U(1) superspace:

Natural to describe "new min" SG
and SG with gauged R-symmetry.

IN NEW MIN SG T_α TRANSFORMS AS A CONNECTION
IN OTHER CASES (MIN / NON-MIN SG) ONE MAY EXPECT
TO HIDE T_α INSIDE REDEFINED CONNECTION - U(1) AND SL(2, C)

$$A = E^a A_a + E^\alpha A_\alpha + \bar{E}^{\dot\alpha} \bar{A}_{\dot\alpha} = -A^*$$

to do not write "i"

ENTERS THE COV. DERIVATIVES

$$T^a = \mathcal{D}E^a = dE^a - E^b \wedge \omega_b{}^a$$
$$T^\alpha = \mathcal{D}E^\alpha = dE^\alpha - E^\beta \wedge (\omega_\beta{}^\alpha + A\,\delta_\beta{}^\alpha)$$
$$\bar{T}^{\dot\alpha} = \mathcal{D}\bar{E}^{\dot\alpha} = d\bar{E}^{\dot\alpha} - \bar{E}^{\dot\beta} \wedge (\omega_{\dot\beta}{}^{\dot\alpha} - A\,\delta_{\dot\beta}{}^{\dot\alpha})$$
$$R^{ab} = d\omega^{ab} - \omega^{ac} \wedge \omega_c{}^b$$
$$R^{\alpha\beta} = \frac{1}{4} R^{ab} (\sigma_{ab})^{\alpha\beta} = (\bar{R}^{\dot\alpha\dot\beta})^*$$
$$-\frac{1}{4} R^{ab} \tilde{\sigma}_{ab}{}^{\dot\alpha\dot\beta}$$

$$\mathcal{D}\mathcal{D}T^a = -E^b \wedge R_b{}^a, \qquad DR^{ab} = 0 \iff DR_\alpha{}^\beta = 0,\ D\bar{R}_{\dot\alpha}{}^{\dot\beta} = 0$$
$$\mathcal{D}\mathcal{D}T^\alpha = \underline{-E^\alpha \wedge F} - E^\beta \wedge R_\beta{}^\alpha$$
$$\mathcal{D}\mathcal{D}\bar{T}^{\dot\alpha} = \underline{+\bar{E}^{\dot\alpha} \wedge F} - \bar{E}^{\dot\beta} \wedge R_{\dot\beta}{}^{\dot\alpha}, \qquad dF = 0$$

CONSTRAINTS:

- IN USUAL SSP WE HAVE OBTAINED THESE BY SUPER-WEYL TR. FROM MIN SG ONES.
- THESE INCLUDE T_α WHICH WE HOPE TO MOVE TO THE U(1) CONNECTION $A_\alpha \to A_\alpha + T_\alpha$
- TO REMOVE $\tilde{T}_{ab}{}^a$ we need also some redefinition of the SO(1,3) CONNECTION.

IN PARTICULAR, A SIMPLE SET OF CONSTRAINTS INCLUDES $T_{ab}{}^c = 0$ INSTEAD OF OURS $R_{\alpha\dot\beta}{}^{ab} = 0$
(THUS WE WOULD HAVE $R_{\alpha\dot\beta}{}^{ab} \neq 0$) ($R_{\alpha\dot\beta}{}^{\gamma\delta} \sim G_{\dot\beta}{}^{(\gamma}\delta_\alpha^{\delta)}$)

- CONSTRAINTS FOR $F = dA$ INCLUDES $F_{\alpha\beta} = 0 = F_{\dot\alpha\dot\beta}$, which are NOT DAMAGED BY $A_\alpha \to A_\alpha + T_\alpha$ as far as $D_{(\alpha} T_{\beta)} = 0$

BUT WE WILL HAVE $F_{\alpha\dot\beta} \neq 0$ ($F_{\alpha\dot\beta} \sim G_{\alpha\dot\beta}$)

CONSTRAINTS IN U(1) SSP – SIMILAR TO MIN SG:

CONTENT = MIN SG + SYM for U(1) R-SYMMETRY.

$$T^a = -2i E^\alpha \wedge \bar{E}^{\dot\alpha} \sigma^a_{\alpha\dot\alpha}$$ (notice that here $T_{ab}{}^c = 0$)

a numerical parameter

$$T^\alpha := \underbrace{\mathcal{D} E^\alpha}_{DE^\alpha - E^\alpha \wedge A} = \frac{i}{8} E^b \wedge E^\beta \left((\sigma_b \hat\sigma_c)_\beta{}^\alpha G^c + \gamma\, G_b \delta_\beta^\alpha \right) - \frac{i}{8} E^b \wedge \bar{E}^{\dot\beta} \sigma_{b\dot\beta}{}^\alpha R + \frac{1}{2} E^c \wedge E^b T_{bc}{}^\alpha$$

$$\bar{T}^{\dot\alpha} := \underbrace{\mathcal{D} \bar{E}^{\dot\alpha}}_{D\bar{E}^{\dot\alpha} + \bar{E}^{\dot\alpha} \wedge A} = \frac{i}{8} E^b \wedge E^\beta \sigma_{b\beta}{}^{\dot\alpha} \bar{R} - \frac{i}{8} E^b \wedge \bar{E}^{\dot\beta} \left((\hat\sigma_c \sigma_b)^{\dot\alpha}{}_{\dot\beta} G^c + \bar\gamma\, G_b \delta^{\dot\alpha}_{\dot\beta} \right) + \frac{1}{2} E^c \wedge E^b T_{bc}{}^{\dot\alpha}$$

NO SEPARATE CONSTRAINTS ON $F = dA$ AND $R^{ab} = \frac{1}{2} R^{\alpha\beta} \sigma^{ab}_{\alpha\beta} - \frac{1}{2} R^{\dot\alpha\dot\beta} \hat\sigma^{ab}_{\dot\alpha\dot\beta}$

BUT STUDYING DIM 2 ($\sim E^b \wedge E^\alpha \wedge E^\beta$) components of

$$\boxed{0 = \mathcal{D} T^a + E^b \wedge R_b{}^a}$$

(We calculate in the way suggested by Dragon's theorem)

we find $\boxed{R_{\alpha\beta}{}^{ab} = -\frac{1}{2} \sigma^{ab}_{\alpha\beta} \bar{R}}$, $\boxed{R_{\dot\alpha\dot\beta}{}^{ab} = -\frac{1}{2} \hat\sigma^{ab}_{\dot\alpha\dot\beta} R}$

and ($\sim E^b \wedge E^\alpha \wedge \bar{E}^{\dot\alpha}$) fix $\boxed{\gamma = \bar\gamma}$ and find

$$\boxed{R_{\alpha\dot\alpha}{}^{ab} = -\frac{i}{2} \epsilon^{abcd} \sigma_{c\alpha\dot\alpha} G_d}$$

price to pay for setting $T_{ab}{}^c = 0$

THUS:

$$R^{ab} = -\frac{1}{4} E^\alpha \wedge E^\beta \sigma^{ab}_{\alpha\beta} \bar{R} - \frac{1}{4} \bar{E}^{\dot\alpha} \wedge \bar{E}^{\dot\beta} \hat\sigma^{ab}_{\dot\alpha\dot\beta} R - \frac{i}{2} E^\alpha \wedge \bar{E}^{\dot\alpha} \epsilon^{abcd} \sigma_{c\alpha\dot\alpha} G_d + E^c \wedge E^\beta R_{\beta c}{}^{ab} + E^c \wedge \bar{E}^{\dot\beta} R_{\dot\beta c}{}^{ab} + \frac{1}{2} E^d \wedge E^c R_{cd}{}^{ab}$$

$\Rightarrow$ Ex: To obtain:

$$R^{\alpha\beta} = -\frac{1}{2} E^\alpha \wedge E^\beta \bar{R} + \frac{1}{2} E^\gamma \wedge \bar{E}^{\dot\gamma} \delta_\gamma^{(\alpha} G^{\beta)}_{\dot\gamma} + E^c \wedge E^\gamma R_{\gamma c}{}^{\alpha\beta} + E^c \wedge \bar{E}^{\dot\gamma} R_{\dot\gamma c}{}^{\alpha\beta} + \frac{1}{2} E^d \wedge E^c R_{cd}{}^{\alpha\beta}$$

$$R^{\dot\alpha\dot\beta} = +\frac{1}{2} \bar{E}^{\dot\alpha} \wedge \bar{E}^{\dot\beta} R - \frac{1}{2} E^\gamma \wedge \bar{E}^{\dot\gamma} G_\gamma^{(\dot\alpha} \delta_{\dot\gamma}^{\dot\beta)} + E^c \wedge E^\gamma R_{\gamma c}{}^{\dot\alpha\dot\beta} + E^c \wedge \bar{E}^{\dot\gamma} R_{\dot\gamma c}{}^{\dot\alpha\dot\beta} + \frac{1}{2} E^d \wedge E^c R_{cd}{}^{\dot\alpha\dot\beta}$$

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dim 5/2, $\sim E^c \wedge E^b \wedge E^\alpha$: $\quad R_{\alpha[bc]}{}^a = i \sigma^a_{\alpha\dot\alpha} T_{bc}{}^{\dot\alpha}$ $\quad \Rightarrow$ Ex: to obtain

$$\boxed{R_{\alpha c ab} = 2i\, \sigma_{[a|\alpha\dot\alpha} T_{|b]c}{}^{\dot\alpha} - i \sigma_{c\alpha\dot\alpha} T_{ab}{}^{\dot\alpha}}$$

denoting irreducible parts of the fermionic torsion as

$$T_{\beta\dot\beta\gamma\dot\gamma\,\alpha} := \epsilon_{\beta\gamma} t_{\alpha\dot\beta\dot\gamma} - \frac{1}{8} \epsilon_{\dot\beta\dot\gamma} \left(W_{\alpha\beta\gamma} + \epsilon_{\alpha(\beta} t_{\gamma)} \right)$$

$$T_{\beta\dot\beta\gamma\dot\gamma\,\dot\alpha} := \epsilon_{\dot\beta\dot\gamma} \bar{t}_{\dot\alpha\beta\gamma} - \frac{1}{8} \epsilon_{\beta\gamma} \left(\bar{W}_{\dot\alpha\dot\beta\dot\gamma} + \epsilon_{\dot\alpha(\dot\beta} \bar{t}_{\dot\gamma)} \right)$$

we obtain from $R_{\dot\alpha c ab} = 2i\sigma_{[a|\alpha\dot\alpha}T_{|bc]}{}^{\dot\alpha} - i\sigma_{c\alpha\dot\alpha}T_{ab}{}^{\dot\alpha}$

$$R_{\gamma\delta\dot\delta\alpha\beta} = -i\epsilon_{\gamma(\alpha|}\bar t_{\dot\delta\,\underline{\delta|\beta)}} - i\epsilon_{\gamma\delta}\bar t_{\dot\delta\,\underline{\alpha\beta}} - \frac{3i}{16}\epsilon_{\gamma(\alpha}\epsilon_{\beta)\delta}\bar t_{\dot\delta}$$

$$R_{\dot\gamma\delta\dot\delta\alpha\beta} = i\epsilon_{\delta(\alpha}t_{\beta)\,\underline{\dot\gamma\dot\delta}} + \frac{i}{4}\epsilon_{\dot\gamma\dot\delta}W_{\alpha\beta\delta} + \frac{i}{16}\epsilon_{\dot\gamma\dot\delta}\epsilon_{\delta(\alpha}t_{\beta)}$$

the – c.c. relations are

$$R_{\dot\gamma\delta\dot\delta\dot\alpha\dot\beta} = -i\epsilon_{\dot\gamma(\dot\alpha|}t_{\delta\,\underline{\dot\delta|\dot\beta)}} - i\epsilon_{\dot\gamma\dot\delta}t_{\delta\,\underline{\dot\alpha\dot\beta}} - \frac{3i}{16}\epsilon_{\dot\gamma(\dot\alpha}\epsilon_{\dot\beta)\dot\delta}t_{\delta}$$

$$R_{\gamma\delta\dot\delta\dot\alpha\dot\beta} = i\epsilon_{\dot\delta(\dot\alpha}\bar t_{\dot\beta)\,\underline{\gamma\delta}} + \frac{i}{4}\epsilon_{\gamma\delta}\bar W_{\dot\alpha\dot\beta\dot\delta} + \frac{i}{16}\epsilon_{\gamma\delta}\epsilon_{\dot\delta(\dot\alpha}\bar t_{\dot\beta)}$$

finally dim 3 component of $\mathcal{D}T^a + E^b\wedge R_b{}^a = 0$ gives the standard

$$\boxed{R_{[cdb]}{}^a = 0}$$

BI for fermionic torsion: $0 = I_3^\alpha := \mathcal{D}T^\alpha + E^\beta\wedge R_\beta{}^\alpha + E^\alpha\wedge F$

include the U(1) R-symm. curvature

dim 3/2 : $\sim E^\beta\wedge E^\gamma\wedge E^\delta$: $\boxed{F_{\gamma\delta}=0}$, $\sim E^\beta\wedge\bar E^\beta\wedge\bar E^\gamma$ $\boxed{F_{\dot\gamma\dot\delta}=0}$

$\sim E^\beta\wedge E^\gamma\wedge\bar E^{\dot\gamma}$ $\quad 0 = \delta_{(\beta}{}^\alpha F_{\gamma)\dot\gamma} + \frac{1}{4}\delta_{(\gamma}{}^\alpha G_{\beta)\dot\gamma} - \frac{\gamma}{4}\delta_{(\beta}{}^\alpha G_{\gamma)\dot\gamma} \Rightarrow$ $\boxed{F_{\gamma\dot\gamma} = -\frac{1}{4}(1-\gamma)G_{\gamma\dot\gamma}}$

dim 2 : $\underbrace{\sim}_{}$ $E^c\wedge E^\beta\wedge E^\gamma$ $\quad 0 = -\delta_{(\beta}{}^\alpha F_{\gamma)c} - R_{(\gamma|c|\beta)}{}^\alpha + \frac{i}{8}(\sigma_c\hat\sigma_d)_{(\beta}{}^\alpha\mathcal{D}_{\gamma)}G^d + \frac{i\gamma}{8}\delta_{(\beta}{}^\alpha\mathcal{D}_{\gamma)}G_c$

$\epsilon_{\dot\alpha\alpha}\sigma^c_{\delta\dot\delta}$

$\epsilon^{\delta\alpha}$ $[\alpha\dot\delta]$

$$F_{(\beta\,\gamma)\dot\gamma} = -\frac{i}{8}(2-\gamma)\mathcal{D}_{(\beta}G_{\gamma)\dot\gamma} + \frac{i}{2}t_{\dot\gamma\,\underline{\beta\gamma}}$$

OR $\quad F_{\beta\gamma\dot\gamma} = -\frac{i}{8}(2-\gamma)\mathcal{D}_\beta G_{\gamma\dot\gamma} + \frac{i}{2}t_{\dot\gamma\,\underline{\beta\gamma}} - 2i\epsilon_{\beta\gamma}\bar W'_{\dot\gamma}$

THEN, SUBSTITUTING BACK:

$$0 = 2i\epsilon_{\alpha(\beta}\epsilon_{\gamma)\delta}\left(\bar W'_{\dot\delta} - \frac{3}{64}\bar t_{\dot\delta}\right) + \frac{i}{4}\epsilon_{\alpha(\beta}\left(\mathcal{D}_{\gamma)}G_{\delta\dot\delta} - 4t_{\dot\delta\,\underline{\delta|\gamma)}}\right) + (\alpha\leftrightarrow\delta)$$

$\epsilon^{\delta\gamma}$: $\quad (\alpha\beta)$: $\dot\delta\to\dot\gamma$ $\quad \boxed{t_{\dot\gamma\,\underline{\alpha\beta}} = \frac{1}{4}\mathcal{D}_{(\alpha}G_{\beta)\dot\gamma}}$ $\quad$ c.c. $\quad \boxed{t_{\gamma\,\underline{\dot\alpha\dot\beta}} = -\frac{1}{4}\bar{\mathcal{D}}_{(\dot\alpha|}G_{\gamma|\dot\beta)}}$

$[\alpha\beta]$: $\quad \bar W'_{\dot\gamma} = -\frac{1}{8}\mathcal{D}^\epsilon G_{\epsilon\dot\gamma} + \frac{3}{64}\bar t_{\dot\gamma}$ — denoted by $\bar W''_{\dot\gamma}$ in calculations!

$$\boxed{F_{\beta\gamma\dot\gamma} = -\frac{i}{8}(1-\gamma)\mathcal{D}_\beta G_{\gamma\dot\gamma} - 2i\epsilon_{\beta\gamma}\bar W_{\dot\gamma}}$$

$\bar W_{\dot\gamma} = \bar W'_{\dot\gamma} + \frac{1}{32}\mathcal{D}^\epsilon G_{\epsilon\dot\gamma} = -\frac{3}{32}\mathcal{D}^\epsilon G_{\epsilon\dot\gamma} + \frac{3}{64}\bar t_{\dot\gamma}$

$\sim E^c\wedge\bar E^{\dot\beta}\wedge\bar E^{\dot\gamma}$: $\quad \boxed{\bar{\mathcal{D}}_{\dot\gamma}R = 0}$

$\sim E^c \wedge E^\beta \wedge \bar{E}^{\dot\beta}$ $\quad 0 = -\delta_\beta{}^\alpha \left(F_{\dot\beta c} - \frac{i}{8}\bar{\mathcal{D}}_{\dot\beta} G_c\right) - R_{\dot\beta c \beta}{}^\alpha + \frac{i}{8}(\sigma_c \bar\sigma_d)^\alpha{}_\beta \bar{\mathcal{D}}_{\dot\beta} G^d - \frac{i}{8}\sigma_{c\beta\dot\beta}\mathcal{D}^\alpha R - 2i\,\sigma^b_{\beta\dot\beta} T_{bc}{}^\alpha$

$\cdot\, \epsilon_{\dot\alpha'\alpha}\, \sigma^c_{\dot\gamma \gamma}$ $\longrightarrow \Leftarrow \ldots$ $\quad \Leftarrow \ldots$

$(\dot\beta\dot\gamma) \begin{cases} (\beta\gamma) \\ [\beta\gamma] \end{cases}$ $\boxed{0=0}$

$\epsilon_{\dot\beta\dot\gamma}$ $\quad \epsilon_{\beta\gamma} \Rightarrow$

$(\beta\gamma) \Rightarrow$ (THE SAME)

$$\boxed{t_\alpha = \frac{2}{3}\bar{\mathcal{D}}^{\dot\alpha} G_{\alpha\dot\alpha} + \frac{4}{3}\mathcal{D}_\alpha R} \Rightarrow \boxed{W_\alpha = \frac{1}{8}\bar{\mathcal{D}}^{\dot\alpha} G_{\alpha\dot\alpha} + \frac{1}{16}\mathcal{D}_\alpha R}$$

$dF = 0$ with $F = -\frac{1}{4}(1-\gamma)\, E^\alpha \wedge \bar{E}^{\dot\alpha} G_{\alpha\dot\alpha} + E^c \wedge E^\beta F_{\beta c} + \frac{1}{2} E^b \wedge E^a F_{ab}$

dim $3/2$: $\quad 0 = 0$ $\qquad F_{\beta c} = -\frac{i}{8}(1-\gamma)\mathcal{D}_\beta G_c + i(\sigma_c \bar{W})_\beta$

dim 2: $\quad E^b \wedge E^\beta \wedge E^\gamma$ $\qquad \boxed{\mathcal{D}_\beta \bar{W}_{\dot\gamma} = 0}$ c.c. $\boxed{\bar{\mathcal{D}}_{\dot\beta} W_\gamma = 0}$

$E^b \wedge E^\beta \wedge \bar{E}^{\dot\beta}$ $\qquad \boxed{\mathcal{D}^\alpha W_\alpha - \bar{\mathcal{D}}_{\dot\alpha} \bar{W}^{\dot\alpha} = 0}$

$$\boxed{F_{\beta\dot\beta\,\gamma\dot\gamma} = \frac{1}{2}\epsilon_{\dot\beta\dot\gamma}\mathcal{D}_{(\beta} W_{\gamma)} - \frac{1}{2}\epsilon_{\beta\gamma}\bar{\mathcal{D}}_{(\dot\beta}\bar{W}_{\dot\gamma)}} \Leftrightarrow \boxed{F_{bc} = \frac{1}{8}(\sigma_{bc})_\alpha{}^\beta \mathcal{D}_\beta W^\alpha + \frac{1}{4}\bar{\mathcal{D}}_{\dot\beta}\bar{W}^{\dot\alpha}(\bar\sigma_{bc})^{\dot\beta}{}_{\dot\alpha}}$$

$0 = \mathcal{D} R^{\alpha\beta}$ WITH $R^{\alpha\beta} = -\frac{1}{2}E^\alpha \wedge E^\beta \bar{R} + \frac{1}{2}E^\gamma \wedge \bar{E}^{\dot\gamma}\delta_\gamma^{(\alpha} G_{\dot\gamma}{}^{\beta)} + E^c \wedge E^\gamma R_{\gamma c}{}^{\alpha\beta} + \frac{1}{2}E^d \wedge E^c R_{cd}{}^{\alpha\beta}$

dim $3/2$

$\sim E^\alpha \wedge E^\beta \wedge E^\gamma$ $\qquad \boxed{\mathcal{D}_\gamma \bar{R} = 0}$ (already obtained)

$\ldots$

dim 2

$\sim E^c \wedge \bar{E}^{\dot\gamma} \wedge \bar{E}^{\dot\delta}$ $\qquad \boxed{\bar{\mathcal{D}}_{\dot\gamma} W_{\alpha\beta\gamma} = 0}$ (can be obtained from $I_3^\alpha = 0$)

ALREADY AT THIS STAGE WE CAN SEE THE FIELD CONTENT OF "OUR" SUPERFIELD THEORY IN FLAT SSP

$$\underbrace{\underset{\substack{6_b+0\\(10_b-4_{diffs}=6)}}{e_\mu{}^a(x)=E_\mu^a|_0}\,,\quad \underset{\substack{0+12_f\\(16_f-4_{susy}=12)}}{\psi_\mu{}^\alpha(x)=E_\mu^\alpha|_0}\,,\quad \underset{(1+1+4)_b+0}{R,\bar R,G_a}}_{\text{MIN SG}}\,,\quad \underbrace{\underset{0+4_f}{W_\alpha,\bar W_{\dot\alpha}},\ \underset{\substack{3_b+0\\(4_{A_\mu}-1_{gauge\,sym.})}}{F_{ab}}\quad \underset{1_b+0}{D^\alpha W_\alpha+\bar D\bar W^{\dot\alpha}}}_{\text{SYM OF U(1) R-SYMM.}}$$

D-TERM

A REDUCIBLE MULTIPLET / 2-MULTIPLETS.

TO DESCRIBE "OLD MIN" SUGRA WE JUST SET $\boxed{W_\alpha=0}$

TO DESRIBE "NEW MIN" SUGRA IN U(1) SSP WE HAVE TO SET $R=0=\bar R$.

Then $\mathcal{D}\mathcal{D}R-\bar{\mathcal{D}}\bar{\mathcal{D}}\bar R=0=\mathcal{D}_a G^a$ OFF-SHELL!!!

LINEARIZED VERSION $\partial_\mu G^\mu=0$ is SOLVED BY $G^\mu=\epsilon^{\mu\nu\rho\sigma}\partial_\nu B_{\rho\sigma}$

ACTUALLY, WE CAN OBTAIN THE DESCRIPTION OF "NEW MIN" SG IN U(1) SSP by requiring the existence of closed 2-form

$$\boxed{H_3=dB_2=iE^a\wedge E^\alpha\wedge\bar E^{\dot\alpha}\sigma_{a\alpha\dot\alpha}+\frac{1}{3!}E^d\wedge E^c\wedge E^b H_{bcd}}$$

obeying $dH_3=0$

REMARK N1: TO HAVE DYNAMICAL TENSOR MULTIPLET WE CAN REQUIRE ∃ OF CLOSED 3-FORM WITH

$$H_{\alpha\dot\alpha a}=i\sigma_{a\alpha\dot\alpha}e^{U}$$

WITH REAL SUPERFIELD U

SUCH A SUPERFIELD ∃ IN SSP OR MIN SG (WITHOUT U(1) AS WELL)

$$\boxed{H_3 = dB_2 = i E^a \wedge E^\alpha \wedge \bar{E}^{\dot\alpha} \sigma_{a\alpha\dot\alpha} + \frac{1}{3!} E^c \wedge E^b \wedge E^a H_{abc}}$$

CONSTRAINTS ARE $H_{\alpha\beta\gamma} = 0$,

$H_{\alpha\beta c} = 0 = H_{\dot\alpha\dot\beta c}$, $H_{\alpha\dot\beta c} = i\sigma_{c\alpha\dot\beta}$

- THUS ORIGINALLY WE HAVE $H_{\alpha bc}$ and $H_{\dot\alpha bc}$

$$H_3 = dB_2 = i E^a \wedge E^\alpha \wedge \bar{E}^{\dot\alpha} \sigma_{a\alpha\dot\alpha} + \frac{1}{2} E^c \wedge E^b \wedge E^\alpha H_{\alpha bc} + \text{c.c.} + \frac{1}{3!} E^c \wedge E^b \wedge E^a H_{abc}$$

However, THE COMPONENT $I_{\alpha\beta\dot\gamma c} \equiv 0$ of the BI $\boxed{I_4 = dH_3 = 0}$

READ $0 = i\sigma^b_{(\alpha|\dot\gamma} H_{|\beta)bc} \Rightarrow \boxed{H_{\alpha bc} = 0}$

- $dH_3 = 0 = \cancel{\phi} + iE^a \wedge E^\alpha \wedge \bar{T}^{\dot\alpha} \sigma_{a\alpha\dot\alpha} + iE^a \wedge \bar{E}^{\dot\alpha} \wedge T^\alpha \sigma_{a\alpha\dot\alpha} - iE^c \wedge E^b \wedge E^\alpha \wedge \bar{E}^{\dot\alpha} \sigma^a_{\alpha\dot\alpha} H_{abc} +$

$+ \frac{1}{8} E^b \wedge E^a \wedge E^\alpha \wedge \bar{E}^{\dot\alpha} (\sigma_a \hat\sigma_c \sigma_b - \sigma_b \hat\sigma_c \sigma_a) G^c - \frac{1}{8} E^b \wedge E^a \wedge E^\alpha \wedge E^\beta (\sigma_{ab})_{\alpha\beta} \bar{R} +$

$+ \frac{1}{8} E^b \wedge E^a \wedge \bar{E}^{\dot\alpha} \wedge \bar{E}^{\dot\beta} (\hat\sigma_b \sigma_a)_{\dot\alpha\dot\beta} R + \frac{i}{2} E^c \wedge E^b \wedge E^a \wedge E^\alpha \sigma_{[a|\alpha\dot\alpha} T^{\dot\alpha}_{|bc]} + \frac{i}{2} E^c \wedge E^b \wedge E^a \wedge \bar{E}^{\dot\alpha} T^\alpha_{[ab} \sigma_{c]\alpha\dot\alpha}$

$+ \frac{1}{3!} E^d \wedge E^c \wedge E^b \wedge E^\alpha D_\alpha H_{bcd} + \frac{1}{3!} E^d \wedge E^c \wedge E^b \wedge \bar{E}^{\dot\alpha} \bar{D}_{\dot\alpha} H_{bcd} + \frac{1}{3!} E^d \wedge \dots \wedge E^a \mathcal{D}_{[a} H_{bcd]}$

$- \frac{i}{4} E^b \wedge E^a \wedge E^\alpha \wedge \bar{E}^{\dot\alpha} \epsilon_{abcd} \sigma^c_{\alpha\dot\alpha} G^d$

$\sim E^b \wedge E^a \wedge E^\alpha \wedge E^\beta$ $\boxed{\bar{R} = 0}$ $\sim E^b \wedge E^a \wedge \bar{E}^{\dot\alpha} \wedge \bar{E}^{\dot\beta}$ $\boxed{R = 0}$

$\sim E^b \wedge E^a \wedge E^\alpha \wedge \bar{E}^{\dot\alpha}$ $\boxed{H_{abc} = -\frac{1}{4} \epsilon_{abcd} G^d}$

$\sim E^d \wedge \dots \wedge E^a$: $\boxed{\mathcal{D}_{[a} H_{bcd]} = 0} \Leftrightarrow \boxed{\mathcal{D}_a G^a = 0}$

$\sim E^d \wedge E^c \wedge E^b \wedge E^\alpha$ $\boxed{\mathcal{D}_\alpha G^a = 2i \epsilon^{abcd} \sigma_{b\alpha\dot\alpha} T_{cd}{}^{\dot\alpha}}$

c.c. $\boxed{\bar{\mathcal{D}}_{\dot\alpha} G^a = 2i \epsilon^{abcd} T_{bc}{}^\alpha \sigma_{d\alpha\dot\alpha}}$

$\boxed{R=0}$

$$T^a = \mathcal{D}E^a = DE^a = -2i\, E^\alpha \wedge \bar{E}^{\dot\alpha} \sigma^a_{\alpha\dot\alpha}$$

$$T^\alpha = \mathcal{D}E^\alpha = \frac{i}{8} E^b \wedge E^\beta \left((\sigma_b \tilde\sigma_c)_\beta{}^\alpha G^c + \gamma G_b \delta_\beta^\alpha\right) + \frac{1}{2} E^b \wedge E^a T_{ab}{}^\alpha$$

$$T_{\beta\dot\beta\,\gamma\dot\gamma\,\alpha} = -\frac{i}{4}\epsilon_{\beta\gamma}\bar{\mathcal{D}}_{(\dot\beta|}G_{\alpha|\dot\gamma)} - \frac{1}{8}\epsilon_{\dot\beta\dot\gamma}\left(W_{\alpha\beta\gamma} + \frac{2}{3}\epsilon_{\alpha(\beta}\bar{\mathcal{D}}^{\dot\varepsilon}G_{\gamma)\dot\varepsilon}\right)$$

$$\bar{T}^{\dot\alpha} = \mathcal{D}\bar{E}^{\dot\alpha} = -\frac{i}{8} E^b \wedge \bar{E}^{\dot\beta}\left((\tilde\sigma_c \sigma_b)^{\dot\alpha}{}_{\dot\beta} G^c + \gamma G_b \delta^{\dot\alpha}_{\dot\beta}\right) + \frac{1}{2} E^c \wedge E^b T_{bc}{}^{\dot\alpha}$$

$$T_{\beta\dot\beta\,\gamma\dot\gamma\,\dot\alpha} = +\frac{i}{4}\epsilon_{\dot\beta\dot\gamma}\mathcal{D}_{(\beta}G_{\gamma)\dot\alpha} - \frac{1}{8}\epsilon_{\beta\gamma}\left(\bar{W}_{\dot\alpha\dot\beta\dot\gamma} - \frac{2}{3}\epsilon_{\dot\alpha(\dot\beta|}\mathcal{D}^{\varepsilon}G_{\varepsilon|\dot\gamma)}\right)$$

$$R^{ab} = -\frac{i}{2} E^\alpha \wedge \bar{E}^{\dot\alpha}\epsilon^{abcd}\sigma_{c\alpha\dot\alpha}G_d + E^c \wedge E^{\phi} R_{\phi c}{}^{ab} + \frac{1}{2} E^d \wedge E^c R_{cd}{}^{ab}$$

$$R^{\alpha\beta} = \frac{1}{2} E^\gamma \wedge \bar{E}^{\dot\gamma}\delta_\gamma^{(\alpha} G_{\dot\gamma}{}^{\beta)} + E^c \wedge E^\gamma R_{\gamma c}{}^{\alpha\beta} + E^c \wedge \bar{E}^{\dot\gamma} R_{\dot\gamma c}{}^{\alpha\beta} + \frac{1}{2} E^d \wedge E^c R_{cd}{}^{\alpha\beta}$$

$$R_{\gamma\,\delta\dot\delta\,\alpha\beta} = -\frac{i}{4}\epsilon_{\gamma\delta}\mathcal{D}_{(\alpha}G_{\beta)\dot\delta} \underbrace{-\frac{i}{8}\epsilon_{\gamma(\alpha}\mathcal{D}_{\beta)}G_{\delta\dot\delta} - \frac{i}{8}\epsilon_{\gamma(\alpha|}\mathcal{D}_\delta G_{|\beta)\dot\delta} + \frac{i}{8}\epsilon_{\gamma(\alpha}\epsilon_{\beta)\delta}\mathcal{D}^\varepsilon G_{\varepsilon\dot\delta}}_{\ll\ -\frac{i}{4}\epsilon_{\gamma(\alpha|}\mathcal{D}_\delta G_{|\beta)\dot\delta}}$$

$\bar{\mathcal{D}}_{(\dot\delta}G_{\delta)|\beta)}$

$$R_{\dot\gamma\,\delta\dot\delta\,\alpha\beta} = \frac{i}{4}\epsilon_{\dot\gamma\dot\delta}W_{\alpha\beta\gamma} + \frac{i}{24}\epsilon_{\dot\gamma\dot\delta}\epsilon_{\delta(\alpha}\bar{\mathcal{D}}^{\dot\varepsilon}G_{\beta)\dot\varepsilon} - \frac{i}{4}\epsilon_{\delta(\alpha|}\bar{\mathcal{D}}_{(\dot\delta}G_{\dot\varepsilon)|\beta)}$$

$$R^{\dot\alpha\dot\beta} = -\frac{1}{2} E^\gamma \wedge \bar{E}^{\dot\gamma} G_\gamma{}^{(\dot\alpha}\delta_{\dot\gamma}{}^{\dot\beta)} + E^c \wedge E^\gamma R_{\gamma c}{}^{\dot\alpha\dot\beta} + E^c \wedge \bar{E}^{\dot\gamma} R_{\dot\gamma c}{}^{\dot\alpha\dot\beta} + \frac{1}{2} E^d \wedge E^c R_{cd}{}^{\dot\alpha\dot\beta}$$

$$R_{\dot\gamma\,\delta\dot\delta\,\dot\alpha\dot\beta} = \frac{i}{4}\epsilon_{\dot\gamma\dot\delta}\bar{\mathcal{D}}_{(\dot\alpha|}G_{\delta|\dot\beta)} + \frac{i}{4}\epsilon_{\dot\gamma(\dot\alpha|}\bar{\mathcal{D}}_{\dot\delta}G_{\delta|\dot\beta)}$$

$$R_{\gamma\,\delta\dot\delta\,\dot\alpha\dot\beta} = \frac{i}{4}\epsilon_{\gamma\delta}\bar{W}_{\dot\alpha\dot\beta\dot\gamma} - \frac{i}{24}\epsilon_{\gamma\delta}\epsilon_{\dot\delta(\dot\alpha|}\mathcal{D}^\varepsilon G_{\varepsilon|\dot\beta)} + \frac{i}{4}\epsilon_{\delta(\dot\alpha|}\mathcal{D}_{(\gamma}G_{\delta)|\dot\beta)}$$

$$F = dA = -\frac{1}{4}(1-\gamma)E^\alpha \wedge \bar{E}^{\dot\alpha}G_{\alpha\dot\alpha} + E^b \wedge E^\alpha\left(-\frac{i}{8}(1-\gamma)\mathcal{D}_\alpha G_b + i(\sigma_b\bar{W})_\alpha\right) +$$
$$"=F^*"$$
$$+ E^b \wedge \bar{E}^{\dot\alpha}\left(-\frac{i}{8}(1-\gamma)\bar{\mathcal{D}}_{\dot\alpha}G_b - i(W\sigma_b)_{\dot\alpha}\right) + \frac{1}{2}E^b \wedge E^a F_{ab}$$

$$F_{\alpha b} = \frac{i}{4}(1-\gamma)\Psi_{\alpha b} - \frac{i}{4}(\sigma_b\tilde\sigma_c)_\alpha{}^\beta\Psi_\beta{}^c, \quad c.c.$$

$$F_{\dot\alpha b} = \frac{i}{4}(1-\gamma)\bar\Psi_{\dot\alpha b} - \frac{i}{4}(\tilde\sigma_c\sigma_b)^{\dot\beta}{}_{\dot\alpha}\bar\Psi_{\dot\beta}{}^c$$

$$\boxed{\mathcal{D}_\alpha \bar{W}_{\dot\alpha} = 0}, \quad \boxed{\bar{\mathcal{D}}_{\dot\alpha}W_\alpha = 0}, \quad \boxed{\mathcal{D}^\alpha W_\alpha - \bar{\mathcal{D}}^{\dot\alpha}\bar{W}_{\dot\alpha} = 0}$$

$$F_{\beta\dot\beta\,\gamma\dot\gamma} = \frac{i}{2}\epsilon_{\dot\beta\dot\gamma}\mathcal{D}_{(\beta}W_{\gamma)} - \frac{i}{2}\epsilon_{\beta\gamma}\bar{\mathcal{D}}_{(\dot\beta}\bar{W}_{\dot\gamma)} \iff F_{bc} = \frac{i}{8}(\sigma_{bc})_\alpha{}^\beta\mathcal{D}_\beta W^\alpha + \frac{i}{8}(\tilde\sigma_{bc})^{\dot\beta}{}_{\dot\alpha}\bar{\mathcal{D}}_{\dot\beta}\bar{W}^{\dot\alpha}$$

$\gamma = 1$: just the standard SYM expressions!

$$\boxed{W_\alpha = \frac{1}{8}\bar{\mathcal{D}}^{\dot\alpha}G_{\alpha\dot\alpha}} \sim \sigma_{a\alpha\dot\alpha}\bar\Psi^{a\dot\alpha} \longleftarrow \text{superfield GRAVITINO EQS (THEIR L.H.S.)}$$

$$\boxed{\bar{W}_{\dot\alpha} = -\frac{1}{8}\mathcal{D}^\alpha G_{\alpha\dot\alpha}} \sim \Psi^{a\alpha}\sigma_{a\alpha\dot\alpha}$$

$\bar{\mathcal{D}}_{\dot\alpha}W_\alpha = 0 \Rightarrow \boxed{\bar{\mathcal{D}}\bar{\mathcal{D}}G_a = 0}$, $\boxed{\mathcal{D}\mathcal{D}G_a = 0}$

$\mathcal{D}^\alpha W_\alpha - \bar{\mathcal{D}}^{\dot\alpha}\bar{W}_{\dot\alpha} = 0 \Rightarrow \boxed{\mathcal{D}^a G_a = 0}$

$$H_3 = dB_2 = i E^a \wedge E^\alpha \wedge \bar{E}^{\dot\alpha}\sigma_{a\alpha\dot\alpha} - \frac{1}{4!}E^c \wedge E^b \wedge E^a \epsilon_{abcd}G^d$$

$$\mathcal{D}_\alpha G^a = 2i\epsilon^{abcd}\sigma_{b\alpha\dot\alpha}\bar{T}_{cd}{}^{\dot\alpha} = 2i\Psi^a_\alpha, \quad \bar{\mathcal{D}}_{\dot\alpha}G^a = 2i\epsilon^{abcd}T_{bc}{}^\alpha\sigma_{d\alpha\dot\alpha} = 2i\bar\Psi^a_{\dot\alpha}$$

$$T^a = \mathcal{D}E^a = DE^a = -2i\,E^\alpha \wedge \bar{E}^{\dot\alpha}\,\sigma^a_{\alpha\dot\alpha}$$

$$T^\alpha = \mathcal{D}E^\alpha = \frac{i}{8}E^b\wedge E^\beta\left((\sigma_b\tilde\sigma_c)_\beta{}^\alpha G^c + \gamma G_b\delta_\beta^\alpha\right) + \frac{1}{2}E^b\wedge E^a\,T_{ab}{}^\alpha$$

$$T_{\beta\dot\beta\,\gamma\dot\gamma\,\alpha} = -\frac{i}{4}\epsilon_{\beta\gamma}\bar{\mathcal{D}}_{(\dot\beta|}G_{\alpha|\dot\gamma)} - \frac{1}{8}\epsilon_{\dot\beta\dot\gamma}\left(W_{\alpha\beta\gamma} + \frac{2}{3}\epsilon_{\alpha(\beta}\bar{\mathcal{D}}^{\dot\varepsilon}G_{\gamma)\dot\varepsilon}\right)$$

$$\bar{T}^{\dot\alpha} = \mathcal{D}\bar{E}^{\dot\alpha} = -\frac{i}{8}E^b\wedge\bar{E}^{\dot\beta}\left((\tilde\sigma_c\sigma_b)^{\dot\alpha}{}_{\dot\beta}G^c + \gamma G_b\delta^{\dot\alpha}_{\dot\beta}\right) + \frac{1}{2}E^c\wedge E^b\,T_{bc}{}^{\dot\alpha}$$

$$T_{\beta\dot\beta\,\gamma\dot\gamma\,\dot\alpha} = +\frac{i}{4}\epsilon_{\dot\beta\dot\gamma}\mathcal{D}_{(\beta}G_{\gamma)\dot\alpha} - \frac{1}{8}\epsilon_{\beta\gamma}\left(\bar{W}_{\dot\alpha\dot\beta\dot\gamma} - \frac{2}{3}\epsilon_{\dot\alpha(\dot\beta|}\mathcal{D}^\varepsilon G_{\varepsilon|\dot\gamma)}\right)$$

$$R^{ab} = -\frac{i}{2}E^\alpha\wedge\bar{E}^{\dot\alpha}\,\epsilon^{abcd}\sigma_{c\alpha\dot\alpha}G_d + E^c\wedge E^\beta R_{\beta c}{}^{ab} + \frac{1}{2}E^d\wedge E^c R_{cd}{}^{ab}$$

$$R^{\alpha\beta} = \frac{1}{2}E^\gamma\wedge\bar{E}^{\dot\gamma}\,\delta_\gamma^{(\alpha}G_{\dot\gamma}{}^{\beta)} + E^c\wedge E^\gamma R_{\gamma c}{}^{\alpha\beta} + E^c\wedge\bar{E}^{\dot\gamma}R_{\dot\gamma c}{}^{\alpha\beta} + \frac{1}{2}E^d\wedge E^c R_{cd}{}^{\alpha\beta}$$

$$R_{\gamma\,\delta\dot\delta\,\alpha\beta} = -\frac{i}{4}\epsilon_{\gamma\delta}\bar{\mathcal{D}}_{(\alpha}G_{\beta)\dot\delta}\;\underbrace{-\frac{i}{8}\epsilon_{\gamma(\alpha}\mathcal{D}_{\beta)}G_{\delta\dot\delta} - \frac{i}{8}\epsilon_{\delta(\alpha|}\mathcal{D}_\gamma G_{|\beta)\dot\delta} + \frac{i}{8}\epsilon_{\gamma(\alpha}\epsilon_{\beta)\delta}\mathcal{D}^\varepsilon G_{\varepsilon\dot\delta}}_{\Leftarrow\; -\frac{i}{4}\epsilon_{\gamma(\alpha|}\mathcal{D}_\delta G_{|\beta)\dot\delta}}$$

$\mathcal{D}_{(\gamma}G_{\delta)|\dot\beta}$

$$R_{\dot\gamma\,\delta\dot\delta\,\alpha\beta} = \frac{i}{4}\epsilon_{\dot\gamma\dot\delta}W_{\alpha\beta\gamma} + \frac{i}{24}\epsilon_{\dot\gamma\dot\delta}\epsilon_{\delta(\alpha}\bar{\mathcal{D}}^{\dot\varepsilon}G_{\beta)\dot\varepsilon} - \frac{i}{4}\epsilon_{\delta(\alpha|}\bar{\mathcal{D}}_{\dot\delta}G_{\dot\gamma|\beta)}$$

$$R^{\dot\alpha\dot\beta} = -\frac{1}{2}E^\gamma\wedge\bar{E}^{\dot\gamma}\,G_\gamma{}^{(\dot\alpha}\delta_{\dot\gamma}{}^{\dot\beta)} + E^c\wedge E^\gamma R_{\gamma c}{}^{\dot\alpha\dot\beta} + E^c\wedge\bar{E}^{\dot\gamma}R_{\dot\gamma c}{}^{\dot\alpha\dot\beta} + \frac{1}{2}E^d\wedge E^c R_{cd}{}^{\dot\alpha\dot\beta}$$

$$R_{\dot\gamma\,\delta\dot\delta\,\dot\alpha\dot\beta} = \frac{i}{4}\epsilon_{\dot\gamma\dot\delta}\mathcal{D}_{(\dot\alpha|}G_{\delta|\dot\beta)} + \frac{i}{4}\epsilon_{\dot\gamma(\dot\alpha|}\bar{\mathcal{D}}_{\dot\delta}G_{\delta|\dot\beta)}$$

$$R_{\gamma\,\delta\dot\delta\,\dot\alpha\dot\beta} = \frac{i}{4}\epsilon_{\gamma\delta}\bar{W}_{\dot\alpha\dot\beta\dot\gamma} - \frac{i}{24}\epsilon_{\gamma\delta}\epsilon_{\dot\delta(\dot\alpha|}\mathcal{D}^\varepsilon G_{\varepsilon|\dot\beta)} + \frac{i}{4}\epsilon_{\dot\delta(\dot\alpha|}\mathcal{D}_\gamma G_{\delta|\dot\beta)}$$

$$F = dA = -\frac{1}{4}(1-\gamma)E^\alpha\wedge\bar{E}^{\dot\alpha}G_{\alpha\dot\alpha} + E^b\wedge E^\alpha\left(-\frac{i}{8}(1-\gamma)\mathcal{D}_\alpha G_b + i(\sigma_b\bar{W})_\alpha\right) +$$
$$" {-F^*} "$$
$$+\,E^b\wedge\bar{E}^{\dot\alpha}\left(-\frac{i}{8}(1-\gamma)\bar{\mathcal{D}}_{\dot\alpha}G_b - i(W\sigma_b)_{\dot\alpha}\right) + \frac{1}{2}E^b\wedge E^a F_{ab}$$

$$\boxed{\mathcal{D}_\alpha\bar{W}_{\dot\alpha} = 0}\,,\quad \boxed{\bar{\mathcal{D}}_{\dot\alpha}W_\alpha = 0}\,,\quad \boxed{\mathcal{D}^\alpha W_\alpha - \bar{\mathcal{D}}^{\dot\alpha}\bar{W}_{\dot\alpha} = 0}$$

$$F_{\beta\dot\beta\,\gamma\dot\gamma} = \frac{i}{2}\epsilon_{\dot\beta\dot\gamma}\mathcal{D}_{(\beta}W_{\gamma)} - \frac{i}{2}\epsilon_{\beta\gamma}\bar{\mathcal{D}}_{(\dot\beta}\bar{W}_{\dot\gamma)} \iff F_{bc} = \frac{i}{8}(\sigma_{bc})_\alpha{}^\beta\mathcal{D}_\beta W^\alpha + \frac{i}{8}(\tilde\sigma_{bc})^{\dot\beta}{}_{\dot\alpha}\bar{\mathcal{D}}_{\dot\beta}\bar{W}^{\dot\alpha}$$

$$\boxed{F_{ab} = \frac{1}{4}(1-\gamma)\bar{\mathcal{D}}\Psi_{ab} - \frac{i}{4}(\sigma_b\tilde\sigma_c)_\alpha{}^\beta\Psi_\beta^c}\,,\quad \text{i.e. } F_{ab} = \frac{1}{4}(1-\gamma)\Psi_{ab} - \frac{i}{4}(\tilde\sigma_c\sigma_b)^{\dot\beta}{}_{\dot\alpha}\bar\Psi_{\dot\beta}^c$$

$\gamma = 1$: Just the standard SYM expressions!

$$\boxed{W_\alpha = \frac{1}{8}\bar{\mathcal{D}}^{\dot\alpha}G_{\alpha\dot\alpha}} \sim \sigma_{a\alpha\dot\alpha}\Psi^{a\dot\alpha} \leftarrow \text{SUPERFIELD GRAVITINO EQS.}$$

$$\boxed{\bar{W}_{\dot\alpha} = -\frac{1}{8}\mathcal{D}^\alpha G_{\alpha\dot\alpha}} \sim \bar\Psi^{\alpha a}\sigma_{a\alpha\dot\alpha}$$

$\bar{\mathcal{D}}_{\dot\alpha}W_\alpha = 0 \Rightarrow \boxed{\bar{\mathcal{D}}\bar{\mathcal{D}}G_a = 0}\,,\quad \boxed{\mathcal{D}\mathcal{D}G_a = 0}$

$\mathcal{D}^\alpha W_\alpha - \bar{\mathcal{D}}^{\dot\alpha}\bar{W}_{\dot\alpha} = 0 \Rightarrow \boxed{\mathcal{D}^a G_a = 0}$

$$H_3 = dB_2 = i\,E^a\wedge E^\alpha\wedge\bar{E}^{\dot\alpha}\sigma_{a\alpha\dot\alpha} - \frac{1}{4!}E^c\wedge E^b\wedge E^a\,\epsilon_{abcd}G^d$$

$$\mathcal{D}_\alpha G^a = 2i\,\epsilon^{abcd}\sigma_{b\alpha\dot\alpha}T_{cd}{}^{\dot\alpha} = 2i\bar\Psi^a_\alpha\,,\qquad \bar{\mathcal{D}}_{\dot\alpha}G^a = 2i\epsilon^{abcd}T_{bc}{}^\alpha\sigma_{d\alpha\dot\alpha} = 2i\Psi^a_{\dot\alpha}$$

Spacetime SUSY of "new" min SG from U(1) SSP

$$E^a \to e^a,\quad E^{\underline{\alpha}} \to \psi^{\underline{\alpha}},\quad i_\epsilon E^a = 0,\quad i_\epsilon E^{\underline{\alpha}} = \epsilon^{\underline{\alpha}}$$

$$\delta_\epsilon e^a = -2i(\psi\sigma^a\bar\epsilon - \epsilon\sigma^a\bar\psi)$$

$\gamma = 0$ – Howe (?)
$\gamma = 1$ Müller ($T_{\alpha\dot\alpha}=0$)

$$\delta_\epsilon \psi^\alpha = \mathcal{D}\epsilon^\alpha + \frac{i}{8}e^b\left((\epsilon\sigma_b\tilde\sigma_a)^\alpha G^a + \gamma G_b\epsilon^\alpha\right)$$

$$\delta_\epsilon \bar\psi^{\dot\alpha} = \mathcal{D}\bar\epsilon^{\dot\alpha} - \frac{i}{8}e^b\left((\tilde\sigma_a\sigma_b\bar\epsilon)^{\dot\alpha} G^a + \gamma G_b\bar\epsilon^{\dot\alpha}\right)$$

$$\delta_\epsilon A = i_\epsilon F = -\frac{1-\gamma}{4}\psi\sigma_a\bar\epsilon\cdot G^a - \frac{1-\gamma}{4}\epsilon\sigma_a\bar\psi\cdot G^a + e^a\left(\epsilon^\alpha F_{\alpha a}|_0 + \bar\epsilon^{\dot\alpha}\bar F_{\dot\alpha a}|_0\right) =$$

$$= -(\delta_\epsilon A^*)$$

$$\boxed{= -\frac{1-\gamma}{4}\psi\sigma_a\bar\epsilon\cdot G^a - \frac{1-\gamma}{4}\epsilon\sigma_a\bar\psi\, G^a + \frac{1}{4}e^a(1-\gamma)\left(\epsilon\bar\Psi_a - \Psi_a\bar\epsilon\right) - \frac{1}{4}e^a\left(\epsilon\sigma_a\tilde\sigma_b\bar\Psi^b - \Psi^b\sigma_b\tilde\sigma_a\bar\epsilon\right)}$$

$$F_{\alpha a} = -\frac{i}{8}(1-\gamma)\mathcal{D}_\alpha G_a + i\,\sigma_{a\alpha\dot\alpha}\underbrace{\bar W^{\dot\alpha}}_{\epsilon^{\dot\alpha\dot\beta}(-\frac{1}{8})\mathcal{D}^\beta G_{\beta\dot\beta}} = -\frac{i}{8}(1-\gamma)\underbrace{\mathcal{D}_\alpha G_a}_{2i\Psi_{\alpha a}} + \frac{i}{8}(\sigma_a\tilde\sigma_b)_\alpha{}^\beta\mathcal{D}_\beta G^b =$$

$$= \frac{1}{4}(1-\gamma)\Psi_{\alpha a} - \frac{1}{4}(\sigma_a\tilde\sigma_b)_\alpha{}^\beta\Psi_\beta{}^b$$

$$\delta_\epsilon B_2 = i_\epsilon H_3 = -i\psi\wedge\sigma^{(1)}\bar\epsilon - i\epsilon\sigma^{(1)}\bar\psi$$

$$\delta_\epsilon G^a = i_\epsilon\mathcal{D}G^a = 2i\epsilon\bar\Psi^a - 2i\Psi^a\bar\epsilon = -2i(\Psi^a\bar\epsilon - \epsilon\bar\Psi^a)$$

BUT IN THE CASE OF $\delta_\epsilon G^a$ and $\delta_\epsilon A$ THIS IS NOT THE END OF STORY:

$$(\mathcal{D}\psi^\alpha = \tfrac{1}{2}e^b\wedge e^a\,\psi_{ab}{}^\alpha)$$

$$T_{bc}{}^\alpha|_0 = \psi_{bc}{}^\alpha - 2\,\psi_{[b|}{}^\beta T_{\beta|c]}{}^\alpha|_0 + \emptyset =$$

$$= \psi_{bc}{}^\alpha - \frac{i}{4}(\psi_{[b}\sigma_{c]}\tilde\sigma_a)^\alpha G^a - \frac{i\gamma}{4}\psi_{[b}^\alpha G_{c]}$$

$$\Rightarrow\quad \Psi_\alpha{}^a|_0 = \overset{0}{\Psi}{}_\alpha{}^a - G^{[a}(\psi_b\sigma^{b]})_\alpha + \frac{i\gamma}{4}\epsilon^{abcd}(\psi_b\sigma_c)_\alpha G_d$$

$$\delta_\epsilon G^a = -2i(\overset{0}{\Psi}{}^a\bar\epsilon - \epsilon\overset{0}{\bar\Psi}{}^a) + 2iG^{[a}(\psi_b\sigma^{b]}\bar\epsilon - \epsilon\sigma^{b]}\bar\psi_b) + \frac{\gamma}{2}\epsilon^{abcd}(\psi_b\sigma_c\bar\epsilon + \epsilon\sigma_b\bar\psi_c)G_d$$

no contribution to $\delta_\epsilon G^a\cdot G_a$

$\delta_\epsilon A$ is VERY COMPLICATED; SIMPLIFIES FOR $\gamma = 1$

$$i_\epsilon\delta_\epsilon A = -\frac{1}{4}\left(\epsilon\sigma_a\tilde\sigma_b\overset{0}{\bar\Psi}{}^b - \overset{0}{\Psi}{}^b\sigma_b\tilde\sigma_a\bar\epsilon\right) + \frac{3}{8}G^b\left(\psi_b\sigma_a\bar\epsilon - \epsilon\sigma_b\bar\psi_a\right) -$$