General case: F-theory on elliptically fibered CY_{n+1} on base B_n.

(n+1) complex   n-complex.

$\vec{u}$: coordinate on B_n.

$$y^2 = x^3 + f(\vec{u})\, x + g(\vec{u}).$$

functions on B.

General situation: f: a section of some line bundle L^4,

g: Section of some line bundle L^6.

L: some line bundle on B_n.

y : Section of L^3

x: Section of L^2.

What is the condition for vanishing c_1 ?

$c_1(B)$: Chern class of B. $\left.\right\}$ 2-forms
$c_1(L)$: Chern class of L $\left.\right\}$ on B.

x, y.
$\shortparallel$

$c_1(B)$ + chern-class of fiber coordinates
- Chern class of the constraint.

$$c_1(B) + 2\, c_1(L) + 3\, c_1(L) - 6\, c_1(L) = 0.$$

$$\Rightarrow \quad c_1(B) = c_1(L).$$

~~Other~~

$$j(\tau(\vec{u})) = \frac{4 \cdot (24 f)^3}{\underbrace{4f^3 + 27 g^2}_{= \Delta(\vec{u})}}$$

Weak coupling limit : Parametrize
$f(\vec{u})$ and $g(\vec{u})$ as :

$$f = -3h^2 + c\eta$$

$$g = -2h^3 + ch\eta + c^2 \chi.$$

c = constant, η : section of L^4,
χ : section of L^6, h : section of L^2.

Repeat the analysis p.

Orientifold plane at zeroes of $h(\vec{u})$

└ codimension 2.

$\Rightarrow$ 7 plane.

D7 - branes at zeroes of

$\eta^2 + 12 h X$.

What is the manifold whose orientifold is this?

After orientifold the manifold is B.

Fixed pts. at zeroes of $h(u)$.

$\Rightarrow$ Need double cover of B.

$\xi^2 = h(u)$ → has this property.

section of L

& $\forall u$ we have two points $\pm \xi$.

Except for $h(u) = 0$.

$\Rightarrow \xi$ is the correct coordinate there..

Orbifold action: $(-1)^{F_L} \cdot \Omega \cdot \sigma_2$

$\sigma_2 : \xi \to -\xi$.

What is the chern-class of

$$\xi^2 - h(\vec{u}) = 0.$$

$$\underbrace{c_1(B) + c_1(L)}_{\text{from } \xi} - \underbrace{2c_1(L)}_{\text{deg. of constraint}}$$

$= c_1(B) - c_1(L) = 0$ by the CY_{n+1} condition.

$\Rightarrow$ B_n is not CY_n but $\xi^2 - h(\vec{u}) = 0$ is.

$\Rightarrow$ An orientifold of II B on CY_n.