Split SUSY From Induced-Gravity Palatini-Like Higgs Inflation

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Based on:

- *C.P.*, *Phys. Lett. B* **868**, 139739 (2025) [arXiv:2505.23243];
- *C.P.*, *Astronomy* **5**, no. 1, 9 (2026) [arXiv:2602.05623].

Outline

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Coupling non-Minimally the Higgs-Inflaton to Gravity

- The Idea of **Induced-Gravity (IG)** Is Related to the **Dynamical Generation** of $m_{\rm P}$ At the Vacuum Of a Theory[1]
- It Can be Implemented at the End of an Inflationary Stage Driven by A **Grand Unified Theory (GUT)** Scale Higgs Field ϕ.
- We Consider the **Jordan Frame (JF)** Action Of ϕ **non-Minimally Coupled** to the Ricci Scalar Curvature, $\mathcal{R}$, With

$$\mathsf{S}=\int d^4x\sqrt{-\mathfrak{g}}\left(-\frac{1}{2}f_{\mathcal{R}}(\phi)\mathcal{R}+\frac{f_{\rm K}(\phi)}{2}g^{\mu\nu}\partial_\mu\phi\partial_\nu\phi-V(\phi)\right),\quad \text{Where}\quad f_{\mathcal{R}}(\phi)=c_{\mathcal{R}}\frac{\phi^2}{m_{\rm P}^2}\quad \&\quad V=\frac{\lambda^2}{16}(\phi^2-M^2)^2$$

Are the Frame Function and the Potential of ϕ. Also $\mathfrak{g}$ is the Determinant Of The Background Metric and We Allow for a **Kinetic Mixing** Through the Function $f_{\rm K}(\phi)$ Parameterized via $f_{\mathcal{R}}$ as $f_{\rm K}=f_{\mathcal{R}}^m$ with $0\leq m<10$.

- **Recovering Einstein Gravity** at the Vacuum $\langle\phi\rangle=M$ Implies $f_{\mathcal{R}}(\langle\phi\rangle)=1 \quad\Rightarrow\quad c_{\mathcal{R}}=m_{\rm P}^2/M^2$.
- If we Perform a **Conformal Transformation**[2] According Which We Define the **Einstein Frame (EF)** Metric $\widehat{g}_{\mu\nu}$

$$\widehat{g}_{\mu\nu}=f_{\mathcal{R}}\,g_{\mu\nu}\quad\Rightarrow\quad\sqrt{-\widehat{\mathfrak{g}}}=f_{\mathcal{R}}^2\sqrt{-\mathfrak{g}},\ \widehat{g}^{\mu\nu}=g^{\mu\nu}/f_{\mathcal{R}}\quad\text{and}\quad\widehat{\mathcal{R}}=\mathcal{R}/f_{\mathcal{R}},$$

Where We Adopt The **Palatini Formulation**, We Arrive at S in the EF $\mathsf{S}=\int d^4x\sqrt{-\widehat{\mathfrak{g}}}\left(-\frac{1}{2}\widehat{\mathcal{R}}+\frac{1}{2}\widehat{g}^{\mu\nu}\partial_\mu\widehat{\phi}\partial_\nu\widehat{\phi}-\widehat{V}\left(\widehat{\phi}\right)\right)$.

Here we Introduce the **EF Canonically Normalized Field**, $\widehat{\phi}$, and **Potential**, $\widehat{V}$, Defined As Follows:

$$d\widehat{\phi}/d\phi=J=(f_{\rm K}/f_{\mathcal{R}})^{1/2}=f_{\mathcal{R}}^{(m-1)/2}\quad\text{and}\quad\widehat{V}(\widehat{\phi})=V(\phi)/f_{\mathcal{R}}(\phi)^2\quad\text{with}\quad\phi=\phi(\widehat{\phi}).$$

- The **Synergy** Between V and $f_{\mathcal{R}}$ Provides a **Flat** Enough $\widehat{V}$ Convenient to Drive Inflation Even for $J=1$ When $m=1$.
- The Analysis of Inflation Can Be Performed in the **EF** Using The **Standard Slow-Roll** Approximation.

[1] A. Zee (1979); R. Fakir and W.G. Unruh (1990); N. Kaloper, L. Sorbo and J. Yokoyama (2008); C.P. (2013)

[2] K. Maeda (1989); D.S. Salopek, J.R. Bond and J.M. Bardeen (1989); T. Tenkanen (2020).

Inflationary Observational and Theoretical Requirements

• The **Number of e-foldings**, $\widehat{N}_\star$, that the Scale $k_\star = 0.05/\mathrm{Mpc}$ Suffers During inflation has to be Sufficient to Resolve the Horizon and Flatness Problems of Standard Big Bang (using Reduced Planck Units With $m_{\rm P} = 1$):

$$\widehat{N}_\star = \int_{\widehat{\phi}_{\rm f}}^{\widehat{\phi}_\star} d\widehat{\phi}\, \frac{\widehat{V}}{\widehat{V}_{,\widehat{\phi}}} = \int_{\phi_{\rm f}}^{\phi_\star} d\phi\, J^2 \frac{\widehat{V}}{\widehat{V}_{,\phi}} \simeq 50-60$$

Where $\phi_\star$ $[\widehat{\phi}_\star]$ is The Value of ϕ $[\widehat{\phi}]$ **When $k_\star$ Crosses Outside** The Inflationary Horizon;
$\phi_{\rm f}$ $[\widehat{\phi}_{\rm f}]$ is the Value of ϕ $[\widehat{\phi}]$ at the **End of Inflation** Which Can Be Found From The Condition:

$$\max\{\widehat{\epsilon}(\phi_{\rm f}), |\widehat{\eta}(\phi_{\rm f})|\} = 1, \quad \text{With} \quad \widehat{\epsilon} = \frac{1}{2}\left(\frac{\widehat{V}_{,\widehat{\phi}}}{\widehat{V}}\right)^2 = \frac{1}{2J^2}\left(\frac{\widehat{V}_{,\phi}}{\widehat{V}}\right)^2 \quad \text{and} \quad \widehat{\eta} = \frac{\widehat{V}_{,\widehat{\phi}\widehat{\phi}}}{\widehat{V}} = \frac{1}{J^2}\left(\frac{\widehat{V}_{,\phi\phi}}{\widehat{V}} - \frac{\widehat{V}_{,\phi}}{\widehat{V}}\frac{J_{,\phi}}{J}\right).$$

• The **Amplitude $A_{\rm s}$ of the Power Spectrum** of the Curvature Perturbations is To Be Normalized With ***Planck*** Data:

$$\sqrt{A_{\rm s}} = \frac{1}{2\sqrt{3}\,\pi}\frac{\widehat{V}(\widehat{\phi}_\star)^{3/2}}{|\widehat{V}_{,\widehat{\phi}}(\widehat{\phi}_\star)|} = \frac{|J(\phi_\star)|}{2\sqrt{3}\,\pi}\frac{\widehat{V}(\phi_\star)^{3/2}}{|\widehat{V}_{,\phi}(\phi_\star)|} = 4.618\cdot 10^{-5}\,.$$

• The (Scalar) **Spectral Index**, $n_{\rm s}$, And **Tensor-to-Scalar Ratio**, r, Found Respectively As:

$$n_{\rm s} = 1 - 6\widehat{\epsilon}(\phi_\star) + 2\widehat{\eta}(\phi_\star) \quad \text{and} \quad r = 16\widehat{\epsilon}(\phi_\star),$$

Has to Be Compatible With The **ACT** (DR6), Combined With *Planck*, Bicep2/*Keck Array* and DESI BAO Data [3]

$$n_{\rm s} = 0.9743 \pm 0.0068 \quad \Rightarrow \quad 0.967 \lesssim n_{\rm s} \lesssim 0.981 \quad \text{and} \quad r \leq 0.038 \quad \text{(P-ACT-LB-BK18 data at 95\% c.l.)}$$

• The Hierarchy Between The **Inflationary Scale** & **The Ultraviolet Cut-off**[4], $\Lambda_{\rm UV}$, of the Effective Theory has to be:

$$\widehat{V}(\phi_\star)^{1/4} \leq \Lambda_{\rm UV} \quad \text{for} \quad \phi \leq \Lambda_{\rm UV} \quad \text{With} \quad \Lambda_{\rm UV} \sim 1 = m_{\rm P}.$$

[3] *Planck and* Bicep2*/Keck Array Collaborations (2021); ACT Collaborations (2025)*

[4] *C.P. Burgess et al. (2009); J.F. Barbon and J.R. Espinosa (2009); A. Kehagias et al. (2013).*

Inflation Analysis

- In the Case of IPI The Kinetic Normalization $d\widehat{\phi}/d\phi = J = f_{\mathcal{R}}^{(m-1)/2}$ Includes Just **One** Contribution. Also, we Obtain

$$\widehat{V}_{\rm IPI} = \frac{\lambda^2\phi^4}{16 f_{\mathcal{R}}^2} \simeq \frac{\lambda^2}{16 c_{\mathcal{R}}^2},\ \ \widehat{\epsilon} \simeq \frac{8c_{\mathcal{R}}}{f_{\mathcal{R}}^m f_V^2}\ \ \text{with}\ \ f_V = c_{\mathcal{R}}\phi^2 - 1\ \ \text{and}\ \ \widehat{\eta} \simeq \widehat{\epsilon}(4+m-(2+m)c_{\mathcal{R}}\phi^2)/2.$$

- $\widehat{N}_\star \simeq 3c_{\mathcal{R}}^2\phi_\star^5 f_{\mathcal{R}\star}^{m-1}/4f_{V\star}^2 \ \Rightarrow\ \phi_\star = 8(1+m\widehat{N}_\star/c_{\mathcal{R}})^{1/2(1+m)}$

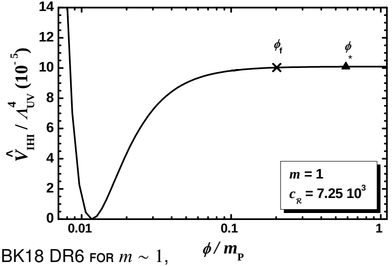
Therefore $\phi_\star < m_{\rm P} \ \Rightarrow\ c_{\mathcal{R}} > (8(m+1)\widehat{N}_\star)^{1/m}$ (for $m \neq 0$.)

Note That $\phi_\star < m_{\rm P}$ **Requires** Necessarily $m > 0$.

- $A_{\rm s}^{1/2} \simeq 4.618\cdot 10^{-5} \ \Rightarrow\ c_{\mathcal{R}} \sim \lambda^{\frac{2(m+1)}{2m+1}}$ for $\widehat{N}_\star \simeq 50$. I.e.,

$c_{\mathcal{R}} \simeq 9.9\cdot 10^9\lambda^2,\ 1.2\cdot 10^6\lambda^{4/3}, 2.2\cdot 10^5\lambda^{6/5}$ for $m = 0, 1, 2$.

As a Result, IPI Takes Place Along The **Flat** Part Of $\widehat{V}_{\rm IPI}$.



- The Remaining Observables can be Done **Compatible** With P-ACT-LB-BK18 DR6 for $m \sim 1$,

Since $n_{\rm s} \simeq 1 - \dfrac{m+2}{(m+1)\widehat{N}_\star} - O\left(c_{\mathcal{R}}^{-1/(m+1)}\right)$, $\alpha_{\rm s} \simeq -\dfrac{m+2}{(m+1)\widehat{N}_\star^2}$ And $r \simeq \dfrac{16}{(m+1)\widehat{N}_\star}(8c_{\mathcal{R}}(m+1)\widehat{N}_\star))^{-1/(m+1)}$.

- Performing an **Expansion** for Low ϕ values, We Obtain[5] $\Lambda_{\rm UV} = m_{\rm P}/\sqrt{c_{\mathcal{R}}}$ Since

$$J^2\dot{\phi}^2 = 1\dot{\delta\phi}^2\ \ \text{and}\ \ \widehat{V} \simeq \frac{\lambda^2\delta\phi^2}{4c_{\mathcal{R}}}\left(1 - 3\frac{\delta\phi}{\Lambda_{\rm UV}} + \frac{25}{4}\frac{\delta\phi^2}{\Lambda_{\rm UV}^2} - 11\frac{\delta\phi^3}{\Lambda_{\rm UV}^3} + \frac{35}{2}\frac{\delta\phi^4}{\Lambda_{\rm UV}^4} + \cdots\right)\ \text{With}\ \ \delta\phi \simeq \delta\phi$$

However, The Model Does not Enface Problem With **Unitarity** Since $\widehat{V}_{\rm IPI}(\phi_\star)^{1/4} \ll \Lambda_{\rm UV}$ Although $\phi_\star \gg \Lambda_{\rm UV}$.

[5] F. Bauer and D.A. Demir (2010); J. McDonald (2020); C.P (2025, 2026).

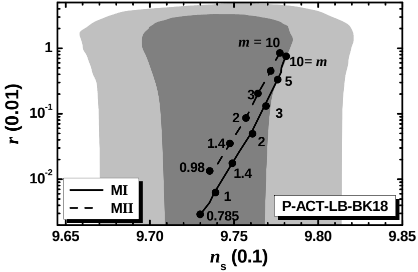
Compatibility with ACT DR6

• IPI can Be Done Even More **Predictive** If we Identify the Mass Of the Gauge Boson $\langle M_A\rangle$ With the GUT Scale $M_{\mathbb{G}}$.

$$\text{I.e., } \langle M_A\rangle = gM = gm_{\rm P}/\sqrt{c_{\mathcal{R}}} = M_{\mathbb{G}} \;\;\Rightarrow\;\; c_{\mathcal{R}} = g^2 m_{\rm P}^2/M_{\mathbb{G}}^2 \;\text{ with }\; g = g_{\mathbb{G}}.$$

• Supplementing the Particle Content of the Standard Model (**SM**) With Two **Vector-Like Fermion** Representations We Obtain 2 Models (MI and MII) Which Ensure **Gauge Coupling Unification And Vacuum Stability.**[6]

Model:	MI	MII
Particle Content		
SM+	$6\,(\mathbf{1},\mathbf{2},1/2)$ $2\,(\mathbf{8},\mathbf{1},0)$	$1\,(\mathbf{1},\mathbf{4},1/2)$ $2\,(\mathbf{6},\mathbf{1},2/3)$
With Masses (TeV)	$0.25-2$ $0.5-5$	$0.25-5$ $0.25-5$
GUT Quantities		
$g_{\mathbb{G}}$ $M_{\mathbb{G}}/10$ YeV	0.71 2.34	1.159 8.58



• Imposing $\widehat{N}_\star \simeq 56$ and $\sqrt{A_{\rm s}} = 4.618\cdot 10^{-5}$, we Obtain the **Allowed Curves** In the $n_{\rm s}-r$ Plane for MI & MII.

• We Observe that $(n_{\rm s}, r)$ are **Compatible** With P-ACT-LB-BK18 Data Even for **Low** (and so, More Natural) m values.

• It Would Be Interesting to Connect this Scheme With the **MSSM** Unification, Working in the Context of **SUGRA,** Where The **Gauge Hierarchy** Problem May Be Somehow Addressed. We focus on $m=1$ Which Requires Just **Quadratic** K's.

[6] *B. Bhattacherjee, P. Byakti, A. Kushwaha, S.Vempati (2017).*

Einstein Frame SUGRA (i.e. Supergravity) Action

- The Relevant Part of the **EF** Action In Four Dimensional, $\mathcal{N}=1$ SUGRA is (z^α are Scalar Complex Fields):

$$\mathsf{S}=\int d^4x\sqrt{-\mathfrak{g}}\left(-\frac{1}{2}\widehat{\mathcal{R}}^2+K_{\alpha\bar\beta}g^{\mu\nu}D_\mu z^\alpha D_\nu z^{*\bar\beta}-\widehat{V}_{\rm SUGRA}\right),\quad \text{Where}\quad K_{\alpha\bar\beta}:=\partial^2_{z^\alpha z^{*\bar\beta}}K>0,\quad K^{\bar\beta\alpha}K_{\alpha\bar\gamma}=\delta^{\bar\beta}_{\bar\gamma};$$

$$\widehat{V}_{\rm SUGRA}=\widehat{V}_{\rm F}+\widehat{V}_{\rm D}\quad\text{With}\quad \begin{cases}\widehat{V}_{\rm D}=g^2{\rm D}_a^2/2, & {\rm D}_a=z_\alpha\left(T_a\right)^\alpha_\beta K_{,z^\beta}\\ \widehat{V}_{\rm F}=e^K\left(K^{\alpha\bar\beta}D_\alpha W D^*_{\bar\beta}W^*-3|W|^2\right)\end{cases}\quad\text{and}\quad\begin{cases}D_\mu z^\alpha=\partial_\mu z^\alpha+igA^a_\mu T^a_{\alpha\beta}z^\beta,\\ D_\alpha=\partial_\alpha+\partial_\alpha K\ \text{with}\ \partial_\alpha=\partial_{z^\alpha}\end{cases}$$

A^a_μ is The Vector Gauge Fields, g is the Gauge Coupling and T_a are the Generators of the Gauge Transformations Of z^α.

- $\widehat{V}_{\rm SUGRA}$ Depends on the **Superpotential** $W=W(z^\alpha)$ and **Kähler Potential** $K=K(z^\alpha,z^{*\bar\beta})$, From Which W Appears Only in $\widehat{V}_{\rm F}$ Whereas K Influences Both $\widehat{V}_{\rm F}$ & $\widehat{V}_{\rm D}$.
- Note that **By Construction** K Has to Imply ${\rm D}_a=0$ Since It is Easier to **Reproduce** $\widehat{V}_{\rm IPI}$ from $\widehat{V}_{\rm F}$.
- To Erase the Extra Contributions into $\widehat{V}_{\rm IPI}$ Induced by $\widehat{V}_{\rm F}$ We Introduce a **Stabilizer Field**[7] S & a Semi-**Logarithmic** K.
- If We Adopt [8] $\boldsymbol{K=-Nm^2_{\rm P}\ln\left(-\Omega/N\right)}$ (**Ω: Frame Function**) and Perform a Conformal Transformation, **S In JF** Reads

$$\mathsf{S}=\int d^4x\sqrt{-\mathfrak{g}}\left(\frac{\Omega}{2N}m^2_{\rm P}\mathcal{R}+m^2_{\rm P}\left(\Omega_{\alpha\bar\beta}+\frac{3-N}{N}\frac{\Omega_\alpha\Omega_{\bar\beta}}{\Omega}\right)D_\mu z^\alpha D^\mu z^{*\bar\beta}-\frac{27}{N^3}\Omega\mathcal{A}_\mu\mathcal{A}^\mu-V_{\rm SUGRA}\right),\quad\text{Where}$$

We use Obligatorily the **Metric** Formulation, $\mathcal{A}_\mu=-iNm^2_{\rm P}\left(\Omega_\alpha D_\mu z^\alpha-\Omega_{\bar\alpha}D_\mu z^{*\bar\alpha}\right)/6\Omega$ and $V_{\rm SUGRA}=\Omega^2\widehat{V}_{\rm SUGRA}/N^2$.

- The **Emergence** Of The Conventional Einstein Gravity At The Vacuum Dictates: $-\langle\Omega/N\rangle=1$.
- Despite There is no Consistent Palatini Formulation, $(\widehat{V}_{\rm IPI},J)$ Can be Reproduced Selecting W and K.

[7] R. Kallosh, A. Linde and T. Rube (2011); C.P. and N. Toumbas (2016).

[8] M.B. Einhorn and D.R.T. Jones (2010); S. Ferrara, R. Kallosh, A. Linde, A. Marrani and A. Van Proeyen (2010, 2011); R. Kallosh (2026).

Introduction of the Stabilizer Field

- **Stabilizer** is Called A Gauge-Singlet Superfield $z^1 = S$ Which Is Introduced **Linearly in W** & Is **Stabilized** at $S=0$
  - Assuring the **Boundedness of $\widehat{V}_{\rm F}$** Since The Dangerous Term $-3|W|^2$ Vanishes.
  - Assisting in the Generation of the **non-SUSY Potential** From $|\partial_S W|^2$ Since $\langle K_\alpha W\rangle_{\rm I} = \langle\partial_X W\rangle_{\rm I} = 0$ for $X \neq S$.
- The Path $S=0$ Can Be Done Stable If We Adopt $K_{\rm st} = N_{\rm st}\ln\left(1+|S|^2/N_{\rm st}\right)$ With $0 < N_{\rm st} < 6$.

The Proposed W, $W_{\rm IPI}$

- We Introduce of Two Chiral Superfields $z^2 = \Phi$ & $z^3 = \bar\Phi$, **Charged Oppositely** Under A Gauge $U(1)$ Symmetry,

E.g., $U(1)_{B-L}$, and The Following $W_{\rm IPI} = \lambda S\left(\bar\Phi\Phi - M^2/4\right)$,

Determined **Uniquely** at Renormalizable Level From $U(1)_{B-L}$ & a Global $U(1)_R$ Under Which $R(W_{\rm IPI}) = R(S)$.

Superfields:	S	Φ	$\bar\Phi$
$U(1)_R$	1	0	0
$U(1)_{B-L}$	0	2	-2

$W_{\rm IPI}$ Leads to a GUT **Phase Transition** in SUSY Vacuum $\langle S\rangle \simeq 0,\ |\langle\Phi\rangle| = |\langle\bar\Phi\rangle| = M/2$.

The Proposed K, $K_{\rm IPI}$

- We Need a Kähler Potential K for the Higgs Inflationary Sector **Such That**

$$\left\langle K_{\alpha\bar\beta}\right\rangle_{\rm I} \ni 1 = J^2 = (d\widehat\phi/d\phi)^2 \ \text{and}\ \widehat{V}_{\rm IPI} \ni \langle\widehat{V}_{\rm F}\rangle_{\rm I} \ni \langle e^K\rangle_{\rm I} = 1/(c_{\mathcal R}\phi^2)^2.$$

- Both Objectives Are Achieved, if We Adopt the **Following** K Which Are **Quadratic and Invariant** Under $U(1)_{B-L}$ & $U(1)_R$:

$$K_{\rm IPI} = -\ln F_{\mathcal R} - \ln F^*_{\mathcal R} + F_{\rm sh}\quad \text{Where}\quad F_{\mathcal R} = 4c_{\mathcal R}\bar\Phi\Phi\quad \text{And}\quad F_{\rm sh} = \left|\Phi-\bar\Phi\right|^2.$$

Here We Use **Integer** Prefactors for the $\ln$ (To Avoid **Tuning**) & The Contribution of $K_{\rm IPI}$ into $K_{\alpha\bar\beta}$ **Originate Just** From $F_{\rm sh}$.

- For **$|\Phi| = |\bar\Phi|$ & arg Φ=-arg $\bar\Phi$**, $\langle K_{\rm IPI}\rangle_{\rm I} = -2\ln c_{\mathcal R}\phi^2$ And So, the **IG Requirement** Implies $-\langle\Omega/2\rangle = 1 \Rightarrow c_{\mathcal R} = (m_{\rm P}/M)^2$.
- This Same Configuration **Eliminates** The Corresponding **D-Term**, Since $D_{B-L} = \Phi K_\Phi - \bar\Phi K_{\bar\Phi} = \left(|\Phi|^2 - |\bar\Phi|^2\right) = 0$.

Therefore, we Identify Inflaton With the **Common Radial Part** of Φ & $\bar\Phi$.

THE RELEVANT SUPER- & KÄHLER POTENTIALS

- IPI CAN BE EMBEDDED IN A $B-L$ EXTENSION OF MSSM **PROMOTING** TO GAUGE THE PRE-EXISTING GLOBAL $U(1)_{B-L}$.
- THE RELEVANT **SUPERPOTENTIAL** IS INVARIANT UNDER THE $\mathbb{G}_{\rm SM}\times U(1)_{B-L}$ GAUGE GROUP & ALSO RESPECTS 3 OTHER GLOBAL SYMMETRIES (R,B,L):

$$W = \lambda S\left(\bar\Phi\Phi - M^2/4\right)$$

TO ACHIEVE IPI & BREAK $U(1)_{B-L}$

$$+\ \lambda_\mu S\,H_u H_d$$

TO **GENERATE** THE μ PARAMETER OF MSSM

$$+\ \lambda_{ij\nu}\bar\Phi N_i^c N_j^c$$

TO GENERATE **MAJORANA** MASSES FOR NEUTRINOS

& ACTIVATE **NON-THERMAL LEPTOGENESIS**

$$+\ h_{ijN} N_i^c L_j H_u$$

TO GENERATE **DIRAC** MASSES FOR NEUTRINOS

$$+\ W_{\rm MSSM}(\mu=0)$$

(NOTE THAT 3 RIGHT-HANDED NEUTRINOS, N_i^c, ARE NECESSARY TO CANCEL THE $B-L$ **GAUGE ANOMALY**)

SUPER-FIELDS	REPRESENTATIONS UNDER $\mathbb{G}_{\rm SM}\times U(1)_{B-L}$	GLOBAL SYMMETRIES R	B	L
	MATTER FIELDS			
e_i^c	$(\mathbf{1},\mathbf{1},1,1)$	1	0	−1
N_i^c	$(\mathbf{1},\mathbf{1},0,1)$	1	0	−1
L_i	$(\mathbf{1},\mathbf{2},-1/2,-1)$	1	0	1
u_i^c	$(\mathbf{3},\mathbf{2},-2/3,-1/3)$	1	−1/3	0
d_i^c	$(\mathbf{3},\mathbf{2},1/3,-1/3)$	1	−1/3	0
Q_i	$(\bar{\mathbf{3}},\mathbf{2},1/6,1/3)$	1	1/3	0
	HIGGS FIELDS			
H_d	$(\mathbf{1},\mathbf{2},-1/2,0)$	0	0	0
H_u	$(\mathbf{1},\mathbf{2},1/2,0)$	0	0	0
S	$(\mathbf{1},\mathbf{1},0,0)$	2	0	0
$\bar\Phi$	$(\mathbf{1},\mathbf{1},0,2)$	0	0	−2
Φ	$(\mathbf{1},\mathbf{1},0,-2)$	0	0	2

- THE ABOVE W MAY COOPERATE WITH THE **FOLLOWING** K

$$K = K_{\rm IPI} + K_{\rm st}\quad \text{WHERE}\quad K_{\rm st} = N_{\rm st}\ln\left(1+\sum_{\alpha=1}^{5}|X_\alpha|^2/N_{\rm st}\right)\quad \text{WITH}\ \ 0<N_{\rm st}<6\ \ \text{AND}\ \ X^\alpha = S, H_u, H_d, \widetilde{N}_i^c, \widetilde{L}_i$$

WHICH PARAMETERIZES THE **COMPACT** KÄHLER MANIFOLD $SU(15)/U(1)$ WITH CONSTANT SCALAR CURVATURE $210/N_{\rm st}$.

Tree-Level Inflationary Potential

- If We Use The **Parameterizations**:

$$\Phi = \phi e^{i\theta}\cos\theta_\Phi \ \text{ and } \ \bar\Phi = \phi e^{i\bar\theta}\sin\theta_\Phi \quad \text{with } \ 0\leq\theta_\Phi\leq\pi/2 \ \text{ and } \ X^\beta = \left(x^\beta + i\bar x^\beta\right)/\sqrt{2},$$

Where $X^\beta = S, H_u, H_d, N_i^c$, We Can Define the **D-Flat Inflationary Path** Imposing the Conditions

$$\langle\theta\rangle_{\rm I} = \langle\bar\theta\rangle_{\rm I} = 0,\ \langle\theta_\Phi\rangle_{\rm I} = \pi/4 \ \text{ and } \ \langle X^\beta\rangle_{\rm I} = 0 \quad (:\ \mathrm{I})$$

- The only Surviving term of $\widehat{V}_{\rm F}$ Along the Path in Eq. (I) **Reproduces** the non-SUSY Potential, Since

$$\widehat{V}_{\rm IPI} = \langle e^K K^{SS^*}\,|W_{,S}|^2\rangle_{\rm I} = \frac{\lambda^2}{16}\frac{f_W^2}{c_{\mathcal{R}}^4\phi^4} \ \text{ with } \ f_W = c_{\mathcal{R}}\phi^2 - 1.$$

- We Then Computing $K_{\alpha\bar\beta}$ Along Eq. (I), We Find That the Initial Fields Are **Canonically Normalized**, I.e.,

$$\left(\langle K_{\alpha\bar\beta}\rangle_{\rm I}\right) = \text{diag}\left(\underbrace{1,...,1}_{17\ \text{elements}}\right).$$

- Therefore, We **Recover** the $\phi - \widehat{\phi}$ **Relation** for the non SUSY Case with $m=1$.
- We Check The **Stability** of the Trajectory in Eq. (I) w.r.t the Fluctuations of the Various Fields. I.e.,

$$\left\langle\frac{\partial\widehat{V}_{\rm SUGRA}}{\partial z^\alpha}\right\rangle_{\rm I} = 0 \ \ \&\ \ m^2_{z^\alpha} > 0,\ \ \text{Where } \ m^2_{z^\alpha} = \text{Egv}\left[M^2_{\alpha\beta}\right] \ \text{ With } \ M^2_{\alpha\beta} = \left\langle\frac{\partial^2\widehat{V}_{\rm SUGRA}}{\partial z^\alpha\partial z^\beta}\right\rangle_{\rm I} \ \ \&\ \ z^\alpha = \theta_1,\theta_2,\theta_\Phi, x^\beta, \bar x^\beta.$$

Here Egv Are the **Eigenvalues** of $M^2_{\alpha\beta}$ & the Subscript I Denotes Computation along Eq. (I).

- We Introduce the **Mass** Eigenstates

$$\theta_\pm = \phi(\theta\pm\bar\theta),\ \ h_\pm = (h_u \pm h_d)/\sqrt{2} \ \text{ and } \ \bar h_\pm = (\bar h_u \pm \bar h_d)/\sqrt{2}.$$

Stability and Radiative Corrections

The **Mass-Squared Spectrum** Along The Inflationary Trajectory

Fields	Eingestates	Masses Squared	
14 Real Scalars	θ_+	$m^2_{\theta+}$	$3(1+4c_{\mathcal{R}}/f_W^2)\widehat{H}^2_{\rm IPI}$
	$\widehat{\theta}_\Phi$	$m^2_{\theta_\Phi}$	$M^2_{BL}+6(1-4c_{\mathcal{R}}/f_W+4/\phi^2)\widehat{H}^2_{\rm IPI}$
	$s,\bar{s}$	m^2_s	$6(1/N_{\rm st}+4/\phi^2 f_W^2)\widehat{H}^2_{\rm IPI}$
	$h_\pm,\bar{h}_\pm$	$m^2_{h\pm}$	$3\left(1+1/N_{\rm st}\pm 4\lambda_\mu c_{\mathcal{R}}/\lambda f_W\right)\widehat{H}^2_{\rm IPI}$
	$\tilde{\nu}^c_i,\bar{\tilde{\nu}}^c_i$	$m^2_{i\tilde{\nu}^c}$	$3\left(1+1/N_{\rm st}+16\lambda^2_{iN^c}/\lambda^2\phi^2\right)\widehat{H}^2_{\rm IPI}$
	$\widetilde{l}_i,\bar{\widetilde{l}}_i$	$m^2_{i\widetilde{l}}$	$3(1+1/N_{\rm st})\widehat{H}^2_{\rm IPI}$
1 Gauge Boson	A_{BL}	M^2_{BL}	$g^2\phi^2$
7 Weyl Spinors	$\psi_\pm$	$m^2_{\psi\pm}$	$12\widehat{H}^2_{\rm IPI}/c^2_{\mathcal{R}}\phi^4$
	$\lambda_{BL},\psi_{\Phi-}$	M^2_{BL}	$g^2\phi^2$
	N^c_i	$m^2_{iN^c}$	$48\lambda^2_{iN^c}c^2_{\mathcal{R}}\phi^2\widehat{H}^2_{\rm IPI}/\lambda^2 f_W^2$

- We can Obtain $\forall\,\alpha,\ m^2_{\chi^\alpha}>0$. Especially

$$m^2_s>0\ \Leftrightarrow\ N_{\rm st}<6\ \text{and}\ m^2_{h-}>0\ \Leftrightarrow\ \lambda_\mu/\lambda<(1+N_{\rm st})(c_{\mathcal{R}}\phi_{\rm f}^2-1)/4N_{\rm st}c_{\mathcal{R}}\simeq(0.1-6)\cdot10^{-2}.$$

- We can Obtain $\forall\,\alpha,\ m^2_{\chi^\alpha}>\widehat{H}^2_{\rm IPI}$ and So, **Only** The Perturbations of ϕ During IPI Can Contribute to A_s;
- $M_{BL}\neq0$ Signals the Fact that That $U(1)_{B-L}$ Is Broken and so, **no Topological Defects** are Produced;
- The One-Loop **Radiative Corrections** à la Coleman-Weinberg to $\widehat{V}_{\rm IPI}$ Can Be Kept Under Control.

Testing Against Observations

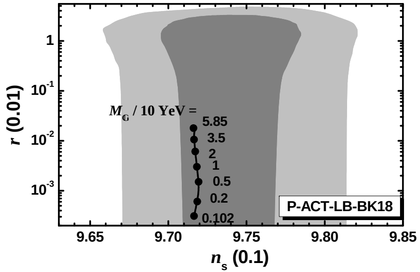
- We **Determine** $c_{\mathcal{R}}$ Demanding That The Unification Scale $M_{\mathbb{G}}$ is Identified with M_{BL} at the Vacuum, I.e.,

$$\langle M_{BL}\rangle^2 = g^2M^2 = g^2m_{\rm P}^2/c_{\mathcal{R}} = M_{\mathbb{G}}^2 \ \Rightarrow\ c_{\mathcal{R}} = g^2m_{\rm P}^2/M_{\mathbb{G}}^2 \ \text{ with }\ g = g_{\mathbb{G}} \simeq 0.7 \ \text{(GUT Gauge Coupling).}$$

- Enforcing $\widehat{N}_\star \simeq 50$ and $\sqrt{A_{\rm s}} = 4.618\cdot 10^{-5}$, we Obtain the **Allowed Curve** In the $n_{\rm s}-r$ Plane Varying $M_{\mathbb{G}}$ (or $c_{\mathcal{R}}$).
  - $n_{\rm s}$ is **Independent** of $M_{\mathbb{G}}$ but r **Increases** With $M_{\mathbb{G}}$.
  - We Find The Allowed Range

    $$0.102 \lesssim M_{\mathbb{G}}/10\ {\rm YeV} \lesssim 5.85 \ \text{ With }\ g_{\mathbb{G}} = 0.7,$$

    Where the **Lower [Upper]** Bound Comes from the **Constraint** $\lambda < 3.5$ [$\phi_\star < m_{\rm P}$].
  - **MSSM** Unification With $M_{\mathbb{G}} = 20$ YeV is Possible Whereas **String-Scale** Unification (With $M_{\mathbb{G}} \sim 500$ YeV) is not Favored.
  - The Results **Mimic** The Ones for $m=1$ of non-SUSY Regime.



I.e., for $\widehat{N}_\star \simeq 50$ We Find $\quad n_{\rm s} = 1-3/2\widehat{N}_\star \simeq 0.972 \quad$ and $\quad r \simeq 2/(c_{\mathcal{R}}\widehat{N}_\star^3)^{1/2} = (0.3-18)\cdot 10^{-5}$

Which are **Compatible** With P-ACT-LB-BK18 (& SPT) Data.

Particle Spectrum At the Vacuum

- At the SUSY Vacuum, The Inflaton $\delta\phi$ And The Right-Handed Neutrinos, N_i^c, Acquire Respectively The **Masses**:

$$m_{\delta\phi} \simeq \frac{\lambda m_{\rm P}}{\sqrt{2c_{\mathcal{R}}}} \simeq (0.48-3.8)\ {\rm YeV} \ \text{ and }\ M_{iN^c} = \lambda_{iN^c}M\,.$$

Perturbative Reheating

- The Inflaton Can Decay Perturbatively Into:
  - **A Pair of N_j^c** With Majorana Masses M_{jN^c} Through The Following Decay Width

$$\Gamma_{\delta\phi\to N_i^c}=\frac{g_{iN^c}^2}{16\pi}m_{\delta\phi}\left(1-\frac{4M_{iN^c}^2}{m_{\delta\phi}^2}\right)^{3/2}\quad \text{With}\quad g_{iN^c}=\lambda_{iN^c}\quad \text{Arising from}\quad \mathcal{L}_{\delta\phi\to N_i^c}=g_{iN^c}\,\delta\phi\, N_i^c N_i^c\,.$$

  - **H_u and H_d** Through The Following Decay Width

$$\Gamma_{\delta\phi\to H}=\frac{2}{8\pi}g_H^2 m_{\delta\phi}\quad \text{with}\quad g_H=\frac{\lambda_\mu}{\sqrt{2}}\quad \text{Arising from}\quad \mathcal{L}_{\delta\phi\to H_uH_d}=-g_H m_{\delta\phi}\delta\phi H_u^* H_d^*\,.$$

  - **MSSM (s)-Particles XYZ** Through The Following -Dependent 3-Body Decay Width

$$\Gamma_{\delta\phi\to XYZ}=g_y^2\frac{14}{512\pi^3}\frac{m_{\delta\phi}^3}{m_{\mathrm{P}}^2}\quad \text{With}\quad g_y=2y_3c_{\mathcal{R}}^{1/2}\quad \text{and}\quad y_3=h_{t,b,\tau}(m_{\delta\phi})\simeq 0.5\,.$$

    This Decay Arises From $\mathcal{L}_{\delta\phi\to XYZ}=-\lambda_y(\delta\phi/m_{\mathrm{P}})\left(X\psi_Y\psi_Z+Y\psi_X\psi_Z+Z\psi_X\psi_Y\right)+\mathrm{h.c.}$

- Taking into Account The **Decay Widths** Above, We can Estimate The **Reheating Temperature**

$$T_{\mathrm{rh}}=\left(72/5\pi^2 g_*\right)^{1/4}\Gamma_{\delta\phi}^{1/2}m_{\mathrm{P}}^{1/2}\quad \text{with}\quad \Gamma_{\delta\phi}=\Gamma_{\delta\phi\to N_i^c}+\Gamma_{\delta\phi\to H}+\Gamma_{\delta\phi\to XYZ},\quad \text{with}\quad g_*\simeq 228.75\,.$$

Attuning the $\widetilde{G}$ Cosmology

- Our Scheme is Compatible With the Scenario According to Which $\widetilde{G}$ Decays Not Only Before **Big-Bang Nucleosynthesis (BBN)** But Also Before **Lightest SUSY Particle (LSP)** $\tilde{\chi}$ Freeze-out. To Accommodate This, We Compute the

$\widetilde{G}$ **Decay Temperature** $T_{3/2}=\left(90/\pi^2 g_{\mathrm{SM}*}\right)^{1/4}\left(\Gamma_{3/2}m_{\mathrm{P}}\right)^{1/2}$ Where $H(T_{3/2})\simeq\Gamma_{3/2}=\frac{1}{32\pi}\left(\frac{1}{3}N_{\mathrm{ch}}+N_{\mathrm{gs}}\right)\frac{m_{3/2}^3}{m_{\mathrm{P}}^2}$

Is Estimated Taking The Large $m_{3/2}$ limit With $N_{\mathrm{ch}}=49$ and $N_{\mathrm{gs}}=12$.

non-Thermal Leptogenesis (nTL)

- The **Out-Of-Equilibrium Decay** of N_i^c can Generate an L Asymmetry Which Can Be Converted to the B **Yield**:

$$Y_B = -0.35\,2\,\frac{5}{4}\,\frac{T_{\rm rh}}{m_{\delta\phi}}\,\frac{\Gamma_{\delta\phi\to N_i^c}}{\Gamma_{\delta\phi}}\,\varepsilon_i \quad \text{Where} \quad \varepsilon_i = \sum_{j\neq i}\frac{\mathrm{Im}\left[(m_{\rm D}^\dagger m_{\rm D})_{ij}^2\right]}{8\pi\langle H_u\rangle^2 (m_{\rm D}^\dagger m_{\rm D})_{ii}}\Big(F_{\rm S}\left(x_{ij}, y_i, y_j\right)+F_{\rm V}(x_{ij})\Big).$$

Here $x_{ij} := M_{jN^c}/M_{iN^c}$ and $y_i := \Gamma_{iN^c}/M_{iN^c} = (m_{\rm D}^\dagger m_{\rm D})_{ii}/8\pi\langle H_u\rangle^2$ and $m_{\delta\phi} < 2M_{iN^c}$ For Some i with $i=1,2,3$. Also $F_{\rm V}$ and $F_{\rm S}$ Represent, Respectively, The Contributions From **Vertex And Self-Energy** Diagrams.

- $m_{i\rm D}$ are the Dirac Masses Which May Be Diagonalized In the **Weak (primed) Basis**

$$U^\dagger m_{\rm D} U^{c\dagger} = d_{\rm D} = \mathrm{diag}\left(m_{1\rm D}, m_{2\rm D}, m_{3\rm D}\right) \quad \text{Where} \quad L' = LU \quad \text{and} \quad N^{c\prime} = U^c N^c.$$

And Are Related to M_{iN^c} via the **Type I Seesaw** Formula

$$m_\nu = -m_{\rm D}\, d_{N^c}^{-1}\, m_{\rm D}^{\sf T}, \quad \text{Where} \quad d_{N^c} = \mathrm{diag}\left(M_{1N^c}, M_{2N^c}, M_{3N^c}\right) \quad \text{with } M_{1N^c}\leq M_{2N^c}\leq M_{3N^c} \text{ Real and Positive.}$$

- Replacing $m_{\rm D}$ in the See-Saw Formula We Extract The Mass Matrix of **Light Neutrinos** In The Weak Basis

$$\bar m_\nu = U^\dagger m_\nu U^* = -d_{\rm D} U^c d_{N^c}^{-1} U^{c\sf T} d_{\rm D},$$

Which Can Be Diagonalized by the Unitary **PMNS Matrix** U_ν Parameterized As Follows:

$$U_\nu = \begin{pmatrix} c_{12}c_{13} & s_{12}c_{13} & s_{13}e^{-i\delta} \\ -c_{23}s_{12}-s_{23}c_{12}s_{13}e^{i\delta} & c_{23}c_{12}-s_{23}s_{12}s_{13}e^{i\delta} & s_{23}c_{13} \\ s_{23}s_{12}-c_{23}c_{12}s_{13}e^{i\delta} & -s_{23}c_{12}-c_{23}s_{12}s_{13}e^{i\delta} & c_{23}c_{13}\end{pmatrix}\cdot\begin{pmatrix} e^{-i\varphi_1/2} & & \\ & e^{-i\varphi_2/2} & \\ & & 1\end{pmatrix},$$

with $c_{ij} := \cos\theta_{ij}$, $s_{ij} := \sin\theta_{ij}$, δ the CP-Violating Dirac Phase and φ_1 and φ_2 the two CP-violating Majorana Phases.

Post-Inflationary Requirements

- Our Post-Inflationary Setting Can be Characterized as **Successful** If:
  - Be In Agreement With the **Light Neutrino Data** (arXiv:2410.05380).

Parameter	Best Fit Value (2024)	
	Normal	Inverted
	Hierarchy	
$\Delta m^2_{21}/10^{-5}\mathrm{eV}^2$	7.49	
$\Delta m^2_{31}/10^{-3}\mathrm{eV}^2$	2.513	2.451
$\sin^2\theta_{12}/0.1$	3.08	
$\sin^2\theta_{13}/0.01$	2.215	2.224
$\sin^2\theta_{23}/0.1$	4.7	5.62
δ/π	1.1788	1.5235

- The Masses, $m_{i\nu}$, of ν_i Are Calculated as Follows:

$$m_{2\nu}=\sqrt{m^2_{1\nu}+\Delta m^2_{21}}\ \text{ and}$$

$$\begin{cases} m_{3\nu}=\sqrt{m^2_{1\nu}+\Delta m^2_{31}}, & \text{for Normally Ordered (NO) } m_\nu\text{'s} \\ \text{or} & \\ m_{1\nu}=\sqrt{m^2_{3\nu}+\left|\Delta m^2_{31}\right|}, & \text{for Invertedly Ordered (IO) } m_\nu\text{'s}\end{cases}$$

- $\sum_i m_{i\nu}\leq 0.082$ eV at 95% c.l. P-ACT-LB Data.

Note That This Bound **Disfavors** IO!

- We Obtain the **Observationally Required B Yield** Which is $Y_B=(8.697\pm0.054)\cdot10^{-11}$ at 95% c.l.
- **Constraints on M_{iN^c} Are Satisfied.** We have To Avoid Any Erasure Of The Produced Y_L; Ensure That The ϕ Decay To N^c_i Is Kinematically Allowed; and M_{iN^c} are Theoretically Acceptable, We Have To Impose The Constraints:

$$(a)\ \ 10T_{\rm rh}\lesssim M_{1N^c}\lesssim m_{\delta\phi}/2\ \text{ and }\ (b)\ \ M_{iN^c}\lesssim 7.1M\ \Leftrightarrow\ \lambda_{iN^c}\lesssim 3.5.$$

- **$\widetilde G$ & $\tilde\chi$ Abundances Are Under Control.** We Assume **Very Short-Lived** $\widetilde G$ i.e., It Decays for $T=T_{3/2}$ so as it does not Produce non-Thermal $\tilde\chi$. This can Be Happened for

$$T_{3/2}>T_{\rm fo}\ \overset{(\dots)}{\Longrightarrow}\ m_{3/2}>3.1\ \mathrm{PeV}\ (x_{\rm fo}m_{\tilde\chi}/1\ \mathrm{GeV})^{2/3}\ \text{ with }\ x_{\rm fo}=T_{\rm fo}/m_{\tilde\chi}\simeq(1/25-1/20),$$

Where $T_{\rm fo}$ is the Freeze-Out Temperature of $\tilde\chi$ LSP and $m_{\tilde\chi}$ its Mass.

Combining Inflationary and Post-Inflationary Requirements

- Enforcing the Post-Inflationary Constraints, We Can Obtain **Predictions for m_{iD}'s or M_{iN^c}** Employing as **Free Parameters** a Reference Neutrino Mass $m_{1\nu}$ and the 2 Majorana Phases φ_1 and φ_2 .
- **All** the Requirements can be Met (With $Y_B \sim 8.7 \cdot 10^{-11}$) for $g_{\mathbb{G}} = 0.7$, $M_{\mathbb{G}} = 20$ YeV, $m_{3/2} = 40$ PeV and $\lambda_\mu = 10^{-6}$.

Parameters	Cases				
	A	B	C	D	E
Low Scale Parameters					
$m_{1\nu}/0.001$ eV	0.1	0.79	0.869	1	1
$m_{2\nu}/0.001$ eV	8.6	8.7	8.7	8.7	8.7
$m_{3\nu}/0.01$ eV	5	5	5	5	5
$\sum_i m_{i\nu}/0.01$ eV	5.88	5.96	5.98	5.98	5.9
φ_1	$\pi/20$	0	$-\pi/3$	0	$\pi/7$
φ_2	0	$-\pi$	2π	$\pi/25$	-2π

Parameters	Cases				
	A	B	C	D	E
Leptogenesis-Scale Parameters					
$m_{1D}/1$ GeV	93.8	79.81	86.3	89.6	11.1
$m_{2D}/1$ GeV	70.1	60	95.98	89.6	130.67
$m_{3D}/1$ GeV	169.46	111	100	90	160
$M_{1N^c}/0.1$ YeV	1.63	1.34	1.9	1.61	4.06
$M_{2N^c}/1$ YeV	1.4	0.88	1	0.2	1.9
$M_{3N^c}/1$ YeV	126	11.2	8.45	8	15.8

- $\delta\phi$ Is **Kinematically** Allowed to Decay Into The Lightest of N_i^c's, N_1^c Since $2M_{iN^c} > m_{\delta\phi}$ for $i = 2, 3$.
- The **Employed** m_{iD}'s Are Mostly Of Order 100 GeV whereas $M_{1N^c} \sim 0.1$ YeV $< M_{2N^c} \sim 1$YeV $< M_{3N^c} \sim 10$YeV.
- $\widetilde{G}$ Is Constrained to be **Very Short Lived** $T_{\rm rh} \gg 1$ EeV. Indeed We Obtain $1 \lesssim T_{\rm rh}/10$ ZeV $\lesssim 1.44$.
- Due to Large $T_{\rm rh}$'s $|\varepsilon_1|$ Tend To Be **Larger** Than its Observational Value. Due to this Fact We Find Just **Isolated** Solutions, Tuning M_{1N^c} Close To $10T_{\rm rh}$ By Selecting Appropriately m_{iD}'s And φ_1 & φ_2 For Any Chosen $m_{1\nu}$;
- Incorporation Of **Wash-Out** Effects Could Offer A Larger Flexibility In The Exploration Of The Parameter Space.

Generation of the μ-Term of MSSM – *G. Dvali, G. Lazarides and Q. Shafi (1999)*

- The Origin of the μ Term Can be **Explained**, If We Combine the Terms $W_{\rm IPI}+W_\mu=\lambda S\left(\bar\Phi\Phi-M^2/4\right)+\lambda_\mu S H_u H_d$.
- The **SUSY** Part of the Corresponding $V_{\rm tot}=V_{\rm SUSY}+V_{\rm soft}$ is

$$V_{\rm SUSY}=e^K K^{\alpha\bar\beta}W_{{\rm IPI}\alpha}W^*_{{\rm IPI}\bar\beta}=(F_{\mathcal R}F^*_{\mathcal R})^{-1}\left(\left(\lambda^2\left|\bar\Phi\Phi-M^2/4\right|^2+\lambda^2|S|^2\left(|\Phi|^2+|\bar\Phi|^2\right)\right)\right).$$

- The **Soft SUSY-Breaking Terms** Corresponding to $W_{\rm IPI}+W_\mu$ Are Included In

$$V_{\rm soft}=\left(\lambda A_\lambda S\bar\Phi\Phi+\lambda_\mu A_\mu S H_u H_d-{\rm a}_S S\lambda M^2/4+{\rm h.c.}\right)+m^2_{\bar\alpha}\left|z^{\bar\alpha}\right|^2 \quad \text{with} \quad z^{\bar\alpha}=\Phi,\bar\Phi,S,H_u,H_d$$

Where $m_\alpha, A_\lambda, A_\mu$ and ${\rm a}_S$ are Soft SUSY-Breaking Mass Parameters Of the Order of the **Gravitino Mass** $m_{3/2}$.

- **Minimizing** $V_{\rm tot}$ w.r.t Phases and **Substituting** $\langle\Phi\rangle=\langle\bar\Phi\rangle\simeq M/2$ we Obtain

$$\langle V_{\rm tot}(S)\rangle=\lambda^2M^2S^2-\lambda{\rm a}_\mu m_{3/2}M^2S\,,\quad \text{where } m_S\ll M \text{ and } \left(|A_\lambda|+|{\rm a}_S|\right)=2{\rm a}_\mu m_{3/2} \text{ with } {\rm a}_\mu\sim1.$$

- Minimizing Finally $\langle V_{\rm tot}(S)\rangle$ w.r.t S We Obtain a **non-Vanishing $\langle S\rangle$** as Follows:

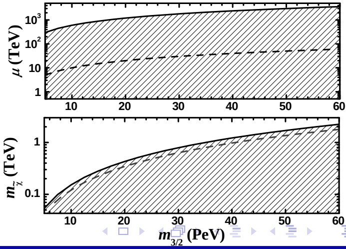
$$\langle S\rangle\simeq{\rm a}_\mu m_{3/2}/\lambda \text{ and So } \mu=\lambda_\mu\langle S\rangle\simeq\lambda_\mu{\rm a}_\mu m_{3/2}/\lambda,\quad \text{Where } \lambda_\mu/\lambda\lesssim(0.1-6)\cdot10^{-2}.$$

- Given that $\mu>0.1$ TeV From the Negative SUSY Searches at LHC , The Result Above Favors $m_{3/2}>0.1$ PeV Hinting at **Split SUSY**.
- Compatibility With the Measured Value Of The **Higgs Boson Mass** at LHC Dictates

$$10\ {\rm TeV}\lesssim m_{3/2}\lesssim60\ {\rm PeV}.$$

- For $m_{\tilde\chi}=0.5$ TeV with $x_{\rm fo}\simeq1/25$, $T_{3/2}<T_{\rm fo}$ Requires $m_{3/2}>22$ PeV and So

We End Up With $22\lesssim m_{3/2}/{\rm PeV}\lesssim60.$



Summary

- We Analyzed IPI, i.e., **Induced-Gravity Higgs Inflation** in **Palatini** Formulation.

- The Strength of the Non-Minimal Coupling Constant $c_{\mathcal{R}}$ can be Uniquely Determined by the Combination of the **IG** and the **GUT** Conjectures .

- In the non-SUSY Regime We Found Results Compatible with P-ACT-LB-BK18 Only in the **Kinetically Modified Version** of the model With $f_{\rm K} = f_{\mathcal{R}}^m$ and $0.785 \lesssim m \lesssim 10.$

- Although SUGRA does not Admit Palatini Formulation, We Introduced a Minimal Model (i.e. **With Quadratic Terms in K**) Which Reproduces the Results of the non-SUSY Case for $m = 1$ And is Excellently **Consistent** with P-ACT-LB-BK18 DR6.

- We Also Proposed a Post-Inflationary Completion which Offers a Nice Solution to **the μ Problem of MSSM** and Allows for **Baryogenesis** via nTL (i.e., non-Thermal Leptogenesis) In the Context Of **Split SUSY** With $m_{3/2} \simeq (22-60)$ PeV.

Thank You!