1/H$,

where $t_H$ is Hubble time and $H$ is Hubble constant:

$$\Omega \Lambda, tp = 1/3 \Lambda c^2 tp^2$$

The vacuum catastrophe = $\Lambda / l_p^{-2} = \Lambda l_p^2$

or when the vacuum catastrophe is express in energy density (J/m³) instead of m²

$$\frac{\epsilon \Lambda}{\epsilon_p} = \frac{3\Lambda c^5}{8\pi G F_p l_p^{-2}}$$

where $F_p = c^4/G$ is the Planck force

as

$$l_p = c t_p$$

$$l_p^2 = c^2 tp^2$$

The vacuum catastrophe = $\Lambda c^2 tp^2$

The vacuum catastrophe = $3 \Omega \Lambda, tp$
Conclusion

The vacuum catastrophe would be the energy density parameter of cosmological constant at Planck time in the $\Lambda$CDM model with a factor of 3 (and with a divisor of $8\pi$ if we express the problem in terms of energy density, $J/m^3$), and it would no longer be a problem.

References:


For the value $l_p^{-2} = 3.83 \times 10^{59} \text{ m}^{-2}$ from the QFT