

$$\begin{aligned}
& \mathcal{N} = \\
& \mathcal{O}_Z = Z^L, \mathcal{O}_X = X^L, Z = \phi_3 + i \phi_6, X = \phi_1 + i \phi_4 \\
(1) \quad & \begin{aligned} & \text{gauge} \\ & \text{fix-} \\ & \text{ing,} \\ & \text{mass} \\ & \text{mix} \\ & \text{di-} \\ & \text{ag-} \\ & \text{o-} \\ & \text{nal-} \\ & \text{iza-} \\ & \text{tion} \\ & \text{etc.} \\ & \mathcal{O}_Z \\ & \mathcal{O}_X \\ & \text{chiral-} \\ & \text{pri-} \\ & \text{mary} \\ & \text{op-} \\ & \text{er-} \\ & \text{q-} \\ & \text{tors} \\ & \text{super-} \\ & \text{con-} \\ & \text{for-} \\ & \text{mal} \\ & \text{pri-} \\ & \text{mary} \end{aligned} \\
& [D, \mathcal{O}(0)] = -i \Delta \mathcal{O}(0), [S^a_\alpha, \mathcal{O}(0)] = 0, [\bar{S}_{a\dot{\alpha}}, \mathcal{O}(0)] = 0
\end{aligned}$$

$$\begin{aligned}
(2) \quad & \begin{aligned} & S^a_\alpha \\ & K^\alpha_\mu \\ & D \\ & \text{scale} \\ & \text{trans-} \\ & \text{for-} \\ & \text{ma-} \\ & \text{tions} \\ & Q^a_\alpha \\ & \bar{P}^\alpha_\mu \end{aligned}
\end{aligned}$$

$$\begin{aligned}
& \exists a \in \{1, \dots, \mathcal{N}\} \exists \alpha \in \{1, 2\} : [Q^a_\alpha, \mathcal{O}(0)] = 0 \\
(3) \quad & \begin{aligned} & \text{??} \\ & \Delta \\ & \mathfrak{g} \\ & \text{psu}(2, 2|4) \\ & ? \end{aligned}
\end{aligned}$$

$$\begin{aligned}
& \{Q^a_\alpha, S_{b\beta}\} = -\frac{i}{2} \varepsilon_{\alpha\beta} (\sigma^{IJ})^a{}_b R_{IJ} - \frac{1}{2} \varepsilon_{\alpha\beta} \delta^a{}_b D + (\sigma^{\mu\nu})_{\alpha\beta} \delta^a{}_b M_{\mu\nu} \\
(4) \quad & \begin{aligned} & (\sigma^{IJ})^a{}_b \\ & SU(4) \\ & R_{IJ} \\ & SO(6) \\ & M_{\mu\nu} \\ & SO(3, 1) \\ & \mathcal{O} \\ & [M_{\mu\nu}, \mathcal{O}(0)] = \\ & 0 \\ & \text{??} \\ & \{ \\ & \quad a \\ & \quad \alpha, S_{b\beta}\}, \mathcal{O}(0)] = \\ & [-i \varepsilon_{\alpha\beta} (\sigma^{IJ})^a{}_b R_{IJ} - \\ & \varepsilon_{\alpha\beta} \delta^a{}_b D, \mathcal{O}(0)] = \\ & 0 \end{aligned}
\end{aligned}$$

$$\begin{aligned}
& \Leftrightarrow (\sigma^{IJ})^a{}_b [R_{IJ}, \mathcal{O}(0)] = \Delta \delta^a{}_b \mathcal{O}(0) \\
(5) \quad & \begin{aligned} & \mathcal{O} \\ & \text{??} \\ & \mathcal{O} \\ & \text{??} \end{aligned}
\end{aligned}$$

$$\begin{aligned}
& [[\mathcal{O}(0), Q^a_\alpha], S_{b\beta}] = 0 \Rightarrow [\mathcal{O}(0), Q^a_\alpha] = 0 \\
(6) \quad & \begin{aligned} & Q^a_\alpha \\ & \mathcal{O} \\ & 1/2 \\ & S_{b\beta} \end{aligned}
\end{aligned}$$

$$(J_1,0,0)$$

$$\Delta_J=$$

$$Q_{3,\dot\alpha}$$

$$\bar{Q}_{4,\dot\alpha}$$

$$psu(2,2|4)$$

$$??$$

$$(9) \quad \{\bar{Q}_{a\dot{\alpha}},\bar{S}^b_{\dot{\beta}}\}=\frac{i}{2}\,\varepsilon_{\dot{\alpha}\dot{\beta}}(\sigma^{IJ})_a{}^b\,R_{IJ}-\frac{1}{2}\varepsilon_{\dot{\alpha}\dot{\beta}}\delta_a{}^bD+(\sigma^{\mu\nu})_{\dot{\alpha}\dot{\beta}}\delta_a{}^b\,M_{\mu\nu}$$

$$(10) \quad \Leftrightarrow (\sigma^{IJ})_a{}^b\,[R_{IJ},\mathcal{O}(0)]=-\Delta\,\delta_a{}^b\,\mathcal{O}(0)$$

$$(J_1,0,0)$$

$$\Delta=$$

$$J_1=$$

$$1/2-$$

$$BPS$$

$$\mathcal{O}^{\mathcal{P}}_{\mathcal{P}}$$

$$e^{\mathcal{P}}_{\mathcal{P}}$$

$$tors$$

$$(J_1,0,0)$$

$$(0,J_2,0)$$

$$(0,0,J_3)$$

$$??$$

$$\mathfrak{g}$$

$$\Delta$$

$$\mathcal{O}_Z$$

$$\mathcal{O}_X$$

$$\mathcal{X}$$

$$??$$

$$(11) \quad [R^{(0)}_{14},\mathcal{O}_X(0)]=L\,\mathcal{O}_X(0),\,[R^{(0)}_{36},\mathcal{O}_Z(0)]=L\,\mathcal{O}_Z(0)$$

$$[D^{(0)},\mathcal{O}_X(0)]=-i\,L\,\mathcal{O}_X(0),\,[D^{(0)},\mathcal{O}_Z(0)]=-i\,L\,\mathcal{O}_Z(0)$$

$$(12)$$

$$D^{(0)}$$

$$R^{(0)}_{IJ}$$

$$SO(6)$$

$$(L,0,0)$$

$$(0,0,L)$$

$$\Delta=$$

$$J_1=$$

$$L$$

$$\Delta=$$

$$J_3=$$

$$L$$

$$\mathcal{O}_Z$$

$$\mathcal{O}_X$$

$$\mathcal{N}=$$

$$4$$

$$\mathcal{O}_X$$

$$\mathcal{O}_Z$$

$$??$$

$$psu(2,2|4)$$

$$\mathcal{O}_X$$

$$\mathcal{O}_Z$$

$$(L,0,0)$$

$$(0,0,L)$$

$$\Delta=$$

$$L$$

$$\mathfrak{g}$$

$$SU(4)\simeq$$

$$SO(6)$$

$$\mathcal{O}_X$$

$$\mathcal{O}_Z$$

$$L$$

$$SO(6)$$

$$(13) \quad \mathcal{O}_X=\Phi_X^{i_1\cdots i_L}[\phi_{i_1}\cdots\phi_{i_L}],\mathcal{O}_Z=\Phi_Z^{i_1\cdots i_L}[\phi_{i_1}\cdots\phi_{i_L}]$$

$$\Phi_X^{i_1\cdots i_L}$$

$$\Phi_Z^{i_1\cdots i_L}$$

$$\mathcal{O}_Z$$

$$Z$$

$$\ell$$

$$\ell+$$

$$1$$

$$\begin{aligned} & \cdots Z(\phi_3+ \\ & i\phi_6)(\phi_3+ \\ & i\phi_6)Z\cdots \\ (14) \quad & =\cdots Z(\phi_3\phi_3-\phi_6\phi_6+i\phi_3\phi_6+i\phi_6\phi_3)Z\cdots \end{aligned}$$

$$\begin{aligned} & \Phi_Z^{\cdots 36\cdots} = \\ & \Phi_Z^{\cdots 63\cdots}, \Phi_Z^{\cdots 33\cdots} + \\ & \Phi_Z^{\cdots 66\cdots} = \\ & 0, \end{aligned}$$

$$\begin{aligned} & \Phi_Z^{\cdots i_\ell i_{\ell+1}\cdots} = 0 for i_\ell, i_{\ell+1} \neq 3, 6 \\ (15) \quad & ?? \\ & \Phi_Z^{i_1\cdots i_L} \end{aligned}$$

$$\begin{aligned} & \Phi_Z^{i_1\cdots i_\ell i_{\ell+1}\cdots i_L} = \Phi_Z^{i_1\cdots i_{\ell+1} i_\ell\cdots i_L}, \sum_{i_\ell=1}^6 \Phi_Z^{i_1\cdots i_\ell i_\ell\cdots i_L} = 0 \\ (16) \quad & \Phi_Z^{i_1\cdots i_L} \end{aligned}$$

$$\begin{aligned} & SO(2,1) \\ & \mathcal{O}_a^e(x)\mathcal{O}_b(y) \\ & |\vec{x}- \\ & \vec{y}| \\ & \vec{y} \\ & x_3,y_3> \\ & 0 \\ & |\vec{x}- \\ & \vec{y}| \\ (17) \quad & x=(\vec{x},x_3),\vec{x}=(x_0,x_1,x_2),|x-y|^2=|\vec{x}-\vec{y}|^2+|x_3-y_3|^2 \\ & \mathcal{O}_a(x)\mathcal{O}_b(y) \end{aligned}$$

$$\begin{aligned} & n_{\ell r-} \\ & ston \\ (18) \quad & x\rightarrow \tilde{x}=\frac{x}{|x|^2}\Rightarrow |x|\rightarrow |\tilde{x}|=\frac{|x|}{|x|^2}=\frac{1}{|x|}\Rightarrow \tilde{x}\rightarrow \frac{\tilde{x}}{|\tilde{x}|^2}=x \\ & SO(2,1) \end{aligned}$$

$$\begin{aligned} & \mathcal{O}_a(x)\mathcal{O}_b(y) \\ & con- \\ & for- \\ & mal \\ & tio \\ & \xi \\ & ?? \\ (19) \quad & |\tilde{x}-\tilde{y}|^2=\frac{|x-y|^2}{x^2y^2},\tilde{x}_3\tilde{y}_3=\frac{x_3y_3}{x^2y^2},\xi=\frac{|x-y|^2}{4x_3y_3}\Rightarrow \tilde{\xi}=\xi \\ & SO(1,1) \end{aligned}$$

$$\begin{aligned} & scale \\ & trans- \\ & for- \\ & ma- \\ & tions \\ (20) \quad & x\rightarrow \tilde{x}=\lambda x, \mathcal{O}_a(x)\rightarrow \tilde{\mathcal{O}}_a(x)=\lambda^{-\Delta_a}\mathcal{O}_a(\lambda^{-1}x) \\ & SO(4,2) \end{aligned}$$

$$\begin{aligned} & \Rightarrow \mathcal{O}_a(x)\mathcal{O}_b(y)=\frac{f_{ab}(\xi)}{(2x_3)^{\Delta_a}(2y_3)^{\Delta_b}} \\ (21) \quad & f_{ab}(\xi) \end{aligned}$$

$$\begin{aligned} & \xi \\ & \Delta \\ & f_{ab}(\xi) \\ & SO(4,2) \\ (22) \quad & \lim_{z_3\rightarrow\infty}\mathcal{O}_a(x+z)\bar{\mathcal{O}}_b(y+z)=\frac{M_{ab}}{|x-y|^{\Delta_a+\Delta_b}} \\ & \mathcal{N}= \end{aligned}$$

$$\begin{aligned} & A \\ & ?? \\ & f_{ab}(\xi) \\ & f_{ab}(\xi)=\xi^{-\frac{\Delta_a+\Delta_b}{2}}\left[M_{ab}+\sum_{n=1}^{\infty}c_{ab,n}\xi^n\right] \end{aligned}$$