

Minimal Supergravity and Inflation with a Large Cutoff

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with

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Low-Energy Supersymmetry **(sparticle spectrum $< 5\text{TeV}$)**

Various Candidate Models of Elementary Particles (beyond the standard model)

To be minimal

MSSM + mInflation

+ ~~mSUSY~~ in mSUGRA

**speculations on orders of
characteristic parameters
and their origins**

Minimal SUGRA Inflation

ϕ **inflaton superfield**

$$W = v^2 \phi - \frac{\lambda}{M^2} \phi^5$$

$$K = |\phi|^2 + \frac{k}{M^2} |\phi|^4 + \dots$$

$$V = e^{\frac{K}{M_G^2}} \left\{ \left(\frac{\partial^2 K}{\partial \phi \partial \phi^*} \right)^{-1} |DW|^2 - 3 \left| \frac{W}{M_G} \right|^2 \right\}$$

$$DW = \frac{\partial W}{\partial \phi} + \frac{\partial K}{\partial \phi} \frac{W}{M_G^2}$$

$$M_G = 2.4 \times 10^{18} \text{ GeV}$$

$$V(\varphi) \simeq v^4 - \frac{2k}{M^2} v^4 \varphi^2 - \frac{5\lambda}{2M^2} v^2 \varphi^4$$

$$\varphi = \sqrt{2} \text{Re } \phi$$

spectral index $n_s \simeq 1 - 8 \frac{k M_G^2}{M^2}$

$$|n_s - 1| \lesssim 0.1$$

$$\frac{k M_G^2}{M^2} \lesssim 10^{-2}$$

loop effects $\frac{k}{M^2} \gtrsim \frac{1}{16\pi^2 M_G^2}$

mSUGRA mediation

$$K = |Z|^2 + |q_i|^2 + \frac{c^{ij}}{M^2} |Z|^2 q_i q_j^* + \dots$$

loop effects $\frac{|c^{ij}|}{M^2} \gtrsim \frac{1}{16\pi^2 M_G^2}$

$$W_{eff} = \Lambda^2 Z$$

$$\delta m_0^2 \simeq \frac{c^{ij}}{M^2} m_0^2$$

$K^0 - \bar{K}^0$ mixing suppressed

$$\left| \frac{\delta m_0^2}{m_0^2} \right| \lesssim 0.6 \times 10^{-2} \left(\frac{m}{\text{TeV}} \right)$$

$$m_0 < 1\text{TeV} < m_{1/2} \text{ or} \\ 1\text{TeV} < m_0 < 5\text{TeV}$$

Dark Matter Candidate

Gaugino-Higgsino mixture

$$\frac{1}{2}m_{Z^0}^2 \simeq \frac{m_{H_d}^2}{\tan^2 \beta} - m_{H_u}^2 - |\mu|^2$$

$$\tan \beta = \langle H_u \rangle / \langle H_d \rangle$$

$$\delta U = \frac{c_{1/2}}{M} Z W^\alpha W_\alpha$$

$$\delta K = \frac{c}{M} Z^* H \bar{H}$$

$$m_{1/2} \sim \frac{c_{1/2} M_G}{M} m_0 \quad m_{\tilde{H}} \sim \frac{c M_G}{M} m_0$$

$\mathcal{O}(100 \text{ GeV})$

$$\frac{kM_G^2}{M^2}$$

$$\frac{c^{ij}M_G^2}{M^2}$$

$$\frac{c_{1/2}M_G}{M}$$

$$\frac{cM_G}{M}$$

$$n_s$$

$$\delta m_0^2$$

$$m_{1/2}$$

$$m_{\tilde{H}}$$

$$M_G \simeq 10^{-1} M$$

Slow-Roll Parameters

$$\epsilon = M_G^2 \left(\frac{V'(\varphi)}{V(\varphi)} \right)^2 \quad \eta = M_G^2 \frac{V''(\varphi)}{V(\varphi)}$$

Inflaton Candidates

Multiple Inflatons

Larger Macroscopic Universe

“Inflationary Dynamics

Suppress FCNC”

**Toward a Minimal Model
of the Supersymmetric
Universe**

Baryogenesis, CP violations,

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