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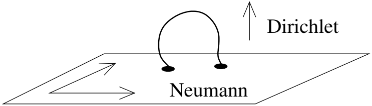
String Phenomenology

- classify different setups in ST which lead to SM-like physics
- within each setup, construct examples with low energy physics as close as possible to SM

Dp-branes $\equiv$ (p+1)-dimensional subspaces on which open strings can end



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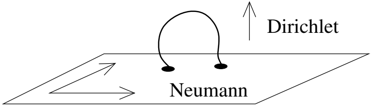

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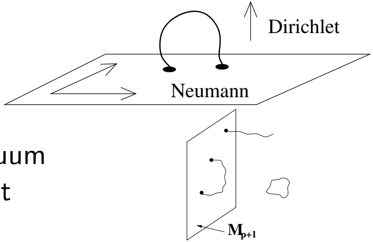

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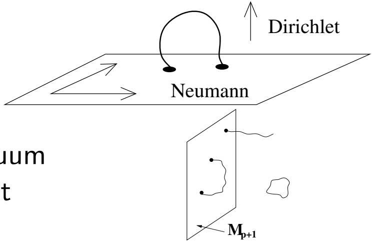

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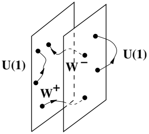

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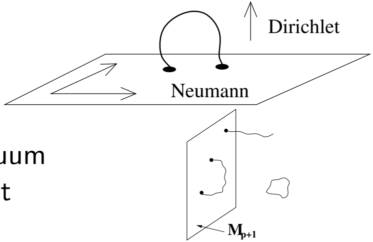

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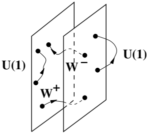

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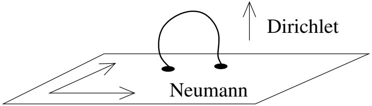

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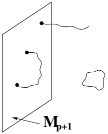

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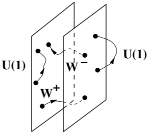

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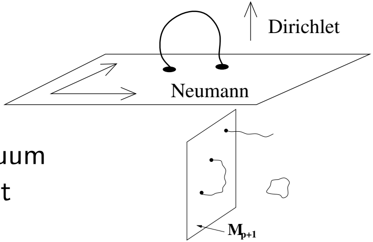

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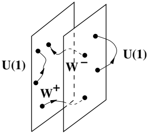

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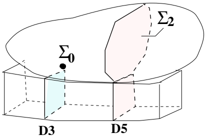
Flat Dp-branes preserve 1/2 of the 32 supercharges of type II ⟶ BPS state ⇒ charge-tension relation

- gravity in 10d $M_4 \times X_6$



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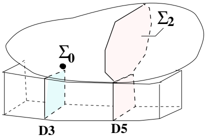

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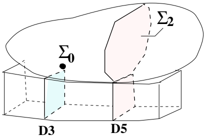
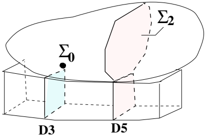


Effective action schematically



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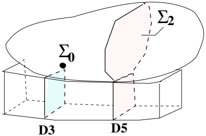

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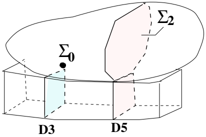

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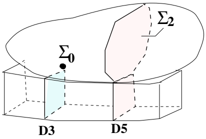

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i.e. generate large Planck mass in 4d with low string scale, by increasing $V_\perp \longrightarrow$ hierarchy problem recast in geometrical terms

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- SUSY breaking condition

$$Q_\alpha + P\tilde{Q}_\alpha = Q_\alpha + P(P^{-1}P')\tilde{Q}_\alpha$$

$\longrightarrow$ write $P^{-1}P' = e^{i\pi(J_1+\ldots+J_{\nu/2})}$, where each $e^{i\pi J}$ has eigenvalues $\pm i \longrightarrow$ SUSY unbroken for $v =$ multiple of 4

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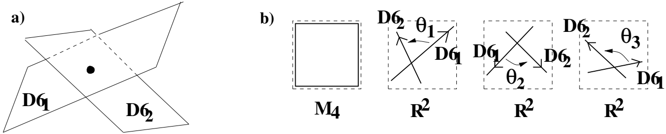

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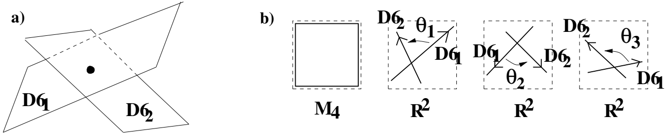

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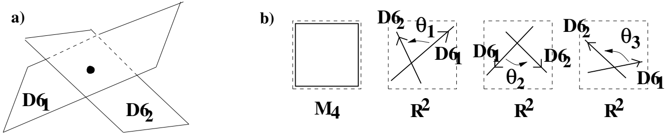

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  - for non zero angles, ψ^i, $i = 1, \dots, 4 \stackrel{GSO}{\longrightarrow}$ chiral fermion in 4d.

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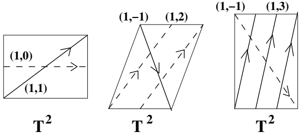

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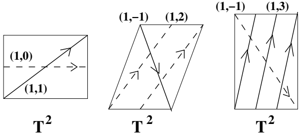

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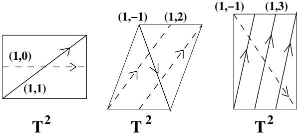

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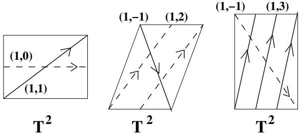

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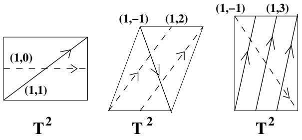

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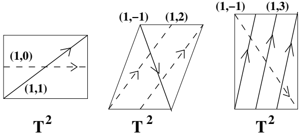

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- $6_a6_b + 6_b6_a \longrightarrow I_{ab}$ replicated chiral left-handed fermions in the bi-fundamental $(N_a, \bar{N}_b)$

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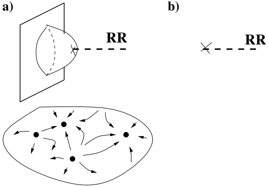

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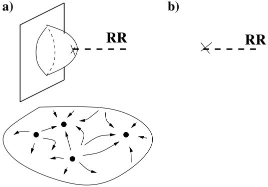

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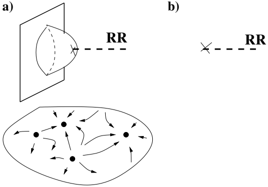

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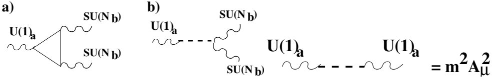

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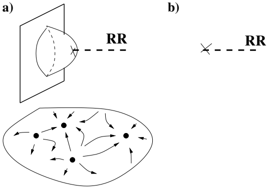

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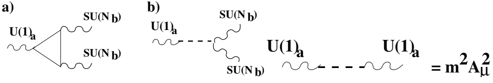

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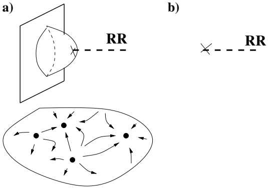

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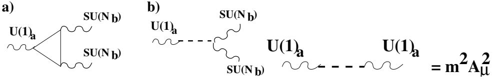

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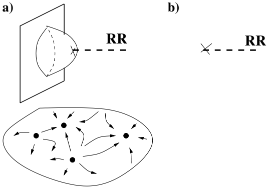

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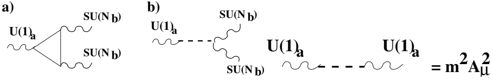

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***Some linear combinations can remain massless, and be used to construct e.g. hypercharge Q_Y

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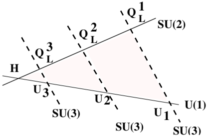
- √ fermion-Higgs coupling from open string instantons ⟶ texture for Yukawa couplings ∼ e^{-Area} 

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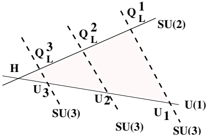
- √ fermion-Higgs coupling from open string instantons ⟶ texture for Yukawa couplings $\sim e^{-Area}$ 

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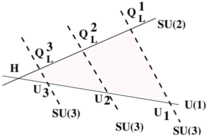
- $\checkmark$ fermion-Higgs coupling from open string instantons $\longrightarrow$ texture for Yukawa couplings $\sim e^{-Area}$ 

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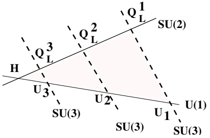
- √ fermion-Higgs coupling from open string instantons ⟶ texture for Yukawa couplings $\sim e^{-Area}$ 

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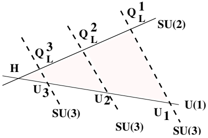
- √ fermion-Higgs coupling from open string instantons ⟶ texture for Yukawa couplings $\sim e^{-Area}$ 

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Thank you for your attention!