Interpretation and solution of the cosmological constant problem.

Stéphane Wojnow,

wojnow.stephane@gmail.com

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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 ΩΛ at Planck time t_p, 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 :

$$\Omega\Lambda,t_p = 1/3\ \Lambda\ c^2\ t_p^{\ 2}$$

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

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or when the vacuum catastrophe is express in energy density (J/m³) instead of m^{-2}

$$\frac{\epsilon_\Lambda}{\epsilon_{\rm Pl}} = \frac{\frac{3\Lambda c^4}{8\pi G}}{F_{\rm Pl}\ l_{\rm Pl}^{-2}}$$

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

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as

$$l_p = c\ t_p$$

$$l_p^{\ 2} = c^2\ t_p^{\ 2}$$

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

The vacuum catastrophe = $3\ \Omega\Lambda,t_p$

Conclusion

The vacuum catastrophe would be the energy density parameter of cosmological constant at Planck time, i.e. at the origin of the universe, in the ΛCDM 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 :

S.E. Rugh and H. Zinkernagel, The Quantum Vacuum and the Cosmological Constant Problem , arXiv:hep-th/0012253

For the value $l_p^{-2} = 3{,}83 * 10^{69}$ m^{-2} from the QFT
Lucas Lombriser, université de Genève, communiqué de presse ,
https://www.unige.ch/communication/communiques/2019/cosmologie-une-solution-a-la-pire-prediction-en-physique/