Branes, Antibranes and Duality

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work done with T. Maxfield and S. Sethi, 1804.xxxxx

Previous work

- Most studied string target spaces are Kähler, Calabi-Yau
- Many tools to study them
- We would like to construct more (generic!) examples of torsional spaces
- Reasons to believe most compactifications are of this type

Previous work

- Torsional geometries are much harder, fewer tools (no large radius limit)
- Instead, study other QFT in same universality class
- Gauged Linear Sigma Models[1], successfully used for CY
- Constructions have been done in $\mathcal{N} = (0, 2)$[2]
- Some of these can also be constructed in $(2, 2)$: more control

[1] [Witten '93]
[2] [Adams, Ernebjerg, Lapan '06; Quigley, Sethi, Stern '12; and others]

Usual $\mathcal{N} = (2,2)$ GLSM Lagrangian:

$$\mathcal{L} = \int d^4\theta \left[|\Phi^i|^2 e^{2Q_i^a V} - \frac{1}{e_a^2} |\Sigma^a|^2 \right] + \int d\theta^+ d\bar{\theta}^- t^a \Sigma^a$$

Charged Φ^i are chirals, field strength Σ is twisted chiral:

$$\bar{D}_\pm \Phi = 0, \qquad \bar{D}_+ \Sigma = D_- \Sigma = 0.$$

$t = r^a + i\theta^a$. B is proportional to θ^a,

$$B \sim \theta^a F^a \Rightarrow H = dB = 0$$

Usual $\mathcal{N} = (2,2)$ GLSM Lagrangian plus an extra field:

$$\mathcal{L} = \int d^4\theta \left[|\Phi^i|^2 e^{2Q_i^a V} - \frac{1}{e_a^2} |\Sigma^a|^2 \right] + \int d\theta^+ d\bar{\theta}^- t^a \Sigma^a - \int d^4\theta |Y|^2$$

Y twisted chiral and periodic,

$$\bar{D}_+ Y = D_- Y = 0, \qquad Y \sim Y + 2\pi i$$

Usual $\mathcal{N} = (2,2)$ GLSM Lagrangian

$$\mathcal{L} = \int d^4\theta \left[|\Phi^i|^2 e^{2Q_i^a V} - \frac{1}{e_a^2} |\Sigma^a|^2 \right] + \int d\theta^+ d\bar{\theta}^- t^a \Sigma^a$$
$$- \int d^4\theta |Y|^2 + k^a \int d\theta^+ d\bar{\theta}^- Y \Sigma^a$$

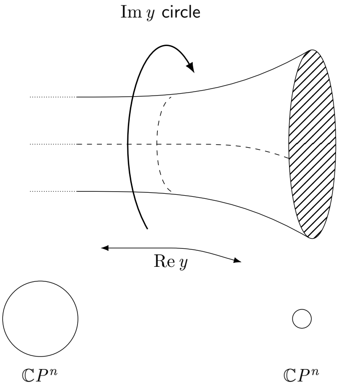
Y twisted chiral and periodic,

$$\bar{D}_+ Y = D_- Y = 0, \qquad Y \sim Y + 2\pi i$$

Now

$$B \sim [\theta^a + k^a \, \mathrm{Im}(y)] \, F^a \Rightarrow H \sim k^a \, d \, \mathrm{Im}(y) F^a$$

Adding a Y to a $\mathbb{C}P^n$ model creates non-compact direction.

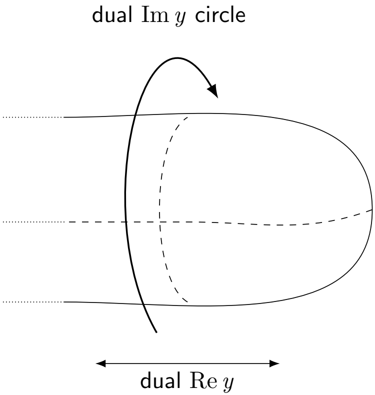


Non-trivial H-flux

$$\int_{\mathcal{C}\times S^1} H = 2\pi k$$

Size of S^1 blows up at H source, as the size of the $\mathbb{C}P^n$ vanishes.
In a CFT, this would be the location of NS5-brane.

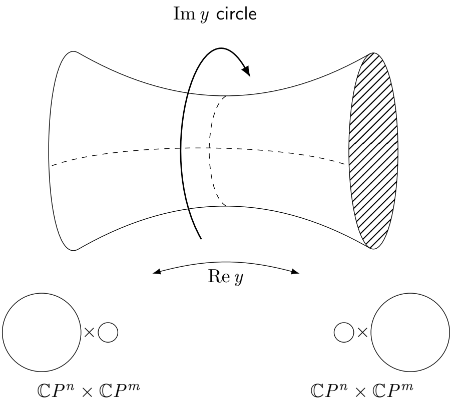
Adding a Y to a $\mathbb{C}P^n$ model creates non-compact direction. T-dualise the circle isometry: Kähler cigar geometry, flows to 2d black hole[3].



T-dualise other field instead: $\mathcal{N} = 2$ sine-Liouville, FZZ duality.

[3] [Hori, Kapustin '01; '02]

Second $U(1)$ allows us to make range of Y compact.



$$\int_{\mathcal{C}\times S^1} H = 2\pi k$$
$$\int_{\tilde{\mathcal{C}}\times S^1} H = 2\pi \tilde{k}$$

Can calculate quantum cohomology ring: depends on k-s!
This is a massive model. Can we build compact, conformal models?

- General picture: we can add twisted sigma models, with superpotential couplings to Y-fields.
- Then dualisation to Kähler models is no longer possible, except perhaps locally: T-fold?
- Rich forest of models to explore
- With $(2,2)$, many tools available