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Expanding universe with a time-dependent cosmological constant

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It is possible to examine the expansion of universe with an accelerating epoch. The prophecy of an expanding universe from Einstein's Field Equations were affirmed by the perceptions of Edwin Hubble and Adam G. Reises in mid twentieth century. Late perceptions of Saul Perlmutter on expansion of the universe with an increasing speed in a specific epoch has awakened the search for new cosmological models that reflect universe expansion with an acceleration. The following equations were derived using Einstein's field equations and Robertson Walker metric; $\left(\kappa\rho c^2 = \Lambda - \frac{3K}{R^2} - \frac{3\dot{R}^2}{c^2R^2}, \kappa P = -\Lambda + \left(\frac{K}{R^2} + \frac{2R\ddot{R}+\dot{R}^2}{c^2R^2}\right)\right)$. A cosmological model is considered as a phenomenological model with cosmological constant in the form of $\Lambda = \beta\frac{\ddot{R}}{R}$ and it could be identified as phenomenological decay law for Λ, where β is a constant. Hence, relationship between ρ and Λ is derived using above three equations as $\frac{\Lambda}{\rho} = \frac{-4\pi G\beta}{(3-\beta c^2)}$. Thereafter, Λ' was introduced which has same dimensions as ρ; $\left(\Lambda' = \frac{\Lambda c^2}{8\pi G}\right)$. Using current Λ value, the Λ' was found as 5.9×10^{-27} kg m^{-3} and similarly, possible values for beta were obtained as $\left(\beta > \frac{3}{c^2}\right)$ using present day mass density. The best value for beta was chosen as $= \frac{3.1}{c^2}$, where β varies between $\frac{3}{c^2}$ and $\frac{4}{c^2}$. Therefore, $\rho = 3.8 \times 10^{-28}$ kg m^{-3}. Then phenomenological decay law can be written as $\Lambda = \frac{3.1}{c^2}\frac{\ddot{R}}{R}$. The equation of scalar factor R that consisted of beta and considered value for K at $K = 1$ was derived. That is; $(\beta c^2 - 2)\ddot{R}R - \dot{R}^2 - c^2 = 0$. $\ddot{R} = \frac{c^2+\dot{R}^2}{(1.1)R}$ is the modified equation which was obtained after substituting the beta value. This could be defined as a second order non-linear ordinary differential equation. Also, this is a hyper geometric function and that means the solution contains singular points. Interpretation of this study is that the universe formed by singularity.

Keywords: Phenomenological decay law, Cosmological constant, Cosmological model, Epoch