Factorised 3d $\mathcal{N} = 4$ orthosymplectic quivers

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Why 3d $\mathcal{N} = 4$?

Challenging

Gauge theories in 3 spacetime dimensions are strongly coupled in IR. Determining their low energy dynamics is therefore challenging in general.

Interesting

- play a central roll in string theory, they capture low energy dynamics of intersecting brane systems in type IIB.
- encode information about the Higgs branch of SCFTs (and gauge theories) in 4,5 and 6 dimensions ("magnetic quivers").
- intrinsically interesting: enhancement of global symmetry, mirror symmetry, geometry of the moduli space

Doable

Due to the amount of supersymmetry (8 supercharges) we can compute and understand many aspects of these theories. Relevant to my talk is the algebraic description of the moduli space (cf Kirsty's talk)

3d $\mathcal{N}=4$

SUSY REPS: V-plet : $A_\mu + 3\,\vec{\Phi}$ (+ fermions).

H-plet : $4\,\varphi$ (+ fermions).

3d $\mathcal{N}=4$ thy is specified by: - gauge group G $\leftrightarrow$ V-plet in Adj of G

- Matter rep. R $\leftrightarrow$ H-plet in R of G.

Moduli Space of Vacua: (classical) (Quantum)

$\mathcal{M}_C$ parameterised by $\langle \vec{\Phi} \rangle$ $\rightsquigarrow$ dressed monopole operators.

$\mathcal{M}_H$ = = $\langle \varphi \rangle$ $\rightsquigarrow$ not renormalized.

Mirror Symmetry

Recall: 4d A_μ: 2 d.o.f.
3d A_μ: 1 d.o.f. $\rightsquigarrow A_\mu \longleftrightarrow \sigma$ "dual photon"

Proof: $\int \mathcal{D}A\, e^{i\int F\wedge *F} = \int \mathcal{D}F\, \mathcal{D}\sigma\, e^{i\int F\wedge *F + \sigma\wedge dF} = \int \mathcal{D}\sigma\, e^{i\int d\sigma\wedge *d\sigma}$

e.o.m. for σ: $dF=0$ (Bianchi)

Lesson: after replacing $A_\mu \longleftrightarrow \sigma$ V-plet $\longleftrightarrow$ H-plet (twisted)

Mirror Map:

$\mathcal{M}_C \longleftrightarrow \mathcal{M}_H$

F.I. parameters $\longleftrightarrow$ masses

⋮

Generalization to include charged matter: abelian mirror symmetry

E.g. U(1) + charge 1 H-plet $\longleftrightarrow$ free H-plet

,

U(1) + 2 charge 1 H-plet $\longleftrightarrow$ U(1)+2 charge 1 H-plet

Magnetic Quivers

idea:

same theory

$\mathcal{H}\left(T^{5d}_{SCFT}\right)$ ⟷ $\mathcal{H}\left(\hat{T}^{5d}_{SCFT}\right)$

UV-duality

or accidental isomorphisms

T^2 ↓

$\mathcal{H}\left(\text{3d non-Lagrangian thy}\right)$

mirror symmetry ↕ S-duality

$\mathcal{C}^{3d}\left(MQ(T^{SCFT}_{5d})\right)$ ⟷ $\mathcal{C}^{3d}\left(\hat{MQ}(T^{SCFT}_{5d})\right)$

by construction

Remarks:

1) not limited to SCFTs
2) " " " 5d

$\mathcal{H}\left(\hat{T}^{5d}_{SCFT}\right)$ ↓ T^2

$\mathcal{H}\left(\text{3d non-Lagrangian thy}\right)$

mirror symmetry ↕ S-duality

can use algebraic description of $\mathcal{C}^{3d}$ to learn about $\mathcal{H}^{5d}$

Q: Is $MQ = \hat{MQ}$ or just $\mathcal{C}^{3d}(MQ) = \mathcal{C}^{3d}(\hat{MQ})$

5d SCFTs

$\rightsquigarrow \exists$ interacting UV F.P's of RG in 5d.

$\rightsquigarrow$ Many admit relevant deformation $\longrightarrow$ IR Gauge thy.

$\rightsquigarrow$ These SCFT's can be engineered using brane webs in IIB.

$\rightsquigarrow \exists$ algorithm to extract $\mathcal{MQ}(T_{5d}^{SCFT})$ given its brane web.

[M.A.-Carta-Dwivedi-Hayashi-Kim-Yagi].

5brane webs w/ O5-plane w/out O5-plane

arthasymplectic $\mathcal{MQ}$ Unitary $\mathcal{MQ}$.

Factorised 3d $\mathcal{N}=4$ Quivers.

Idea: Recall the accidental isomorphism $so(4) \simeq sq(2) \oplus su(2)$. $sq(2)$

$so(4)$ has 2 spinor reps, each has dim 2. Denote them by $\underline{s}, \underline{c}$

$$\to so(4) + m\,\underline{s} + n\,\underline{c} \simeq \underset{+m\,\underline{2}}{su(2)} \oplus \underset{+n\,\underline{2}}{su(2)}$$

$g^2_{YM} \to \infty$ on the $so(4)$ side; $g^2_{YM} \to \infty$ on each $su(2)$ side.

$$\to E_{m+1} \oplus E_{n+1} \quad \text{SCFT}.$$

$$MQ\left(so(4)+m\,\underline{s}+n\,\underline{c}\right) \simeq MQ\left(\underset{+m\,\underline{2}}{su(2)}\right) \otimes MQ\left(\underset{+n\,\underline{2}}{su(2)}\right)$$

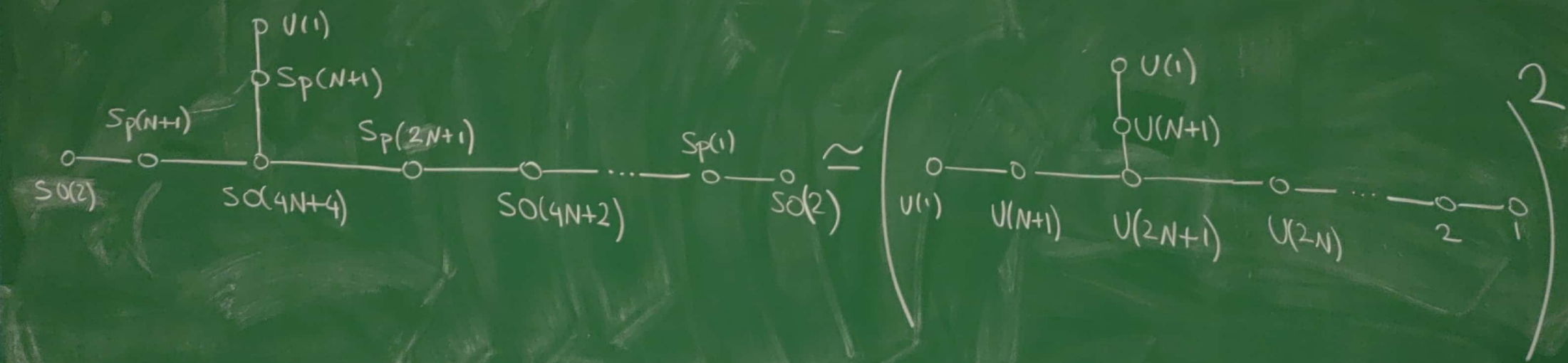
"Factorisation"

OSp $\quad$ $\mathcal{N}$ $\quad$ $\mathcal{N}$

Factorised 3d $\mathcal{N}=4$ Quivers.

$E_{m+1} \times E_{n+1}$ sequences: Single connected OSp quiver $\longleftrightarrow$ (generically) Single connected U-quiver $\otimes$ Single connected U-quiver.

Example: $E_6 \times E_6$ sequence:



Discussion

- I discussed the factorisation of certain 3d $\mathcal{N} = 4$ OSp quivers
- Intuitive origin in terms of 5d magnetic quiver perspective
- Can be made more convining by matching RG invariants - the content of our forthcoming paper
- Relation to Class S - series of papers on factorised Class S theories
- An intrinsically 3d understanding/intuition?

Thank you for your attention!