Flavour SUSY GUTs + ED

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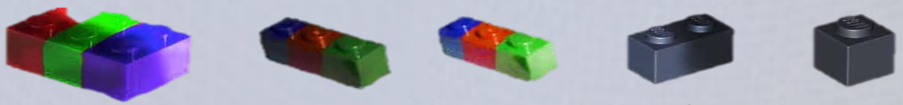
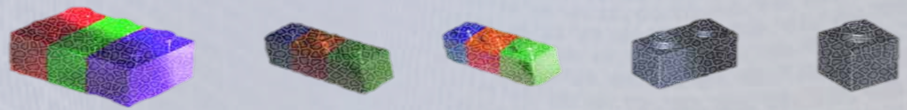
Standard Model

Gauge symmetry $SU(3)_C \times SU(2)_L \times U(1)_Y$

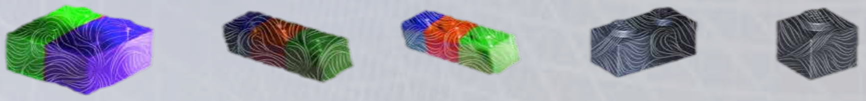
Global symmetry $SO(3,1)$



$Q^1{}_L$	u_R	d_R	$L^1{}_L$	e_R



$Q^2{}_L$	c_R	s_R	$L^2{}_L$	μ_R



$Q^3{}_L$	t_R	b_R	$L^3{}_L$	τ_R

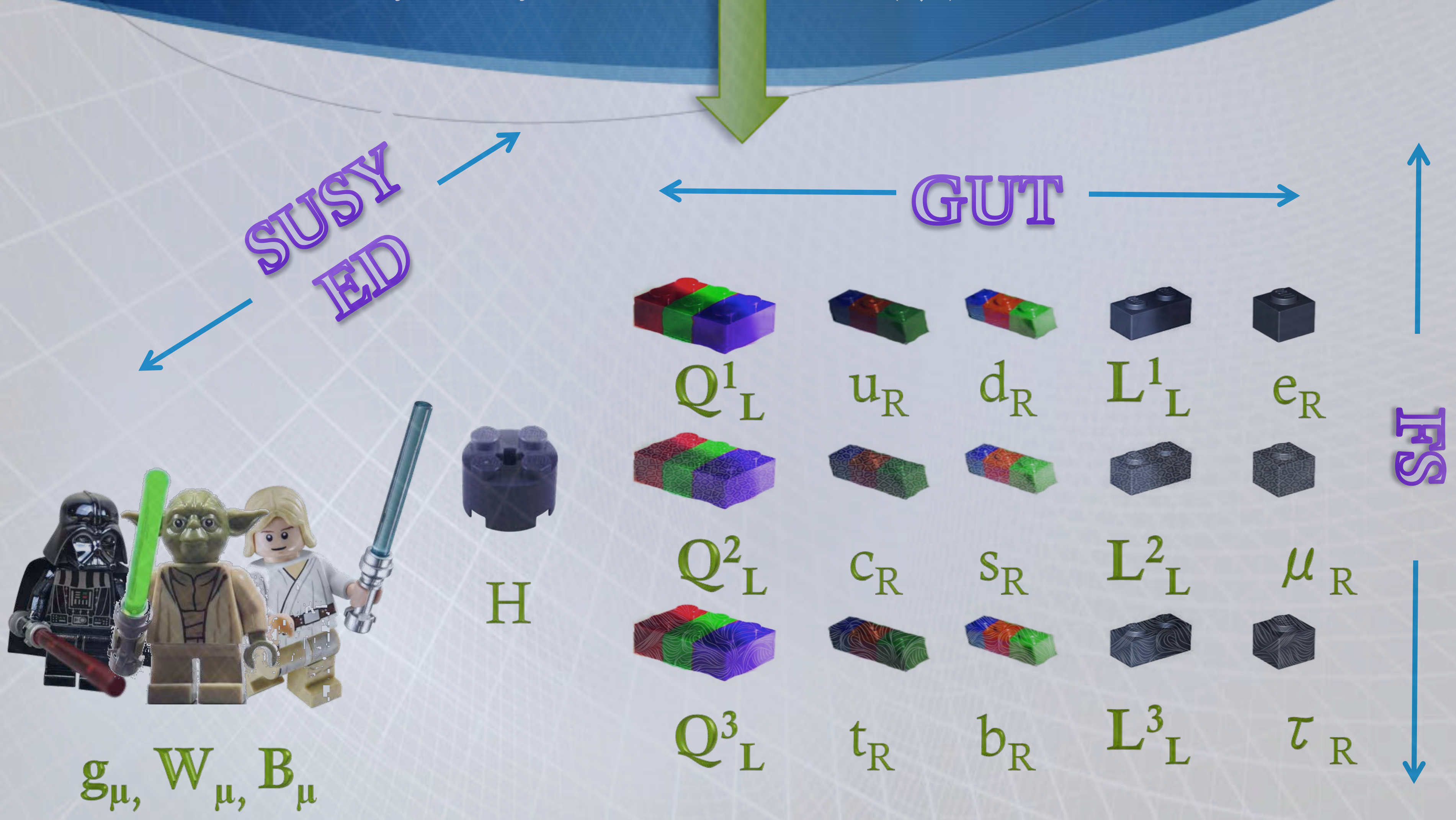
H

g_μ, W_μ, B_μ

Standard Model

Gauge symmetry $SU(3)_C \times SU(2)_L \times U(1)_Y$

Global symmetry $SO(3,1)$




GUT
ED
Flavor
SUSY

Neutrino parameters

NuFIT 4.0 (2018)

		Normal Ordering (best fit)		Inverted Ordering ($\Delta\chi^2 = 4.7$)	
		bfp $\pm 1\sigma$	3σ range	bfp $\pm 1\sigma$	3σ range
without SK atmospheric data	$\sin^2\theta_{12}$	$0.310^{+0.013}_{-0.012}$	$0.275 \to 0.350$	$0.310^{+0.013}_{-0.012}$	$0.275 \to 0.350$
	$\theta_{12}/^\circ$	$33.82^{+0.78}_{-0.76}$	$31.61 \to 36.27$	$33.82^{+0.78}_{-0.76}$	$31.61 \to 36.27$
	$\sin^2\theta_{23}$	$0.580^{+0.017}_{-0.021}$	$0.418 \to 0.627$	$0.584^{+0.016}_{-0.020}$	$0.423 \to 0.629$
	$\theta_{23}/^\circ$	$49.6^{+1.0}_{-1.2}$	$40.3 \to 52.4$	$49.8^{+1.0}_{-1.1}$	$40.6 \to 52.5$
	$\sin^2\theta_{13}$	$0.02241^{+0.00065}_{-0.00065}$	$0.02045 \to 0.02439$	$0.02264^{+0.00066}_{-0.00066}$	$0.02068 \to 0.02463$
	$\theta_{13}/^\circ$	$8.61^{+0.13}_{-0.13}$	$8.22 \to 8.99$	$8.65^{+0.13}_{-0.13}$	$8.27 \to 9.03$
	$\delta_{CP}/^\circ$	215^{+40}_{-29}	$125 \to 392$	284^{+27}_{-29}	$196 \to 360$
	$\frac{\Delta m^2_{21}}{10^{-5}\ eV^2}$	$7.39^{+0.21}_{-0.20}$	$6.79 \to 8.01$	$7.39^{+0.21}_{-0.20}$	$6.79 \to 8.01$
	$\frac{\Delta m^2_{3\ell}}{10^{-3}\ eV^2}$	$+2.525^{+0.033}_{-0.032}$	$+2.427 \to +2.625$	$-2.512^{+0.034}_{-0.032}$	$-2.611 \to -2.412$

TBM

$$U = \begin{pmatrix} 2/3 & 1/3 & 0 \\ 1/6 & 1/3 & 1/2 \\ 1/6 & 1/3 & 1/2 \end{pmatrix}$$

Flavor symmetry G, broken by flavons ϕ

TBM Flavons

$$\langle \phi_1 \rangle \sim \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}, \quad \langle \phi_2 \rangle \sim \begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix} \qquad \langle \phi_3 \rangle \sim \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

Doesn't change mixing angles.

TBM Flavons

$$m_\nu = \sum_i y_\nu^i \frac{v^2}{M_N^i \Lambda^2} \langle \phi_i \rangle \langle \phi_i \rangle^T$$

Two RHN and seesaw

$$m^\nu = a \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix} + b \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix},$$

Highly predictive but not correct.

TBM Flavons

$$m_\nu = \sum_i y_\nu^i \frac{v^2}{M_N^i \Lambda^2} \langle \phi_i \rangle \langle \phi_i \rangle^T$$

Two RHN and seesaw

$$m^\nu = a \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix} + b \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix},$$

$\phi_2 \phi_2$ $\phi_1 \phi_1$

Highly predictive but not correct.

CSDn

Phenomenological search for flavons with real integer entries.
→ Constrained Sequential Dominance

$$\langle \phi_1 \rangle \sim \begin{pmatrix} 1 \\ n \\ n-2 \end{pmatrix}, \quad \langle \phi_2 \rangle \sim \begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}$$

n=1,2,3,4

arXiv:1412.6996

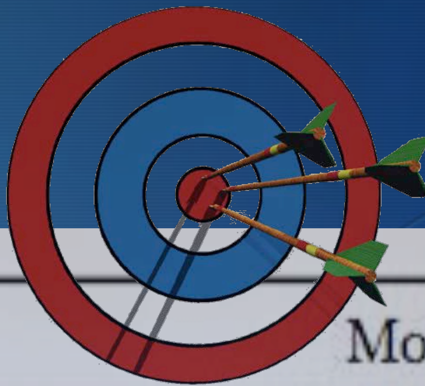
Littlest Seesaw

- Neutrinos in CSD3.
- 2 RHNs.
- Diagonal Charged Leptons
- One physical fixed phase.
- Two free real parameters.

$$m_\nu = a \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix} + b e^{-2i\pi/3} \begin{pmatrix} 1 & 3 & 1 \\ 3 & 9 & 3 \\ 1 & 3 & 1 \end{pmatrix}$$

arXiv:1512.07531

Littlest Seesaw



Observable	Data		Model
	Central value	1σ range	CSD3
θ^{ℓ}_{12} /°	33.62	$32.86 \to 34.38$	34.33
θ^{ℓ}_{13} /°	8.54	$8.57 \to 8.69$	8.58
θ^{ℓ}_{23} /°	47.20	$45.30 \to 49.10$	44.3
δ^{ℓ} /°	234	$178 \to 290$	266
$\Delta m^2_{21}/(10^{-5}\,\mathrm{eV}^2)$	7.51	$7.33 \to 7.69$	7.43
$\Delta m^2_{31}/(10^{-3}\,\mathrm{eV}^2)$	2.52	$2.48 \to 2.56$	2.49
m_1 /meV			0
α_{23}/°			34
χ^2			3.82

a=26.7 meV, b=2.67 meV

arXiv:1803.04978

GUT

$$m_N, m_\nu^D, m_\nu^{LL}, m_u \sim a e^{i\eta} \begin{pmatrix} 1 & 3 & 1 \\ 3 & 9 & 3 \\ 1 & 3 & 1 \end{pmatrix} + b \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix} + c e^{i\eta'} \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$m_e, m_d \sim d e^{i\eta} \begin{pmatrix} 0 & 1 & 1 \\ 1 & 6 & 4 \\ 1 & 4 & 2 \end{pmatrix} + f \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix} + f e^{i\eta'} \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

- **Universal up-type**
- **Universal down-type**
- **At LE, 13 real parameters, 4 phases.**
- **22 observables.**

arXiv:1807.07078

GUT

$$m_N, m_\nu^D, m_\nu^{LL}, m_u \sim a e^{i\eta} \begin{pmatrix} 1 & 3 & 1 \\ 3 & 9 & 3 \\ 1 & 3 & 1 \end{pmatrix} + b \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix} + c e^{i\eta'} \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$\phi_1 \phi_1 \qquad \phi_2 \phi_2 \qquad \phi_3 \phi_3$$

$$m_e, m_d \sim d e^{i\eta} \begin{pmatrix} 0 & 1 & 1 \\ 1 & 6 & 4 \\ 1 & 4 & 2 \end{pmatrix} + f \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix} + f e^{i\eta'} \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$\phi_1 \phi_2 \qquad \phi_2 \phi_2 \qquad \phi_3 \phi_3$$

arXiv:1807.07078

GUT

$$m_N, m_\nu^D, m_\nu^{LL}, m_u \sim a e^{i\eta} \begin{pmatrix} 1 & 3 & 1 \\ 3 & 9 & 3 \\ 1 & 3 & 1 \end{pmatrix} + b \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix} + c e^{i\eta'} \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$m_e, m_d \sim d e^{i\eta} \begin{pmatrix} 0 & 1 & 1 \\ 1 & 6 & 4 \\ 1 & 4 & 2 \end{pmatrix} + f \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix} + f e^{i\eta'} \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

- **CSD3**
- **Perfect fit.**
- **Predictive.**
- **Highly symmetrical.**

arXiv:1807.07078

GUTs

CSD1

- TBM

CSD2

- SO(10) X S_4 arXiv:1710.03229
- SO(10) X SU(3) arXiv:1807.07078

CSD3

- SU(5) X A_4 arXiv:1503.03306
- SO(10) X $\Delta(27)$ arXiv:1512.00850
- SO(10) X S_4 arXiv:1705.01555
- SU(5) X S_4 arXiv:1803.04978
- SO(10) X SU(3) arXiv:1807.07078

Where does CSDn come from?

Flavons

$$\langle \phi_1 \rangle^{CSD3} \sim \begin{pmatrix} 1 \\ 3 \\ -1 \end{pmatrix}, \quad \langle \phi_1 \rangle^{CSD2} \sim \begin{pmatrix} 1 \\ 0 \\ 2 \end{pmatrix},$$

$$\langle \phi_2 \rangle \sim \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}, \quad \langle \phi_3 \rangle \sim \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix},$$

Up to overall rotation and reflection

S_4

S_4	S	T	U
$\mathbf{1}, \mathbf{1}'$	1	1	± 1
$\mathbf{2}$	$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	$\begin{pmatrix} \omega & 0 \\ 0 & \omega^2 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$
$\mathbf{3}, \mathbf{3}'$	$\frac{1}{3}\begin{pmatrix} -1 & 2 & 2 \\ 2 & -1 & 2 \\ 2 & 2 & -1 \end{pmatrix}$	$\begin{pmatrix} 1 & 0 & 0 \\ 0 & \omega^2 & 0 \\ 0 & 0 & \omega \end{pmatrix}$	$\mp\begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}$

S_4

$$SU = \frac{1}{3}\begin{pmatrix} -1 & 2 & 2 \\ 2 & 2 & -1 \\ 2 & -1 & 2 \end{pmatrix}. \quad SU\langle\phi\rangle = \langle\phi\rangle = \begin{pmatrix} a \\ b \\ 2a-b \end{pmatrix}$$

$$\langle\phi_1\rangle^{CSD3} \to b = 3a, \quad \langle\phi_1\rangle^{CSD2} \to b = 0, \quad \langle\phi_2\rangle \to a = 0$$

$$\omega^2 T\langle\phi_3\rangle = \langle\phi_3\rangle$$

Alingnment Potentials

F-term equations of X,Y,Z

CSD3

$$
\begin{aligned}
W_0^{\text{flavon}} \sim \;& X_{3'}(\phi'_{S,U})^2 + X_2(\phi_T)^2 + X_1(\phi'_t)^2 + X_{1'}\phi_T\phi'_t \\
& + Y_3\phi'_{S,U}\rho_{S,U} + Y_{3'}(\xi_T\phi'_t - \phi_T\rho_t) \\
& + Z_{3'}(\phi'_{S,U}\phi_T - \xi_{S,U}\phi'_{\text{atm}}) + \tilde{Z}_{3'}(\phi'_{\text{atm}}\phi'_t - \rho_{S,U}\phi'_{\text{sol}}) \,.
\end{aligned}
$$

arXiv:1607.05276, arXiv:1710.03229

Alingnment Potentials

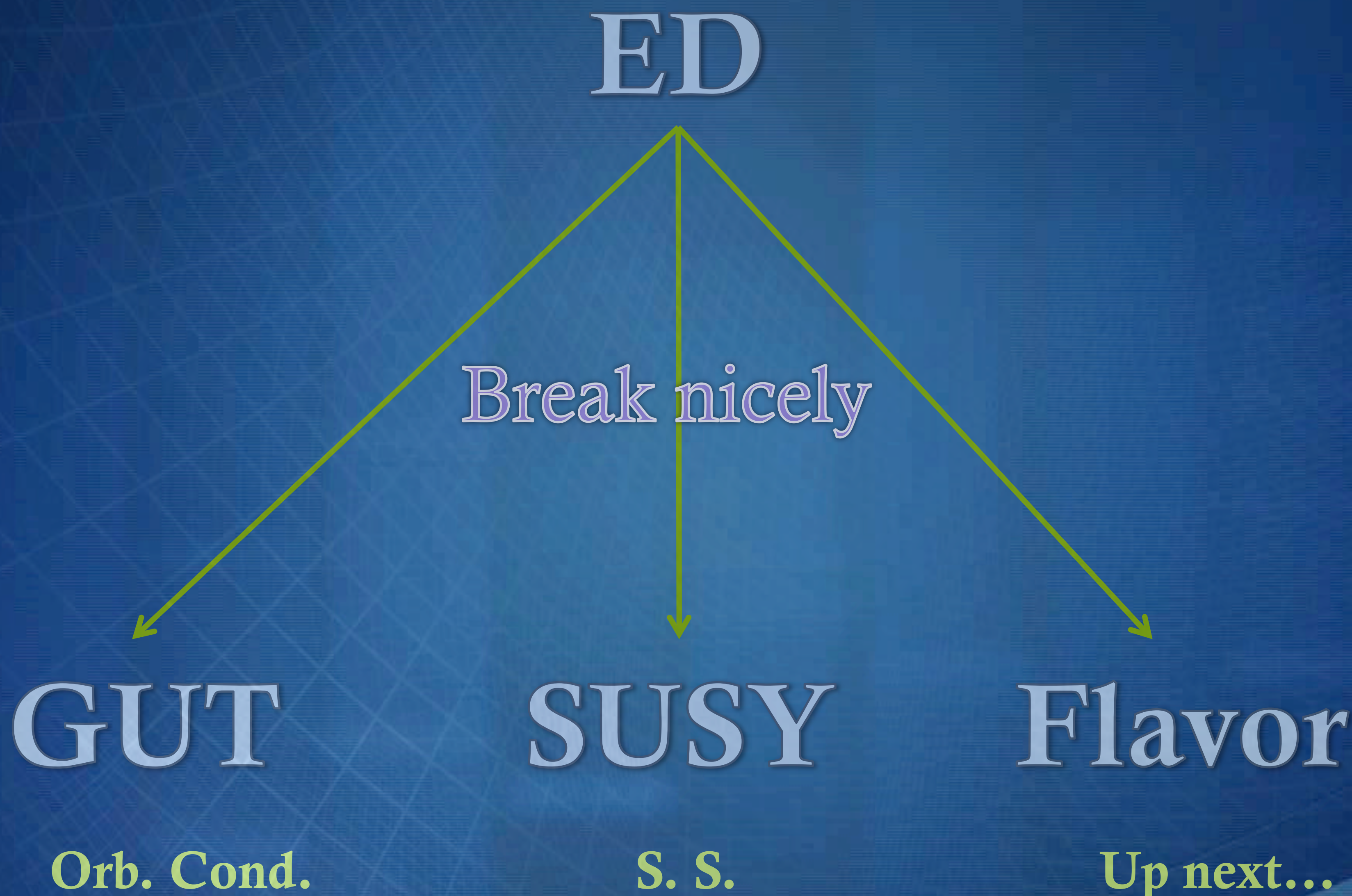
F-term equations of X,Y,Z

CSD3

$$
\begin{aligned}
W_0^{\text{flavon}} \sim \; & X_{3'}(\phi'_{S,U})^2 + X_2(\phi_T)^2 + X_1(\phi'_t)^2 + X_{1'}\phi_T\phi'_t \\
& + Y_3\phi'_{S,U}\rho_{S,U} + Y_{3'}(\xi_T\phi'_t - \phi_T\rho_t) \\
& + Z_{3'}(\phi'_{S,U}\phi_T - \xi_{S,U}\phi'_{\text{atm}}) + \tilde{Z}_{3'}(\phi'_{\text{atm}}\phi'_t - \rho_{S,U}\phi'_{\text{sol}}) \,.
\end{aligned}
$$

arXiv:1607.05276, arXiv:1710.03229

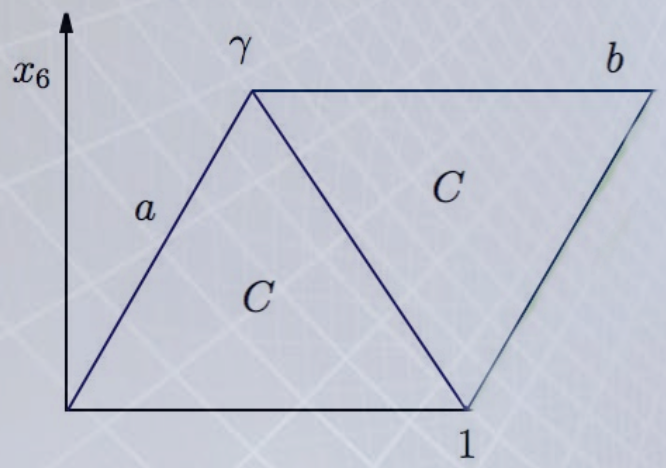
ED

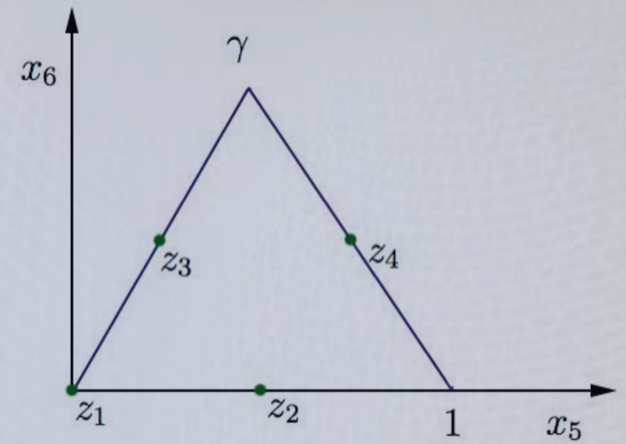

ED
Break nicely
GUT
SUSY
Flavor
Orb. Cond.
S. S.
Up next…

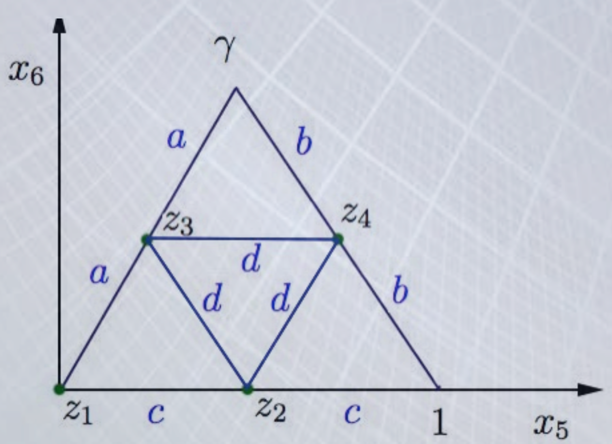
Dear ED: Why S_4?

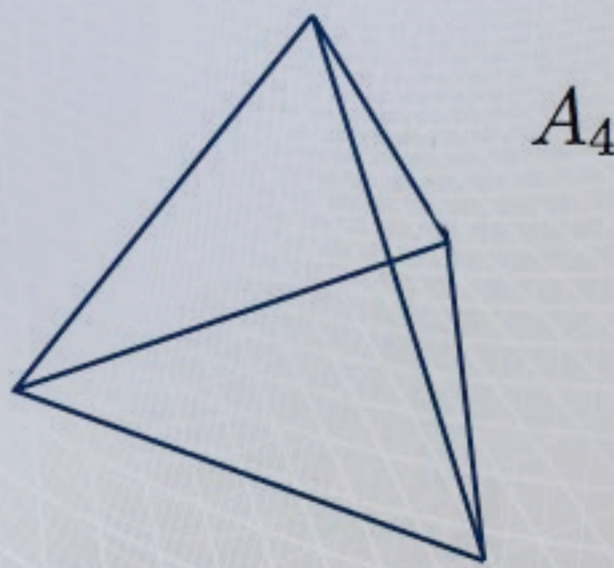
A_4 from T^2/Z_2

$$\gamma = \omega = e^{2\pi i/3}$$



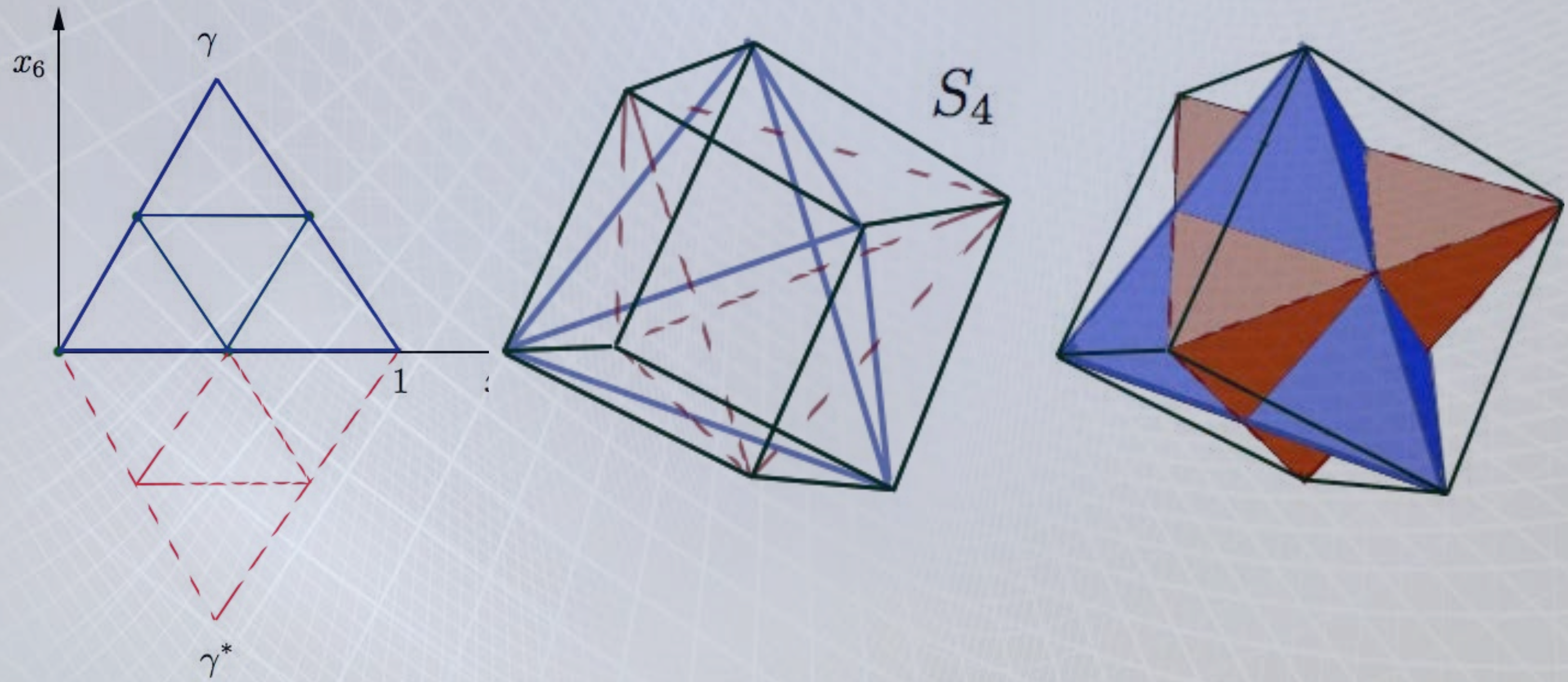






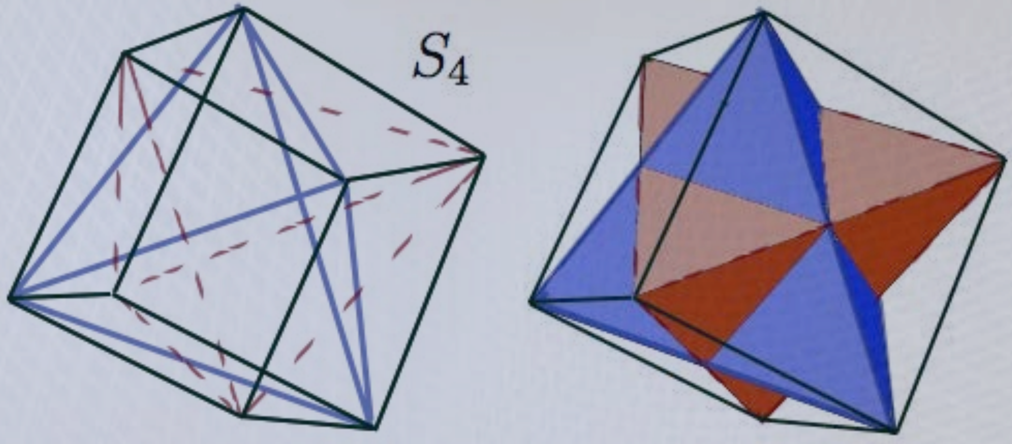
S_4 from T^2/Z_2

Independent reflection of x_5 and x_6



arXiv:1803.04978

S_4 from ED



Remnant symetry after compactification

Through the ancient art of extra dimensional origami.

Dear ED:
Why CSDn?

T^2/Z_2 and S_4

T^2/Z_2 and S_4

S_4	S	T	U
$\mathbf{1}, \mathbf{1}'$	1	1	± 1
$\mathbf{2}$	$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	$\begin{pmatrix} \omega & 0 \\ 0 & \omega^2 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$
$\mathbf{3}, \mathbf{3}'$	$\frac{1}{3}\begin{pmatrix} -1 & 2 & 2 \\ 2 & -1 & 2 \\ 2 & 2 & -1 \end{pmatrix}$	$\begin{pmatrix} 1 & 0 & 0 \\ 0 & \omega^2 & 0 \\ 0 & 0 & \omega \end{pmatrix}$	$\mp \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}$

T^2/Z_2 and S_4

Boundary Condition U :

$$\langle\phi_2\rangle = -U\langle\phi_2\rangle = -\begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 1\\ 0 & 1 & 0\end{pmatrix}\langle\phi_2\rangle \quad\rightarrow\quad \langle\phi_2\rangle \sim \begin{pmatrix}0\\ 1\\ -1\end{pmatrix}.$$

$$\langle\rho\rangle = U\langle\rho\rangle = \begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}\langle\rho\rangle \quad\rightarrow\quad \langle\rho\rangle \sim \begin{pmatrix}1\\ 1\end{pmatrix}.$$

T^2/Z_2 and S_4

Alignment superpotential:

$$\mathcal{W}_A \sim A_1(\phi_3)^2 + A_3(\phi_2\phi_3 - \rho\phi_1),$$

arXiv:1803.04978

T^2/Z_2 and S_4

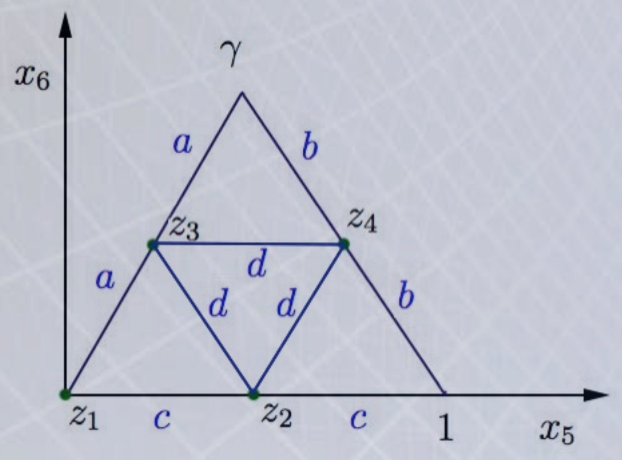
6D: $$\mathcal{W}_A \sim A_1(\phi_3)^2 + A_3(\phi_2\phi_3 - \rho\phi_1),$$

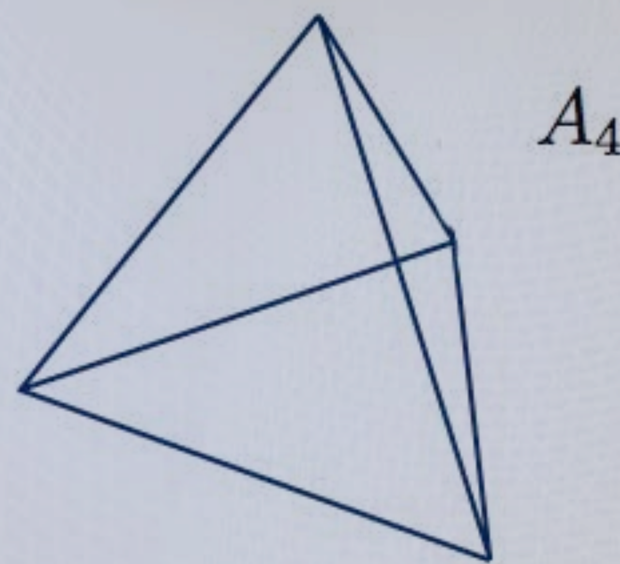
4D:

$$\begin{aligned} W_0^{\text{flavon}} \sim\ & X_{3'}(\phi'_{S,U})^2 + X_2(\phi_T)^2 + X_1(\phi'_t)^2 + X_{1'}\phi_T\phi'_t \\ & + Y_3\phi'_{S,U}\rho_{S,U} + Y_{3'}(\xi_T\phi'_t - \phi_T\rho_t) \\ & + Z_{3'}(\phi'_{S,U}\phi_T - \xi_{S,U}\phi'_{\text{atm}}) + \tilde{Z}_{3'}(\phi'_{\text{atm}}\phi'_t - \rho_{S,U}\phi'_{\text{sol}}) \,. \end{aligned}$$

Could we have no superpotential?

A_4 from T^2/Z_2





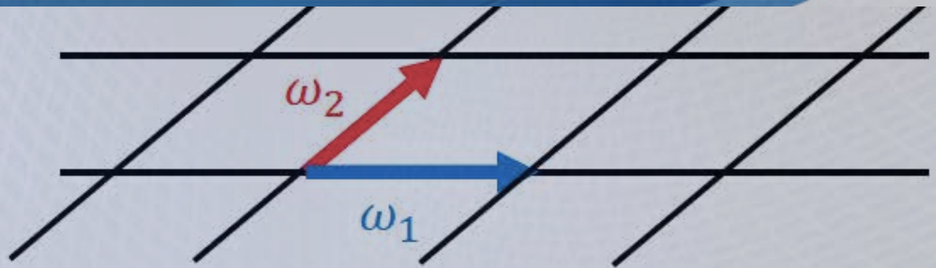
Active transformation ➔ A_4 spacetime symmetry

Passive transformation ➔ A_4 modular symmetry

arXiv:18012.05620

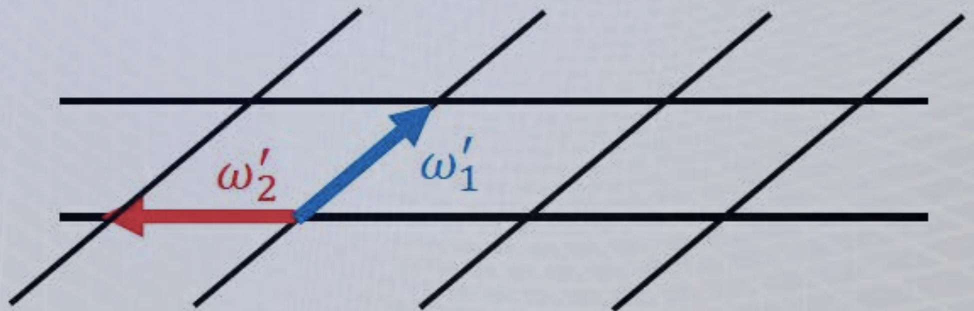
Modular Transformations

There are two independent lattice invariant transformations.



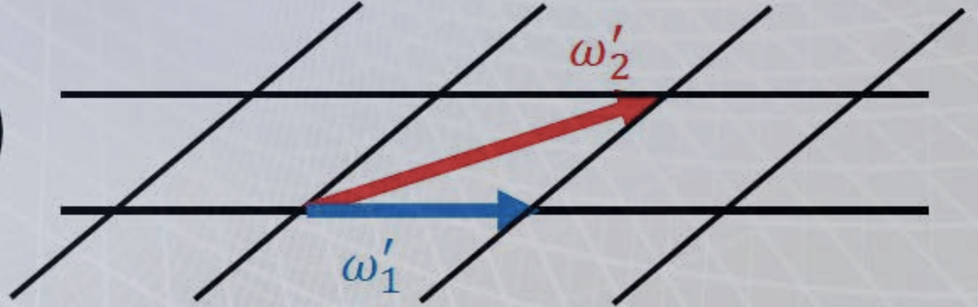
S-transformation

$$\begin{pmatrix}\omega_1' \\ \omega_2'\end{pmatrix} = \begin{pmatrix}0 & 1 \\ -1 & 0\end{pmatrix}\begin{pmatrix}\omega_1 \\ \omega_2\end{pmatrix} = \begin{pmatrix}\omega_2 \\ -\omega_1\end{pmatrix}$$



T-transformation

$$\begin{pmatrix}\omega_1' \\ \omega_2'\end{pmatrix} = \begin{pmatrix}1 & 0 \\ 1 & 1\end{pmatrix}\begin{pmatrix}\omega_1 \\ \omega_2\end{pmatrix} = \begin{pmatrix}\omega_1 \\ \omega_2 + \omega_1\end{pmatrix}$$



Modular Transformations

Yukawa couplings   y   ➔ $Y(w_1, w_2)$ Modular forms

$$\begin{pmatrix} -1 \\ 2\omega \\ 2\omega^2 \end{pmatrix}$$

Fixed by this specific orbifold (No extra freedom)

arXiv:18012.05620

Modular Transformations

Modular Form Y $\begin{pmatrix} -1 \\ 2\omega \\ 2\omega^2 \end{pmatrix}$ **Flavon** ϕ_2 $\begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}$

μ - τ symmetry: $\theta^{l}_{23}=45°$ $\delta^{l}=\pm 90°$

Leptonic Fit $\chi^2=5$ with 4 neutrino parameters.

arXiv:18012.05620

T^2/Z_2 and SU(3)
No superpotential

$T^2/Z_2{}^2$

Independent reflection of x_5 and x_6 → effective $Z^2{}_2$

4 4d branes in total

4 5d branes for each reflection
(Lines that connect 4d branes)

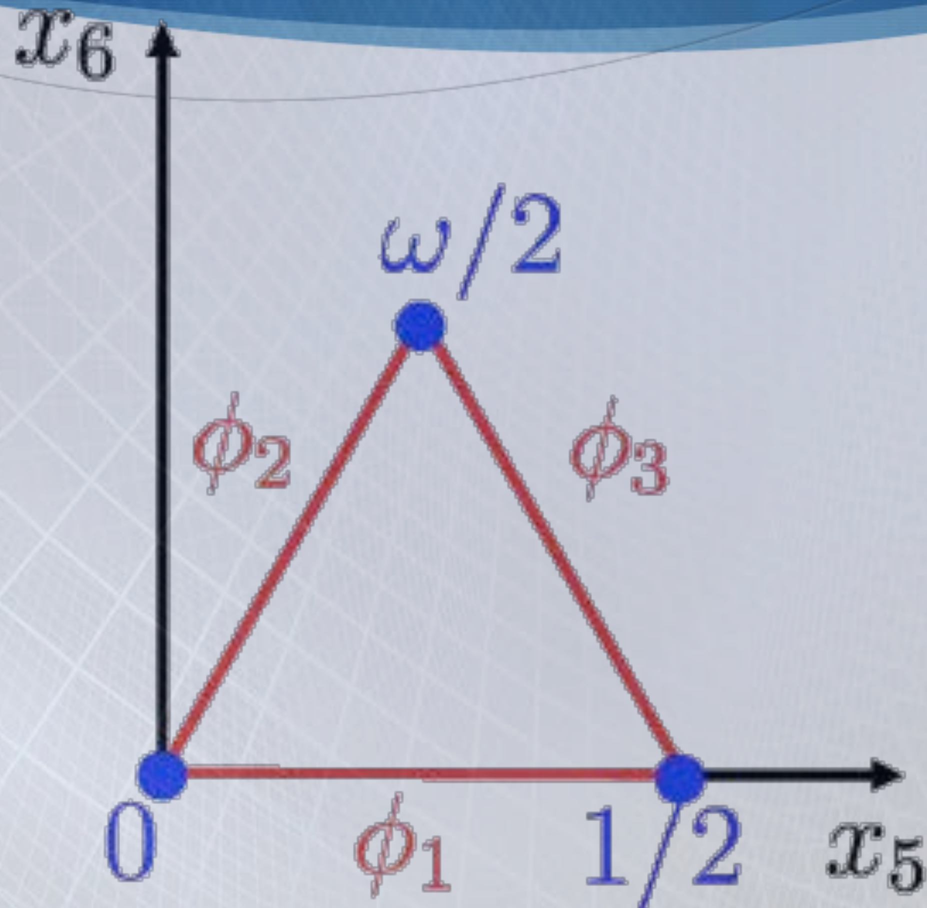
$T^2/Z_2{}^2$

Fermions in 4d branes (No boundary conditions)

Flavons in 5d branes (Some boundary conditions)

Higgs and Gauge F. in bulk   (All boundary conditions)

Flavons in 5d branes



Boundary conditions

$$CSD3: \quad P_0 = SU, \quad P_{\omega/2} = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad P_{1/2} = \begin{pmatrix} 0 & 0 & -1 \\ 0 & 1 & 0 \\ -1 & 0 & 0 \end{pmatrix}$$

$$CSD2: \quad P_0 = SU, \quad P_{\omega/2} = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad P_{1/2} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

arXiv:1807.07078

Boundary conditions

$$CSD3: \quad P_0 = SU, \quad P_{\omega/2} = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad P_{1/2} = \begin{pmatrix} 0 & 0 & -1 \\ 0 & 1 & 0 \\ -1 & 0 & 0 \end{pmatrix}$$

$$CSD2: \quad P_0 = SU, \quad P_{\omega/2} = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad P_{1/2} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$P_0 \langle \phi_1 \rangle = P_{1/2} \langle \phi_1 \rangle = \langle \phi_1 \rangle$$

$$P_0 \langle \phi_2 \rangle = P_{\omega/2} \langle \phi_2 \rangle = \langle \phi_2 \rangle$$

$$P_{1/2} \langle \phi_3 \rangle = P_{\omega/2} \langle \phi_3 \rangle = \langle \phi_3 \rangle$$

Flavons

$$\langle \phi_1 \rangle^{CSD3} \sim \begin{pmatrix} 1 \\ 3 \\ -1 \end{pmatrix}, \quad \langle \phi_1 \rangle^{CSD2} \sim \begin{pmatrix} 1 \\ 0 \\ 2 \end{pmatrix},$$

$$\langle \phi_2 \rangle \sim \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}, \quad \langle \phi_3 \rangle \sim \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix},$$

Up to overall rotation and reflection

The Whole Enchilada

The Whole Enchilada

Field	Representation				Localization		
	$SU(3)$	$SO(10)$	Z_6	Z_3	P_0	$P_{1/2}$	$P_{i/2}$
ψ	$\bar{3}$	16	0	0			
H_{10}^u	1	10	0	0	+1	+1	+1
H_{10}^d	1	10	2	0	+1	+1	-1
$H_{\overline{16}}$	1	$\overline{16}$	0	0	+1	+1	-1
H_{16}	1	16	0	0	+1	+1	-1
$H_{45}^{X,Y}$	1	45	0	1	+1	+1	+1
$H_{45}^{W,Z}$	1	45	2	1	+1	+1	+1
ϕ_1	3	1	2	1	+1	+1	
ϕ_2	3	1	0	1	+1		+1
ϕ_3	3	1	3	1		+1	+1

arXiv:1807.07078

The Whole Enchilada

Field	Representation				Localization		
	$SU(3)$	$SO(10)$	Z_6	Z_3	P_0	$P_{1/2}$	$P_{i/2}$
ψ	$\bar{3}$	16	0	0			
H_{10}^u	1	10	0	0	+1	+1	+1
H_{10}^d	1	10	2	0	+1	+1	-1
$H_{\overline{16}}$	1	$\overline{16}$	0	0	+1	+1	-1
H_{16}	1	16	0	0	+1	+1	-1
$H_{45}^{X,Y}$	1	45	0	1	+1	+1	+1
$H_{45}^{W,Z}$	1	45	2	1	+1	+1	+1
ϕ_1	3	1	2	1	+1	+1	
ϕ_2	3	1	0	1	+1		+1
ϕ_3	3	1	3	1		+1	+1

- **MSSM at LE.**
- **DT, DD split, GUT and Flavour breaking by ED.**
- **Fermion Unification.**
- **Highly predictive ν s.**
- **Perfect fit Qs and CLs.**
- **Small reps.**
- **Few multiplets.**

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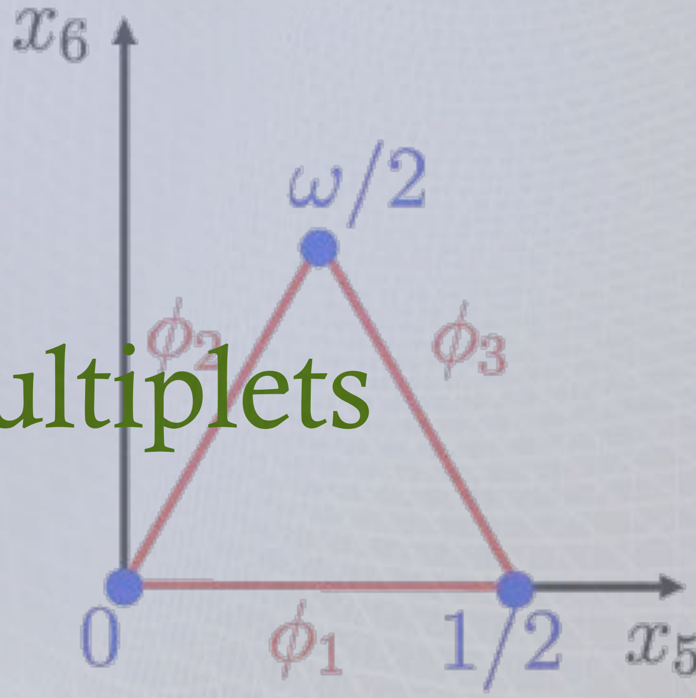
6d SUSY SO(10) GUT SU(3) Flavor

- Rather complete.
- Predictive.
- Less superfield multiplets than the MSSM.

Field	Representation				Localization		
	$SU(3)$	$SO(10)$	Z_6	Z_3	P_0	$P_{1/2}$	$P_{\omega/2}$
ψ	$\bar{3}$	16	0	0			
H_{10}^u	1	10	0	0	+1	+1	+1
H_{10}^d	1	10	2	0	+1	+1	-1
$H_{\overline{16}}$	1	$\overline{16}$	0	0	+1	+1	-1
H_{16}	1	16	0	0	+1	+1	-1
$H_{45}^{X,Y}$	1	45	0	1	+1	+1	+1
$H_{45}^{W,Z}$	1	45	2	1	+1	+1	+1
ϕ_1	3	1	2	1	+1	+1	
ϕ_2	3	1	0	1	+1		+1
ϕ_3	3	1	3	1		+1	+1



Conclusion

We can easily obtain non trivial and predictive flavon alignments through Extra Dimensional mechanisms.