

19th International Summer Institute on Phenomenology of Elementary Particles and Cosmology

GENERAL HOLOMORPHIC PURE SUPERGRAVITY AND ITS COSMOLOGY

Takahiro Terada
Univ. of Tokyo, Japan

Sergei V. Ketov and TT,
JHEP07(2013)127,
arXiv:1304.4319 [hep-th]

GENERALIZATION OF SUPERGRAVITY

19th International Summer Institute on Phenomenology of Elementary Particles and Cosmology

GENERAL HOLOMORPHIC PURE SUPERGRAVITY AND ITS COSMOLOGY

Takahiro Terada
Univ. of Tokyo, Japan

Sergei V. Ketov and TT,
JHEP07(2013)127,
arXiv:1304.4319 [hep-th]

GENERALIZATION OF SUPERGRAVITY

19th International Summer Institute on Phenomenology of Elementary Particles and Cosmology

GENERAL HOLOMORPHIC
PURE SUPERGRAVITY AND
ITS COSMOLOGY

Takahiro Terada
Univ. of Tokyo, Japan

Sergei V. Ketov and TT,
JHEP07(2013)127,
arXiv:1304.4319 [hep-th]

SUPERSYMMETRIZATION OF
MODIFIED GRAVITY

Many reasons to do that!!

- pure theoretical interests
- stringy/quantum corrections
- potential applications to pheno
- application to inflation
- to embed modified gravity into fundamental theory, etc.

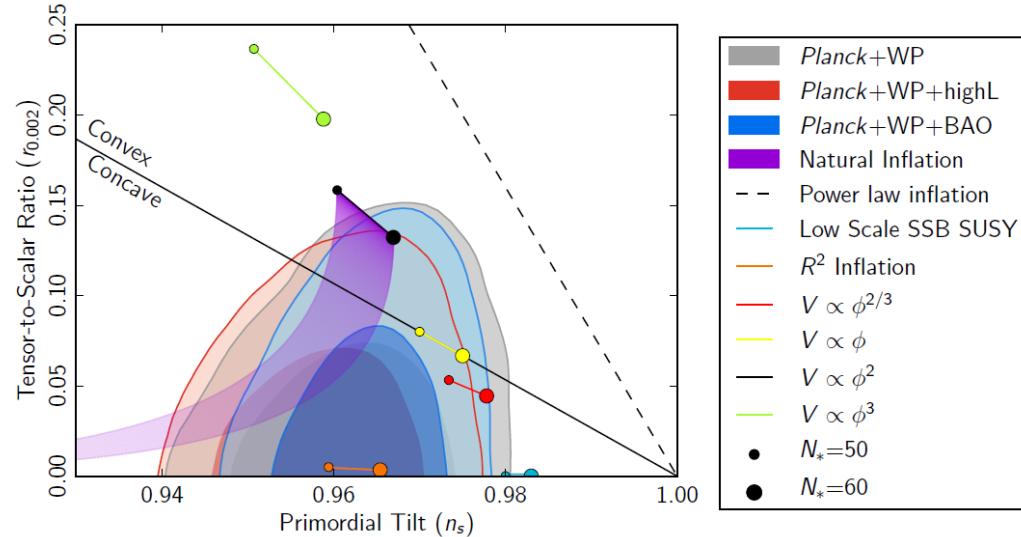
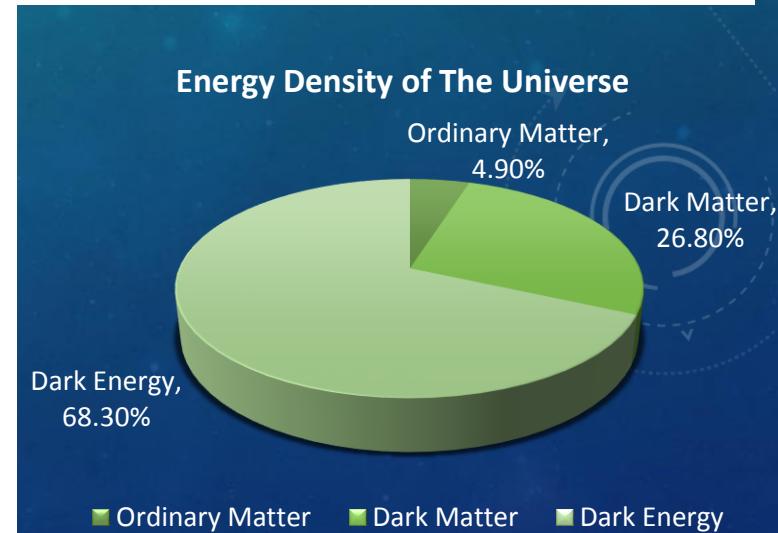
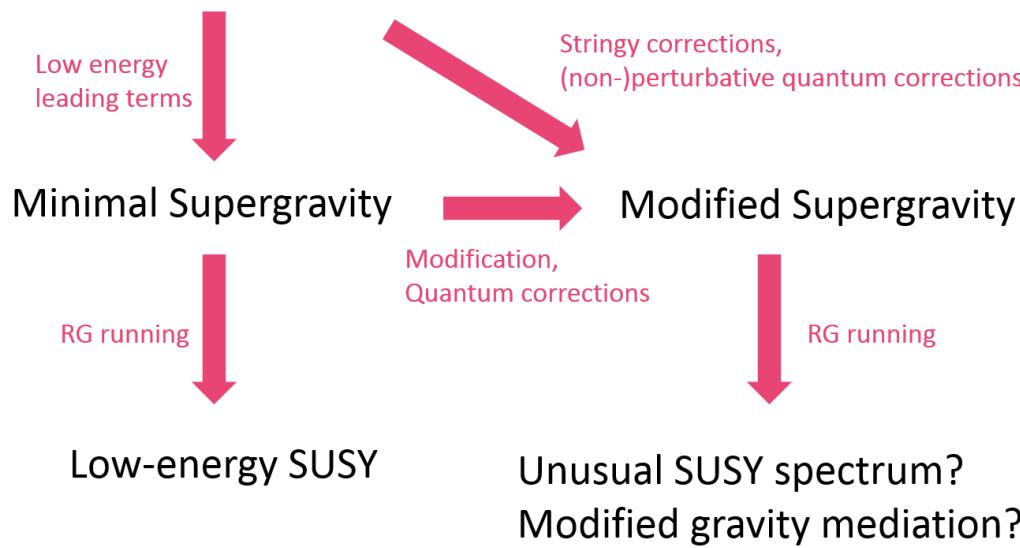


Fig. 1. Marginalized joint 68% and 95% CL regions for n_s and $r_{0.002}$ from *Planck* in combination with other data sets compared to the theoretical predictions of selected inflationary models.

Quantum Gravity (Superstring/M-theory?)



$$G_{\mu\nu} = 8\pi G T_{\mu\nu}$$

Positioning of the work

Simple

Supersymmetrization



R

- A. Einstein, 1915

$f(R)$ gravity

- A. De Felice and S. Tsujikawa, Living Rev. Rel. 13 (2010) 3 and references therein.

$f(R, C)$ gravity

- Our work

NEW

\mathcal{R}

- D. Z. Freedman, P. van Nieuwenhuizen and S. Ferrara, Phys. Rev. D 13 (1976) 3214;
- S. Deser and B. Zumino, Phys. Lett. B 62 (1976) 335.

$F(\mathcal{R})$ supergravity

- S.J. Gates, Jr. and S.V. Ketov, Phys. Lett. B674 (2009) 59

NEW

$F(\mathcal{R}, \mathcal{W})$ supergravity

- Our work

General

Bosonic sector

New action for supergravity

$$\mathcal{L} = \int d^2\Theta 2\mathcal{E} F(\mathcal{R}, \mathcal{W}) + \text{H. c.}$$

where F is a holomorphic function.

$$e^{-1}\mathcal{L} = -\frac{1}{4} \left(-\frac{1}{3}R - \frac{2}{3}ie_a^m \mathcal{D}_m b^a + \frac{4}{9}M^*M + \frac{2}{9}b^a b_a \right) \frac{\partial F}{\partial \mathcal{R}} \Big| - M^* F \Big| \\ - \frac{1}{2304} \epsilon^{\rho\lambda} \left(R_{\lambda\dot\rho\gamma\alpha\beta}^{\dot\rho} + i\epsilon_{\lambda\alpha} \sigma_{\beta\dot\rho}^m \mathcal{D}_m b_\gamma^{\dot\rho} \right) \left(R_{\rho\dot\sigma\delta\epsilon\phi}^{\dot\sigma} + i\epsilon_{\rho\delta} \sigma_{\epsilon\dot\sigma}^n \mathcal{D}_n b_\phi^{\dot\sigma} \right) \frac{\partial^2 F}{\partial W_{\delta\epsilon\phi} \partial W_{\alpha\beta\gamma}} \Big| \\ + \text{H.c.}$$

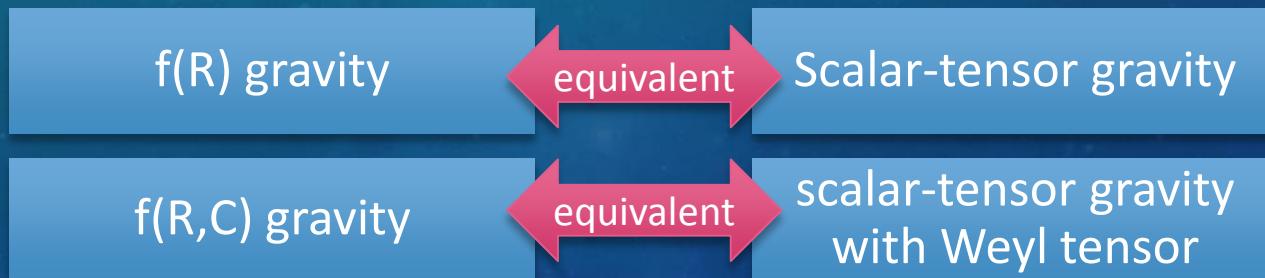
$f(R, C)$ gravity and Inflation

$$S = -\frac{1}{2} \int d^4x \sqrt{-g} f(R, C)$$

Starobinsky model + correction term ($\propto b$) as a simple non-trivial example:

$$f(R, C) = R - \frac{R^2}{6M^2} + bRC^{\mu\nu\rho\sigma}C_{\mu\nu\rho\sigma}$$

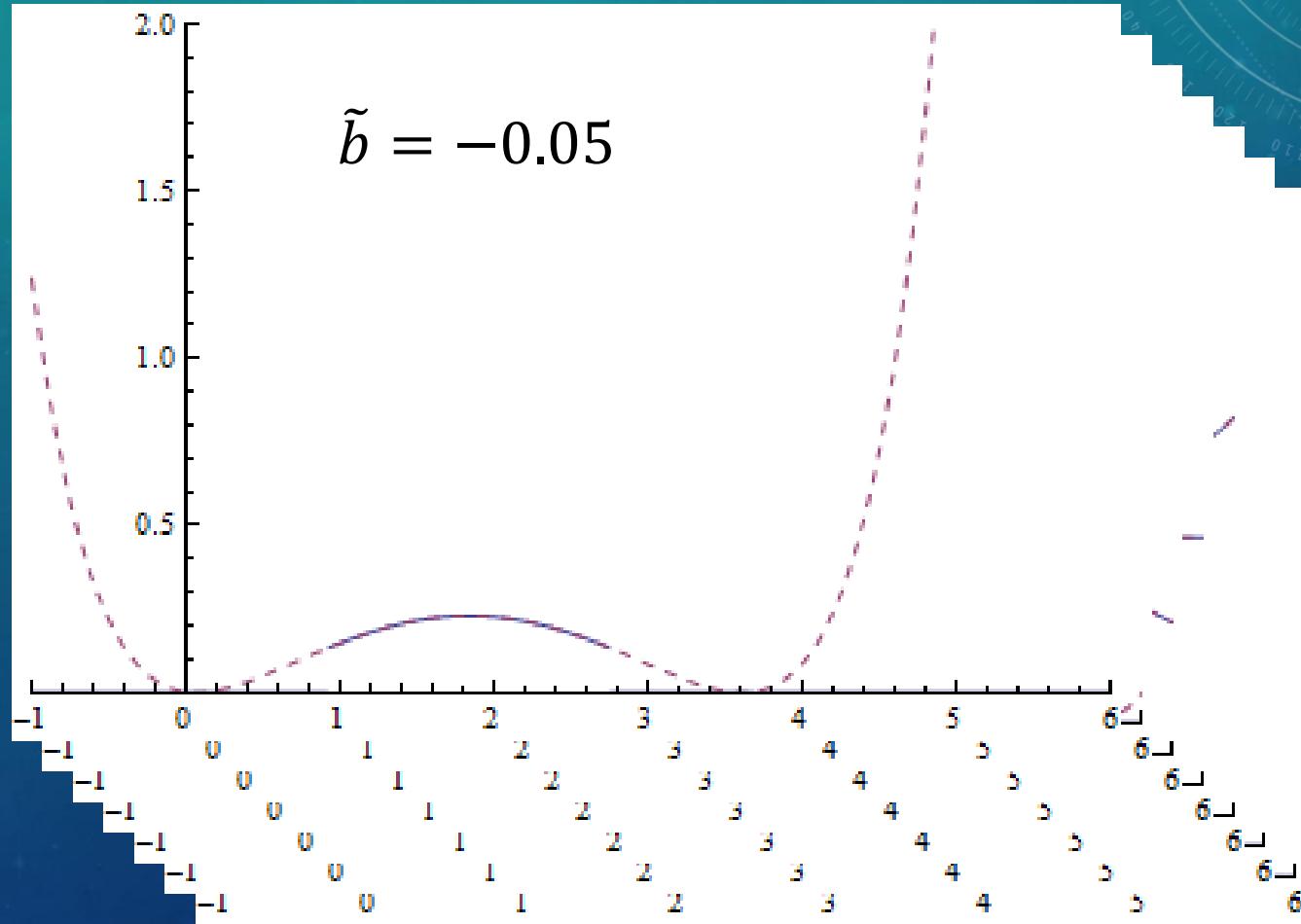
where M is the inflaton mass and b is a coupling constant.



$$V = \frac{3}{4} M^2 \left(1 - e^{-\sqrt{2/3}\sigma} + b C^{\mu\nu\rho\sigma} C_{\mu\nu\rho\sigma} e^{\sqrt{2/3}\sigma} \right)^2$$

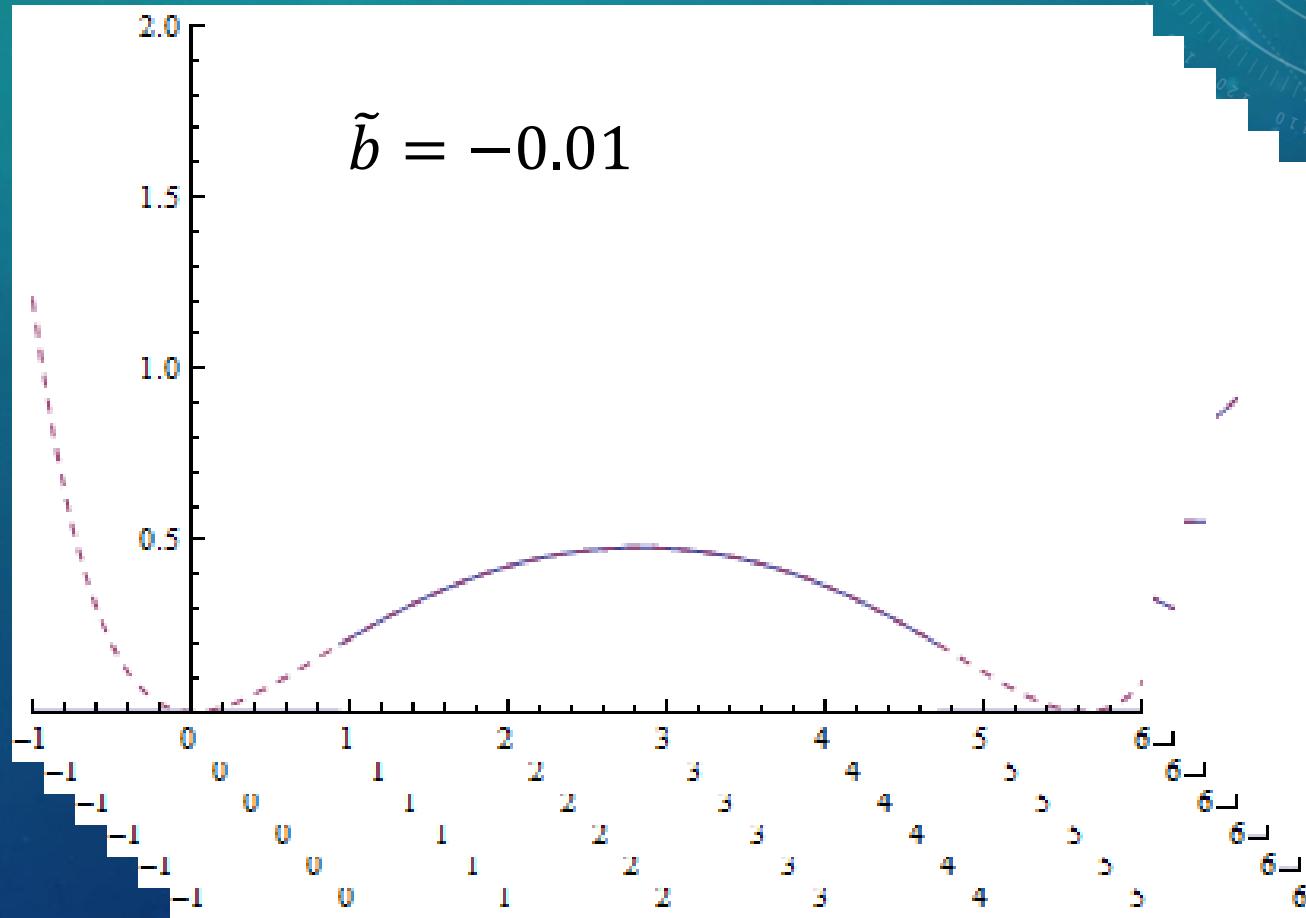
$$V = \frac{3}{4} M^2 \left(1 - e^{-\sqrt{2/3}\sigma} + \tilde{b} e^{\sqrt{2/3}\sigma} \right)^2$$

$$\tilde{b} \equiv b C^{\mu\nu\rho\sigma} C_{\mu\nu\rho\sigma}$$



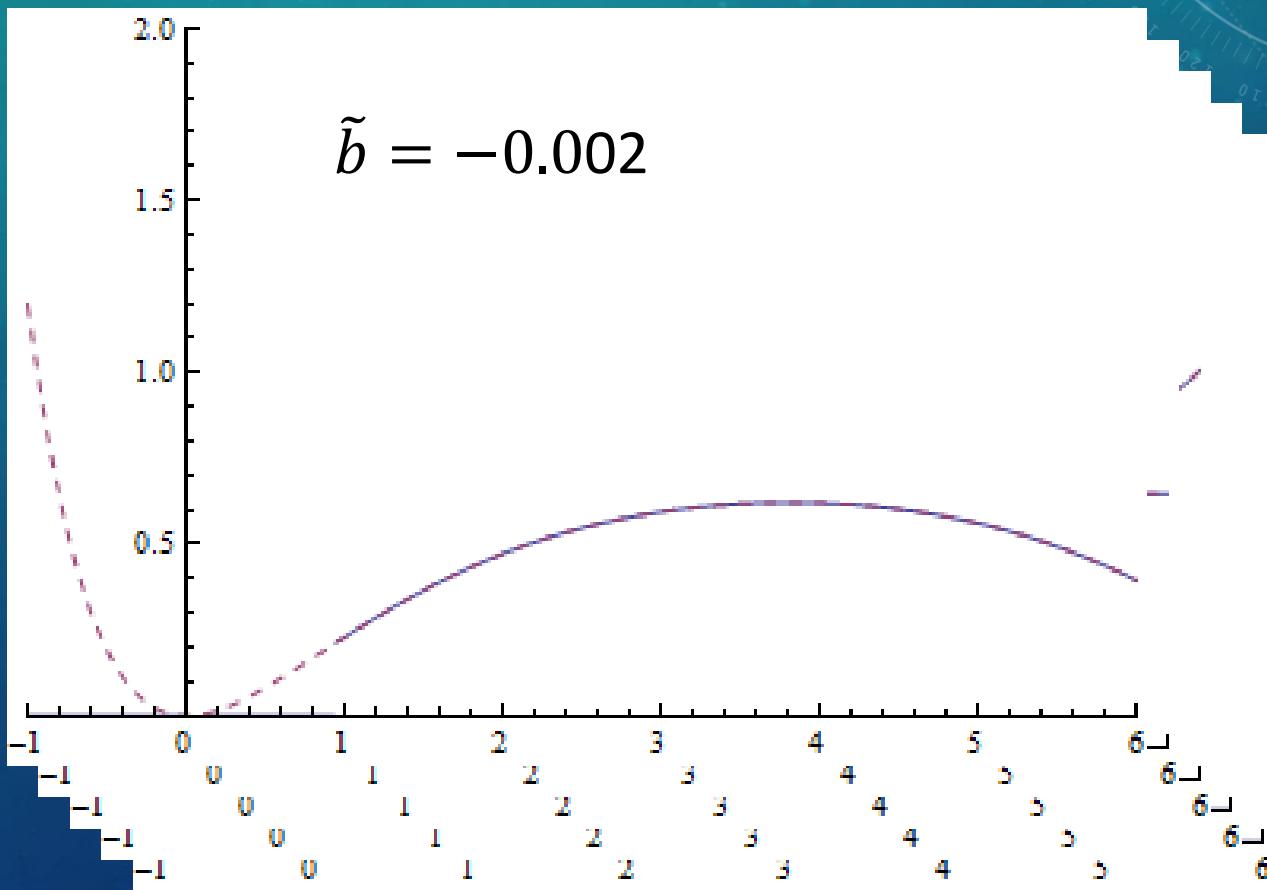
$$V = \frac{3}{4} M^2 \left(1 - e^{-\sqrt{2/3}\sigma} + \tilde{b} e^{\sqrt{2/3}\sigma} \right)^2$$

$$\tilde{b} \equiv b C^{\mu\nu\rho\sigma} C_{\mu\nu\rho\sigma}$$



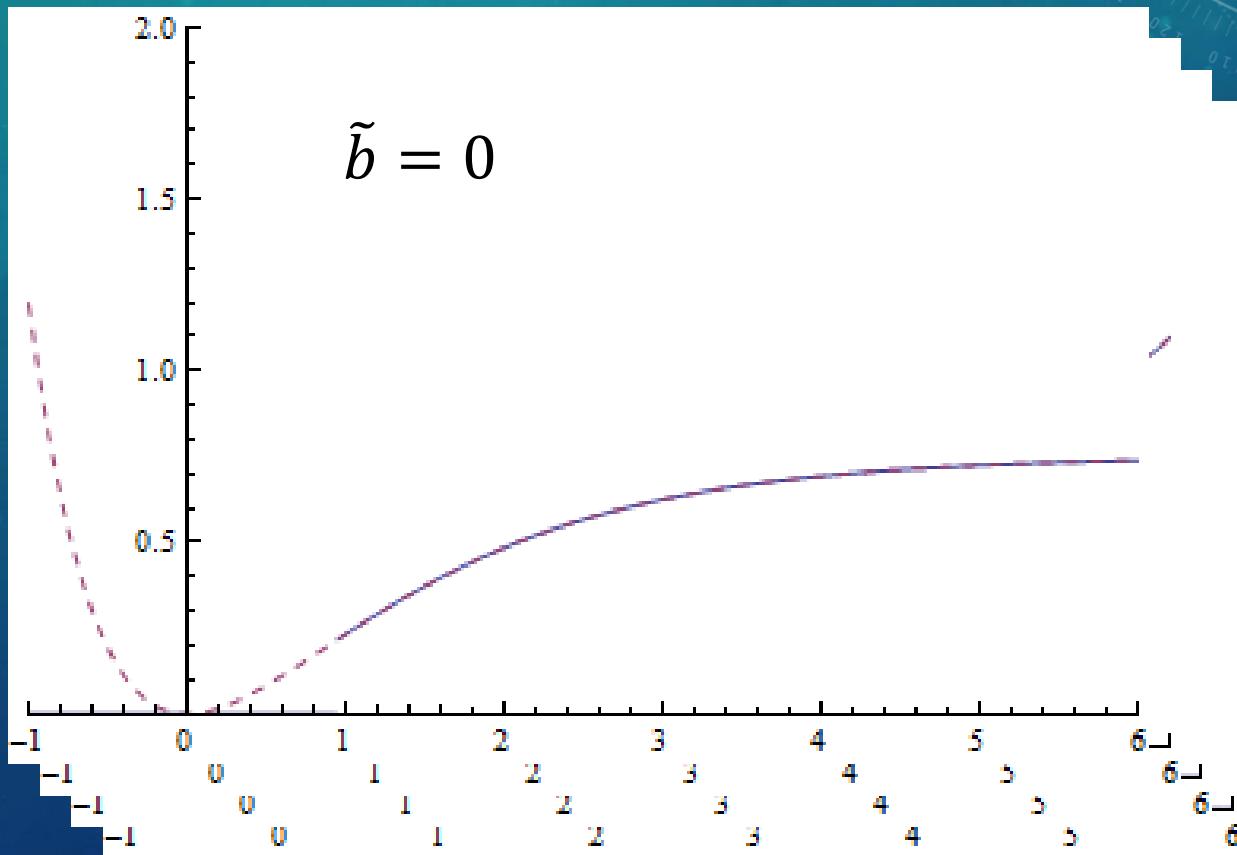
$$V = \frac{3}{4} M^2 \left(1 - e^{-\sqrt{2/3}\sigma} + \tilde{b} e^{\sqrt{2/3}\sigma} \right)^2$$

$$\tilde{b} \equiv b C^{\mu\nu\rho\sigma} C_{\mu\nu\rho\sigma}$$



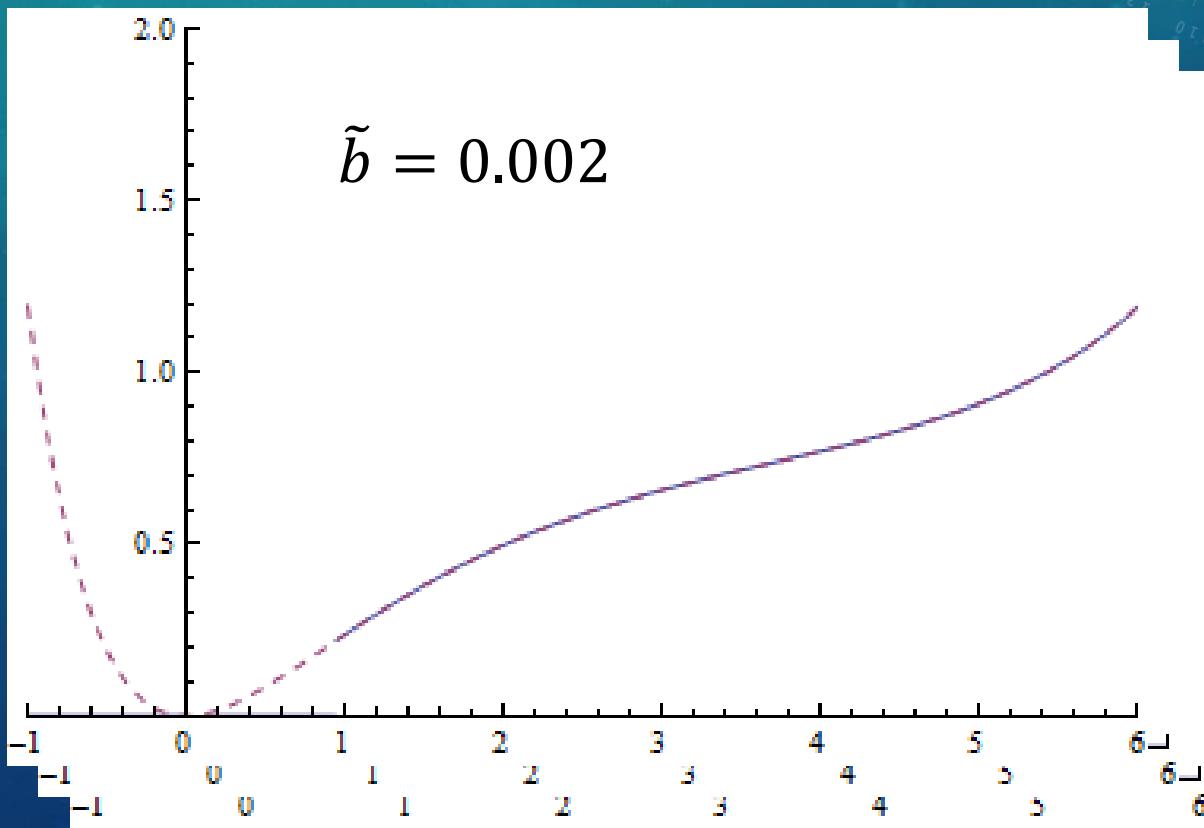
$$V = \frac{3}{4} M^2 \left(1 - e^{-\sqrt{2/3}\sigma} + \tilde{b} e^{\sqrt{2/3}\sigma} \right)^2$$

$$\tilde{b} \equiv b C^{\mu\nu\rho\sigma} C_{\mu\nu\rho\sigma}$$



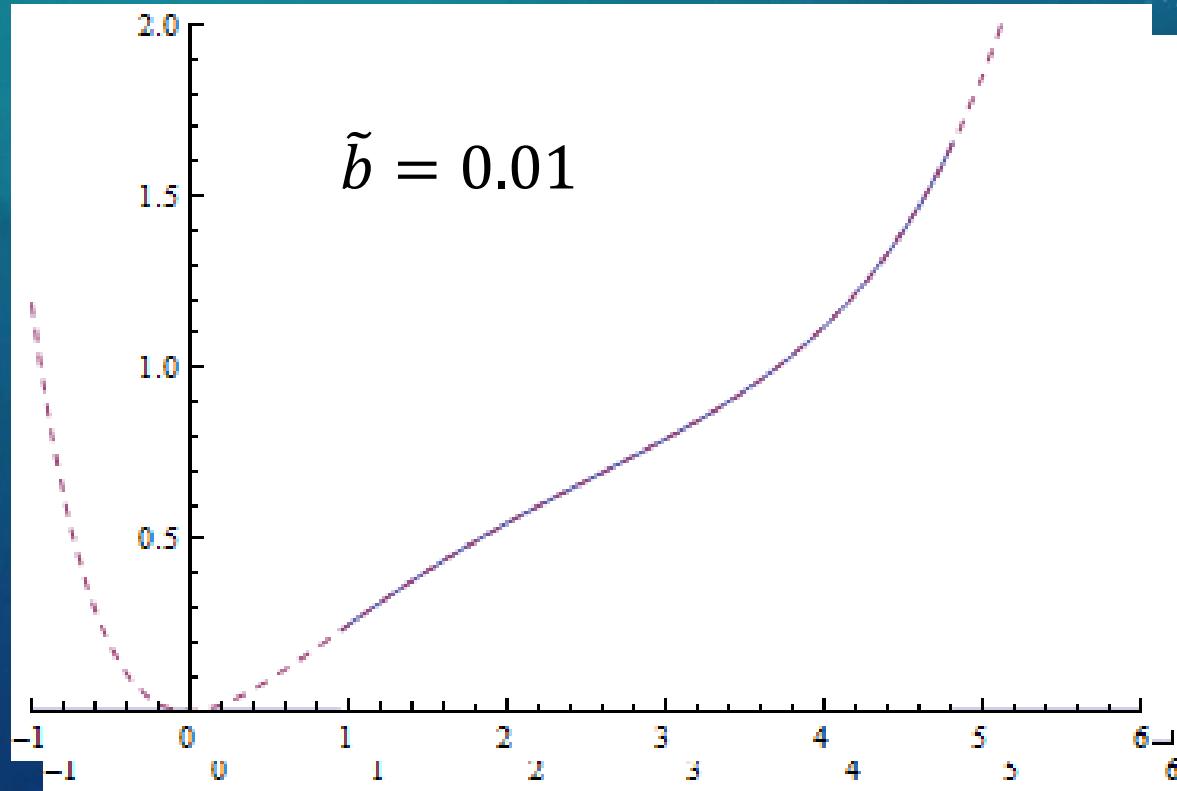
$$V = \frac{3}{4} M^2 \left(1 - e^{-\sqrt{2/3}\sigma} + \tilde{b} e^{\sqrt{2/3}\sigma} \right)^2$$

$$\tilde{b} \equiv b C^{\mu\nu\rho\sigma} C_{\mu\nu\rho\sigma}$$



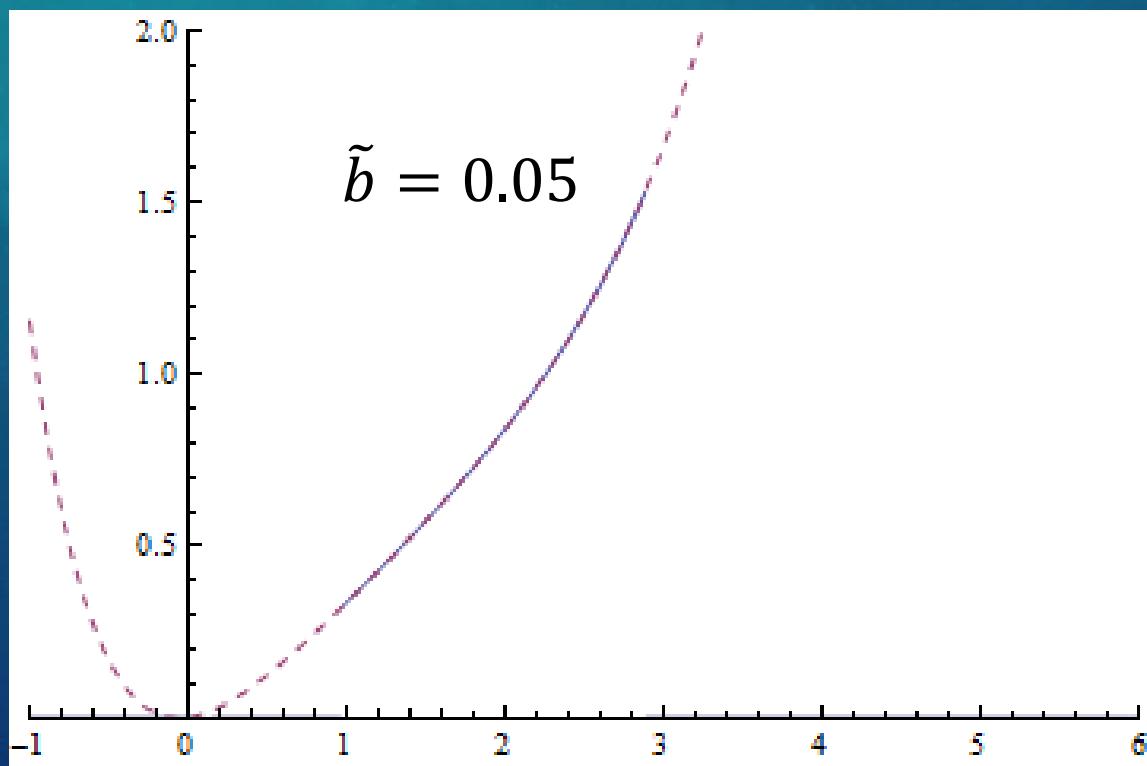
$$V = \frac{3}{4} M^2 \left(1 - e^{-\sqrt{2/3}\sigma} + \tilde{b} e^{\sqrt{2/3}\sigma} \right)^2$$

$$\tilde{b} \equiv b C^{\mu\nu\rho\sigma} C_{\mu\nu\rho\sigma}$$



$$V = \frac{3}{4} M^2 \left(1 - e^{-\sqrt{2/3}\sigma} + \tilde{b} e^{\sqrt{2/3}\sigma} \right)^2$$

$$\tilde{b} \equiv b C^{\mu\nu\rho\sigma} C_{\mu\nu\rho\sigma}$$



19th International Summer Institute on Phenomenology of Elementary Particles and Cosmology

GENERAL HOLOMORPHIC PURE SUPERGRAVITY AND ITS COSMOLOGY

Takahiro Terada
Univ. of Tokyo, Japan

Sergei V. Ketov and TT,
JHEP07(2013)127,
arXiv:1304.4319 [hep-th]

$$\mathcal{L} = \int d^2\Theta 2\mathcal{E} F(\mathcal{R}, \mathcal{W}) + \text{H. c.}$$

SUMMARY

- There are many reasons to study modified supergravity.
- We proposed a new type of action for modified gravity and supergravity.
- It's interesting to compare the results with future CMB data.