New compactifications of F-Theory to 6d $\mathcal{N} = (1, 0)$

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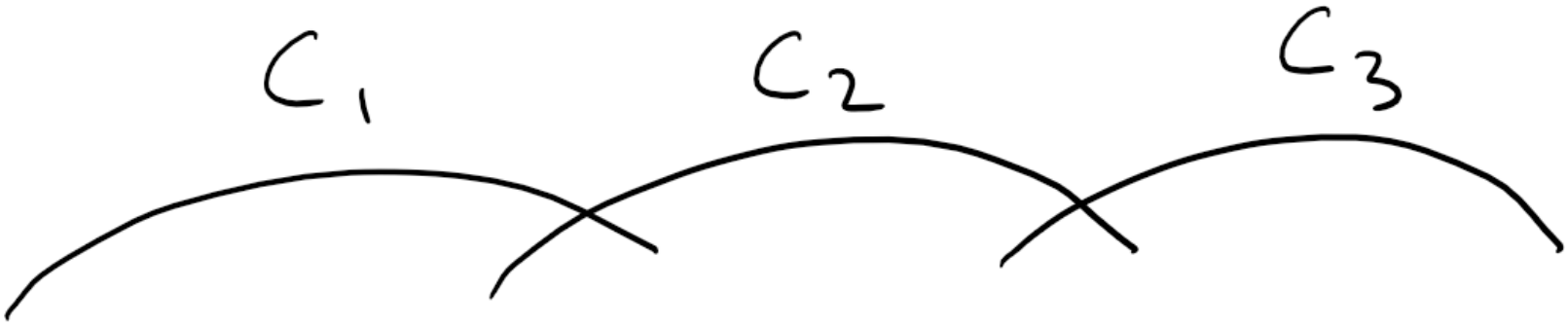
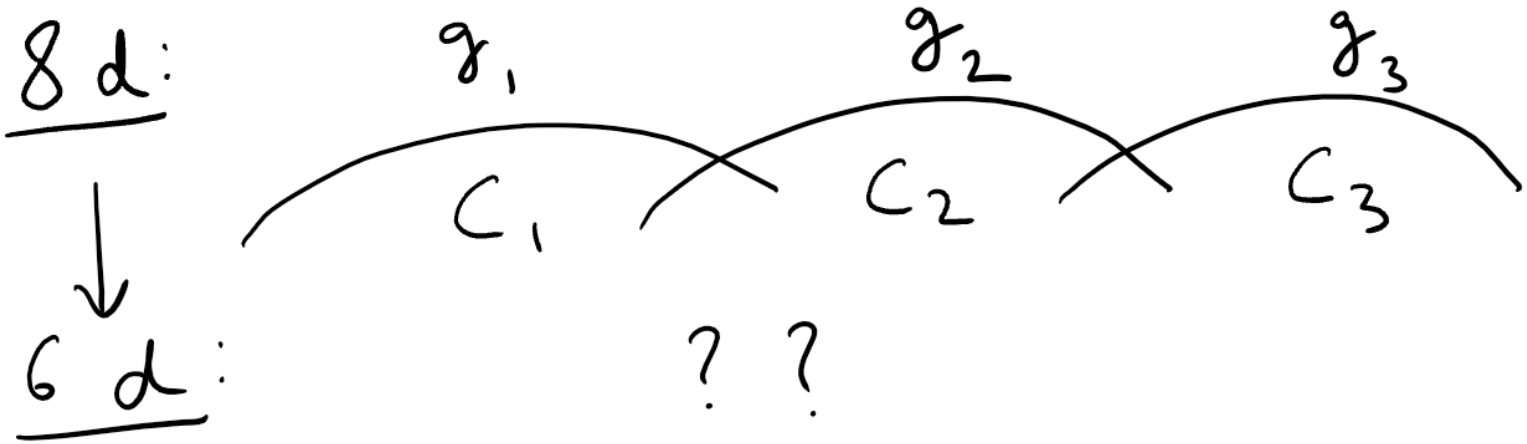
(based on a joint work with Morrison, Tachikawa and Tomasiello)

We are compactifying Type IIB on a complex surface. The surface contains complex curves which represent non-trivial 2-cycles.

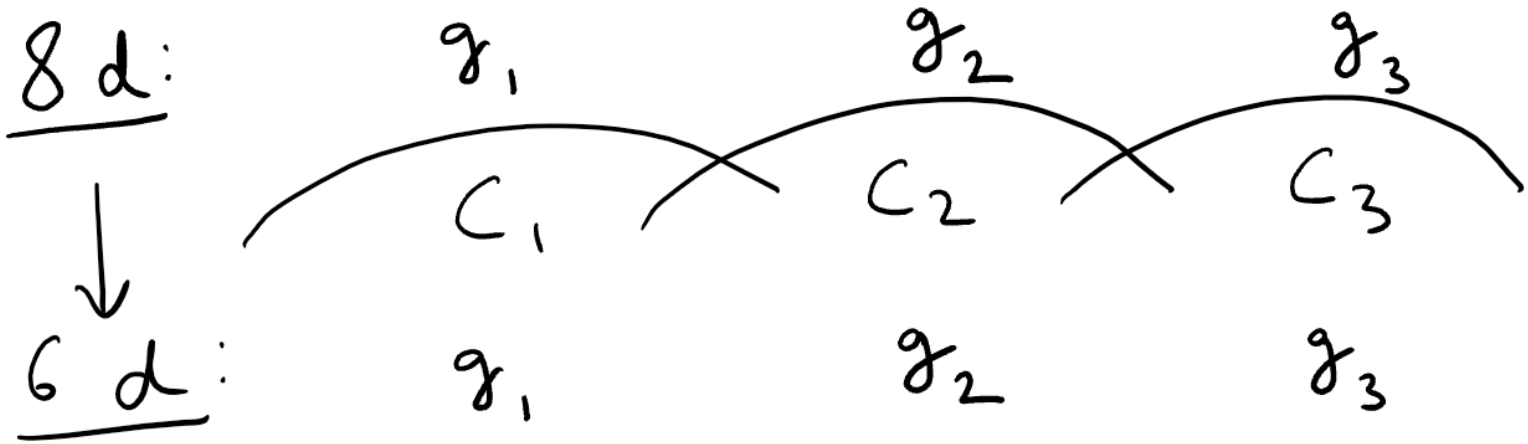


We can wrap (non-perturbative) seven-branes over these curves. Then we are studying a compactification of the 8d gauge theory carried by these seven-branes.

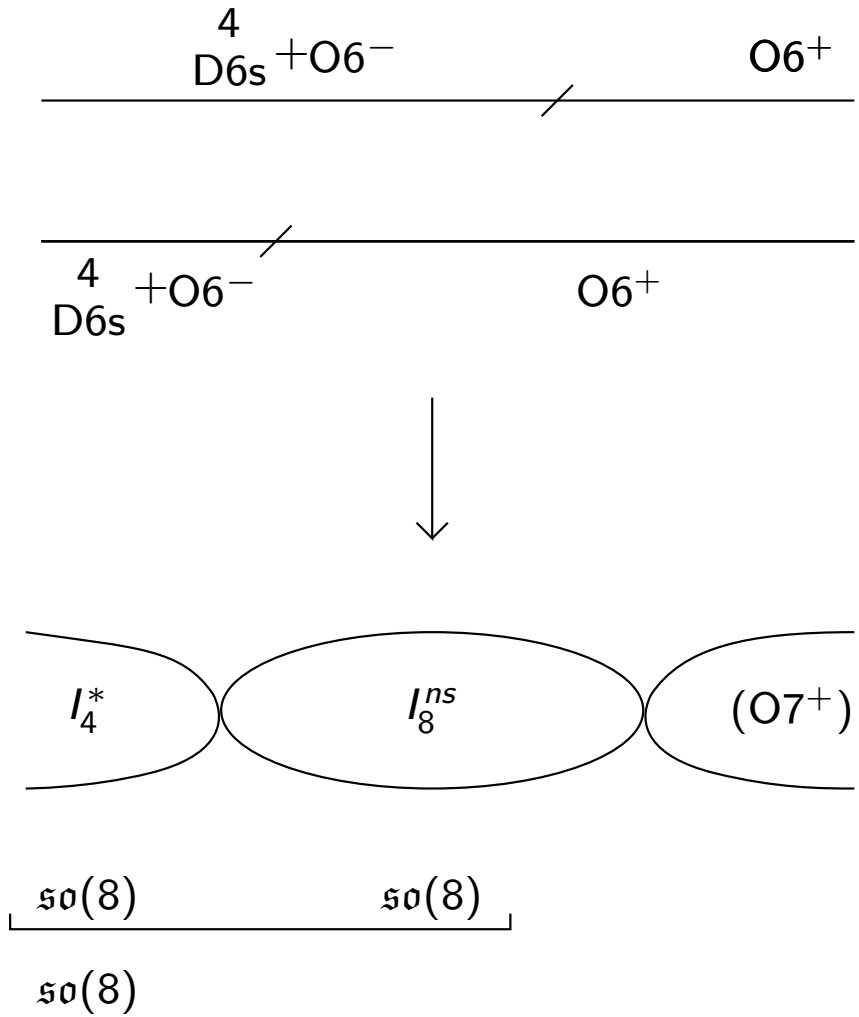
Question: What is the resulting gauge algebra in 6d?



The result of compactification actually depends on some moduli, namely holonomies of 8d gauge fields and the fluxes of (RR and NS-NS) 2-form potentials on these curves. In many cases, we can completely turn off these moduli and go to *the origin* in the moduli space where the 6d gauge algebra simply coincides with the 8d gauge algebra.



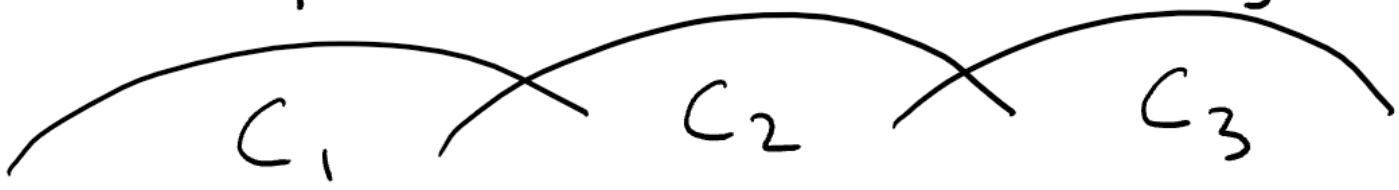
However, it is generally impossible to turn off the moduli when $O7^+$ planes (having RR-charge $+4$) are involved. Let me give you an example:



Traditionally, it was always assumed that the origin of the moduli space exists. The 6d theory at other points in the moduli space could then be studied as a Higgsing of the 6d theory at the origin.

In the presence of $O7^+$, generically the origin does not exist. Rather, there are multiple special points where the theory is "least Higgsed", i.e. the theory at points near such a special point is a Higgsing of the theory at the special point.

8d: g_1 g_2 g_3



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6d: h_1 on $\Sigma_1 = \alpha C_1 + \beta C_2$

h_2 on $\Sigma_2 = \gamma C_2 + \delta C_3$

- If 6d gauge algebras and corresponding divisors are specified, the matter content can be predicted. But, what are the possible choices of 6d gauge algebras and corresponding divisors for a given set of 7-branes?
- There exists a classification of 6d SCFTs arising as compactifications of F-theory not involving $O7^+$. However, some examples of 6d SCFTs are known which only arise in F-theory by using $O7^+$. So, what is the full classification after incorporating $O7^+$?