M. Yamazaki
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Drukker Gaiotto Gomis 1003

Hosomichi Lee Park 1009

Terashima-Y 1103

" 1106

Dimofte-Gukov 1106

A_1 $SU(2)$

6d $(2,0)$

Σ

4d $\mathcal{N}=2$ SCFT on $S^3 \times I$

τ = complexified gauge coupling

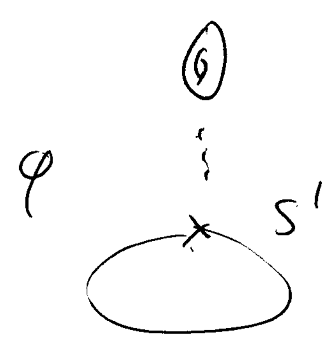
3d Chern-Simons SL_2 on $M_3 = \Sigma \times I$ + b.c. or $(\Sigma \times S^1)_\varphi$

2d Liouville on Σ

1/2 BPS duality domain wall

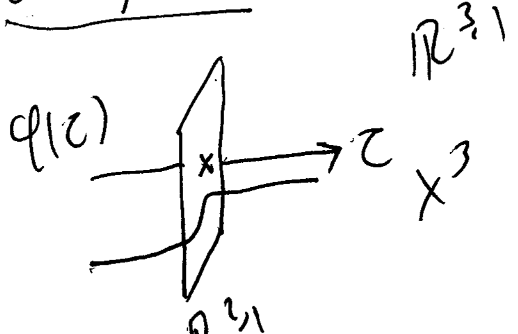
$\cup$

3d $\mathcal{N}=2$ SCFT on S^3



- Σ = punctured Riemann surface
- $\varphi \in MCG(\Sigma)$ = (S-duality in 4d)

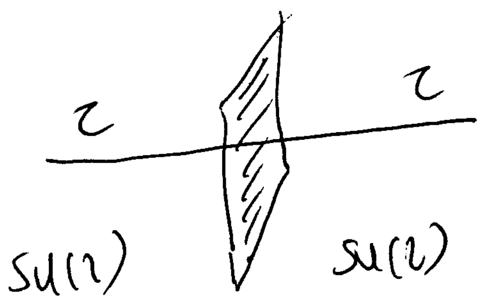
<u>duality wall</u>



Janus

$\circlearrowleft \varphi^{-1}$

3d theory

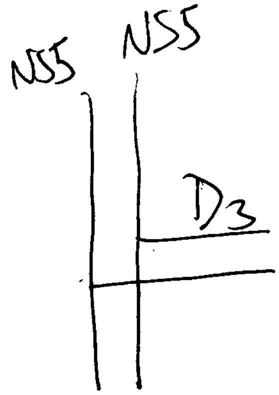


$T[SU(2); \varphi]$

$SU(2) \times SU(2)$ global symmetry

e.g. $\Sigma = T^{2,1}$, $T[SU(2); S]$

= 3d $\mathcal{N}=4$ SQED w/ 2 flavors



$U(1) - \boxed{2}$

gauge   global

$$S^3_b = \{ b^2(x_1^2 + x_2^2) + b^{-2}(x_3^2 + x_4^2) = 1 \}$$

$\Sigma = T^2$ has $MCG(\Sigma) = PSL(2,\mathbb{Z})$

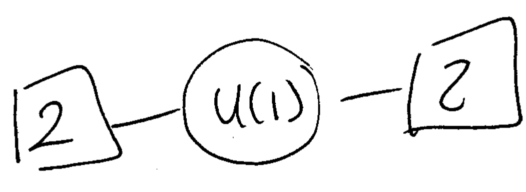
$$S = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \quad T = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$$

$\varphi = ST^k$

CS term.

ST^kS

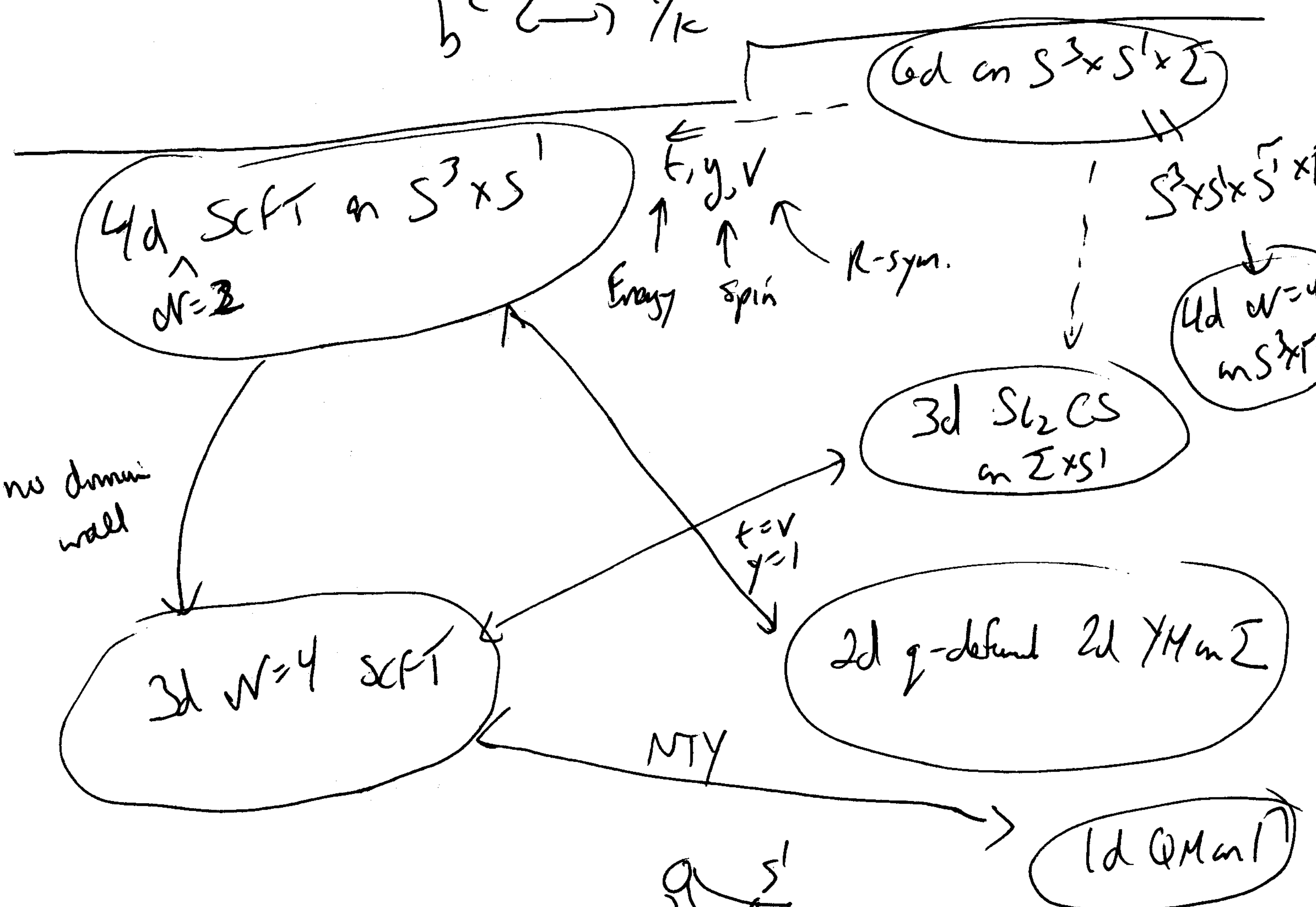
$\left(\varphi = T^k:\ \tau \to \tau + k,\ \delta\theta = 2\pi k\right)$



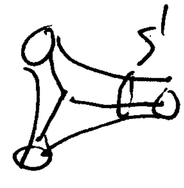
$\varphi = ST^kST^l$

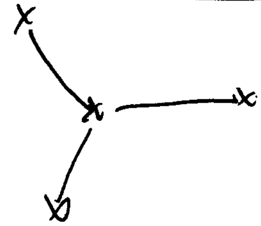
$$Z_{T[SU(2);\varphi]}\left[S^3_b\right]_{(m,m')} = Z_{\substack{3d\ CS \\ SL(2,\mathbb{R})}}\left[M_3\right]_{(l,l')}$$

$$b^2 \longleftrightarrow 1/k$$



$\Sigma = \tilde{\Gamma\times S^1}$





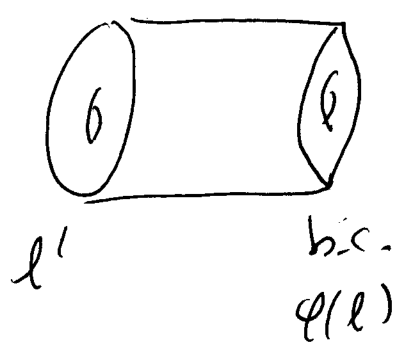
$$t = e^{-\beta/3}, \quad y = e^{-\beta\eta}, \quad v = e^{-\frac{\beta}{3}(1+u)}$$

$\eta = b \qquad u = ?$

2. $\varphi_{\alpha\alpha'} = \langle \alpha | \hat{\varphi} | \alpha' \rangle$

$\hat{\varphi} \circlearrowleft \mathcal{H}_T$: $|\alpha\rangle$ complete basis

3. CS



4d $\mathcal{N}=2^*$ $\Sigma^{1,1}$ $(b \to 0)$ m

$$Z_{3d}[S^3_b] = Tr(\hat{\varphi})$$

$$\int dx \, \exp\left[\frac{1}{2\pi i b^2} V(\vec{x}; m) \right]$$

X: Fock coordinates

$\frac{\partial V}{\partial x} = 0$ at $x = x^*$. $V|_{x=x^*} = vol(M_3) + i\, S(M_3)$