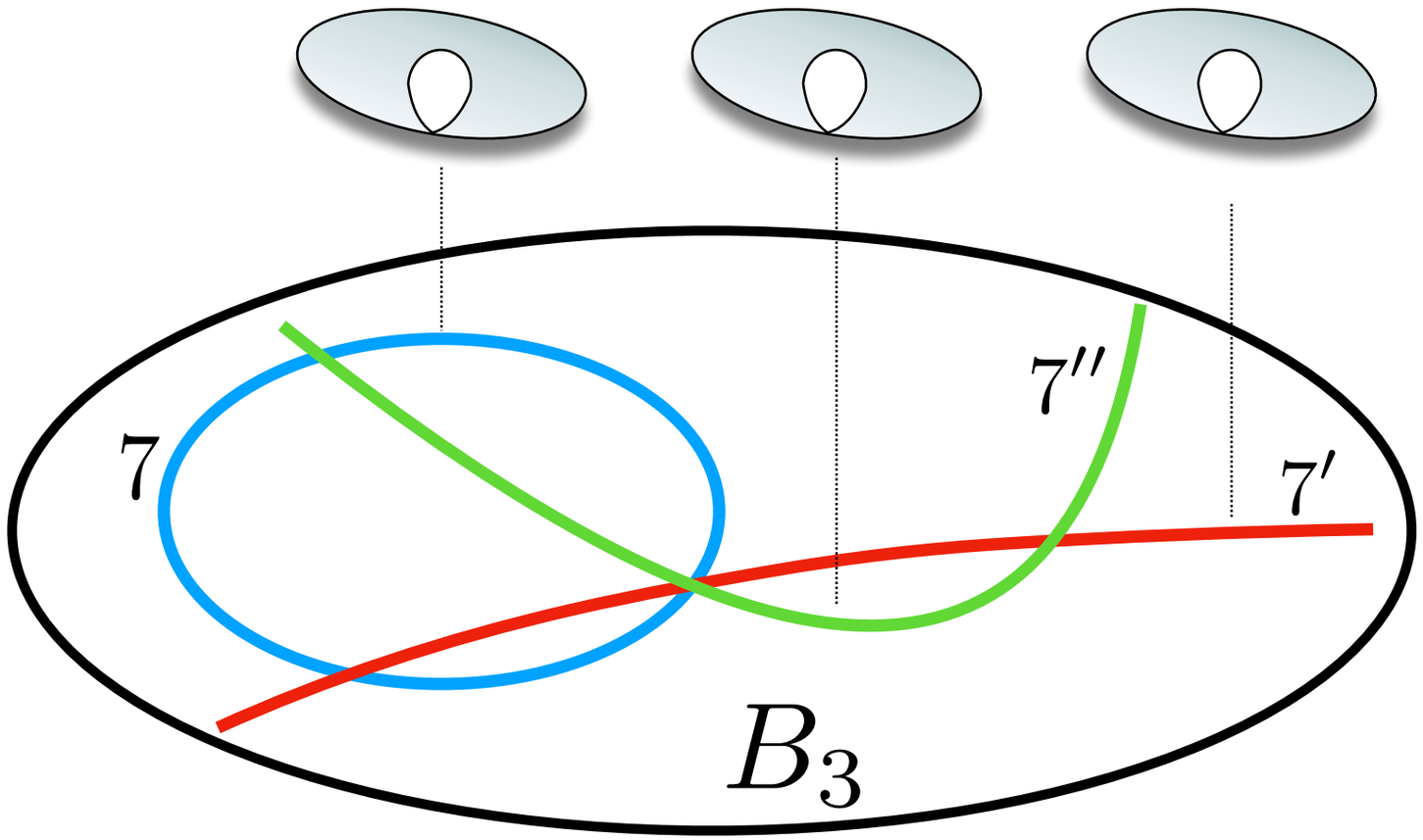
4D Gauge Theories with Conformal Matter

Fabio Apruzzi

UNC Chapel Hill & Penn

Based on 1803.00582 with *J.Heckman, D.Morrison, L. Tizzano*

F-Theory on non-Compact Elliptically Fibered CY4:



(Exceptional Group are Allowed)

- Cod. 1: Divisors, Gauge/Flavor Symm
- Cod. 2: 6D Matter on Curves
- Cod. 3: (Generalized) Yukawas at Points

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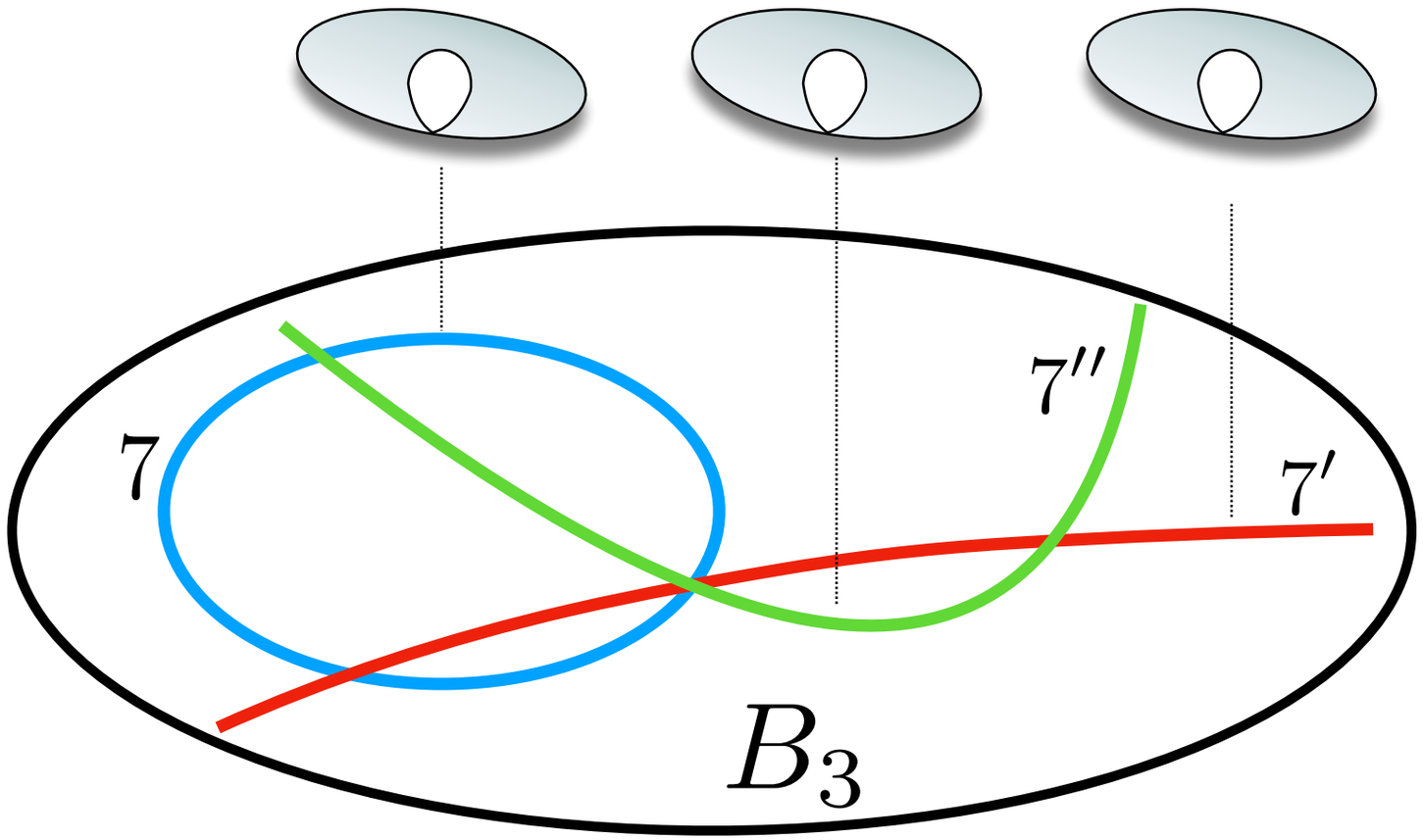

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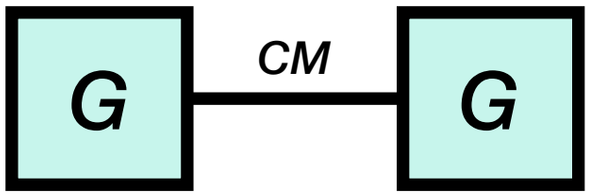
Generalized SQCD with Exceptional Groups Coupled To 6D Matter on Curves

…and (Generalized) Yukawa Couplings

Matter

6D Matter on Curves:

$$G = SO, E_6, E_7, E_8$$



Conformal Matter: is a 6D SCFT
(Generalization of Bifundamental Hypermultiplets)

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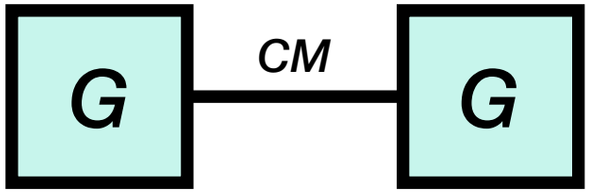

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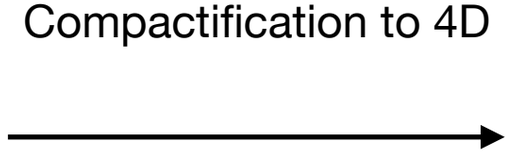
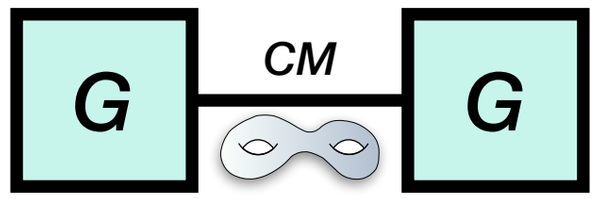
Compactification to 4D



4D Conformal Matter:



$U(1)_{\text{flux}}$

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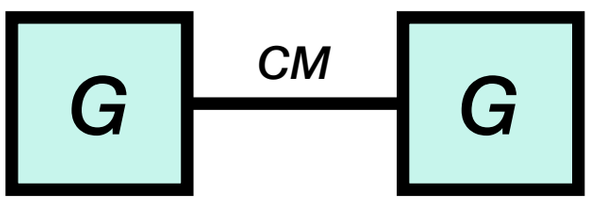

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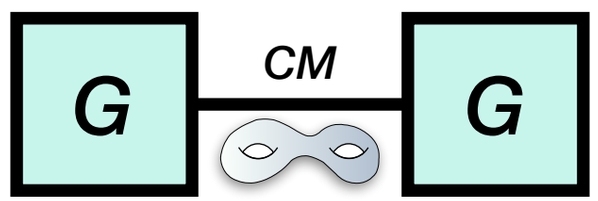

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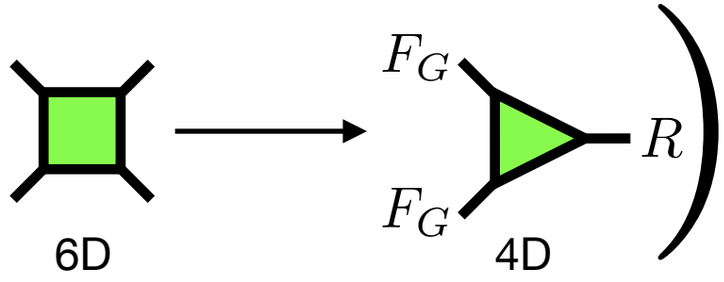
Gauge a common *G* among 1,2 or more 4D Conformal Matter…

Beta Function: $b_G^{\text{Matter}} =$



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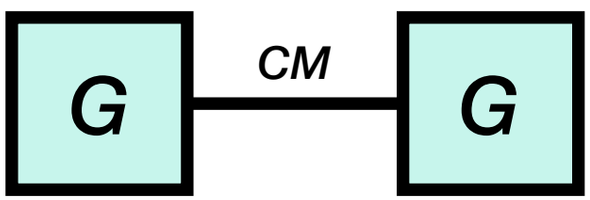

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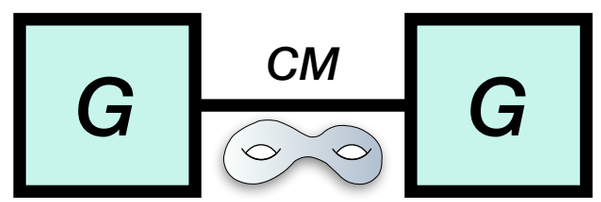

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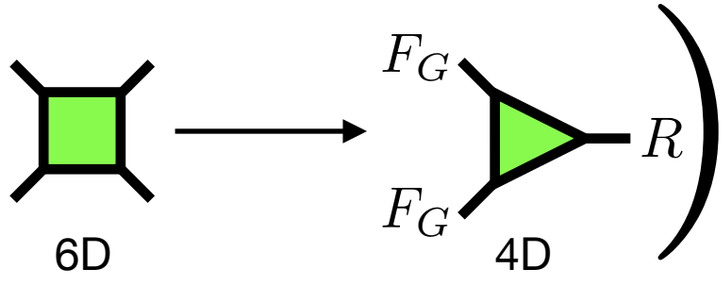
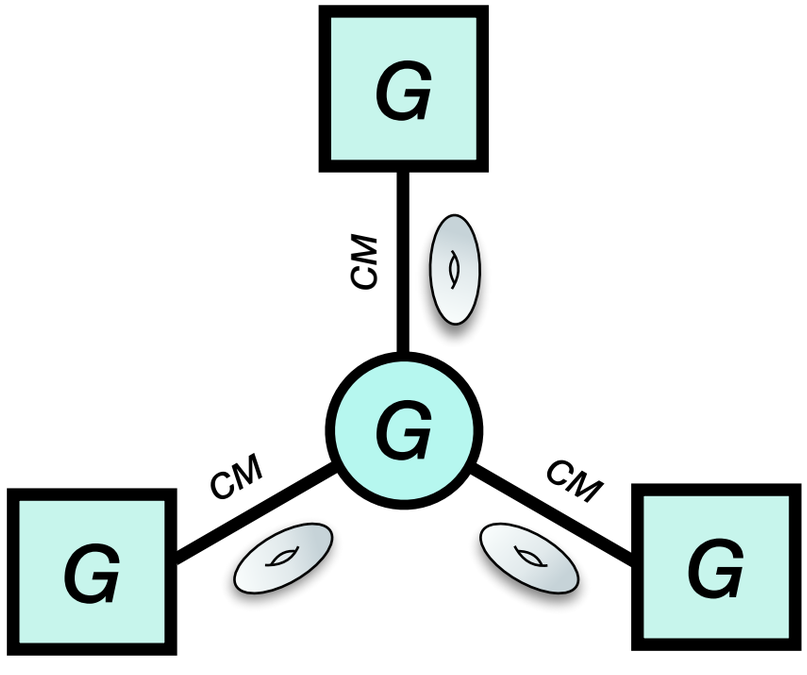
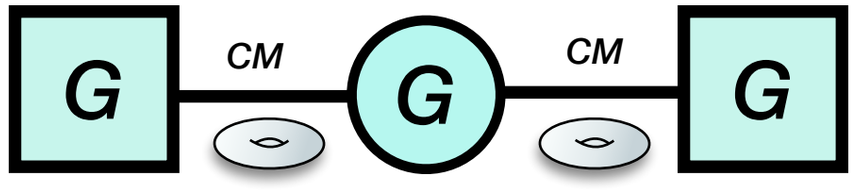
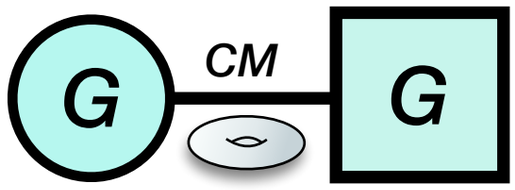
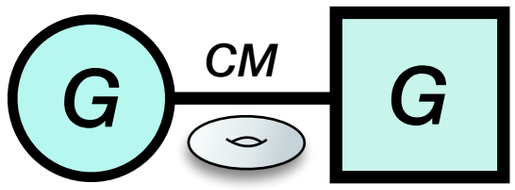






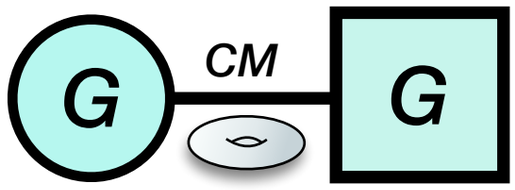
$$b_G = 3h_G^\vee - b_G^{\text{Matter}} = 0$$


G
CM
G



Confinement:

$$\text{Casimir}(\text{Mesons} \in \mathbf{adj}(G_{\text{flav}})) - \text{Baryons} = \Lambda^{2h^\vee_G}$$



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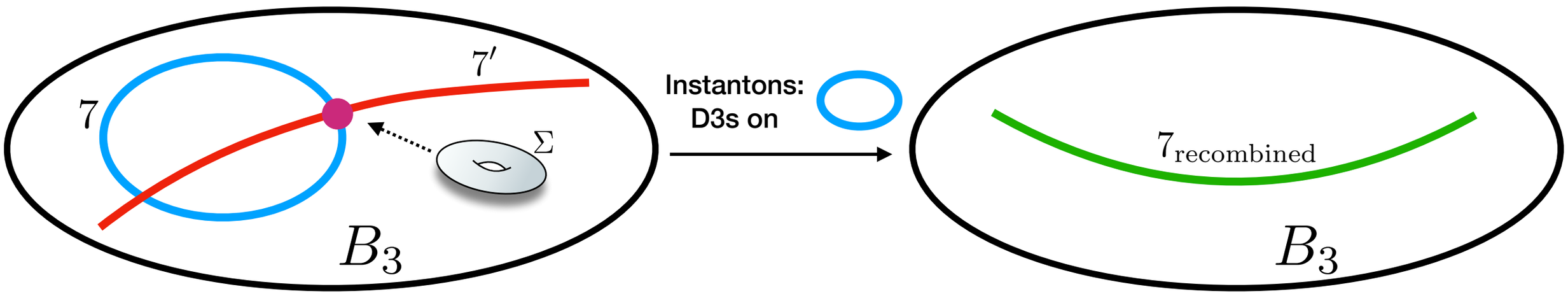
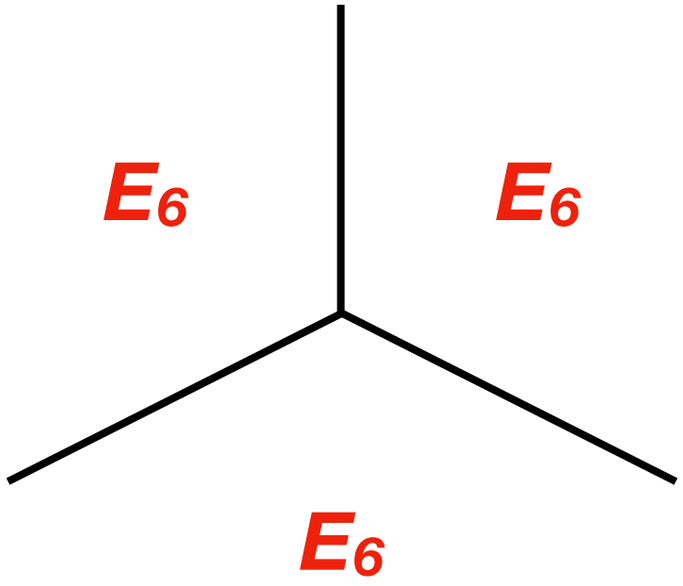
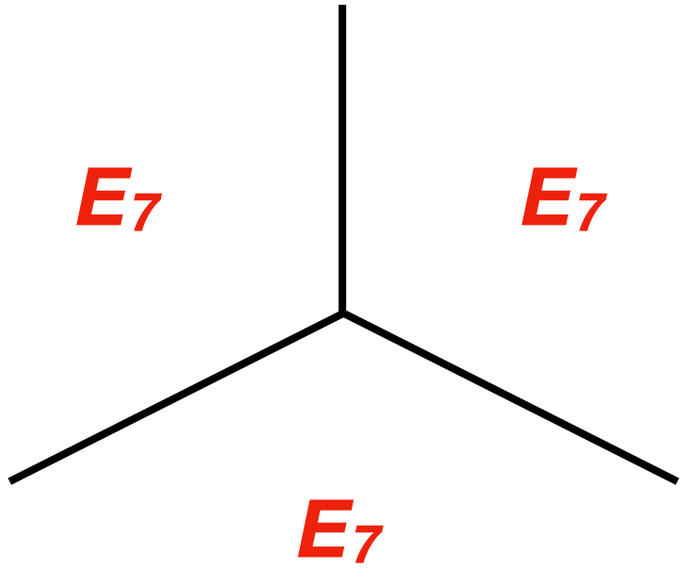
Supported by D3-brane Instantons in F-theory:

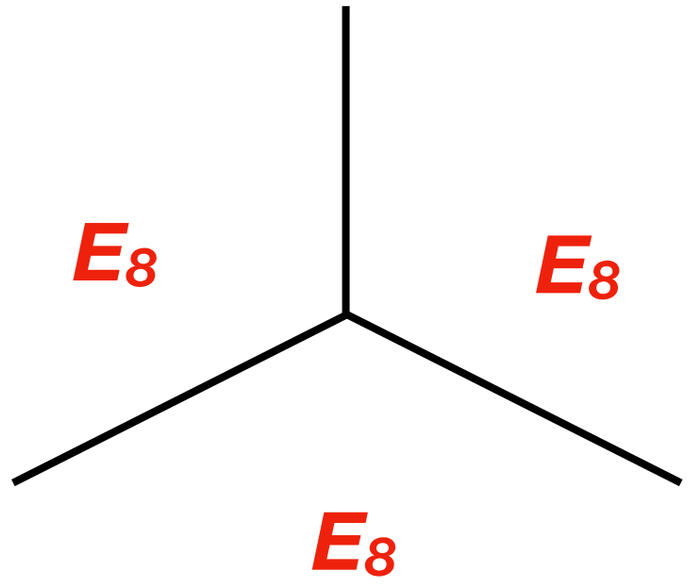


Generalized Yukawa

Locally:







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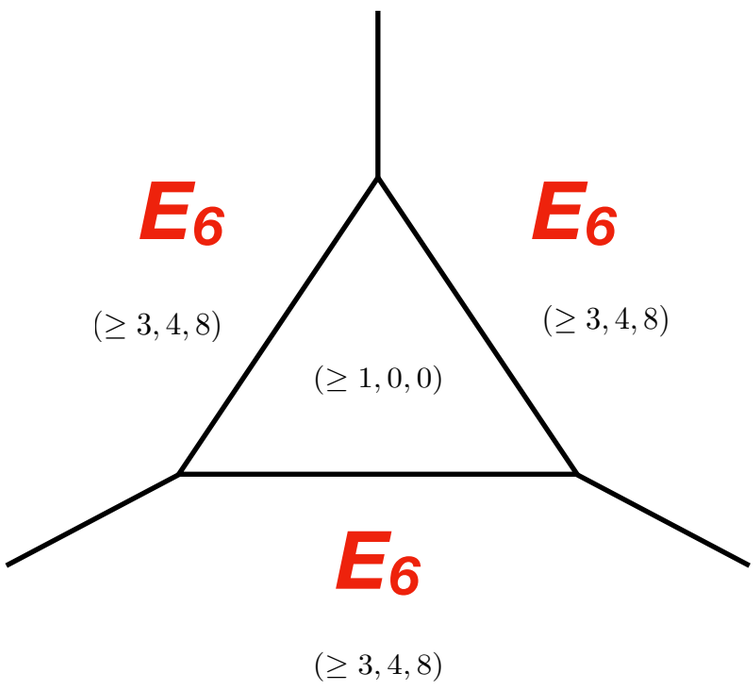
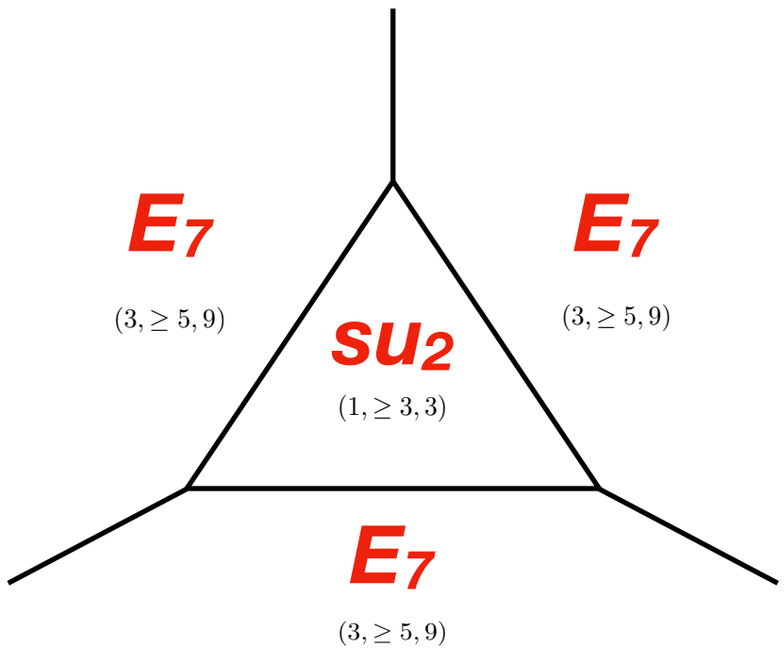
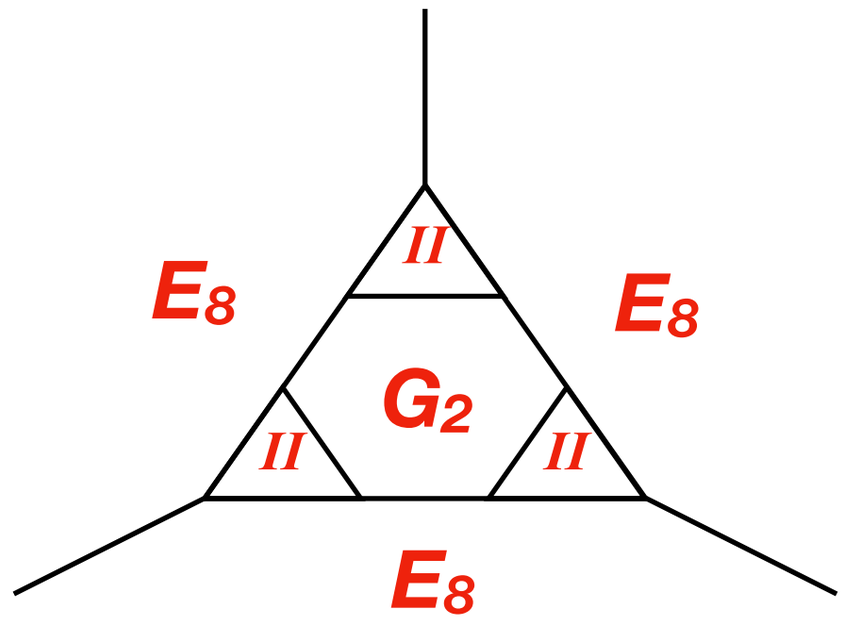
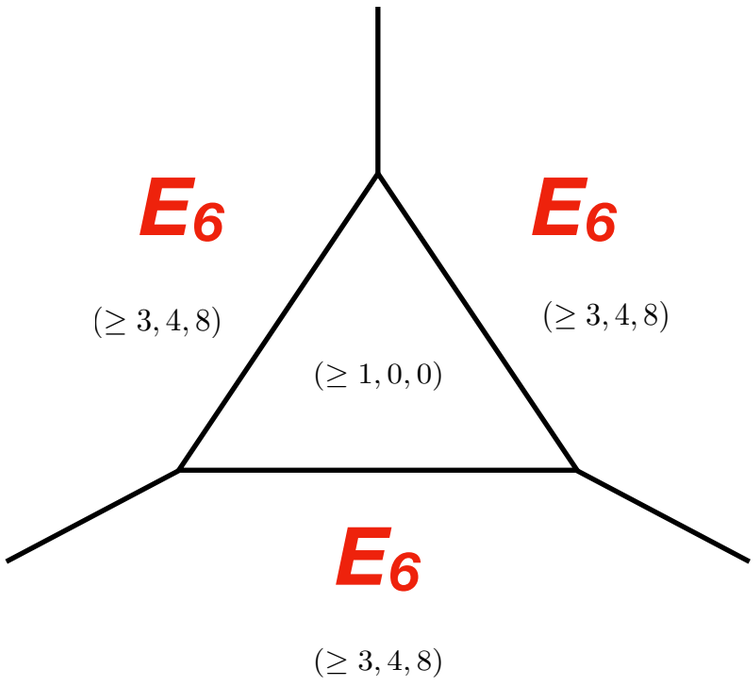
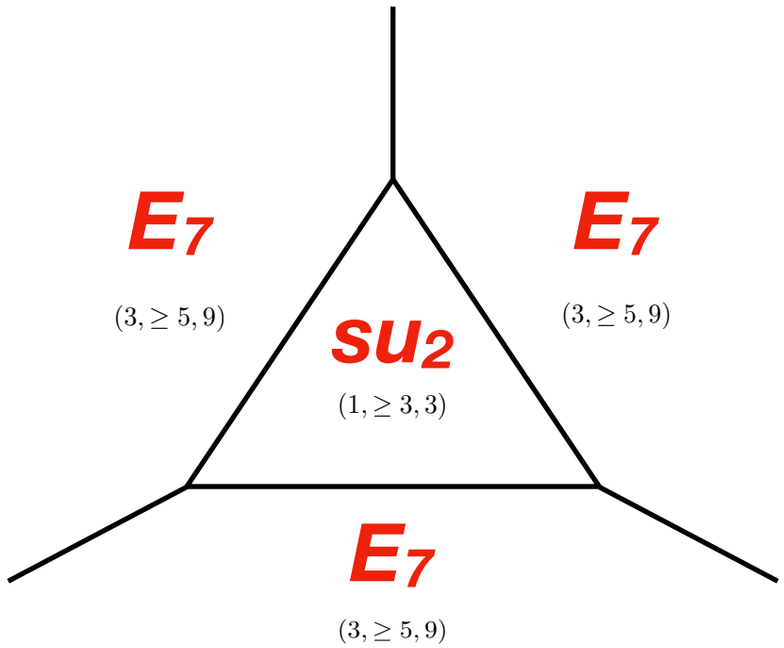

E_6
$(\geq 3,4,8)$
E_6
$(\geq 3,4,8)$
$(\geq 1,0,0)$
E_6
$(\geq 3,4,8)$

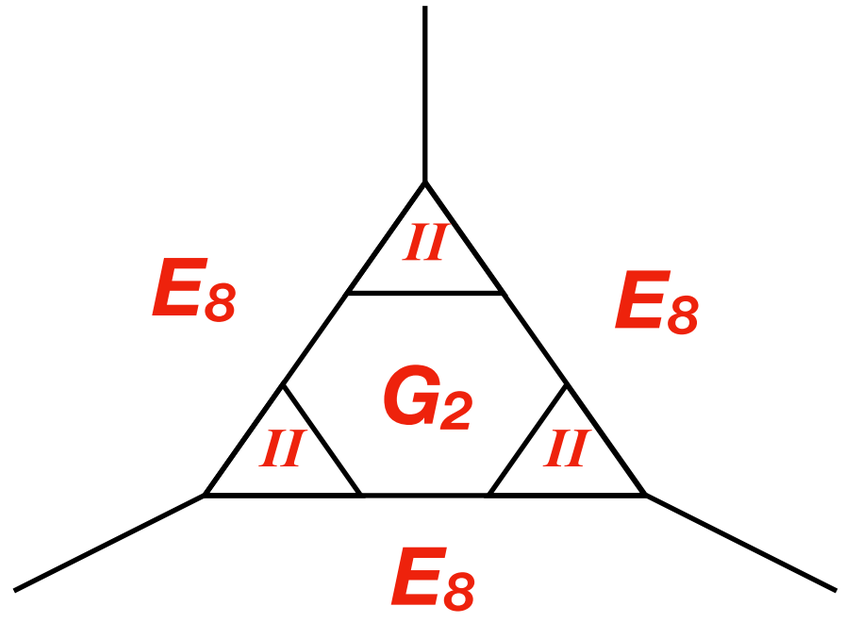

E_7
$(3,\geq 5,9)$
E_7
$(3,\geq 5,9)$
su_2
$(1,\geq 3,3)$
E_7
$(3,\geq 5,9)$

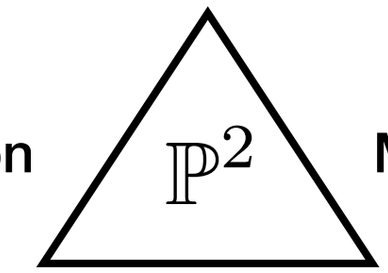

E_8
II
E_8
G_2
II
II
E_8

Locally:



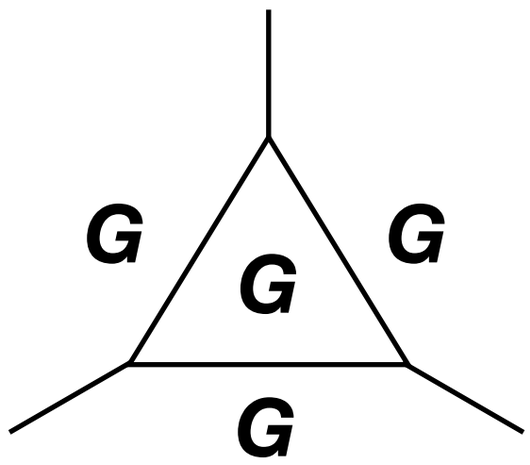


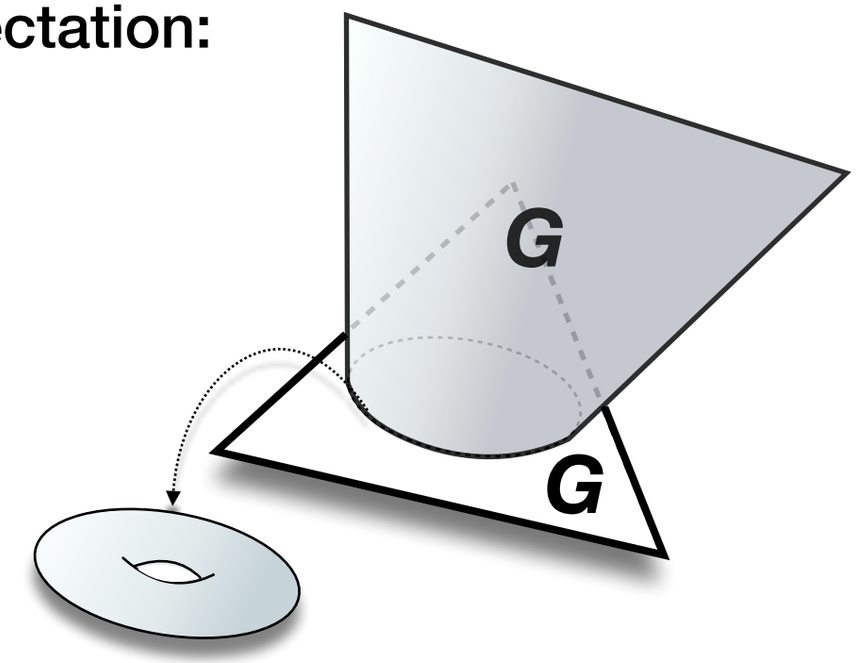


Again Instantons: D3s on 

Mix Complex Structure with Kähler moduli

Change the classical expectation:





Thank you