Speed of light decay (CDK)

2021-12-07

<u>Exponential decay</u>: $P(t) = P(0)\exp[-\lambda t]$, where λ is the decay rate.

c_0 is a fictional "just after creation" speed of light.

$$c_0 = \frac{1}{\Lambda l_P t_P},$$ where Λ is the cosmological constant,

l_P is the Planck length, and t_P is the Planck time.
(This is a basic, back-of-the-envelope calculation.)

$c_0 \sim 1 \times 10^{130}\ \frac{m}{s}$

$$c = c_0 e^{-\lambda t} \longrightarrow e^{-\lambda t} = \frac{c}{c_0}$$

$$\ln\left(e^{-\lambda t}\right) = \ln\left(\frac{c}{c_0}\right)$$

$$-\lambda t = \ln\frac{c}{c_0}$$

$$-\lambda = \frac{1}{t}\ln\frac{c}{c_0} \qquad \frac{c}{c_0} \approx 2.9 \times 10^{-122}$$

$$\lambda = -\frac{1}{t}\ln\frac{c}{c_0} \qquad t = 6.0 \times 10^{3}$$

$$\lambda \approx -\frac{(-280)}{6.0\times10^{3}} \qquad \ln\frac{c}{c_0} \approx \ln\left[2.9\times10^{-122}\right] = -279$$

$$\approx -280$$

$$\lambda \approx 4.7 \times 10^{-2}\ \frac{1}{Yr.}$$

Assume c_1 is c in a year — then $t = 6.001 \times 10^{3}$

$$c_1 = \left(1\times10^{130}\ \frac{m}{s}\right) \times e^{-\left(4.7\times10^{-2}\ yr^{-1}\right)\times\left(6.001\ yr\right)}$$

$$= \left(1\times10^{130}\ \frac{m}{s}\right) \times \left(3\times10^{-123}\right)$$

$$c_1 = 3\times10^{7}\ \frac{m}{s}. \longrightarrow \frac{c}{c_1} \approx \frac{3\times10^{8}}{3\times10^{7}} \sim 10.$$