The multi-measure cosmological model and its peculiar effective potential

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The multimeasure model by Guendelman, Nissimov and Pacheva

- In Jordan frame, the multimeasure action of the model: $S = S_{darkon} + S_{inflaton}$ is :

$$S_{darkon} = \int d^4x \left[\sqrt{-g} + \Phi(C) \right] L(u, Y)$$

- **Riemannian measure**
- **Non-Riemannian measure**
- Lagrangian of the **darkon scalar field** u

$$S_{inflaton} = \int d^4x \Phi_1(A)(R + L^{(1)}) + \int d^4x \Phi_2(B) \left(L^{(2)} + \frac{\Phi(H)}{\sqrt{-g}} \right)$$

- Lagrangians of the **inflaton scalar field** ϕ

where $X(\phi) = -\frac{1}{2} g^{\mu\nu} \partial_\mu \phi \partial_\nu \phi$,

$$Y(u) = -\frac{1}{2} g^{\mu\nu} \partial_\mu u \partial_\nu u$$

$$\Phi_i(Z) = \frac{1}{3} \epsilon^{\mu\nu\kappa\lambda} \partial_\mu Z_{\nu\kappa\lambda}$$

$$L(u, X) = Y(u) - W(u)$$

$$L^{(1)} = X(\phi) - V(\phi), \; V(\phi) = f_1 e^{-\alpha\phi}$$

$$L^{(2)} = be^{-\alpha\phi} X(\phi) + U(\phi), \; U(\phi) = f_2 e^{-2\alpha\phi}$$

- In Einstein frame (for which $\tilde{R}_{\mu\nu} - \frac{1}{2} \tilde{g}_{\mu\nu} \tilde{R} = \frac{1}{2} T^{(eff)}_{\mu\nu}$):

$$S^{(eff)} = \int d^4x \sqrt{-\tilde{g}} (\tilde{R} + L^{(eff)}) \tag{1}$$

with effective Lagrangian of the k-essence type:

$$L^{(eff)} = \tilde{X} - \tilde{Y}(V + M_1 - \chi_2 be^{-\alpha\phi} \tilde{X}) + \tilde{Y}^2 (\chi_2 (U + M_2) - 2M_0).$$

The effective potential of the model is: $U_{eff}(\phi) = \frac{1}{4} \frac{(f_1 e^{-\alpha\phi} + M_1)^2}{\chi_2 (f_2 e^{-2\alpha\phi} + M_2) - 2M_0}$.

The effective cosmological costant: $\Lambda_{eff} = U_+/2 = \frac{M_1^2}{8(\chi_2 M_2 - 2M_0)}$.

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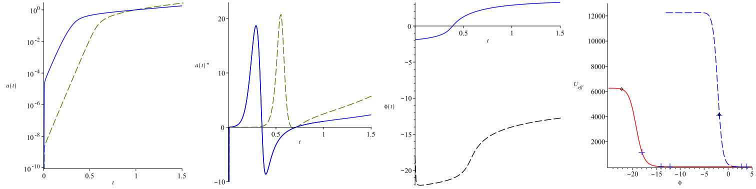
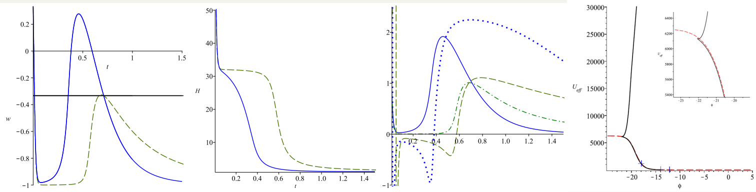
In FLRW metric the equations of motions are ($v = \dot{u}$):

$$v^3 + 3\mathbf{a}v + 2\mathbf{b} = 0 \text{ for } \mathbf{a} = \frac{-1}{3}\frac{V(\phi) + M_1 - \frac{1}{2}\chi_2 b e^{-\alpha\phi}\dot{\phi}^2}{\chi_2(U(\phi) + M_2) - 2M_0}, \mathbf{b} = \frac{-p_u}{2a(t)^3(\chi_2(U(\phi) + M_2) - 2M_0)} \quad (2)$$

$$\dot{a}(t) = \sqrt{\frac{\rho}{6}}a(t), \quad \rho = \frac{1}{2}\dot{\phi}^2\left(1 + \frac{3}{4}\chi_2 b e^{-\alpha\phi}v^2\right) + \frac{v^2}{4}(V + M_1) + \frac{3p_u v}{4a(t)^3} \quad (3)$$

$$\frac{d}{dt}\left(a(t)^3\dot{\phi}\left(1 + \frac{\chi_2}{2}be^{-\alpha\phi}v^2\right)\right) + a(t)^3\left(\alpha\frac{\dot{\phi}^2}{4}\chi_2 b e^{-\alpha\phi}v^2 + \frac{1}{2}V_\phi v^2 - \chi_2 U_\phi\frac{v^4}{4}\right) = 0 \quad (4)$$





- 3 Universe epochs
- Strong friction term
- Can't start from the plateau
- Climbing up the slope
- E-folds': N=18

Thank you for you attention!

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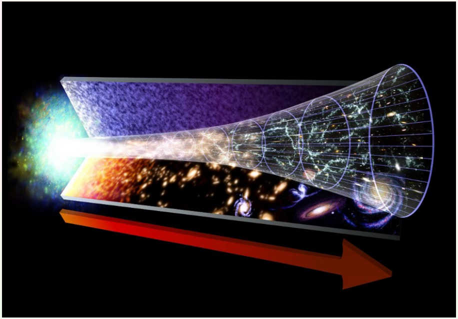

For more details: arXiv:1610.08368, 1801.07133, 1806.08199, 1808.08890