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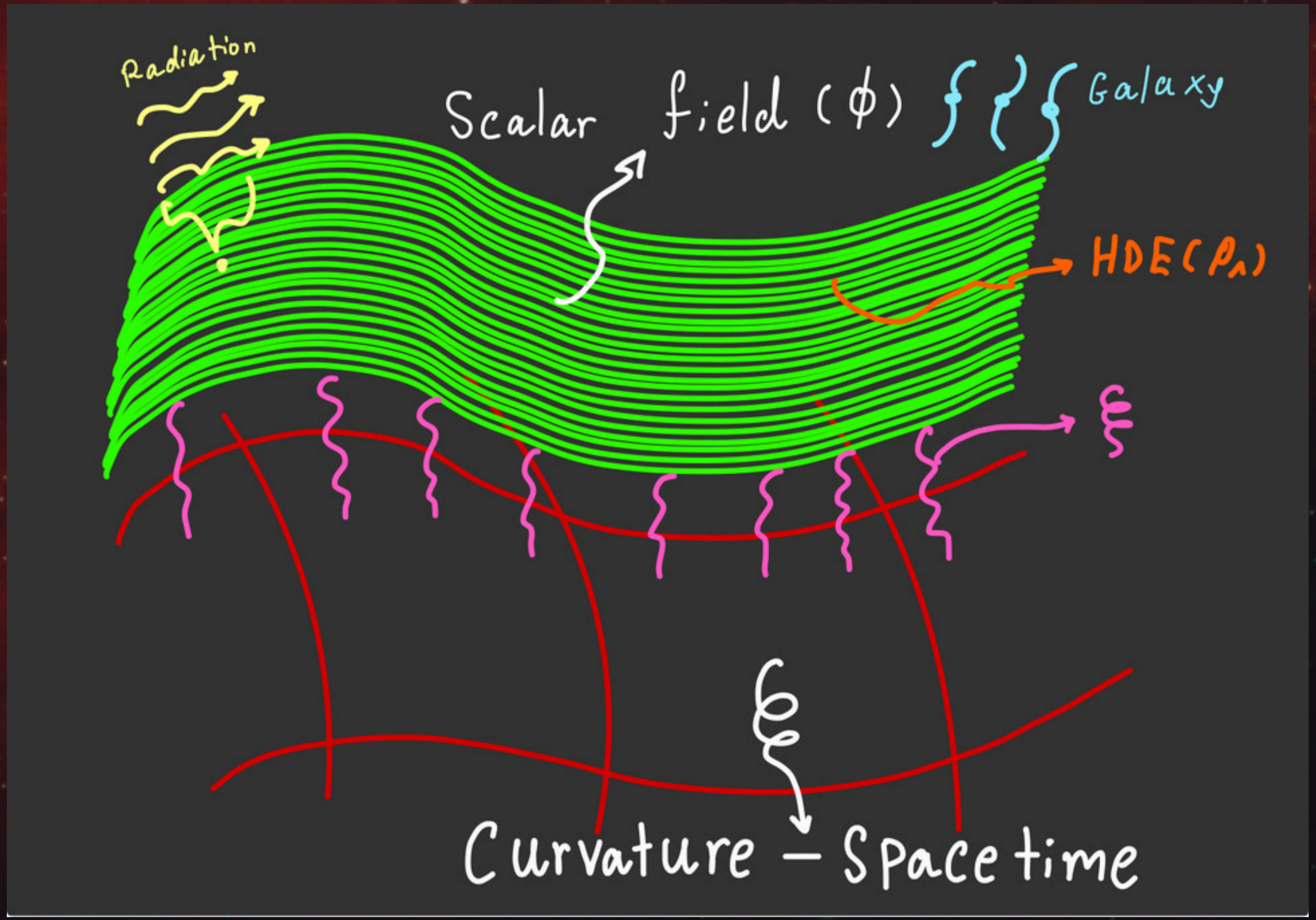
COSMOLOGICAL DYNAMICS OF NON-MINIMAL COUPLING SCALAR FIELD UNDER EXPONENTIAL POTENTIAL WITH HOLOGRAPHIC EFFECTS



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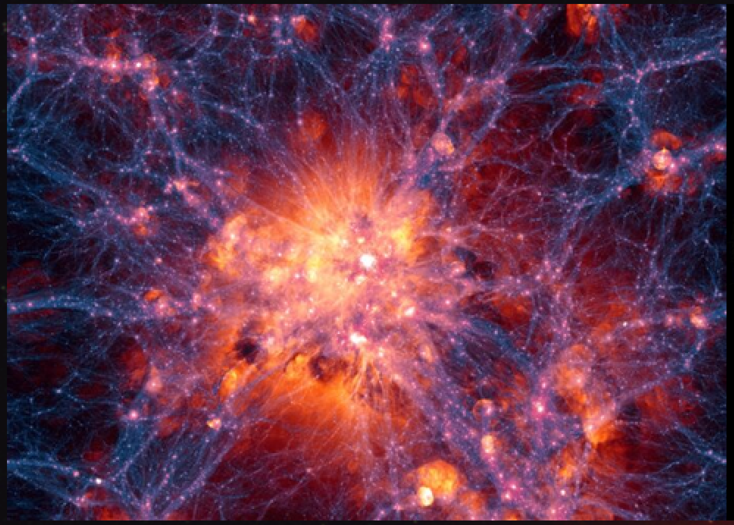
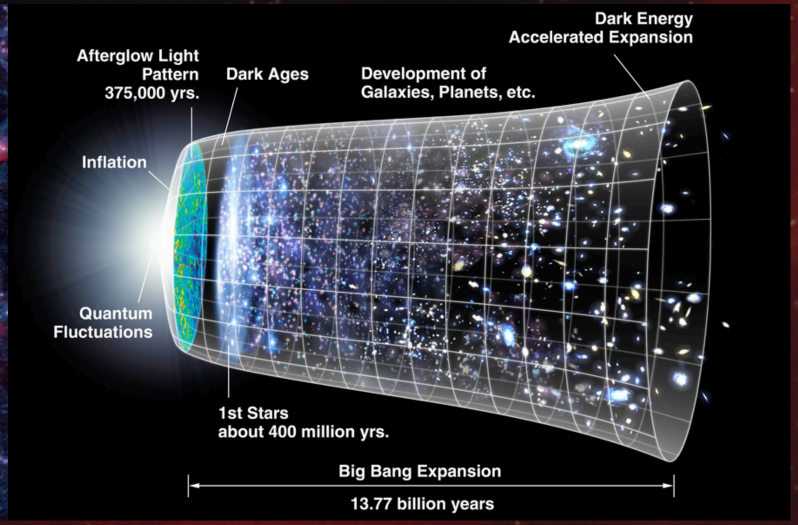
1.Interests and research.



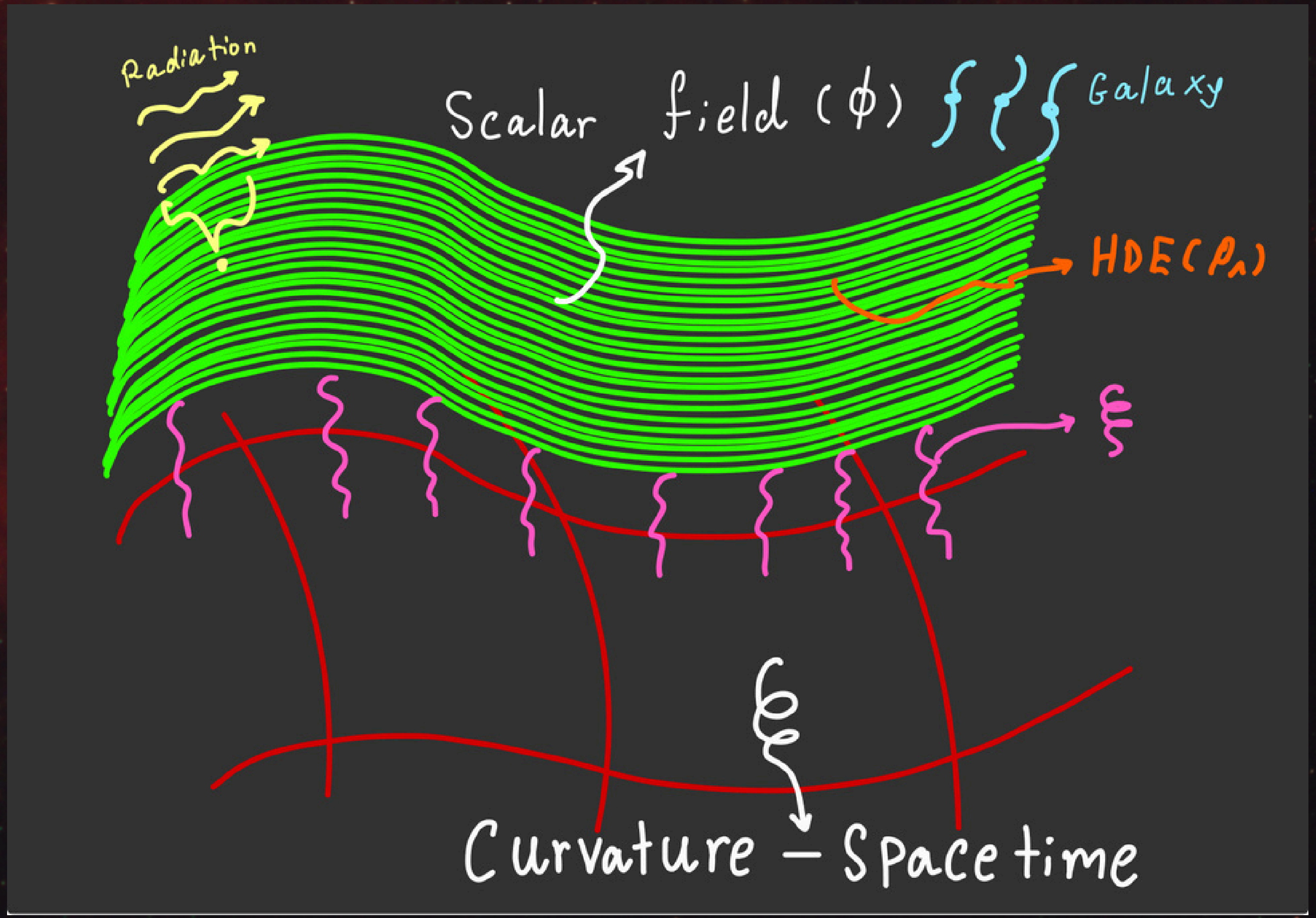


2.Priblem

In Friedmann equation, it have term of ^ , it behaves like vacuum energy with a value of w=1.

Lambda values are consistent with many observations, but where do these values come from? Why are they so small but not equal to zero?
Therefore, lambda definite averages (DEs) explain phenomena well, but cannot explain dynamics.

3.Research concepts



>>>We consider HDE+NMC, because NMC give gravitatinal, scalar dynamicss.
>>> HDE give presciption for all DE density, it liked Holographic principle.

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IF THEORETICAL PHYSICS

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$$S = \int d^4x \sqrt{-g}\left(\frac{R}{16\pi G} - \frac{1}{2}g^{\mu\nu}\nabla_\mu\phi\nabla_\nu\phi + V(\phi) - \frac{1}{2}\xi\phi^2 R\right) + S_m + S_\Lambda\,,$$

$$3H^2 = 8\pi G_{\rm eff}\left(\frac{\dot\phi^2}{2} + V(\phi) + 6\xi H\phi\dot\phi + \rho_m + \rho_\Lambda\right),$$

$$2\dot H + 3H^2 = -8\pi G_{\rm eff}\left[\frac{\dot\phi^2}{2} - V(\phi) - 2\xi\left(\dot\phi^2 + \phi\ddot\phi + 2\phi H\dot\phi\right) + w_\Lambda\rho_\Lambda\right].$$

Varying the action (1) with respect to scalar field provides Klein-Gordon equation governing dynamics of the scalar field,

$$\ddot\phi + 3H\dot\phi + 6\xi\phi\left(\dot H + 2H^2\right) = -V_{,\phi}\,, \tag{14}$$

where $V_{,\phi}$ denotes derivative of the potential with respect to ϕ.

In this work, we consider exponential potential given in the form $V(\phi) = V_0\exp(-\sqrt{8\pi G}\lambda\phi)$ and define $\dot\phi \equiv \psi$. Solving Friedmann equation (10) with equations (12), we obtain two solutions of Hubble parameter,

$$H_{+}(\phi,\psi,\rho_m) = \frac{8\pi G_{\rm eff}\xi\phi\psi}{(1-\epsilon^2)} + \sqrt{\left[\frac{8\pi G{\rm eff}\xi\phi\psi}{(1-\epsilon^2)}\right]^2 + \frac{4\pi G_{\rm eff}(2V_0e^{-\lambda\sqrt{8\pi G}\phi} + 2\rho_m + \psi^2)}{3(1-\epsilon^2)}}\,, \tag{15}$$

IV. SLOW-ROLL APPROXIMATION AND LATE TIME TRAJECTORY

In the slow-roll regime, with negligible dust density, one can approximate $\ddot{\phi} \approx 0$, $\dot{\phi}^2 \ll 2V$ and $\dot{H} \ll H^2$. Hence, the slow-roll Friedmann equation is given by,

$$H^2 \approx \frac{8\pi G V}{3(1-e^2)(1-8\pi G\xi\phi^2)}\left(1+\frac{6\xi H\phi\dot{\phi}}{V}\right). \tag{22}$$

The equation can be integrated directly. We obtain

$$H \approx \frac{8\pi G\xi\phi\dot{\phi}}{(1-e^2)(1-8\pi G\xi\phi^2)} + \sqrt{\left[\frac{8\pi G\xi\phi\dot{\phi}}{(1-e^2)(1-8\pi G\xi\phi^2)}\right]^2 + \frac{16\pi G V}{3(1-e^2)(1-8\pi G\xi\phi^2)}}. \tag{23}$$

In limit $\xi \to 0$ and $e \to 0$, Hubble parameter recovers GR case. Slow-roll Klein-Gordon equation is

$$\dot{\phi} \simeq \frac{-12\xi\phi H^2 + V_{\phi}}{3H}, \tag{24}$$

which can be numerically integrated to obtain approximated late-time trajectories.

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