Flavor Landscape of 10D SYM Theory with General Magnetic Fluxes

based on arXiv:1307.1831 [hep-th], arXiv:13XX.XXXX

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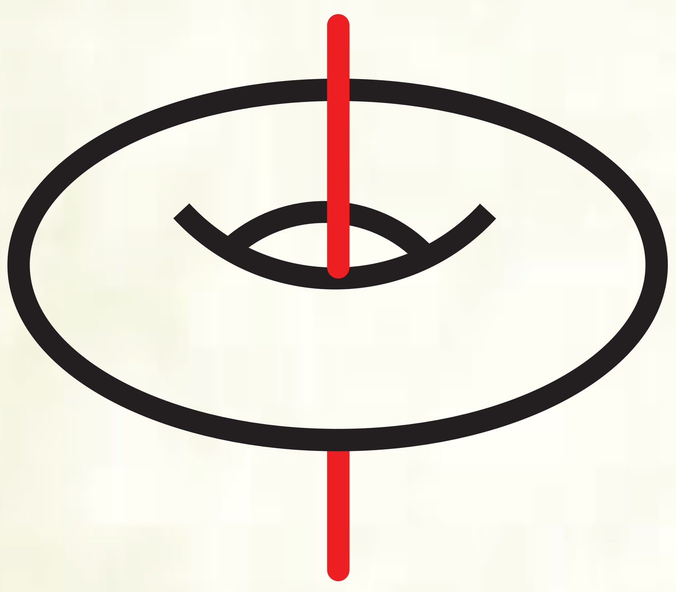
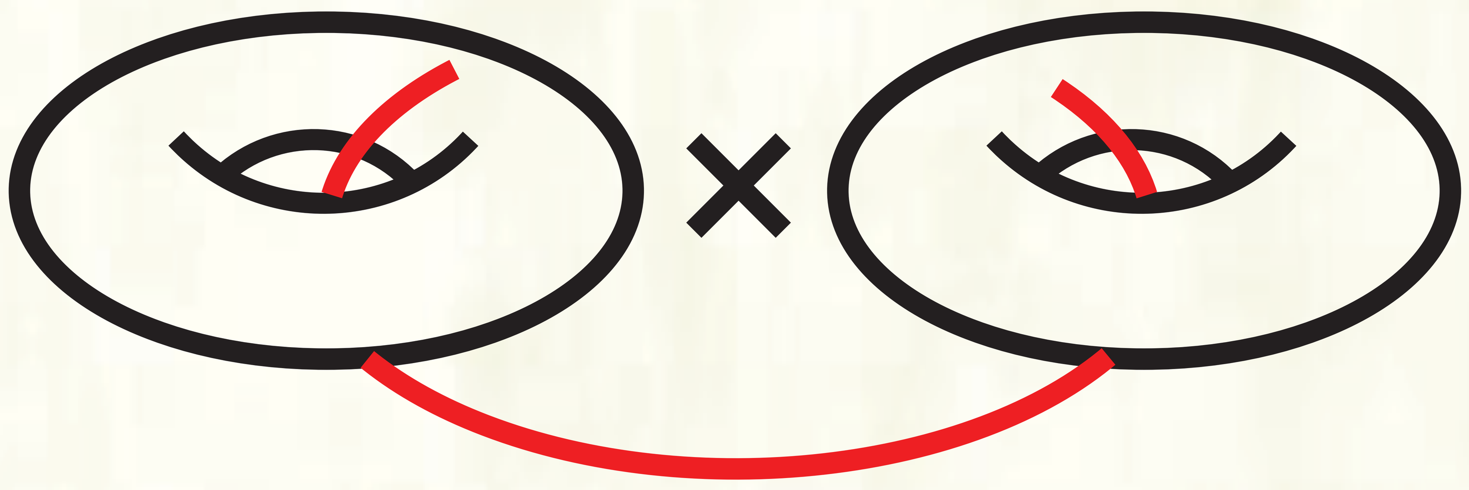
Does superstring theory include (MS)SM ?



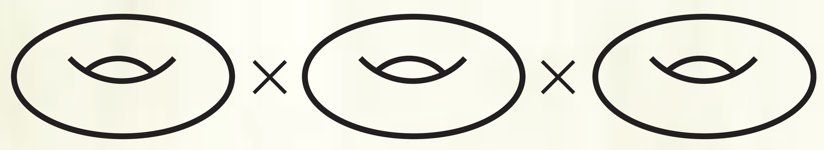
factorizable flux



non-factorizable flux

→ **three generation models from magnetic fluxes on** $T^2 \times T^2 \times T^2$

✓ 10D geometry :

10D spacetime = 4D spacetime × 

✓ Magnetic flux :

✓ $\mathcal{N}=4$ SUSY → $\mathcal{N}=1$ SUSY (chiral)

✓ gauge symmetry breaking

✓ generation of chiral matter

✓ Zero-mode wavefunction :

✓ factorizable flux :

$$\phi^{i_1,i_2,i_3}(x,z_1,z_2,z_3) = \phi^{i_1,i_2,i_3}(x) \otimes \Theta^{i_1}(z_1)\Theta^{i_2}(z_2)\Theta^{i_3}(z_3)$$

$$\Theta^{I}(z) = \mathcal{N}\cdot e^{i\pi M z \frac{\mathrm{Im}\, z}{\mathrm{Im}\,\tau}}\, \vartheta \begin{bmatrix} \frac{I}{M} \\ 0 \end{bmatrix} (Mz, M\tau)$$

Cremades, Ibanez and Marchesano, (2004)

of $I = M$

✓ non-factorizable flux :

$$\phi^{\vec{j},i_3}(x,z_1,z_2,z_3) = \phi^{\vec{j},i_3}(x) \otimes \Theta^{\vec{j}}(\vec{z})\Theta^{i_3}(z_3)$$

$$\Theta^{\vec{j}}(\vec{z},\Omega) = \mathcal{N}\cdot e^{i\pi(\mathbb{N}\cdot\vec{z})(\mathrm{Im}\,\Omega)^{-1}\mathrm{Im}\,\vec{z}}\cdot \vartheta \begin{bmatrix} \vec{j} \\ 0 \end{bmatrix} (\mathbb{N}\cdot\vec{z}\,|\,\mathbb{N}\cdot\Omega)$$

Antoniadis, Kumar and Panda, (2009)

of $\vec{j} = \det \mathbb{N}$

✓ Constraint :

✓ SUSY condition for factorizable flux :

$$\frac{1}{\mathcal{A}^{(1)}}\langle F_{4,5}\rangle + \frac{1}{\mathcal{A}^{(2)}}\langle F_{6,7}\rangle + \frac{1}{\mathcal{A}^{(3)}}\langle F_{8,9}\rangle = 0$$

$\mathcal{A}^{(i)}$ = volume of i-th torus

✓ SUSY condition for non-factorizable flux :

$$\frac{1}{\mathrm{Im}\,\tau_1}\langle F_{4,7}\rangle = \frac{1}{\mathrm{Im}\,\tau_2}\langle F_{6,5}\rangle$$

✓ full-rank Yukawa matrices :

→ mass hierarchies, CKM matrix

✓ Result I :

✓ case with factorizable flux :

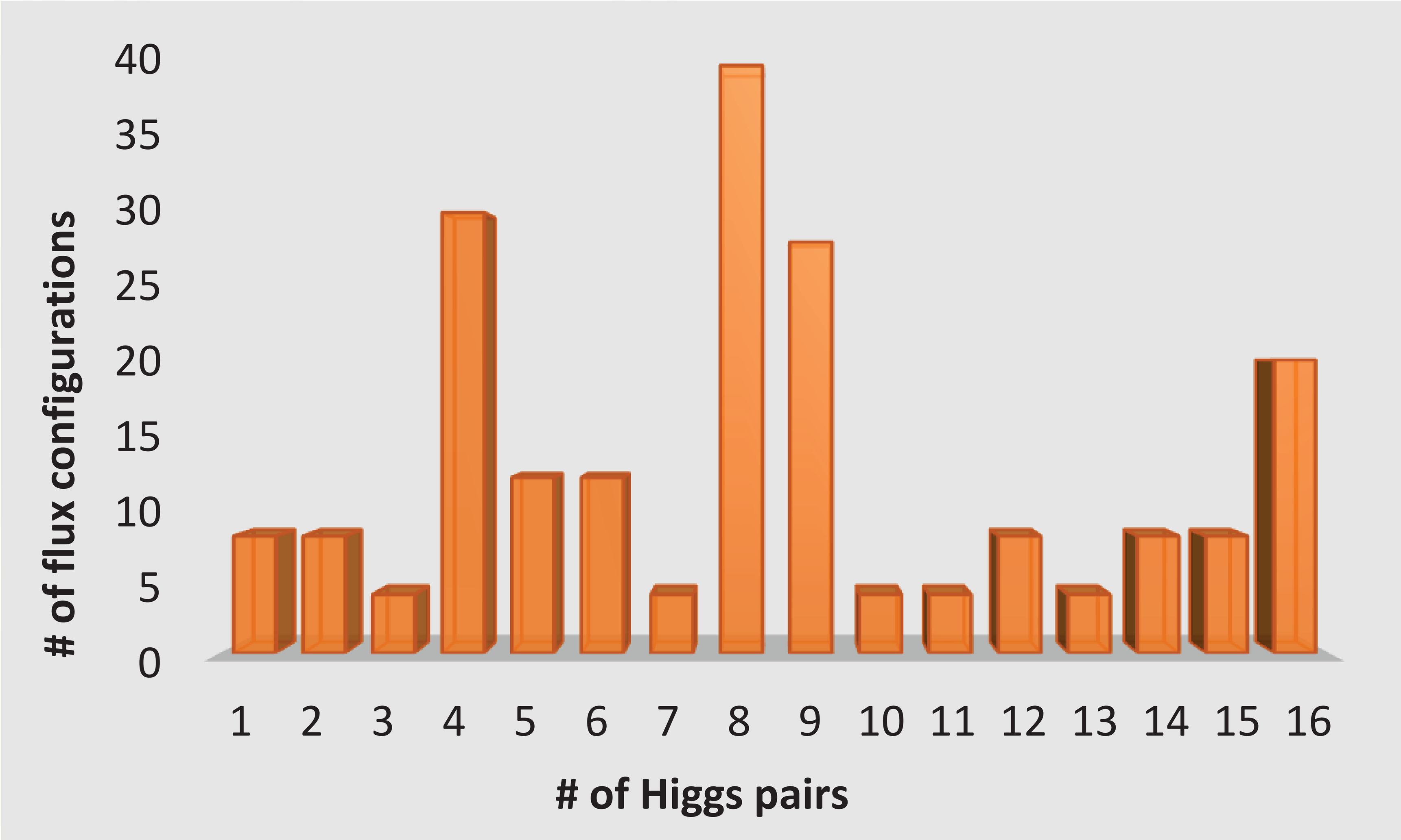
→ MSSM-like models (**six Higgs doublet models**)

→ **Δ(27) flavor symmetry** in all patterns

✓ case with factorizable and non-factorizable flux :

→ MSSM-like models (**various Higgs doublet models**)

→ **Δ(27) flavor symmetry** for $3n$ Higgs pairs



✓ Result II (one-pair Higgs model) :

✓ Yukawa matrix :

$$\lambda_{\mathcal{IJK}} \propto \int d^2y \left[e^{-\pi\vec{y}(\mathbb{N}_L\tilde{\Omega}_L+\mathbb{N}_R\tilde{\Omega}_R+\mathbb{N}_H\Omega)\cdot\vec{y}} \cdot \vartheta \begin{bmatrix} \vec{\mathbf{K}} \\ 0 \end{bmatrix} (i\vec{\mathbf{Y}}\,|\,i\vec{\mathbf{Q}}) \right]$$

Antoniadis, Kumar and Panda, (2009)

→ **full-rank Yukawa matrices**

✓ Summary :

Magnetic flux determines almost everything :
gauge syms, chirality, # of gens, hierarchies, ...