Argyres-Seiberg duality and the Higgs branch

Yuji Tachikawa (IAS)

in collaboration with
Davide Gaiotto & Andy Neitzke
[arXiv:0810.4541]

IPMU, December, 2008

Introduction

- Montonen-Olive S-duality in $\mathcal{N} = 4$ theory
- Seiberg-duality in $\mathcal{N} = 1$ theory

Introduction

- Montonen-Olive S-duality in $\mathcal{N} = 4$ theory
- Seiberg-duality in $\mathcal{N} = 1$ theory

Argyres-Seiberg, Nov 2007

a totally new class of S-duality in $\mathcal{N} = 2$ theory

- Richer structure !
- [Argyres-Wittig] [Aharony-YT] [Shapere-YT]

Introduction

- Montonen-Olive S-duality in $\mathcal{N} = 4$ theory
- Seiberg-duality in $\mathcal{N} = 1$ theory

Argyres-Seiberg, Nov 2007

a totally new class of S-duality in $\mathcal{N} = 2$ theory

- Richer structure !
- [Argyres-Wittig] [Aharony-YT] [Shapere-YT]

- Today: Higgs branch side of the story

Contents

Contents

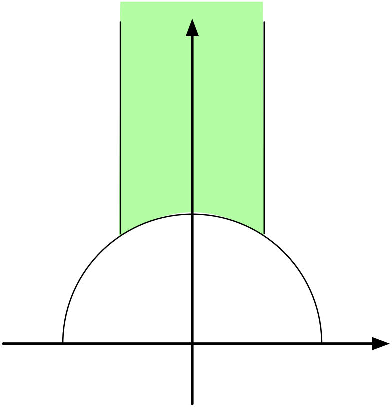
Montonen-Olive S-duality

$\mathcal{N} = 4$ SU(N)

$$\tau = \frac{\theta}{2\pi} + \frac{4\pi i}{g^2}$$

$$\tau \to \tau + 1, \qquad \tau \to -\frac{1}{\tau}$$

- Exchanges monopoles W-bosons
- Comes from S-duality of Type IIB



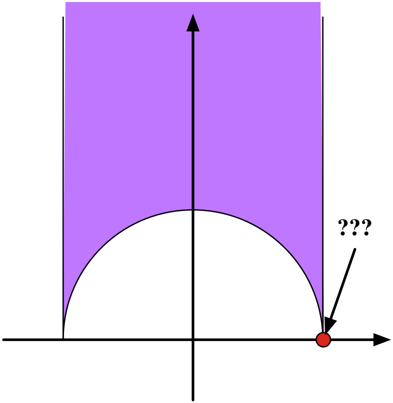
S-duality in $\mathcal{N} = 2$

SU(3) with $N_f = 6$

$$\tau = \frac{\theta}{\pi} + \frac{8\pi i}{g^2}$$

$$\tau \to \tau + 2, \qquad \tau \to -\frac{1}{\tau}$$

- Exchanges monopoles and quarks
- Infinitely Strongly coupled at $\tau = 1$



$SU(3) + 6$ flavors

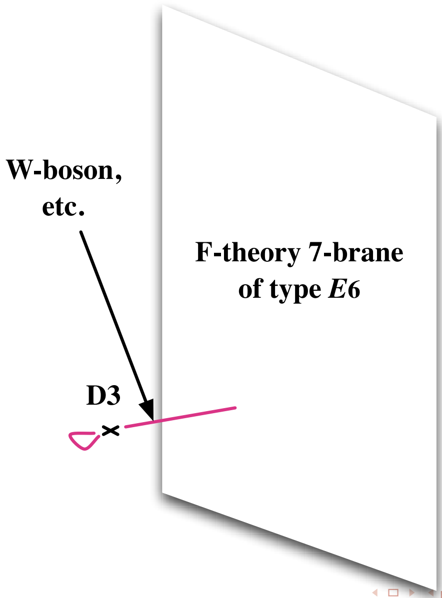
at coupling τ

$\Updownarrow$

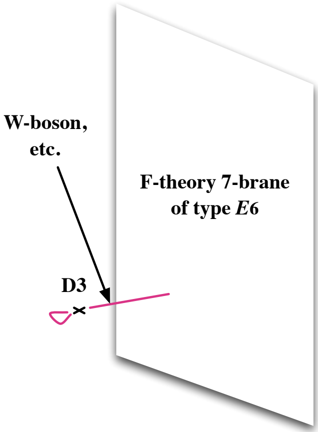
$SU(2) + 1$ flavor $+$ SCFT$[E_6]$

at coupling $\tau' = 1/(1-\tau)$, $SU(2) \subset E_6$ is gauged

SCFT[E_6]



- a 3-brane probing F-theory singularity of type E_6.
- Gauge symmetry on 7-brane
  → Flavor symmetry on 3-brane
- Motion transverse to 7-brane
  → Vector multiplet moduli u,
- Motion parallel to 7-brane
  → free hypermultiplet, discard
- Conformal when $u = 0$, $\dim(u) = 3$
- Family of Seiberg-Witten curve is the elliptic fibration of F-theory.



Argyres-Seiberg: Dimensions

SU(3) + 6 flavors

$\dim(\mathrm{tr}\,\phi^2) = 2, \qquad \dim(\mathrm{tr}\,\phi^3) = 3$

$\Updownarrow$

SU(2) + 1 flavor + SCFT[E_6]

u of SU(2) : dim = 2, $\qquad$ u of SCFT[E_6] : dim = 3

Argyres-Seiberg: Flavor symmetry

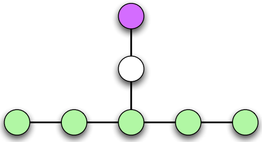
SU(3) + 6 flavors

- Flavor symmetry: $\mathbf{U(6)} = \mathbf{U(1)} \times \mathbf{SU(6)}$

↕

SU(2) + 1 flavor + SCFT[E_6]

- $\mathbf{SO(2)}$ acts on 1 flavor = 2 half-hyper of $\mathbf{SU(2)}$ doublet
- $\mathbf{SU(2)} \subset E_6$ is gauged
- $\mathbf{SU(2)} \times \mathbf{SU(6)} \subset E_6$ is a maximal regular subalgebra



Current Algebra Central Charge

Normalize s.t. a free hyper in the fund. of $\mathbf{SU}(N)$ contributes $\mathbf{2}$ to k_G

$$J^a_\mu(x) J^b_\nu(0) = \frac{3}{4\pi^2} k_G \delta^{ab} \frac{x^2 g_{\mu\nu} - 2x_\mu x_\nu}{x^8} + \cdots$$

A bifundamental hyper under $\mathbf{SU}(N) \times \mathbf{SU}(M)$

$$\longrightarrow \quad k_{\mathrm{SU}(N)} = 2M, \qquad k_{\mathrm{SU}(M)} = 2N$$

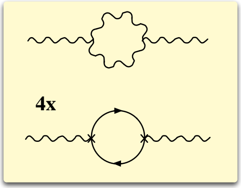
SU(3) + 6 flavors

$$k_{\mathrm{SU}(6)} = 6$$

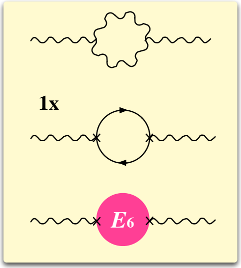
k for SCFT[E_6]

SU(2) $\subset E_6$ central charge:

$SU(2)$ + 4 flavors

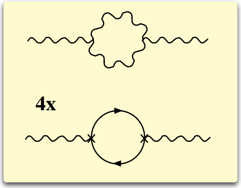


$SU(2)$ + 1 flavor + SCFT[$E6$]

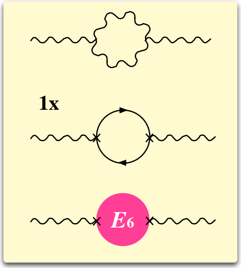


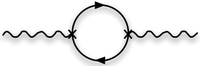
SU(2) $\subset E_6$ central charge:

$SU(2)$ + 4 flavors



$SU(2)$ + 1 flavor + SCFT[E_6]





$= \langle j_\mu j_\nu \rangle_{\text{free hyper}}$

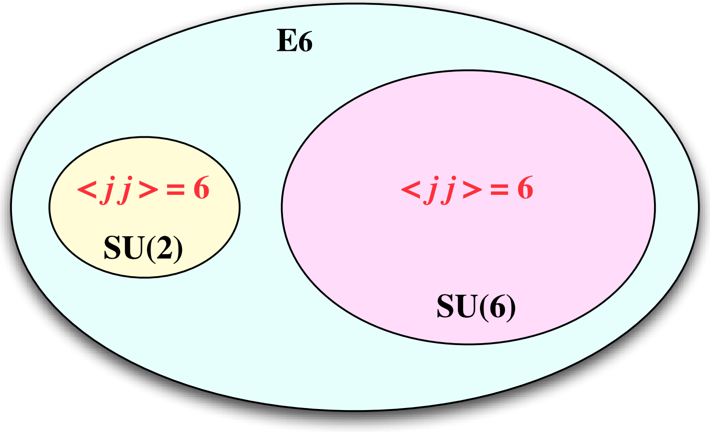
$= \langle j_\mu j_\nu \rangle_{\text{SCFT}[E_6]}$

$\Rightarrow$

$$\langle j_\mu j_\nu \rangle_{\text{SCFT}[E_6]} = 3 \langle j_\mu j_\nu \rangle_{\text{free hyper}}$$

$$= 6$$

k for SCFT[E_6]



$k_{\mathrm{U}(1)}$

SU(3) + 6 flavors

- $k_{\mathrm{U}(1)} = 3 \times 6 = 18$

$\updownarrow$

SU(2) + 1 flavor + SCFT[E_6]

- $k_{\mathrm{U}(1)} = 2 \times 1 \times q^2 \longrightarrow q = 3$

Matching Seiberg-Witten curves

Argyres & Seiberg studied the SW curve on the both sides, and found

Curve of **SU(3)** theory with generic masses $\sum_i m_i Q^i \tilde{Q}_i$

at $\tau \to 1$

$\supset$ Curve of **SCFT**[E_6] with masses to **SU(6)** $\subset E_6$

I won't (can't) explain it today ...

Another example: E_7

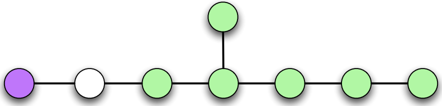
USp(4) + 12 half-hypers in 4

- $\dim(\mathrm{tr}\,\phi^2) = 2, \quad \dim(\mathrm{tr}\,\phi^4) = 4$
- $k_{SO(12)} = 8$

$\updownarrow$

SU(2) w/ SCFT[E_7]

- $\dim(\mathrm{tr}\,\phi^2) = 2$ from SU(2), $\dim(u) = 4$ from SCFT[E_7]
- $SU(2) \times SO(12) \subset E_7$
- $k_{SU(2)\subset E_7} = 8$



	$\mathfrak{g}$ w/ $\mathbf{r}$		= $\widetilde{\mathfrak{g}}$ w/ $\widetilde{\mathbf{r}}$		⊕ SCFT$[d : \mathfrak{h}]$
1.	sp(3)	$\mathbf{14} \oplus 11 \cdot \mathbf{6}$	= sp(2)		$[6 : E_8]$
2.	su(6)	$\mathbf{20} \oplus \mathbf{15} \oplus \overline{\mathbf{15}} \oplus 5 \cdot \mathbf{6} \oplus 5 \cdot \overline{\mathbf{6}}$	= su(5)	$\mathbf{5} \oplus \overline{\mathbf{5}} \oplus \mathbf{10} \oplus \overline{\mathbf{10}}$	$[6 : E_8]$
3.	so(12)	$3 \cdot \mathbf{32} \oplus \mathbf{32}' \oplus 4 \cdot \mathbf{12}$	= so(11)	$3 \cdot \mathbf{32}$	$[6 : E_8]$
4.	G_2	$8 \cdot \mathbf{7}$	= su(2)	$\mathbf{2}$	$[6 : \mathrm{sp}(5)]$
5.	so(7)	$4 \cdot \mathbf{8} \oplus 6 \cdot \mathbf{7}$	= sp(2)	$5 \cdot \mathbf{4}$	$[6 : \mathrm{sp}(5)]$
6.	su(6)	$\mathbf{21} \oplus \overline{\mathbf{21}} \oplus \mathbf{20} \oplus \mathbf{6} \oplus \overline{\mathbf{6}}$	= su(5)	$\mathbf{10} \oplus \overline{\mathbf{10}}$	$[6 : \mathrm{sp}(5)]$
7.	sp(2)	$12 \cdot \mathbf{4}$	= su(2)		$[4 : E_7]$
8.	su(4)	$2 \cdot \mathbf{6} \oplus 6 \cdot \mathbf{4} \oplus 6 \cdot \overline{\mathbf{4}}$	= su(3)	$2 \cdot \mathbf{3} \oplus 2 \cdot \overline{\mathbf{3}}$	$[4 : E_7]$
9.	so(7)	$6 \cdot \mathbf{8} \oplus 4 \cdot \mathbf{7}$	= G_2	$4 \cdot \mathbf{7}$	$[4 : E_7]$
10.	so(8)	$6 \cdot \mathbf{8} \oplus 4 \cdot \mathbf{8}' \oplus 2 \cdot \mathbf{8}''$	= so(7)	$6 \cdot \mathbf{8}$	$[4 : E_7]$
11.	so(8)	$6 \cdot \mathbf{8} \oplus 6 \cdot \mathbf{8}'$	= G_2		$[4 : E_7] \oplus [4 : E_7]$
12.	sp(2)	$6 \cdot \mathbf{5}$	= su(2)		$[4 : \mathrm{sp}(3) \oplus \mathrm{su}(2)]$
13.	sp(2)	$4 \cdot \mathbf{4} \oplus 4 \cdot \mathbf{5}$	= su(2)	$3 \cdot \mathbf{2}$	$[4 : \mathrm{sp}(3) \oplus \mathrm{su}(2)]$
14.	su(4)	$\mathbf{10} \oplus \overline{\mathbf{10}} \oplus 2 \cdot \mathbf{4} \oplus 2 \cdot \overline{\mathbf{4}}$	= su(3)	$\mathbf{3} \oplus \overline{\mathbf{3}}$	$[4 : \mathrm{sp}(3) \oplus \mathrm{su}(2)]$
15.	su(3)	$6 \cdot \mathbf{3} \oplus 6 \cdot \overline{\mathbf{3}}$	= su(2)	$2 \cdot \mathbf{2}$	$[3 : E_6]$
16.	su(4)	$4 \cdot \mathbf{6} \oplus 4 \cdot \mathbf{4} \oplus 4 \cdot \overline{\mathbf{4}}$	= sp(2)	$6 \cdot \mathbf{4}$	$[3 : E_6]$
17.	su(3)	$\mathbf{3} \oplus \overline{\mathbf{3}} \oplus \mathbf{6} \oplus \overline{\mathbf{6}}$	= su(2)	$n \cdot \mathbf{2}$	$[3 : \mathfrak{h}]$

Table 2: Predicted dualities with one marginal operator.

Central charges:

$$\langle T^\mu_\mu \rangle = a \cdot \text{Euler} + c \cdot \text{Weyl}^2$$

calculable for **SCFT[$E_{6,7}$]** using

- **SU(3)** w/ 6 flavors ↔ **SU(2)** + 1 flavor + **SCFT[E_6]**
- **USp(4)** w/ 12 flavors ↔ **SU(2)** + **SCFT[E_7]**

We performed holographic calculation for **SCFT[$E_{6,7,8}$]**

G	E_6	E_7	E_8
k_G	6	8	12
$24a$	41	59	95
$6c$	13	19	31

It was done before publication of [Argyres-Wittig]

Perfectly agreed ! Power of string theory.

Contents

Objective

- Argyres & Seiberg studied the story on the Coulomb branch side.
- I wanted to know the Higgs branch side of the story.

Objective

- Argyres & Seiberg studied the story on the Coulomb branch side.
- I wanted to know the Higgs branch side of the story.
- I have two friends who are experts on hyperkähler things !

$\mathcal{N} = 1$ Seiberg duality

SU(N) w/ N_f flavors q^i, $\tilde{q}_j$

- $m^i_j = q^i_a \tilde{q}^b_j$
- $b^{i_1 i_2 \cdots i_{N_f}} = \epsilon^{a_1 a_2 \ldots a_N} q^{i_1}_{a_1} q^{i_2}_{a_2} \cdots q^{i_N}_{a_N}$
- $\tilde{b}_{i_1 i_2 \cdots i_{N_f}} = \epsilon_{a_1 a_2 \ldots a_N} \tilde{q}^{a_1}_{i_1} \tilde{q}^{a_2}_{i_2} \cdots \tilde{q}^{a_N}_{i_N}$

⇕

SU(N') w/ N_f flavors Q_i, $\tilde{Q}^i$

- w/ singlets $M^i_{j'}$, $W = Q_i \tilde{Q}^j M^i_j$
- $N' = N - N_f$
- $B_{j_1 j_2 \cdots j_{N'}} = \epsilon_{a_1 a_2 \ldots a_{N'}} Q^{a_1}_{j_1} Q^{a_2}_{j_2} \cdots Q^{a_{N'}}_{j_{N'}}$
- $\tilde{B}^{j_1 j_2 \cdots j_{N'}} = \epsilon^{a_1 a_2 \ldots a_{N'}} \tilde{Q}^{j_1}_{a_1} \tilde{Q}^{j_2}_{a_2} \cdots \tilde{Q}^{j_{N'}}_{a_{N'}}$

$\mathcal{N} = 1$ Seiberg duality

Mapping of operators:

$$m^i_j = q^i \tilde{q}_j \leftrightarrow M^i_j$$
$$b^{i_1 i_2 \cdots i_N} \leftrightarrow \epsilon^{i_1 i_2 \cdots i_N j_1 \ldots j_{N'}} B_{j_1 j_2 \cdots j_{N_f - N_c}}$$
$$\tilde{b}_{i_1 i_2 \cdots i_{N_f}} \leftrightarrow \epsilon_{i_1 i_2 \cdots i_{N_f} j_1 \ldots j_{N'}} \tilde{B}^{j_1 j_2 \cdots j_{N'}}$$

Mapping of constraints:

$$m^{[i}_j b^{i_1 \cdots i_N]} = 0 \qquad (\tilde{q}^a_j q^i_{[a} q^{i_1}_{a_1} \cdots q^{i_N}_{a_N]} = 0)$$
$$\rightarrow \quad M^{i_1}_j B_{i_1 \ldots i_{N'}} = 0 \qquad (M^i_j Q^a_i = 0)$$

etc.

Computation of moduli space, $\mathcal{N} = 1$

$$\frac{\{F = 0, D = 0\}}{G} = \frac{\{F = 0\}}{G_{\mathbb{C}}}$$

Basically:

- List gauge-invariant chiral operators
- Impose F-term = 0
- Study the constraints

Computation of moduli space, $\mathcal{N}=2$

$$\frac{\{F^A=0, D^A=0\}}{G}=\frac{\{F^A=0\}}{G_{\mathbb{C}}}$$

- $W=Q\Phi\tilde{Q}$ → $F^A=t^A_{a\bar{a}}Q^a\tilde{Q}^{\bar{a}}$
- $F^A=D^A=0$ imposes **3 dim** G conditions
- $/G$ removes another **dim** G
- → loose **4 dim** G dimensions

Dimensions

SU(3) + 6 flavors Q^i, $\tilde{Q}_i$

$$4 \times 3 \times 6 - 4\,\text{dim}\,\text{SU}(3) = 40$$

$\updownarrow$

SU(2) + 1 flavor $q, \tilde{q}$ +SCFT[E_6]

$$4 \times 2 + ???? - 4\,\text{dim}\,\text{SU}(2)$$

Higgs branch of SCFT[E_6]

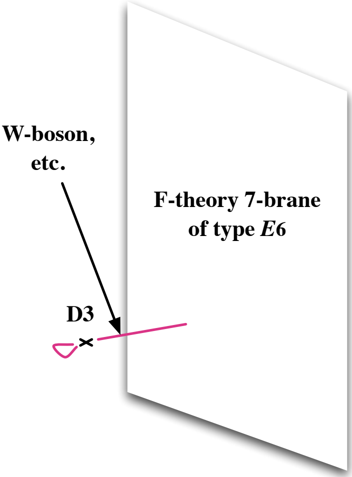
D3 brane absorbed into the 7-brane

$\longrightarrow$ becomes an instanton of type E_6 !

Center of mass along the 7-brane decoupled .

$$\text{dim(centered } k\text{-instanton moduli)}$$
$$= 4h_{E_6}k - 4$$

$$k = 1,\ h_{E_6} = 12 \longrightarrow \text{dim} = 44$$



Dimensions

SU(3) + 6 flavors $Q^i, \tilde{Q}_i$

$$4 \times 3 \times 6 - 4 \dim SU(3) = 40$$

$\Updownarrow$

SU(2) + 1 flavor $q, \tilde{q}$ +SCFT[E_6]

$$4 \times 2 + 44 - 4 \dim SU(2) = 40$$

Operators

SU(3) + 6 flavors Q^i, $\tilde{Q}_i$

- $M^i_j = Q^i_a \tilde{Q}^a_j$
- $B^{[ijk]} = \epsilon^{abc} Q^i_a Q^j_b Q^k_c$
- $\tilde{B}_{[ijk]} = \epsilon_{abc} \tilde{Q}^a_i \tilde{Q}^b_j \tilde{Q}^c_k$
- Lots of constraints.

$\Updownarrow$

SU(2) + 1 flavor $q, \tilde{q}$ +SCFT[E_6]

- ??? $\longrightarrow$ Need to know more about the E_6 instanton moduli space.
- But how? We don't have ADHM for exceptional groups...

One-instanton moduli

- Any one-instanton of G is an embedding of the $\mathbf{SU(2)}$ BPST instanton via $\mathbf{SU(2)} \subset G$
- Space equivalent to a subspace of $g_{\mathbb{C}}$, minimal nilpotent orbit

$$G_{\mathbb{C}} \cdot T^{\rho}, \qquad \rho : \text{highest root}$$

- Equations explicitly known. Just quadratic. [Joseph,Kostant]
- Let $V(\alpha)$: irrep with highest weight α, and $g_{\mathbb{C}} = V(\rho)$.
- Decompose

$$\mathsf{Sym}^2 V(\rho) = V(2\rho) \oplus \mathcal{I}$$

then

$$\{G_{\mathbb{C}} \cdot T^{\rho}\} = \{\mathbb{X} \in g_{\mathbb{C}} \big| \quad (\mathbb{X} \otimes \mathbb{X})\big|_{\mathcal{I}} = 0\}$$

One-instanton moduli of SU(2)

- Equations explicitly known. Just quadratic. [Joseph,Kostant]
- Let $V(\alpha)$: irrep with highest weight α, and $g_{\mathbb{C}} = V(\rho)$.
- Decompose

$$\mathrm{Sym}^2 V(\rho) = V(2\rho) \oplus \mathcal{I}$$

then

$$\{G_{\mathbb{C}} \cdot T^{\rho}\} = \{\mathbb{X} \in g_{\mathbb{C}} \big| \quad (\mathbb{X} \otimes \mathbb{X})\big|_{\mathcal{I}} = 0\}$$

- Parametrize **su(2)** by $x_{1,2,3}$
- $\mathbf{Sym^2\,3 = 5 \oplus 1}$
- $x_1^2 + x_2^2 + x_3^2 = 0$: just $\mathbb{C}^2/\mathbb{Z}_2$.

One-instanton moduli of E_6

$$\mathbb{X} \in \mathbf{adj}(E_6), \qquad (\mathbb{X} \otimes \mathbb{X})\big|_{\mathcal{I}} = 0$$

- We couple **SU(2)** gauge field Φ to $\mathbb{X}$.
- Convenient to decompose under $\mathbf{SU(2)} \times \mathbf{SU(6)} \subset \mathbb{X}$

$$X^i_j, \quad Y^{[ijk]}_\alpha, \quad Z_{(\alpha\beta)}$$

- Superpotential is $W = \Phi^{\alpha\beta} Z_{\alpha\beta}$.

Operators

SU(3) + 6 flavors Q^i, $\tilde{Q}_i$

- $M^i_j = Q^i_a \tilde{Q}^a_j \longrightarrow$ tr M, $\hat{M}^i_j$
- $B^{[ijk]} = \epsilon^{abc} Q^i_a Q^j_b Q^k_c$, $\qquad \tilde{B}_{[ijk]} = \epsilon_{abc} \tilde{Q}^a_i \tilde{Q}^b_j \tilde{Q}^c_k$

$$\Updownarrow$$

SU(2) + 1 flavor $v, \tilde{v}$ +SCFT[E_6]

- X^i_j, $\quad Y^{[ijk]}_\alpha$, $\quad Z_{(\alpha\beta)}$
- F-term=0 $\longrightarrow$ $Z_{(\alpha\beta)} + v_{(\alpha} \tilde{v}_{\beta)} = 0$
- $\hat{M}^i_j = X^i_j$
- $M = \epsilon^{\alpha\beta} v_\alpha \tilde{v}_\beta$
- $B^{[ijk]} = \epsilon^{\alpha\beta} v_\alpha Y^{ijk}_\beta$, $\qquad \tilde{B}^{[ijk]} = \epsilon^{\alpha\beta} \tilde{v}_\alpha Y^{ijk}_\beta$

U(1) charge

$$B^{[ijk]} = \epsilon^{abc} Q_a^i Q_b^j Q_c^k \qquad \tilde{B}_{[ijk]} = \epsilon_{abc} \tilde{Q}_i^a \tilde{Q}_j^b \tilde{Q}_k^c$$

$$B^{[ijk]} = \epsilon^{\alpha\beta} v_\alpha Y_\beta^{ijk} \qquad \tilde{B}^{[ijk]} = \epsilon^{\alpha\beta} \tilde{v}_\alpha Y_\beta^{ijk}$$

U(1) charge of Q: 1 → U(1) charge of v: 3

SU(3) + 6 flavors

- $k_{\mathrm{U(1)}} = 3 \times 6 = 18$

SU(2) + 1 flavor + SCFT[E_6]

- $k_{\mathrm{U(1)}} = 2 \times 1 \times (\text{charge of } v)^2$ → charge of v = 3

Constraints

Constraints of min. nilpotent orbit $E_{6,\mathbb{C}} \cdot T^\rho$

$$(\mathbb{X} \otimes \mathbb{X})\big|_{\mathcal{I}} = 0 \text{ where } \mathrm{Sym}^2\, V(\rho) = V(2\rho) \oplus \mathcal{I}$$

- We decompose $\mathbb{X} = (X^i_j, Y^{[ijk]}_\alpha, Z_{(\alpha\beta)})$
- Decompose $\mathcal{I}$ under $SU(2) \times SU(6)$
- Coefficients laboriously fixed

Constraints

$$0 = X^i{}_j Z_{\alpha\beta} + \frac{1}{4} Y^{ikl}_{(\alpha} Y_{jkl\beta)},$$

$$0 = X^l{}_{\{i} Y_{[jk]\}l\alpha},$$

$$0 = X^{\{i}{}_l Y_\alpha^{[jk]\}l},$$

$$0 = Y_\alpha^{ijk} Z_{\beta\gamma} \epsilon^{\alpha\beta} + X^{[i}{}_l Y_\gamma^{jk]l},$$

$$0 = (Y_\alpha^{ijm} Y_{klm\beta} \epsilon^{\alpha\beta} - 4 X^{[i}{}_{[k} X^{j]}{}_{l]}) \Big|_{0,1,0,1,0},$$

$$0 = X^i{}_k X^k{}_j - \frac{1}{6} \delta^i{}_j X^k{}_l X^l{}_k,$$

$$0 = Y_\alpha^{ijk} Y_{ijk\beta} \epsilon^{\alpha\beta} + 24 Z_{\alpha\beta} Z_{\gamma\delta} \epsilon^{\alpha\gamma} \epsilon^{\beta\delta},$$

$$0 = X^i{}_j X^j{}_i + 3 Z_{\alpha\beta} Z_{\gamma\delta} \epsilon^{\alpha\gamma} \epsilon^{\beta\delta}.$$

Constraints

F-term eq.

$$Z_{(\alpha\beta)} + v_{(\alpha}\tilde{v}_{\beta)} = 0.$$

Identifications

$$\hat{M}^i_j = X^i_j, \qquad \mathrm{tr}\, M = \epsilon^{\alpha\beta} v_\alpha \tilde{v}_\beta$$
$$B^{[ijk]} = \epsilon^{\alpha\beta} v_\alpha Y^{ijk}_\beta$$

$$0 = X^i_k X^k_j - \frac{1}{6}\delta^i_j X^k_l X^l_k,$$
$$0 = X^i_j X^j_i + 3 Z_{\alpha\beta} Z_{\gamma\delta} \epsilon^{\alpha\gamma}\epsilon^{\beta\delta},$$
$$0 = Y^{ijk}_\alpha Z_{\beta\gamma}\epsilon^{\alpha\beta} + X^{[i}_l Y^{jk]l}_\gamma$$

$\rightarrow$

$$\hat{M}^i_j \hat{M}^j_k = \frac{1}{6}\delta^i_j M^m_n M^n_m,$$
$$\hat{M}^i_j \hat{M}^j_i = \frac{1}{6}(\mathrm{tr}\, M)^2,$$
$$\hat{M}^{[i}_j B^{kl]j} = \frac{1}{6}(\mathrm{tr}\, M) B^{ikl},$$

Constraints

$$W = Q^i \Phi \tilde{Q}_i \longrightarrow Q^i_a \tilde{Q}^b_i - \frac{1}{3}\delta^b_a Q^i_c \tilde{Q}^c_i = 0 \longrightarrow$$

$$M^i_j M^j_k = \frac{1}{3}(\mathrm{tr}\, M) M^i_k, \qquad M^{[i}_j B^{kl]j} = \frac{1}{3}(\mathrm{tr}\, M) B^{ijk}, \quad \text{etc.}$$

$$\hat{M}^i_j \hat{M}^j_k = \frac{1}{6}\delta^i_j \hat{M}^m_n \hat{M}^n_m,$$

$$\hat{M}^i_j \hat{M}^j_i = \frac{1}{6}(\mathrm{tr}\, M)^2,$$

$$\hat{M}^{[i}_j B^{kl]j} = \frac{1}{6}(\mathrm{tr}\, M) B^{ikl}, \ldots$$

Contents

Summary

Done

- Argyres-Seiberg duality reviewed.
- Higgs branches compared for E_6 $\longrightarrow$ Perfect agreement !

Summary

Done

- Argyres-Seiberg duality reviewed.
- Higgs branches compared for E_6 $\longrightarrow$ Perfect agreement !

To do

- Other cases E_7 ?
- String theoretic realization of the duality